THE UNIVERSITY OF HULL

A Comparative Study of Ports and Their Hinterlands: Factors Determining Port Performance and Choice

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ABSTRACT

As a consequence of globalisation, port performance has become increasingly important for international trade. Different port regions perform differently. The aim of this research is to identify factors that determine port performance and choice in a comparative study between two case ports in Europe and Asia. Specifically, this research aims to examine factor differences between two European and Asian ports' contexts; to identify the key factors that drive port performance and choice; to investigate the differences in importance and performance among the factors; to analyse how the importance and performance of factors varies for different ports; to analyse the role a port hinterland plays in port performance and choice; and to illustrate the usefulness of key findings for port stakeholders.

The construct of importance factors is based on the literature. The research methodology was that of mixed methods to collect both qualitative and quantitative data in two port regions (China and UK) and was carried out in two phases. Phase one comprised semi-structured in-depth interviews. Phase two consisted of questionnaire-based surveys to validate the factors influencing port performance. The questionnaire surveys were distributed to port experts from 500 organisations and had a 50.8% response rate. Thematic analysis was used for qualitative data analysis of the data from the interviews. Methods for analysis of the data from the questionnaires included descriptive analysis, factor analysis, t-test, Kruskal-Wallis H test, importance-performance analysis and other statistical validation and significance tests.

The findings of this research suggest that ports wishing to outperform competitors can do so by improving the factors that are of high importance but currently perform poorly. This could also be achieved by improving performances on shipping services, shipping prices, overall logistics cost, logistics services and government support in descending order which is based on factor evaluation in this research. The thesis further analyses this result within the context of urgent, salient and basic factors based on IPA, including explicit & implicit importance. Shipping services and cost have a critical effect on port performance. Differences in port charges are the most significant differences in factor importance at the case ports of the Humber and Xiamen. Government support has the most significant differences in factor performance between the two case ports.

This research is not without limitations. The analysis was restricted to two port regions in China and the UK and data used in this research were mainly generated from interviews and questionnaire surveys, responses to which are to some extent subjective.

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LIST OF ABBREVIATIONS

AAPA	American Association of Ports Authorities
ABP	the Association of British Ports
AHP	Analytical Hierarchy Process
ANOVA	Analysis of Variance
ASEAN	the Association of South-East Asian Nations
CILT	Chartered Institute of Logistics and Transport
CSCMP	Council of Supply Chain Management Professionals
DFT	Department for Transport
EDI	electronic data interchange
E-E	Europe-Europe
EU	European Union
FA	factor analysis
FDI	foreign direct investment
FTZ	free trade zone
GDP	gross domestic product
GPO	global port operator
GPS	global positioning satellite
GRT	gross registered ton
GST	Goods and Services Tax
GVA	gross value added
HB	The Humber
IC	Identification Card
ICT	information and communications technology
IT	information technology
IPA	importance-performance analysis
IPO	international port operator
KMO	Kaiser-Meyer-Oklin
KPI	key performance indicators
LPI	logistics perception indicator
LSCI	Liner Shipping Connectivity Index
LSP	logistics service providers
M&As	mergers and acquisitions
MNC	Multinational Corporation
NAICS	North American Industry Classification System
NVA	net value added
NVQ	National Vocational Qualification
NRT	net registered ton

PCA	principal component analysis
PESTEL	Political, Economic, Social, Technical, Environmental and Legislative
PPI	port performance indicator
PRD	Pearl River Delta
PSP	port service provider
RDA	regional development agency
RDC	regional distribution centre
RMB	Renminbi, Chinese currency
SCM	supply chain management
SD	standard deviation
SPSS	Statistical Package for the Social Sciences
TW	Taiwan
TEU	Twenty-Foot Equivalent Units
UNCTAD	United Nations Conference on Trade and Development
VAL	value added logistics
WTO	World Trade Organisation
XM	Xiamen
YRD	Yangtze River Delta
3PL	Third Party Logistics
Δ(C-B)	performance difference between the local ports and other ports
The Humber	The Humber ports

1. INTRODUCTION

1.1 Background to the research

1.1.1 Overview

Globalization and the entry of more nations to the World Trade Organisation (WTO) have fuelled growth in seaborne trade. A United Nations Conference on Trade and Development (UNCTAD 2009) report shows that the world's total merchandise trade value reached 8.02 billion tons of goods loaded, a volume increase of 4.8% over 2006. An increasing growth in world trade generally increases the demand for international shipping services (Michaelowa and Krause 2000). This has been witnessed in the container shipping industry in the past few decades.

Before the economic recession began in 2008, trade growth had caused corresponding cargo container movements to increase in excess of overall economic growth for decades. The shipping lines had thus become busier and port operators had to strive to meet the rapidly expanding needs of customers. The economic recession has had some negative influence on the international trade; however, the world is recovering from the recession, as announced by Premier Jiabao Wen in the Asia-Europe Summit on 5th Oct. 2010 (www.news.xinmin.cn). This implies that the trade volume will rise again. Increasing environmental consciousness may also fuel the demand for transportation by ship as water transport consumes relatively less fuel than other transport modes such as rail and road (Wu and Dun 1995).

Maritime logistics is generally preferred to transport trade cargoes also because it can provide cheap and high volume transport for customers (Tseng et al. 2005; Lagoudis et al. 2006). Being capital intensive, technology intensive and high value-added, ports have a top priority for trade and economic improvement, as ports are in the transportation interface between land and water. They are in a special position in the integrated logistics service chain and play an increasingly important role in supply chains and logistics processes to cope with trade (Bichou and Gray 2004; Zhang 2005; Bryan et al. 2006). They attract the greatest amounts of cargoes and take the largest share of cargo transportation - 90% of the world trade (Potter et al. 2004).

Ports have become the core strategic resource to drive the regional economy within the context of globalization and the trade boom. Ports play a key strategic role in regional economic development (Coppens et al. 2007). The Yangtze River Delta (YRD) was developed with Shanghai ports as the centre; the Pearl River Delta (PRD) was developed with Shenzhen and Guangzhou ports as the centre; the Hongkong and Singapore economies were developed with their international transhipment ports. The same is true for such ports as Rotterdam, Antwerp, London, New York and Valencia.

Ports function as an economic catalyst on revenue and employment. A World Bank study shows that the ratio of direct revenue from port operations to the indirect revenue from port related activities is 1:5, and the ratio of port direct employment to indirect employment is about 1:9 (Wang 2005). Taking Tianjin Port as an example, one 40”TEU (Twenty-foot equivalent units) container brings direct revenue of 800-1,200 Renminbi (RMB) to the port owners as a lump sum of port charges. The same container brings an indirect revenue of 4,800 ~ 7,200 RMB to the port resulting from tugs, pilotage, ports and port ancillary services such as container repair, stockpiling, shipping agents, logistics, financial settlement, trailers and transportation. Every 10,000 tons of port throughput will contribute 1.2 million RMB to Gross Domestic Product (GDP) and create 26 jobs (Wang 2005).

The above highlights the importance of ports, which bear the dual targets of realizing highly efficient logistics and increasing the hinterland economy for sustainable development. This is the reason why ports have attracted economists and researchers to study them.

1.1.2 Previous research

Port functions have developed from the traditional cargo transfer to logistics consolidation and distribution; from traditional physical flow to finance, technology and information flow; from the transport mode of ship/truck transfer to intermodal, and from traditional loading/unloading to containerization and door-to-door intermodal (Bichou and Gray 2004; Notteboom and Rodrigue 2005; Ricci and Black 2005).

Port capabilities and performance vary across the world. Singapore ports are proud of their port efficiency. For example, Singapore’s vessel turnaround time is less than 10 hours; Singapore has high productivity per quay metre; and the number of annual transactions is 8 million (Tongzon 2007). Hongkong is well known as a free trade port. Shanghai is known as the number one port in terms of total cargo volume and number three in terms of container traffic worldwide (AAPA 2009), benefiting from huge logistics demand from its large hinterlands. Rotterdam is known as the door to Europe resulting from its huge transhipment volume from/to the European continent.

The American Association of Ports Authorities (AAPA) has annual assessment for world ports ranking in terms of cargo volumes and container TEUs. World Bank logistics perception index (LPI) shows the ranking of national trading logistics, which largely reflects port performance. Both LPI and AAPA show enormous difference among the world ports. Some underlying factors must exist to determine the difference and such factors are of crucial importance to drive port performance.

Lack of empirical studies on factors influencing port performance

There are some studies on factors influencing business performance, such as Lerner (1997). Jacobson (1990) identify "unobservable" factors to be principal determinants of business success, such as corporate culture, access to scarce resources, management skill and luck. Stakeholder orientation is identified to be positively associated with business performance (Freeman 1984; Clarkson 1995; Greenley and Foxall 1997); structure is found to impact performance (Bain 1956; Scherer 1980; Chen 2007), and ownership is believed to influence performance (Brouthers et al. 2007). There are studies on factors influencing airport performance, such as Halpern (2006). However, there are only a few empirical studies on factors influencing port performance. Huybrechts et al. (2002) identify a series of specific factors (demand conditions, factors conditions, supporting industries, etc.) influencing port performance and determining a competitive advantage, which applied to Antwerp in the Hamburg-Le Havre range. Tongzon (1995) investigates determinants of port performance and efficiency in Southeast Asia. Chen and Zhang (2007) conducted an empirical study to find that a combination of local monopoly and competitive cooperation influences port performance, by employing the structure-conduct-performance (SCP) model.

Relevant researches on logistics performance indicators

Port performance indicators (PPIs) not only measure port performance but also measure factor performance. This implies that PPIs will help to identify the influencing factors. There are a large number of researches on national logistics indictors (Long 2003; Bichou 2006), trading logistics indicators (Skiott-Larsen et al. 2003; Arvis et al. 2010), and port performance indicators. PPIs focus on the technical performance of port assets and their efficiency, such as land, cranes, berths and labour (Brooks et al. 2010). PPIs also have been found to focus on time, cost, quality, output, services, efficiency and logistics support by other organizations and researchers (Brooks 1985; World Bank 1991; Nombela 1999; de Langen 2003; UNESCAP 2005; UNCTAD 2006; Trujillo and

Nombela 1999; Bichou 2006; Robinson 2006; Talley 2006; Arvis et al. 2007; Slack 2007; Tongzon 2007; Wu 2008; DFT 2009; etc.). It is worth noting that factors influencing port performance are dynamic and they change over time, and such factors are closely related to PPIs.

Criteria for port competition and port choice

Booming international trade and the fast-growing shipping industry have aroused port competitiveness, which has altered port market positions. As a consequence, ports are no longer seen as a safe business. In order for a port to have good performance and to be selected by customers, it should be competitive. Porter (1990) notes that competitive advantages are created in the interplay between the rivalry, demanding customers, and the quality of related and supporting sectors, whereas a port's related and supporting sectors have much to do with its hinterland; hence, the port hinterlands are crucial for port performance and port choice. The competition has drawn the attention of a number of researchers who have proposed different competitive components of port competition, apart from PPIs. These components are considered as determinants of port performance.

Pearson (1980) considers confidence in port schedules, frequency of calling vessels, variety of shipping routes and accessibility of the port as port competitive components. Collison (1984) identifies average waiting time in port and port service capacity as competitive components. Slack (1985) adds tariffs, port congestion and inter-linked transportation networks to the components. Brooks (1984; 1985) proposes three more components: port costs, port reputation and/or loyalty and experience of cargo damage. Murphy et al. (1988; 1989; 1991; 1992) consider the port facilities and equipment available, convenient pickup and delivery times, information concerning handling, assistance in claims handling and cargo handling flexibility, port operations policy, international politics, change of social environment, trade market, economic factors, and features of competitive ports as the important competitive components. UNCTAD (1992) notes geographical location, networks in the hinterland, availability and efficiency of transportation, stability of the port and port information system as competitive components. McCalla (1994) considers container transport routes as a specific important component. Arvis et al. (2007) add safety handling, customs service, rapidness, simple documents in port, and skills of port to the port competitive components.

The relevant port competitive components and determinants are identified as factors that influence port performance. They are also factors considered for port choice, as what makes ports competitive will make a port perform well and contribute to the port selection. Since 2000, a few empirical studies on port competitiveness and port choice have been conducted. Lirn et al. (2003) studied transhipment port selection criteria from a container carrier's perspective. Their study revealed the criteria to be handling cost of containers, proximity to main navigation routes, proximity to import/export area, basic infrastructure conditions and existing feeder network, which were identified as important in descending order of importance. Tongzon and Heng (2005) studied port competition and choice and proposed eight key determinants of port competitiveness: 1. Port (terminal) operations efficiency level; 2. Port cargo handling charges; 3. Reliability; 4. Port selection preferences of carriers and shippers; 5. The depth of the navigation channel; 6. Adaptability to the changing market environment; 7. Landside accessibility; 8. Product differentiation.

Tongzon (2007) conducted an empirical study in Singapore ports with manufacturers and third party logistics providers (3PLs) and subsequently conducted another empirical study in the Association of South-East Asian Nations (ASEAN) region, attempting to identify the determinants of port competitiveness. He noted that the factors of cost of production, management quality, prices, quality of the service, exchange rates, government policies, political stability, investments in human and physical infrastructure, centrality or proximity to markets would decide the international competitiveness of ports.

Yeo et al. (2008; 2010) conducted an empirical study in China and South Korea with carriers and port operators and the study results revealed that port service, hinterland condition, availability, convenience, logistics cost, regional centre and connectivity are the determining factors in Northeast Asia. Cullinane et al. (2005) and Comtois and Dong (2007) analysed port competition between Shanghai and Ningbo, which share the same hinterland. They found that market-based reforms, the increasing globalization of China's economy, continuing economic development in the hinterland and China's entry into the WTO all contributed to the growing demand for port services. They identified that low price, quality of services, central government policies on regional development, natural endowments (particularly depth of water), good inland transport infrastructure and logistical systems, growing cargo resources and leading liners such as Maersk and K-Line contributed to ports' competitiveness.

Comparative studies on port choice in different regions

There are a number of studies on particular regional ports and some comparative studies were conducted in different regions. For example, the Australian Bureau of Industry Economics (1993) compared some selected ports within Australia. Fleming and Baird (1999) reflect port competition in the US and western Europe. Cullinane and Wang (2006) study efficiency of European container ports and Ng (2009) looked at port competition in North Europe. Cullinane et al. (2005) and Comtois and Dong (2007) compared the ports of Ningbo and Shanghai in China. Yap and Lam (2006) compared the ports of Singapore, Port Klang and Tanjung Pelepas for competitiveness. Tongzon (2007) investigated choice on ASEAN ports. Yeo et al. (2008) evaluated the competitiveness of container ports between Korean and China. Lam and Yap (2008) analysed competition between major ports in Southeast Asia. Notteboom et al. (2009) addressed competition and coordination among adjacent seaports. Yet, few empirical studies compare port performance between Europe and Asia, especially between the UK and China, let alone comparison of factors that influence their port performance. Comparing the different factors is important for port managers to learn from others who do better in terms of performance.

Prior studies on informants

Although the empirical studies by previous researchers on port studies involve certain port stakeholders, such as global carriers (Saeed 2009; Lirn et al. 2003, 2004), cargo interests-manufacturers (Tongzon 2007), suppliers of services-3PLs (Tongzon 2007), and freight forwarders (Tongzon 2009), the operators or agents of the world’s largest service providers, multinational logistics carriers and shipping companies (Ojala et al. 2007), carriers and port operators (Yeo et al. 2008), they do not study ports by involving all key port stakeholders in a single study. Murphy et al. (1992, 1994) and Notteboom & Winkelmans (2001) group stakeholders into shippers, forwarders, shipping lines, port managers. Bichou and Gray (2004) group port stakeholders into port operators, transport providers, shippers, forwarders and carriers. However, they did not include other port stakeholders into their empirical study, such as government agency, academics and consultants. The competitiveness components identified by these studies might therefore have some informant bias, as they are not addressed by a variety of key port stakeholders in the same study. Taking wider stakeholders into account can avoid bias in decision making.

1.2 The research gap, aim and objectives

Some of the reviewed studies in Section 1.1.2 addressed PPIs that are related to factors influencing port performance; other studies presented the components or determinants of port competitiveness that may be considered as factors influencing port performance as well. Generally, port performance is strongly related to such factors as scope of the hinterland, local product structure, local economic development level, status of the world economy, government policy on supporting trade, landside infrastructure, population, and culture (Tongzon 2007). Martino and Morvillo (2008) consider activities (performed by port operators and supply chain players), resources (port infrastructure, links to ports and services) and inter-organizational relationships (cooperation based on trust and shared strategic objectives) as key factors in port competitiveness within the conceptual categories of SCM.

Since factors influencing port performance are so important, port managers are eager to identify the factors, so that they can improve the factors and then improve port performance accordingly. However, although port authorities have always had an interest in factors driving port performance, only a few empirical studies were conducted. To improve port performance, such factors need exploring. As port performance is a complex reflection of trading and economy, a comprehensive group of factors may have influence on it concurrently apart from factors proposed by Tongzon (2007), Huybrechts et al. (2002) and other authors.

Researchers have conducted studies on port performance (Lambertides and Louca, 2008; Brooks and Pallis, 2008), PPIs and criteria for port competition (Fleming and Baird, 1999; Cullinane et al., 2005; Song and Panayide, 2008; Tongzon and Heng, 2005; Martino and Morvillo, 2008; Tongzon, 2007; Yeo et al., 2008) and port selection (Murphy et al., 1992; Lirn et al., 2003; 2004; Wiegmans et al., 2008). However, few studies are identified to investigate factors influencing port performance.

Murphy et al. (1991) employed factor analysis to group the influencing factors into two categories: customer service issues and freight handling capabilities, but they did not prioritise the factors, nor did they include external factors such as environmental factors, government support, location, etc. Wiegmans et al. (2008) classified different groups of factors, but they did not prioritise them, measure them or compare them. The factors were not quantified to see how important they were and how the performance were different between the factors except Tongzon and Heng (2005). Failing to quantify factors does not provide sufficient information and allow port managers to identify the importance hierarchy order of factors, so that the factors cannot be treated in a proper importance position. The factors with different importance should be treated differently to avoid waste of resources and increase port efficiency.

Tongzon and Heng (2007) quantified the relationship between port ownership structure and port efficiency; however, they only quantified one factor and missed other factors. They identified that private sector participation in the port industry to some extent and adaptability to the customers' demand could increase port competitiveness, yet they failed to identify other factors. Briefly, the studies did not classify, measure, prioritise and compare the factors influencing port performance in a single study.

The literature did not identify sufficient factors influencing port performance. Even when writers identified some factors, they failed to make sense of these factors, nor did they use them to explain port performance. The importance of factors influencing port performance, lack of previous research on comparative studies on factors influencing port performance between European and Asian ports, lack of studies on more informants engagement to avoid bias, lack of studies on quantifying and prioritising factors driving port performance, have resulted in knowledge gaps, which have motivated the research aim and objectives, stated below.

Research aim

According to Golden-Biddle and Locke (2006), research is conducted to fill a gap in knowledge which previous research may have missed, being therefore incomplete, inadequate and incommensurate with theory and practice. This research is intended to address the identified research gaps. Firstly, the current study considers as many key port stakeholders as possible, including consignors/consignees, port service providers (PSPs), carriers, port managers and other key port stakeholders. Secondly, factors that determine port performance and port choice are identified from various port stakeholders' points of view. Thirdly, the empirical research was conducted in UK and Chinese ports to find out key factors that determine port performance, and compare the differences and similarities between ports. This research seeks to explore the factors that influence port performance and investigate if and why the ports perform differently. The research results may be able to be generalized to similar European and Asian countries.

The aim of this research is to identify factors that determine port performance and choice in a comparative study between two ports: one in European and one in Asia, and propose a strategy for case port stakeholders to improve their port performance. This research also seeks to identify how port managers can improve port performance. The research attempts to discover how different the factors are in terms of factor importance and factor performance in the respective ports, and why the factors perform differently in different contexts. The research also considers port choice, which is closely related to port performance.

Research objectives

In order to achieve the above aim, the objectives of this research are to:

1. Identify the key factors that drive port performance and choice
2. Investigate the differences in importance and performance among the factors
3. Analyse how the factor importance and performance vary for different ports
4. Analyse the role port hinterland plays in port performance and choice
5. Illustrate the usefulness of the key findings from the analysis for port stakeholders.

The research objectives are achieved using a variety of research methods and data sources, presented in a later section.

1.3 Significance of the study

Seaports are key constituents in the supply chain and their pre-eminent role in international distribution is unlikely to be challenged (Notteboom and Winkelmans 2001). As ports perform differently, it is important to identity factors influencing port performance. Only by identifying the different factors can a region find a way to improve the factors, and only by improving the key factors can port performance be improved accordingly. The research results contribute to both theory and practice.

Theoretically, it offers a different dimension to theorising factors influencing port performance, having implications for academics. Firstly, both internal and external factors influence port performance, and some of the external factors may influence internal factors. Secondly, this is a research study involving all the key port stakeholders in a single study to avoid interviewee bias. Thirdly, this research contributes to the literature with a comprehensive review of up-to-date port performance indicators and factors influencing port performance. Fourthly, it is a cross-culture empirical study to compare the performance and factors influencing two European and Asian ports, which has not been done before due to language and data constraints. Finally, it is an empirical research to apply importance-performance analysis (IPA) in the port sector to improve service quality.

Practically, the research findings can be used in the consideration of port management and future port development. The outcomes are expected to aid port managers and other stakeholders that have direct or indirect power over port performance to focus attention on improving port performance in order to compete more effectively.

1.4 Methodology

This research is exploratory regarding the factors that determine port performance. It is also concerned with investigating these factors across port regions. Mixed methods are utilised in this research to achieve the listed research objectives by both qualitative and quantitative data. Mixed methods are regarded in this research as appropriate and consistent with the nature of interpretivist and positivist enquiry (Hussey and Hussey 1997). Mixed methods were selected as they are understood increasingly to provide multidimensional insights into many management research problems (Mangan et al. 2004), to complement each other and improve confidence in findings (Bazeley 2008), and to enhance the validity of the research results (Filippini 1997).

The research was carried out by means of a literature review and surveys in the ports of Humber (the UK) and Xiamen (China). A purposive sampling approach was followed for the selection of research context. China was selected because China's entry to the WTO has a significant impact on the activities in trading, freight transportation and distribution, warehousing and freight forwarding, and 90% of China's international trade freight is handled at the ports (UNCTAD 2002). China is a typical eastern developing country. The UK was selected because 95% of the UK's international trade freight is handled at the ports (Potter 2004). The industrial revolution and developments in transport, particularly maritime shipping development once made the UK ports famous such as Liverpool, Southampton and London very prosperous. The UK is an island country whose sea-shipment is the main transport mode. The choice of ports in both countries also allows a comparison of two ports in Europe and Asia.

Specifically, the Humber was selected as it is the largest port complex in UK and bears 25% of the UK's international trade by value. It once enjoyed greater glory through trade. However, it has lost its position since the 1970s with the decline of the fishing industry. Xiamen was selected as it is one of first cities/ports to enjoy the preferential policy of special economic zones. Studying these two port regions may result in identification of factors that influence port performance.

In line with the adopted survey strategy, literature review, interviews and questionnaires were conducted in different research phases. Firstly, literature was reviewed to form the research foundation and help to develop a good understanding and insight into the relevant previous research and emerging trends. The review focused on construction and conceptualisation of factors that influence port performance and port choice. It provided the background to this research and generated an initial list of potentially important factors. Secondly, to answer the research questions, forty interviews with key port stakeholders in the Humber (UK) and Xiamen (China) were conducted to explore the factors that influence their port performance and reduce the number of factors identified from the literature. Thirdly, a questionnaire was designed based on both the literature and interview results, and questionnaire surveys were conducted. Two hundred and fifty-four valid questionnaire responses (one hundred and fifty-two from Xiamen and ninety-two from the Humber) were used to assess the reliability and validity of the factors derived from the literature and to identify any new factors. The questionnaire results also validated the interview results. In addition, secondary documents and information from a variety of sources were collected and examined in order to understand the selected ports.

The following explains the research process and how each research objective was achieved. This is also shown in Figure 1.1.

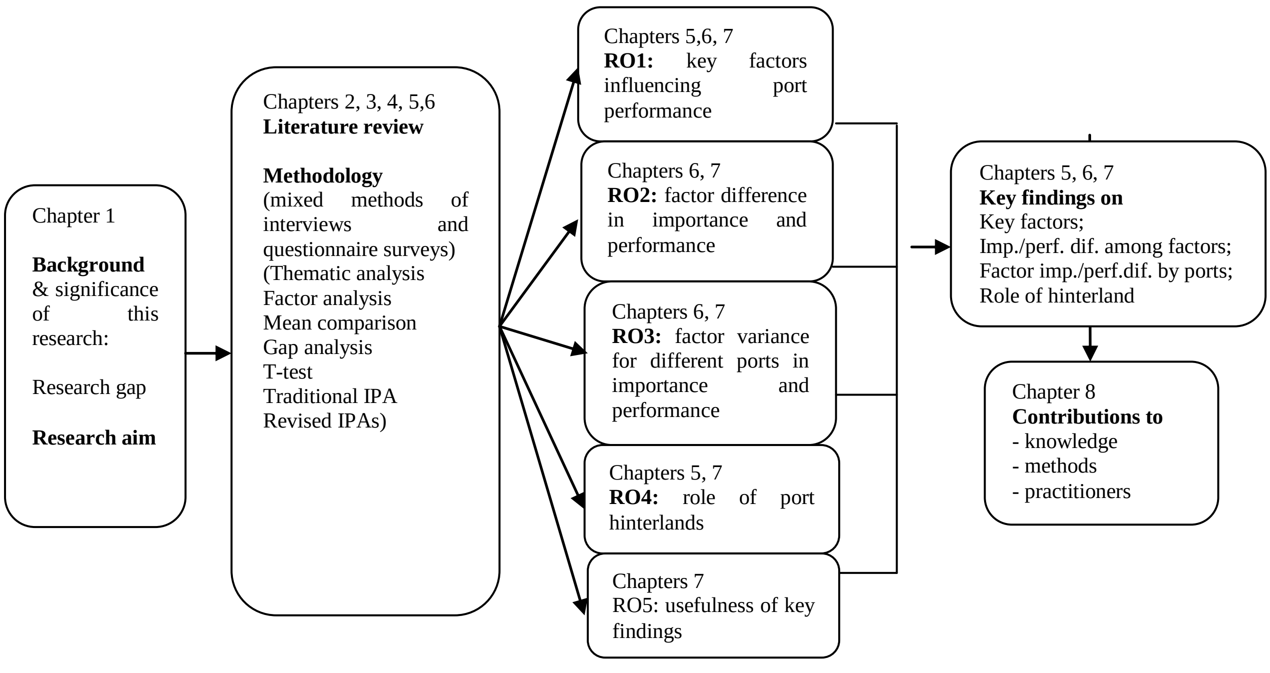


Figure 1. 1 Research route map (RO: research objective)

Firstly, the research background, significance of this research and knowledge gap were investigated, which justifies why this research was undertaken and how research objectives were formulated.

Secondly, it was decided how the research objectives would be achieved. Regarding Research Objective 1, exploratory interviews were conducted and a questionnaire survey was developed. The factors drawn from the literature and the exploratory interviews were used to ascertain the respondents' understanding of the factor importance. A questionnaire was designed to discover the importance assigned to factors by respondents. Respondents were asked to evaluate factor importance of their focal ports, factor performance of their focal ports and factor performance of other ports. To understand the importance comprehensively, explicit factor importance of the selected factors was ranked by mean in descending order. A traditional importance-performance matrix was employed to extract factors needing urgent actions which had explicit means with low performance and with high importance. Importance-performance gap analysis was used to identify factors requiring quality service improvement. Performance gap analysis (between focal ports and other ports) identified factors needing actions to improve service quality. This performance gap analysis together with factor importance was employed to identify salient factors. Revised IPA was employed to identify basic factors employing 3-factor theory. The factor importance and determinants obtained by various analyses achieve the first research objective.

With regard to Research Objective 2, differences in importance and performance among the factors were investigated by mean difference between factor importance and mean difference between factor performances. Concerning Research Objective 3, interviews and questionnaires were used to cross-analyse how the factor importance and performance varied for different ports. Independent-Samples t-tests were conducted to identify the distinctions in importance and performance between different ports.

As for Research Objective 4, semi-structured in-depth interviews were conducted and the answers to open questions in the questionnaire were examined to investigate the role a port hinterland plays in port performance and choice. Regarding Research Objective 5, implications for port stakeholders were put forward based on the interview and questionnaire findings and in-depth discussion of the findings with the support of the literature.

After the objectives were achieved, research contributions were derived from the findings in terms of knowledge, practice and research methods.

1.5 Outline of the thesis

This thesis consists of eight chapters. Chapter 1 introduces the research as a whole. Background information on the research topic, a summary of previous research, the research gap, aim and objectives, and a brief explanation of the methodology are given.

This is followed by a literature review in Chapters 2 and 3. Chapter 2 discusses the general background of ports. It covers the concept of port, relevant theories to support this research and port activities. This chapter then addresses port functions, roles and changes. It reviews the literature on trends in maritime transport, and tackles the issues of port ownership and port challenges. Theories underpinning port performance are briefly reviewed. Chapter 3 reviews the literature on port performance and key performance indicators (KPIs), which are then categorised. This is followed by reviews on criteria of port competition and choice. This chapter also presents examples of current and historically successful ports; some common lessons on factors that make them outstanding are learned. Factors selected for the fieldwork are then extracted from the successful ports and the presented literature.

Chapter 4 describes how the research was designed and conducted. After a brief review of the research aim and objectives, the research philosophy of social enquiry and management and the researcher's personal philosophical stance on the current research are set out. This is followed by a discussion of the research methods. The survey strategy adopted is explained, and a justification is given for using interviews and a questionnaire survey as the main methods for data collection. Then selection of locations and interviewees for the empirical research is presented and justified. Importance-performance analysis is detailed addressed. This chapter ends by presenting the tools employed for data analysis and data interpretation, and addressing ethical considerations.

Chapters 5 and 6 present the data analysis and research findings. Chapter 5 contains the analysis and findings of the interviews. Common patterns and a number of themes emerge. They shed light on the main factors that influence port performance. Chapter 6 presents the questionnaire analysis, starting with data cleaning, followed by the data validity and reliability. Then factor analysis is conducted to extract aggregate-factors from the questionnaire factors. Principal component analysis is conducted to reduce the data. The main data analysis concerns about analysis of descriptive comparison between the two case ports. Detailed comparisons of factor importance and factor performance are presented, and the distinctions between factor importance and factor performance are reported. The importance-performance analysis is applied through the importance-performance matrix, and the factors for improvement are identified by various techniques.

Chapter 7 discusses the findings based on the supporting literature and combined results from data analysis in Chapters 5 and 6. The research objectives are discussed one by one. An evaluation of respondents' aggregated perceptions of the importance reveals that all the factors are perceived as important (their mean scores are over 3.0 on a 5-point Likert scale), although different regions have their own priorities for improvement. Mean comparison, gap analysis, traditional IPA and revised IPA provide different results from different angles employing the same data. These are integrated with interviews to identify the common basic factors, salient factors and factors for urgent actions for the ports of Humber and Xiamen to concentrate on. Based on the research findings and related discussions, implications for port managers are presented for the Humber and Xiamen in turn.

Chapter 8 concludes this research. It first discusses the key findings. Then, the achievement of the research objectives is demonstrated. This is followed by a discussion of the originality and contributions of the research. The chapter finishes with limitations of this research and suggestions for future research.

2. LOGISTICS, SUPPLY CHAIN MANAGEMENT AND PORTS

The main objective of this chapter is to review the extant literature. This chapter begins with a definition of logistics and supply chain management (SCM) and their inter-relationship. Then it introduces the definition of port, addresses port activities, port roles, logistics chains and port-centric logistics. These are followed by relevant theories underpinning port performance, port development trends and challenges. Lastly the chapter ends with a summary.

2.1 Defining logistics and supply chain management

Logistics and SCM are vague and broadly tackled concepts as they are not clearly defined and distinguished. They are in nature linked to most disciplines such as transport economics, operations management, marketing, quality management, supply and purchasing management, engineering, geography and information and communications technology (ICT). Although the two terms are often used interchangeably, it is necessary to distinguish them. This section will review the different definitions and make clear the definition adopted for this research.

2.1.1 Definition of Logistics

The word logistics originates from the ancient Greek logos (λόγος) whose meaning was related to mathematical calculations. During the early twentieth century, logistics was used in a military context when the Americans used it to describe the organisation of moving, lodging and supplying troops and equipment (Mangan et al. 2008). Later on, the application of logistics moved into the business area and focused on the movement of goods and the flow of information from one point to another in the supply chain, to meet the demand requirements of the end customer. Today, logistics is applied not only to manufacturing business, but also to service sectors such as banks, hospitals, schools, posts and ports. Logistics has definitely become the backbone to support business and national and global economic growth.

A number of definitions of logistics have been given in the past few decades. APICS and the Concise Oxford Dictionary define logistics as the art and science of obtaining, producing, and distributing material and product. The Chartered Institute of Logistics and Transport (CILT) defines logistics as “the time-related positioning of resources to meet user requirement”, which involves “getting the right product to the right place in the right quantity at the right time, in the best condition and at an acceptable cost”

(Mangan et al. 2008). The authors add another two “R”s to CILT’s definition (“to the right customer” and “in the right way”) and note that getting all the “R”s correct can be a serious challenge for business.

Logistics has been recognised as one of the last real frontiers of opportunity for firms to improve their corporate efficiency (Drucker 1962). Different definitions of business logistics have been given by Luttwak (1971), Cavinato (1982), Novack et al. (1992), Bowersox and Closs (1996), Christopher (1998), Cox et al. (1998) and Coyle and Bardi (2003). Logistics is augmented to include customer services along with goods and information movement (Cooper et al. 1997). Transportation, warehousing, order processing, customer service, administration and inventory holding are considered as components of business logistics activities (Lambert et al. 1998a).

Bechtel and Jayaram (1997) distinguish manufacturing logistics and service logistics. They note that logistics in retailing is a pull system (highly customer driven) while that in manufacturing is a push system somewhat driven by the customer but significantly by the suppliers. Logistics process output is viewed as creating value for the ultimate customer (Langley and Holcomb 1992) and contributing to the profitability of the firm at present or in the future (Cooper 1994). Lummus et al. (2001) state that the variety of definitions indicates that logistics entails the process of planning, implementing and controlling the flow and storage of goods and services from the point of origin to the customer, conforming to customer requirements, including inbound, outbound, internal and external movements, and return of materials and products.

Most of the definitions entail the movement of materials and products from origin to end customers (including pre-production, in-production and post-production), but some miss the flow of information, while some miss the purpose of serving customers. There has been no consensus but confusion over logistics, although there are some common connotations among the different definitions. The researcher will adopt the most widely accepted definition by the US-based Council of Supply Chain Management Professionals (CSCMP), which defines logistics as part of SCM, i.e.

> *“that part of the supply chain process that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and related information from the point of origin to the point of consumption in order to meet customers’ requirement”(Vitasek, K. 2010).*

This definition represents a supply chain orientation in the sense of “from point of origin to point of consumption” (Lambert et al. 1998b). It integrates material management and physical distribution, including flows of materials, information and services in both manufacturing and service sectors.

Grant et al. (2006) note that logistics plays a key role in two significant ways in the economy. First, logistics is one of the major business costs, which affects and is affected by other economic activities. Second, logistics, an important activity to facilitate sales of goods and services, supports the movement and flow of economic transactions.

Logistics has experienced six eras of evolution since the 1900s, namely, farm to market, segmented functions, integrated functions, customer focus, logistics as a differentiator, and behavioural and boundary spanning (Kent and Flint 1997). As the logistics boundary itself is changing, the definition of logistics is updated through the efforts of academics, practitioners and professional associations to match the "current" perspective. Logistics is often associated with SCM, which is defined in the next section.

2.1.2 Definition of supply chain management

The supply chain (SC) concept originates in the logistics literature and logistics has continued to have a significant impact on the SCM concept (Jones and Riley 1985; Monczka et al. 2001). Consultants introduced SCM in 1982 (Oliver and Webber 1982; Grant et al. 2006). SCM's initial emphasis was to facilitate product movement, coordinate supply and demand by retailers, who began to compete by the management of materials, and then the concept spread to other industries (Bechtel and Jayaram 1997). The term SCM has risen to prominence (Cooper et al. 1997) because of global sourcing, an emphasis on time and quality-based competition and the respective contribution to greater environmental uncertainty (Mentzer et al. 2001).

From the five schools of thought (functional awareness school, linkage school, information school, integration and process school and future school of thought) (Bechtel and Jayaram 1997), some researchers define that SCM encompasses different functions such as flow of materials, purchasing and sales (Tyndall et al. 1998; Mentzer et al. 2001), some emphasize the links between different functions (Lummus et al. 2001; Harrison and Hoek 2005), some focus on information technology (Handfield and Nichols, 1999; Harding 2004), some highlight the integration of processes and functions (Ayers 2003; Monczka et al. 2001; Bolstorff and Rosenbaum 2003) while others highlight relationships (Lummus et al. 2001; Mentzer et al. 2001). The different schools of definition result in confusion for both researchers and practitioners.

CSCMP re-conceptualized SCM from integrating logistics to integrating and managing key business processes across the supply chain, which means SCM is a more strategic approach than logistics (Grant et al. 2006). CSCMP defines SCM as

> *"Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, Supply Chain Management integrates supply and demand management within and across companies." (Vitasek 2010)*

This definition reflects that SCM is a combination of strategy and activity, encompassing collaboration (Gibson et al. 2005), and this is what this research adopts.

2.1.3 Relationship between logistics and SCM

The terms "logistics" and "SCM" are often confused and viewed as overlapping (Larson and Halldorsson 2004) because the concepts are not well defined and the professional world uses both terms to talk about the same issues (Long 2003). The unclear boundary of SCM has made it difficult to design educational and research programmes in SCM and it is difficult to implement SCM (Larson and Halldorsson 2004).

Before 1998, most practitioners, consultants and academics did not differentiate SCM from logistics (Grant et al. 2006). Larson and Halldorsson (2004) investigate the two concepts and find four relationships between them, as Figure 2.1 shows.

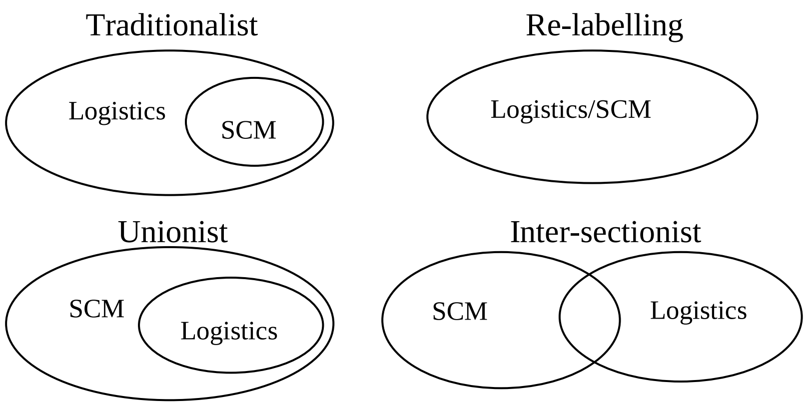


Figure 2. 1 Relationships between logistics and SCM concept

Source: Larson and Halldorson (2004) "Logistics vs. SCM"

The **traditionalist** positions SCM as a function or subset of logistics because the logistics community tends to view SCM as "logistics outside the firm to include customers and suppliers" (Stock and Lambert 2001a). This reduces SCM to a single function and a special type of logistics. Traditional practitioners would create a new "SCM analyst" position within the logistics group. Analysts focus on logistics problems within or between organisations and the SCM leader would report to the logistics head (Larson and Halldorsson 2004; Larson et al. 2007). In the view of traditionalists, educators can simply add an SCM lecture to the logistics management course or insert a SCM chapter into a logistics text-book (Larson and Halldorsson 2004).

According to Larson and Halldorsson (2004), **re-labelling** just entails a name change; what was logistics is now SCM. There are no clear specific characteristics to differentiate these two concepts (Simchi-Levi et al. 2002). Therefore, in people's understanding, SCM and integrated logistics management are not appreciably different (Copacino 1997). Some would even regard SCM as a synonym for logistics (Cooper et al. 1997). An international survey with SC managers was conducted in 2001 and a number of responses reflect the re-labelling perspective (Gammelgaard and Larson 2001). To relabellers, educators will teach the same old logistics course under a new name of SCM while practitioners will be re-titled from "logistics analyst" to "SCM analyst" with little or no change in job description.

Unionists see logistics as a part of SCM and consider that SCM completely subsumes logistics (Giunipero and Brand 1996). With the increasing interest in SCM, many authors have discussed the differences between SCM and logistics. Both Stevens (1990) and Hewitt (1994) agree that the final stage of SCM implementation is a process rather than a function. Cooper et al. (1997) present that SCM is not just another name for logistics but includes elements that are not typically included in logistics, such as information systems integration and coordination of functional activities.

Educators might remove logistics management from the curriculum and cover the essentials of logistics in a new SCM course; or they may keep the old logistics management course and create a SCM course to develop further the cross-functional, inter-organisational nature of strategic logistics and related functional areas (Larson and Halldorsson 2004). Practitioners would change the organisational structure/chart and create a new high-level position.

Mentzer et al. (2001), Cooper et al. (1997) and Lambert et al. (1998b) take the unionist view that SCM comprises logistics. This view has been reinforced through a number of industry practitioners. Executives have visualized the necessity to go beyond the logistics function and focus on making business processes more effective and efficient and integrate all key business operations across the SC (Cooper et al. 1997; Lambert et al. 1998b). Grant et al. (2006) suggest that SCM is more comprehensive than logistics because the management of multiple SCM processes includes the logistics process.

Inter-sectionists see SCM and logistics as partially overlapping. Practitioners can add a SCM staff function and educators would champion an interdisciplinary SCM major. Perhaps team-taught, cross-functional SCM courses could split into modules that are aligned with traditional functions or positioned at functional interfaces (Larson et al. 2007).

Some people may change their views on the relationship between SCM and logistics as time passes. For example, Stock and Lambert were traditionalists in 2001 (Stock and Lambert 2001b) but they became unionists in 2004 (Lambert 2004a; Lambert 2004b). According to a survey in 2001, most respondents (SC managers) held the view of re-labelling and then became unionists (Gammelgaard and Larson 2001). Results of another international survey by Larson and Halldorsson (2004) show that 51% of the respondents were relabellers and 22% were unionists. Only two years later, when a third survey was conducted by Larson et al. (2007), the result was quite different. This time, 47% of respondents were unionist, and re-labellers had a sharp drop from 51% to only 6%. What is worth noting is that all respondents had CSCMP membership.

It seems that academics tend to be re-labellers while practitioners tend to be unionists. People may become more SC oriented as the unionist view has gained popularity. This research takes the unionist view as it is more widely accepted and it is the trend that relabellists become unionists. The next section will discuss ports in the context of logistics systems and global logistics chains.

2.2 Ports and global logistics chains

Increasing globalization and a growing degree of product customization have resulted in more complex supply chains that demand a more rapid response to order delivery and more effective movement of goods across the world, which makes logistics a new service sector crossing departments, industries and regions. How to make goods move more efficiently to satisfy international and national trading has thus become a key factor to drive the regional economy and its development, which cannot be separated from port efficiency.

2.2.1 Ports in global logistics chains

The port is a land area with maritime and hinterland access that has developed into a logistics and industrial centre, playing an important role in global industrial and logistics networks (Notteboom and Winkelmans 2001) (when logistics chains come together, they form logistics networks). De Langan (2003) defines a port as a collection of a diverse set of economic activities. Ports are the locations where road, rail and waterway start and end for cargo consolidation and distribution, so Long (2003) defines a port as the intersection of different modes of transport. Seaports are hubs in worldwide transport to ensure interactions of domestic and international markets. They witness flows of goods and services between industries, consumers, and different countries. Many seaports and major inland river ports are critical ports as cargo transport centres, intermodal between road, rail, air and waterway.

Being pivotal places for sea/land transport interface, places where ships and cargoes are handled and services are given to them, nodes of shipping networks and elements in value-driven chain systems, ports have become elements and links in a global logistics and value chain (Robinson 2002). Ports not only deliver value to shippers and third-party logistics (3PL) service providers, but also capture value for ports themselves. Beresford et al. (2004) note the increased use of information and communications technology in the integrating SCM trend at ports; this indicates that ports are elements of the global supply chain.

Souza et al. (2003) divide container ports into three types: hub ports, feeder ports and direct-call ports. Trujillo and Nombela (1999) categorise seaports into landlord, tool and service ports, which differ essentially in terms of the relative role of the port managers and the private sector operators. In the case of a landlord port, port authorities own and manage the port infrastructure while private firms provide port services and own their assets: superstructure (like building) and equipment (like cranes); an example is Barcelona. Most port authorities are owners of the land inside the port areas (Bichou and Gray 2005). In this case, land rent and port dues are their income. The authorities have two main goals: to facilitate sustainable economic development of the port as a whole, and to become an efficient and effective organisation that generates income to cover costs, to make investments and to yield a return on shareholders’ investment (Lugt and De Langen 2007). In the case of a tool port, port authorities own the infrastructure, superstructure and equipment, while private firms provide services by renting port assets, through concessions or licenses. In the case of a service port, such as Singapore port authorities (SPA), port authorities are responsible for the port as a whole. They own the infrastructures and hire employees to provide services directly.

The globalisation of production has been one of the main drivers for the change in the port industry. The multi-national companies (MNCs) focus on innovation and customers instead of ownership and management of many production sites. They reduce cost by outsourcing production to the low cost developing countries, where goods are produced and distributed all over the world via ports. Global sourcing thus acts as a major driver of world trade and has deeply affected transportation and distribution systems (Notteboom 2006). Ports are a dynamic player in the competitive SCM scenario (Martino and Morvillo 2008).

2.2.2 Port activities

The freight that ports handle is often categorised into liquid bulk (like oil, petroleum, chemicals), dry bulk (like animal foodstuffs, coal, fertilizer, cement fines, minerals, grain, fertilizer slag), break bulk (general loose non-containerised cargo, stowed directly in a ship), and unitised freight [comprising both Roll-on Roll-off (Ro-Ro) and lift on, Lift off (Lo-Lo)] cargoes. Ro-Ro are items that can be driven on/off a vessel, including Heavy Goods Vehicles, cars, buses and other vehicular traffic, while LoLo are unitised or containerized cargo to be loaded or unloaded by crane (Tongzon 1995). The activities related to freight handling are port activities.

According to Bichou and Gray (2005), there are two major components in a port system: ships and cargoes. This has led to two types of logistics services: services to ships and services to cargo. The services happen in two separate areas: at the sea or waterway side, and at the ship/shore interface. The services to ships include such services as dredging, pilotage, mooring/unmooring, berthing, repair and maintenance, supply and bunkering. Based on the Department for Transport (DFT) and North American Industry Classification System (NAICS), the services to cargo include transport, warehousing, freight agency, stowing, break bulk and consolidation, manufacturing, cargo handling (carriage, packaging, processing), trading, insurance, finance, customs agencies, distribution and information treatment for planning, implementing and controlling the cargoes flowing to and from the hinterlands and forelands in a port area. The services are largely port activities.

The port activities may be within a particular region or across different regions from supplier to consumers between different ports or between ports and hinterlands. De Langen (2003) includes a typology of port-related industries for the different port activities. The port industry incorporates all economic activities that are required for the movement of ships and their cargoes and passengers through the port. According to the

Bureau of Transport Economics Report 101 (Economics 2000), the typical activities of the port industry are categorised as shown in Table 2.1.

Table 2. 1Port-related activities

Category	Activities	Role
Port authority operations	Preparing, co-ordination and promotion, land and property management, safety and emergency response, shipping channels and navigations aids, port authority wharves, berths, jetties, infrastructure for roads and utilities	Cluster manager (De Langen 2003)
Ship operations	Shipping lines/agents, pilotage, towage, line boats, mooring/unmooring, bunkering, ship supplies, ship repairs and maintenance, container repairs, container maintenance and servicing, container stevedores	Shipping lines are essentially the port customers
Ship loading and unloading/discharging	Private wharves, berths, jetties, container and bulk stevedoring, livestock stevedoring, bulk cargo loading/unloading, passenger terminals	Ship services at water side
Cargo services	Customs brokers, freight forwarders, container packing/unpacking, cargo surveyors, wool dumping and fumigation	Cargo services at sea/shore interface
The land transport and storage	Road transport, rail transport, transfer between road/rail and storage facilities and storage	Cargo storage and movement
Government agencies	Customs, quarantine, ship safety, port safety, environmental management and port policy administration.	Port services on safety

Source: adapted from Economics (2000)

Most ports are run by government entities, often known as port authorities, usually by a commission assigned by a local or regional government (Long 2003). The port authorities are the land managers with responsibility for a safe, sustainable and competitive development of the port and they face three trends: ongoing port reform (privatisation, corporatisation and commercialization), extension of port competition towards the hinterlands, and increasing importance of the "licence to operate" (Lugt and De Langen 2007).

In port activities, the following ten factors are often considered, namely, tariffs and non-tariff barriers, trade, efficiency of customs administration, efficiency of import-export procedures, transparency of border administration, availability and quality of transport infrastructure, availability and quality of transport services, availability and use of ICTs, regulatory environment and physical security (Hanouz and Lawrence 2009). Because of the dissimilar physical features of ports, the variety of cargo and ship types, and the wide range of port services, port activities need to be implemented efficiently and effectively. Ports have thus been developed, as described in the next section.

2.2.3 Port development and port generations

Four phases of port development

Ports have experienced four phases of development, namely, setting, expansion, specialisation and regionalization (Bird 1980), which are represented by Figure 2.2. The first phase was "setting", when ports functioned as traditional transhipment hubs. With the evolution of maritime technologies and skills improvement in material handling, ports entered the second phase of "expansion". More general cargoes were shipped and handled at the port with a wider urban area. Later on, some ports became more specialized in one or more shipping products by making use of their advantages in location and resources, entering the third phase of “specialisation”. Containerised cargo and bulk cargo emerged then. Some ports prefer handling containers, while others show more interest in bulk materials. Ports also have function preferences at this stage, for example, Rotterdam is a transhipment port, while Antwerp is an export port.

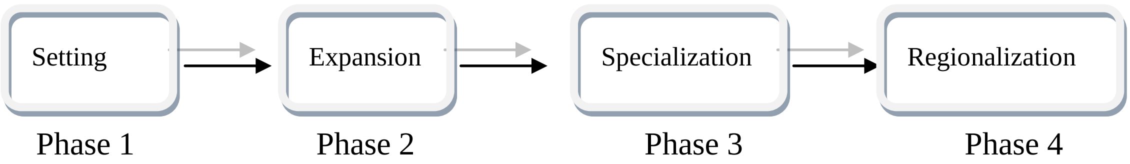


Figure 2. 2 Four phases of port development

Notteboom and Rodrigue (2005) claim that ports have entered the fourth phase of “regionalisation”. Freight distribution centres and freight corridors have emerged to allow ports to serve very large inland hinterlands. A port’s hinterlands connections in this sense determine the success of that port. Some seaport terminals that act primarily as transhipment hubs have an extensive maritime hub-and-spoke and collection & distribution networks. Garcia-Alonso and Sanchez-Soriano (2009) conclude that the maritime areas and the hinterlands complement each other, as ports are included in important maritime lines and with an important volume of national traffic.

Port generations

The port generations proposed by UNCTAD are widely cited. UNCTAD (1999b) distinguishes ports into four generations, with port roles and functions, institutional structuring, operational and management practices varying significantly from generation to generation, which is presented in Figure 2.3. First and second generation ports are operated in a traditional manner. Third generation ports handle containers and provide value-added services, employing technology and know-how. Fourth generation ports are mainly the product of recent vertical and horizontal integration strategies.

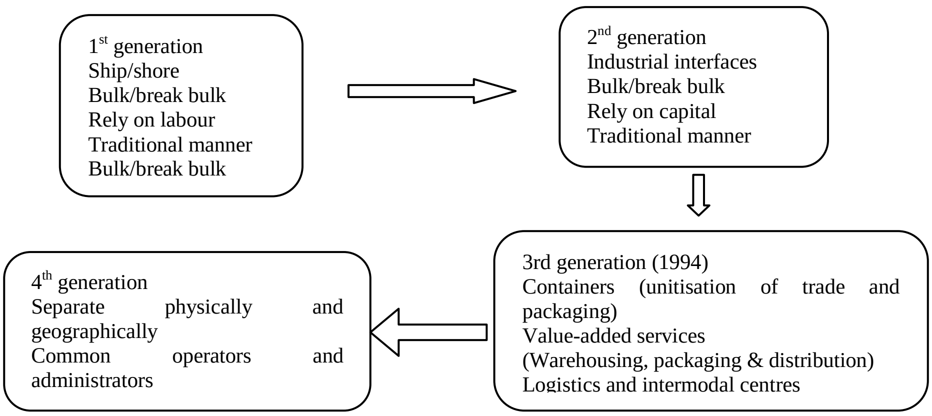


Figure 2. 3 Port generations

It is worth acknowledging that although some ports have already entered the fourth generation, many ports are still in the first or second generation.

2.2.4 Port functions, roles and role change

Port functions

The basic functions of ports are transport, transhipment, loading and unloading, storage and distribution, which are closely related to port activities. With the advantage of location, many important ports have adopted the concept of “front port, back factory” to provide processing, assembling and cargo sorting and other value-added services, which can not only reduce the transport cost and the packaging damage during the handling and transport, but also ensure the quality of products. Ports function as distribution or dedicated areas for both global logistics services and value-added logistics (VAL) (Harding and Juhel 1997). They can evolve from a transhipment centre to a complex of functions within a logistics system (Notteboom and Winkelmans 2001).

With increasing trade, a port has to be competitive and port functions need to expand. Besides the above basic functions at the traditional sea/land interface and value-added services, ports have developed some other services including trade, financial, leisure and property development activities, marketing and decision-making information for the port customers (shippers and carriers), agency, insurance, freight forwarding, carrier forwarding, customs and other trade services. Ports integrate the various logistics functions to become a logistics network with more connotations than just a transport link, as shown in Figure 2.4. The port system serves not only as an integral component of the transport system, but also as a major sub-system of the broader production and logistics systems (Bichou and Gray, 2004). As one irreplaceable point in the logistics chain, ports have opportunities to develop as logistics centres by expanding their traditional services and value-added services.

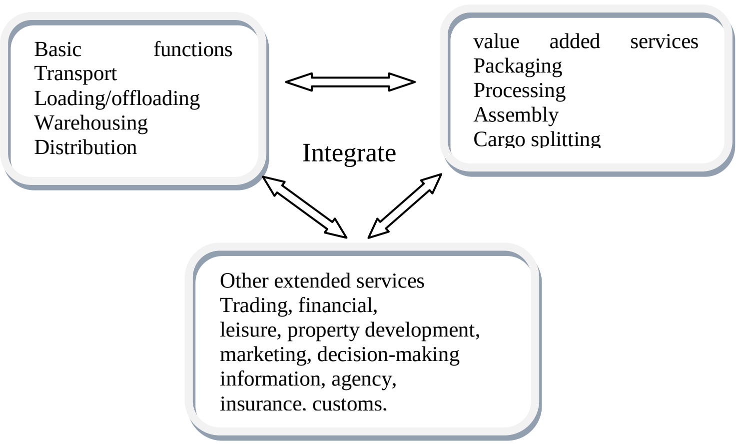


Figure 2. 4 Port functions

Port roles

Port roles are diverse in scope and nature. With the activities performed, ports play different roles as economic catalyst, job generator, communication and other influences. Moreover, their roles are changing.

Economic catalyst: Ports play a vital role in the regional economy to provide the link between suppliers and customers. From an economic perspective, ports are increasingly related to the competitiveness of economies (Cullinane et al. 2002; Sanchez et al. 2003; Bryan et al. 2006). Developing ports is beneficial to the capital structure of the regional economy. As Benito et al. (2003) note, ports, being dynamic industrial and local clusters, are important for the creation of economic value.

Bichou (2006) found that port impact studies focus on two areas: port economic impacts and port trade efficiency. Because of the port-city interface, ports are seen as economic catalysts for the regions they serve. The port services and activities generate aggregated benefits and socio-economic wealth for the geographical region through urban planning and environmental economics. Ports are thus seen as a driving force and engine in local and national economic development and policy makers consider ports as economic catalysts (Gooley 1999; Bichou and Gray 2005). Policy makers are interested in including ports in regional policy such as urban planning and expansion, safety, security and environmental sustainability (Bichou and Gray 2005). As ports are critical trade facilitators, they can generate additional economic benefits in such activities as land ownership (berths, terminals) and cargo handling (Mangan and Cunningham 2000).

The objectives of UK ports are to serve the national interest and support the competitiveness of national and regional economies, according to the government policy for the UK ports (DFT). Ports thus should remain capable of handling trade and its potential development efficiently and sustainably to promote international trade and economic development, employment, and industry in the port city and hinterlands, and to optimize the maritime logistics sector structure. Bryan et al. (2006) quantify the economic significance of the port activities in South Wales, showing multiplier effects of the Association of British Ports (ABP) port activities in terms of ports' contribution to the local economy and employment.

Job generator: Ports function as job generators by increasing the opportunity for jobs. Mechanization has created many new opportunities for employment by new machines. Ports provide direct and indirect jobs to the local community and society, and generate income for employees who will consume in the community accordingly. For example, the Rotterdam port complex was directly responsible for 86,500 jobs in 2006, which means 10% of the population in Rotterdam work for the port (www.portofrotterdam.com). As ports provide employment, income for local communities and flow-on effects through purchases from other industries, they have economic multiplier effects as a growth pole.

Communication and integrated logistics system: Besides the direct impact on the economy by creating jobs and generating income, ports have indirect impact on economic competitiveness as they attract inward investment, improve access to tourists, support international or inter-regional trading activities and enable companies to get access to markets (Bryan et al. 2006). Moreover, ports play a proactive role in promoting communications of culture, science and technology.

As reviewed in 2.3.4, the roles of ports have been changing. Robinson (2002) notes that ports could be more proactive as key elements in value-driven chain systems by creation of competitive advantage and value-added delivery. Perceived from an integrated logistics, trade and supply channel approach, ports can claim further roles and dimensions as logistics centres, and trade channels (Grant et al. 2006). Ports can bring together various SC members to the "integrated channel management system", where the port stands as a key location linking different flows and channels with their members (Bichou and Gray 2004).

2.2.5 Port hinterlands

Literally, port hinterlands refer to the land behind a port. A hinterland is the area from which port customers are drawn (UNCTAD 2006) but it is difficult to define in spatial terms (Pettit and Beresford 2008). Slack (2007) indicates that changing port-hinterlands relations has a clear impact on port development patterns. The performance of seaports is strongly entwined with the development and performance of associated inland networks that give access to cargo bases in the hinterlands.

Garcia-Alonso and Sanchez-Soriano (2009) analyse the actual inter-port distribution of traffic to study port choice in Spain, and conclude that apart from port location, the hinterlands of a port contribute to the port selection process. Port prosperity is closely related to the economic wealth of its hinterlands and forelands (Pettit and Beresford 2008). For example, due to lack of inland hinterlands, the glory of Portuguese trade did not last long and Portugal's port development was constrained, although its economy was flourishing at the time. The transit trade could only play a very small role in improving the local economy. On the contrary, as the Netherlands and UK had rich inland hinterlands, as these countries became prosperous, trade and navigation developed. The economy of port cities and their surrounding areas also increased, as in the cases of Amsterdam and London.

Modern ports compete for far-reaching cargoes with far-distant counterparts in terms of hub, transhipment and intermodalism. The shift of port activities from sea/shore interface to the land-side development and the use of intermodal transportation have prompted the redefinition of port hinterlands. The logistical hinterlands are facing the reality of containerization, trade imbalances, repositioning costs, manufacturing and leasing costs, and usage preferences (Dowd and Leschine 1990; Bassan 2007).

Notteboom and Rodrigue (2005) claim that ports have entered the phase of “regionalisation”. Freight distribution centres and freight corridors have emerged to allow ports to serve very large inland hinterlands. A port’s hinterlands connections in this sense determine the success of that port. Some seaport terminals that act primarily as transhipment hubs have an extensive maritime hub-and-spoke and collection & distribution networks. Garcia-Alonso and Sanchez-Soriano (2009) conclude that the maritime areas and the hinterlands complement each other, as ports are included in important maritime lines and with an important volume of national traffic.

Increasing containerization and port regionalization are mutually influential. Port regionalisation is characterised by a strong functional interdependency and even joint development of a specific load centre and selected multimodal logistics platforms. It brings the perspective of port development to a higher geographical scale beyond the port perimeter (Notteboom and Rodrigue 2005). Ports and hinterlands are actually part of the same continuum and they are closely bound together in a symbiotic relationship.

Port regionalisation depends much on the cargo support from the hinterlands, which have two directions, landside and seaside. As ports have strong links with the inland dimensions, the port foreland proximity and hinterlands production and consumption base have enlarged. The increasing cargo availability and port regionalisation have triggered changes in larger vessel size with fewer calls and better liner services (Notteboom and Rodrigue 2005; Mangan et al. 2008).

Port regionalisation is supposed to reduce the inland access costs by one third, which account for 18% of the total logistics costs globally (Stopford 2002). Corridors and inland terminals are cornerstones in port regionalization. Similarly, freight distribution centres and development of a broader regional load centre come to the fore for value-added logistics and port regionalisation, which play the role of growth pole in serving large logistics poles at the transport nodes (Notteboom and Rodrigue 2005).

The scope of port hinterlands varies. The country border is no longer a constraint or limitation on port development. The European Union's (EU) becoming a single market in 1993 has led to European integration. This indicates that previous country-specific logistics strategies are not optimal any more (O'Laughlin et al. 1993). The Oresund region is another example indicating that regions should go beyond country borders to make logistics more efficient. The new bridge over Oresund has brought a psychological importance as a visible symbol of coherence and physically linked Copenhagen and Malmo, although the research findings by Skjott-Larsen et al. (2003) show that these two cities still use separate logistics structures for customers.

The ten ASEAN countries are the Asian counterpart to the EU. Despite the attainment of free trade within the bloc, conditions are tougher than in Europe or North America for their logistics. The ASEAN country governments maintain protectionist measures due to their underdevelopment. Bookbinder and Tan (2003) suggest that ASEAN performs as a whole region rather than individual countries to improve the logistics performance.

EU, Oresund and ASEAN are cases depicting that port hinterlands can extend across borders. There are other cases where port hinterlands are smaller than a nation. In the USA, New Jersey, Long Beach, and the Great Lakes are different regions, and their logistics performances vary. In the UK, the southeast area logistics performance is different from that of the Yorkshire and Humber region. In China, the inland west logistics is different from that of the Pearl River Delta and that of the Yangtze River Delta. Within the region, the management system, the government policies, laws and regulations are the same, which results in frequent economic transactions and economic coordination, which makes regional port research more logical and feasible. These examples have shown that regional ports are practical. The different ports perform differently. Why they perform differently and how their performance can be improved is worth researching. Before investigating ways of improving port performance, the factors influencing performance need identifying. However, there is a gap in the literature for factors influencing port performance, which makes the current research significant.

2.3 Relevant theories underpinning port performance

There is no suitable theory underpinning factors influencing port performance. However, some relevant theories are available and will be reviewed in this section.

2.3.1 Stakeholder theory

According to Freeman and Reed (1983), stakeholders refer to any identifiable group or individual who can affect or be affected by the achievement of an organisation's objectives. As different stakeholders have different and competing interests, perceptions and ideas (Castro and Nielson 2003), they see their own interest without appreciating what is important to others. Hence, the interests of stakeholder groups constitute diverse sets of expectations, needs and values (Harrison and John 1994). This diversity of interests causes a potential problem: failure to satisfy one particular stakeholder may be detrimental to the others (Freeman 1984) due to resource scarcity and managerial incapability (Mahoney and Pandian 1992). To balance the interest of different stakeholders, stakeholder theory says managers should make decisions by considering the interest of relevant stakeholders (Sternberg 2000). This theory is critically important as contemporary firms must satisfy a variety of stakeholders to survive in a volatile and uncertain environment (Foley 2005).

The importance of stakeholder orientation comes from several areas: a number of studies suggest stakeholder orientation is positively associated with performance (Freeman 1984; Greenley and Foxall 1997; Clarkson 1995). A stakeholder orientation is a condition for excellence, as stakeholders are not isolated from each other; one stakeholder's success is dependent on others (Polonsky 1995). The latest development initiatives such as the Global Reporting Initiative (GRI) (Hedberg and Malmborg 2003), the Dow Jones Sustainability World Index (DJSI world), the United Nations Global Compact (Kell 2005) and the Ethical Trading Initiative (ETI) (Blowfield 1999) have shown emerging evidence that sustainability is stakeholder orientated. The stakeholder theory implies that all the relevant port stakeholders need to be considered when the port scheme is stipulated.

2.3.2 SCP paradigm

The structure-conduct-performance (SCP) paradigm was first raised by Bain (1956) and Scherer (1980). The tenet of the SCP paradigm is that the industry's structure influences the industry's conduct, which in turn influences the economic performance of an industry (Bain 1956). In terms of port sector, port economic performance is measured by profitability, value-added, technology development and employment; conduct refers to the port activities; and structure is mainly defined by the degree of concentration and market share distribution (Ormanidhi and Stringa 2008). Structure is the determinant of conduct, such as the number and size of buyers and sellers, technology, the degree of product differentiation, the extent of vertical integration, and the level of barriers to entry (Scherer 1980).

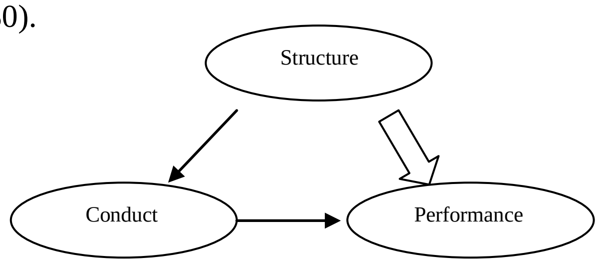


Figure 2. 5 Structure-conduct-performance, adapted from Bain (1956)

There are three main causal relationships between S-C-P, and the most important one is that structure impacts performance, see Figure 2.5. SCP is criticized, however, as it lacks a more explicit analysis of the firm's actions and its ability to influence its performance.

2.3.3 PESTEL analysis

The factors in the macro-environment may affect the performance of an industry, and the factors can be categorised by employing the PESTEL model, see Figure 2.6. PESTEL is an acronym for Political, Economic, Social, Technical, Environmental and Legislative (Armstrong 2006). This framework provides a strategic technique to analyse the external macro-environment of a business or industry and identifies the strategic factors that influence the business. It ensures that some basic factors are not overlooked or ignored. The PESTEL framework is a simple way to encourage the development of external and strategic thinking, but it may over-simplify the data for strategic decision. Nor does it investigate internal factors. As the macro environment often changes, PESTEL analysis needs undertaking on a regular basis.

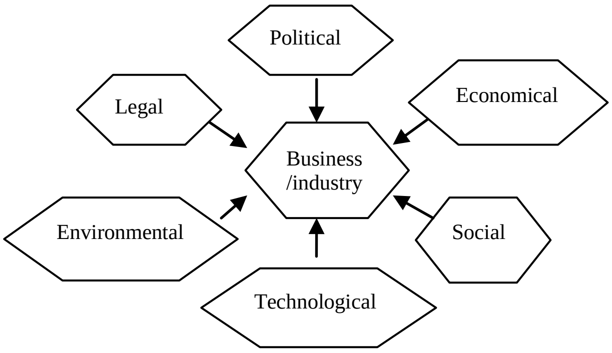


Figure 2. 6 PESTEL analysis model

2.3.4 Three-factor theory

Research into customer satisfaction suggests that service attributes fall into three categories with a different impact on customer satisfaction, which is known as 3-factor theory (Matzler et al. 1996; Oliver 1997; Matzler et al. 2003). The first category is basic factors, known as dissatisfiers. They are minimum requirements that produce consumer dissatisfaction when not fulfilled, but do not result in customer satisfaction when fulfilled or exceeded. Their negative performance has a greater impact on overall satisfaction than positive performance. The second category is excitement factors, known as satisfiers, which increase customer satisfaction when delivered, but cause no dissatisfaction if not delivered. Their positive performance has a stronger influence on overall consumer satisfaction than negative performance. The third category is performance factors, which produce satisfaction when performance is high and produce dissatisfaction when performance is low.

These four theories are related to this research. Concerning stakeholder theory, this research involves relevant stakeholders as sources of empirical data to reflect different stakeholders' views on port performance. Regarding the SCP paradigm, as structure influences performance, the structure of ports is investigated to find out whether port structure influences port performance. As for PESTEL theory, external factors are analysed to identify different factors influencing port performance. With regard to three-factor theory, the factors influencing port performance are categorised to benefit port managers by highlighting different implications.

2.4 Trends in maritime freight transport

Maritime industry has been developing and some trends in maritime freight transport and the port industry have emerged as follows:

2.4.1 Up-scaling of vessel size

Underpinned by economies of scale, container ships have experienced the development of six generations (Rodrigue et al. 2009), see Figure 2.7. Maersk announced in February 2011 that their new vessels with the capacity of 18,000TEUs would be put into use in 2013. In an attempt to win market share, shipping lines invested in larger vessels that are safer, faster and more efficient at lower cost (Cullinane and Khanna 2000). Not only are the sizes of deep-sea container ships increasing, but also the sizes of the feeder container ships are being up-scaled. The research by Ng and Kee (2008) shows that optimal sizes of feeder containerships in intra-Southeast Asia will increase by 2015.

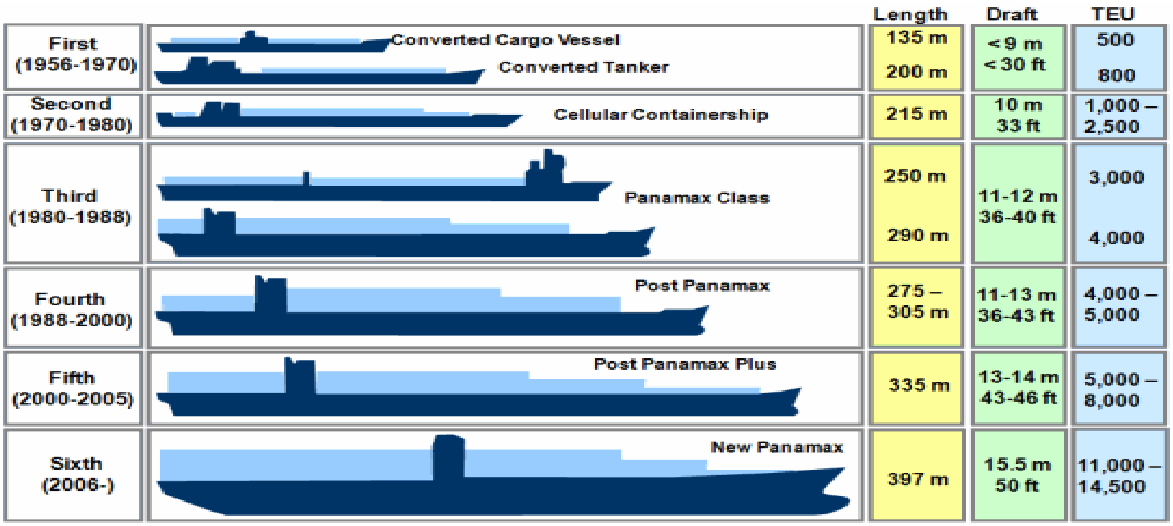


Figure 2. 7 Six generations of container ships

(Source: Rodrigue et al. 2009)

The increasing vessel size can reduce logistics cost but has profound influence on port development. Firstly, it has put pressure on port facilities and landside infrastructure, as not all ports can accept the call of large vessels. The pressure includes deep water berths, cranes, trucks, a large amount of back-up land, storage and warehousing, anchorages, tugboats and pilot launches. This may involve investments in infrastructure such as better access to ports by dredging, extending and supporting existing quays, or providing breakwaters. At the same time, the port technical infrastructure should be improved, as larger vessels require ports to provide better superstructure and larger terminal capacity to load and discharge cargo, such as better cargo handling equipment of cranes and storage facilities, height of bridges and navigation channel safety (UNCTAD 2009).

Secondly, to make the most use of port infrastructure and superstructure, an effective operational system is required to achieve quicker moves per hour, as larger vessels require more efficient port operations. Larger size ships have pushed ports to improve their productivity and operations efficiency. For example, the loading/unloading efficiency should be 300 moves/hour to cope with a vessel with over 3,000 TEUs, twice the current container operations efficiency (UNCTAD 2000). Thirdly, larger vessels require direct intermodal connections, often via on-dock rail so that no congestion happens at the port. Fourthly, larger vessels require a very good port location, as larger vessels call at fewer ports to save transit time. They require the ports to be rich in cargo resources, as fewer calls would reduce the port charges but increase the cargo volume. If the volume is insufficient (utility rate is below 60%) to fill the container vessels, the vessel would suffer loss (UNCTAD 2000).

Lastly, the increasing ship size and further concentration of power into fewer megacarriers make the main players more competitive for mainstream liner business, whereas the small players are forced to niche markets (UNCTAD 2000).

2.4.2 Shifts in supply chains and port logistics integration

Supply chains are stretching with increasing economic globalization and the efficiency of supply chains is becoming an essential component in the worldwide flow of goods and services. The success of a port depends on the ability to integrate the port effectively into the networks of business relationships that shape supply chains (Notteboom and Rodrigue 2005). In other words, the success of a seaport no longer depends solely on its internal weaknesses and strengths. It is more and more determined by the ability of the port community to fully exploit synergies with other transport nodes and other players in the logistics networks.

The integration strategies of the market players have created an environment where ports are increasingly competing within transport chains or supply chains (Notteboom 2006). This implies that a port's competitiveness has become increasingly dependent on external coordination and control. Port choice has become more a function of network. Port selection criteria are related to the entire network, where the port is just one node. Major port clients concentrate their service packages not on the ports' sea/land interface, but on the quality and reliability of the entire logistics chain. Capturing and keeping important clients on a sustainable basis requires integrated services characterised by a high level of reliability and flexibility, short time-to-market, and transparency within efficient governance structures (Notteboom 2006).

The shifts in supply chains have enabled ports to be either directly or indirectly involved in the vertical and horizontal integration undertaken by many international shipping lines and logistics service providers, with the context of world economy integration, free trade, containerization and information system support.

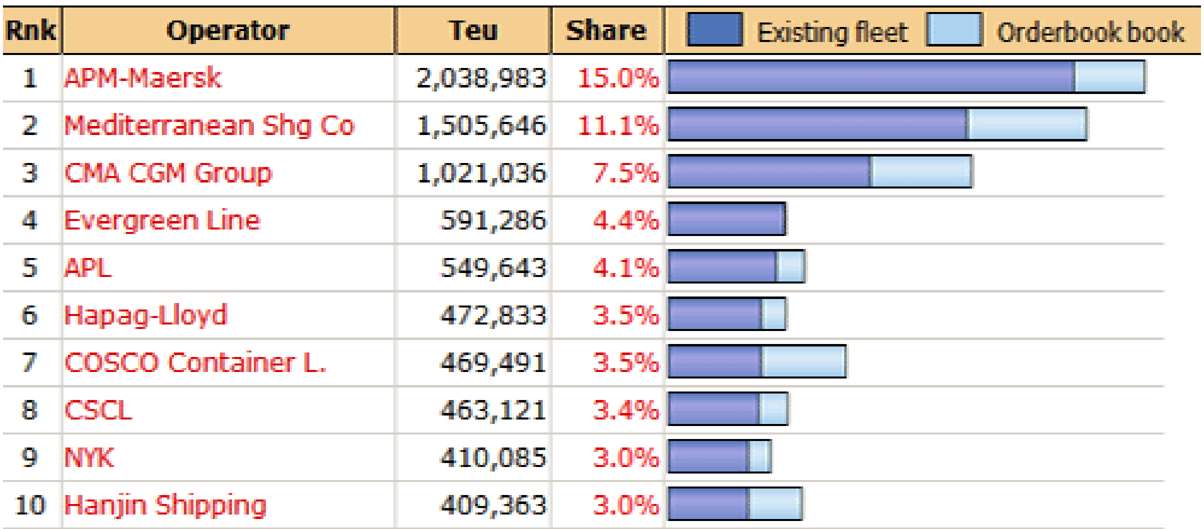
Horizontal integration between shipping lines

The large shipping lines cooperate all over the world for cargo resources. Mergers and acquisitions (M&As) facilitate risk sharing as well as improving shipping frequency

(Cullinane et al. 2002). The most important alliances are the Grand Alliance (P&O Nedlloyd, OOCL, Hapag-Lloyd, NYK and MISC), the Cosco/K-Line/Yangming Alliance, the United Alliance (Hanjin and Senator) and the New World Alliance (APL, Hyundai and Mitsui OSK Lines) (Notteboom 2006). The (M&As between Maersk and Sealand (1999), between P&O and Nedlloyd (1997), between Singapore Neptune Orient Lines (NOL) and APL, Hanjin's buying 70% of DSR-Senator, Sinotrans' merging with China Yangtze Navigation Group, CMA's acquisition of CGM and CGT, CP's takeover of a number of small container lines, exemplify the horizontal M&A of shipping lines.

The strategic alliances provide their members with easy access to more markets or services with lower cost implications and allow them to share terminals and cooperate in many areas at sea and ashore. Carrier M&A aims to gain greater concentration in the shipping lines industry, to achieve efficiency, and to win more market share and enjoy market power. They represent a massive concentration of power in the container shipping industry. The M&A enables more capital available for investment in larger vessels, to achieve economies of scale without creating a new business entity.

Maersk website publishes that Maersk Line is the largest shipping company worldwide, accounting for 17% of the world container market with over 500 container ships and 1.5million containers. The top three carriers APM-Maersk, Mediterranean Shipping Company and CMA CGM Group account for 35% of the world containers. The top 20 container carriers' capacity accounted for over 80% of the world shipping capacity in 2009. Figure 2.8 presents the top 10 container operators in terms of container TEU and market share.



Rnk	Operator	Teu	Share	Existing fleet / Orderbook book
1	APM-Maersk	2,038,983	15.0%	
2	Mediterranean Shg Co	1,505,646	11.1%	
3	CMA CGM Group	1,021,036	7.5%	
4	Evergreen Line	591,286	4.4%	
5	APL	549,643	4.1%	
6	Hapag-Lloyd	472,833	3.5%	
7	COSCO Container L.	469,491	3.5%	
8	CSCL	463,121	3.4%	
9	NYK	410,085	3.0%	
10	Hanjin Shipping	409,363	3.0%	

Figure 2. 8 Top 10 container operators by TEU in Nov. 2009

Source: http://www.axs-alphaliner.com

As global liner operators, Maersk Sealand, MSC, CMA-CGM and P&O Nedlloyd have a strong presence in both primary and secondary routes. MOL and Evergreen have explored secondary routes such as Africa and South America, while APL, Hanjin, NYK, COSCO and HMM focus on intra-Asian trade, trans-Pacific trade and the Europe–Far East route. Many carriers have allocated 70–80% of their capacity to a strategic alliance (Notteboom 2004; Notteboom 2006).

Carrier M&As provide members with the opportunity to justify investments in larger ships and enable more purchasing power in negotiations with ports and terminals (Cullinane 2004). The carriers are operating not only in a market but as key players embedded in supply chains. They are networked third party service providers that can intervene between sellers and buyers. The services depend on their capability and knowledge. Liner service network design has tended to move from a pure cost-driven practice to a more customer-oriented differentiation practice, as the optimal network design is not only carrier-specific, but also to meet shippers' needs and to motivate shippers' willingness to pay for a better service (Notteboom 2006).

Vertical integration between ports and carriers

Containerization has promoted the cooperation of ports and carriers to reduce the risks of investment in new container terminals. The shipping lines are expanding their scope to terminal operations and hinterlands transport, having dedicated terminals, liner owned agencies (LOA) and getting involved in inland transportation (Notteboom and Winkelmans 2001). In the strategies of vertical integration, ocean carriers have engaged in ownership restructuring to improve operational efficiency and reduce port costs due to increasing pressure from globalization of shipping and trade (Mangan et al. 2008). In this way, carriers are becoming more involved in port management than before. Based on the extent of the carriers' relative participation in international, regional or local liner shipping networks, they tend to fulfil different types of role into different ports (Cullinane 2004).

A.P. Moller-Maersk is the largest container ship operator in the world, with its headquarters in Copenhagen, Denmark. Maersk's APM Terminal branch is the second largest container operator worldwide. Maersk started container terminal investment in China from the 1990s, due to China's booming economy and international trade. The first terminal investment was Yantian in 1994, and then the investment extended to Dalian (1997), Shanghai (2003), Qingdao (2003), and Xiamen (2004) (www.maersk.com).

Following the recent trends of vertical integration by carriers into terminal leasing or ownership, carriers are sometimes associated with port management. In such cases, the carriers and shippers are part of the integrated port management system. That is to say, the port authority, the carriers and shippers all compose an integrated port management system (Bichou and Gray 2004). However, integration of international logistics channels is not easy, although M&A have become popular. For example, it is difficult for shipping lines and ports to integrate as both parties try to optimize the use of their respective assets (ships versus berths and warehouses).

In the liner shipping industry, wider geographical coverage and cost reductions through economies of scale are the underlying reasons for horizontal and vertical integration strategies through mergers and acquisitions or strategic alliances (Souza et al. 2003).

Horizontal integration between ports

Port horizontal integration means port networking with overseas, neighbouring and inland ports, involving the port authorities policies and the joint use of scarce resources (Notteboom and Winkelmans 2001). The strategy of horizontal integration is seen in port co-operation and mergers, for example, cooperation between Shanghai and ASEAN ports, between Xiamen, Zhangzhou and Quanzhou ports, between Shenzhen, Guangzhou and Hongkong, between Copenhagen and Malmo Ports. Horizontal integration is also seen in the expansion of certain ports beyond their initial spatial bases.

2.4.3 Global port/terminal operators (GPOs)

To reduce cost and improve efficiency, shippers would seek carriers to provide efficient and cost effective services, while carriers would seek cost reduction and operation efficiency at the ports they use (Mangan et al. 2008). According to a report by Drewry (2010), Hutchison Port Holdings (HPH), APM Terminal, PSA, DP World, China Ocean Shipping Company (COSCO), Eurogate, Evergreen, NYKLINE, SSAMARINE and P&O are the leading port operators worldwide. The smaller terminal operators cannot compete against the major players but concentrate on niche markets.

In order to respond to the concentration trend of shipping lines, the terminal operators have been seeking scale increase. A number of global port operators (GPOs) and international terminal operators (ITOs) have emerged that increasingly control and manage a number of ports worldwide. For example, P&O ports have joined Hutchison, PSA in Singapore and APM Terminals. A.P. Moller - Maersk Group (Copenhagen) operates 50 terminals worldwide as explained earlier. Dubai Ports World (DPW) was created by a merger between the Dubai Ports Authority (DPA) and an international business, DPI Terminals. In 2006, DPW purchased P&O of UK, which was then the fourth largest ports operator in the world. DPW operate 19 major ports worldwide. Hutchison Whampoa's subsidiary Hutchison Port Holdings operates in five of the seven busiest container ports in the world, handling 13% of the world's container traffic (www.hph.com). Hutchison owns and manages terminals in Shanghai, Xiamen and Yantian. The Port of Singapore Authorities (PSA) owns and manages ports and terminals in other countries. Global terminal operators clearly have shifted their mindset from a local port level to a port network level. In this sense, ports are no longer perceived as non-moveable assets (Bichou and Gray 2005).

The top 10 container ports ranking in 2009 by AAPA shows that 70% of the top 10 container ports by tonnage are from China. Among the 10 ports, only Rotterdam is outside Asia. In terms of container TEUs, 8 out of the top 10 container ports are from Asia and 6 out of the top 10 ports are from China. The increasing trend in both tonnage volume and TEU throughput increase in the past 20 years shows that Asian, especially China's freight, accounts for a large share. The ranking positions are also evidence that the dominant international trade is with Asia and China. This explains why GPOs concentrate their investment in China.

With the increasing global scale of operations, the large port operators are in a position of potential market domination, which may affect free choice and reduce competition (Souza et al. 2003). Other major regional port operators, such as ABP in UK and Dubai Port Authorities in the UAE, have also expanded their activities internationally with considerable specialisation and international expertise in container terminal management and development.

It should also be noted that not all terminal operators are integrated by M&A. Effective network integration can be realised through better coordination with 3PL or other logistics service providers. The literature has paid much attention to vertical and horizontal integration including ports in the logistics chain, but it overlooks integration of the various activities in the port organisation itself (Bichou and Gray 2004). This is mainly due to the complex organisational structure and management of ports, which has always been a central issue of port management and a major obstacle to the development of a comprehensive conceptual framework of port management.

2.4.4 Powerful port users

According to Notteboom (2006), different firms exert different levels of power in a supply chain. Logistics integration in the transport industry results in a concentration of power at the port demand side. Seaports increasingly have to deal with large port clients who possess strong bargaining power on terminal and inland transport operations.

Ports and port authorities essentially have to deliver values to each customer and capture values. This demands the identification of what various customers want and how port managers can play a role in the value creation process. In the contemporary logistics-restructured port environment, it has become more difficult to identify the port customers that really exert power in the logistics chain. In some cases, the chain manager is situated at the end of the chain. For example, supermarket chains (such as Wal-Mart, Carrefour) exert power over the supply lines of food products. Large forwarding agencies negotiate rates with shipping lines and route the cargo they manage according to a combination of determinants such as price, transit time and reliability. Large shippers often have direct contracts with one or more shipping lines for their worldwide shipments. They decide which port to choose depends on the type of cargo involved, the cargo generating power of the shipper, the characteristics related to specific trade routes, the terms of trade, terms of sale and minimum cum cost (Notteboom 2006).

Mega shippers are sometimes perceived as port owners by operating dedicated oil or car terminals. BP Chemicals in Hull, for example, has leased two jetties from ABP (the port authority) to handle its chemical products and raw materials. Another example is GBA Group operations in Immingham. GBA leases the Immingham terminal as its dedicated car terminal for its logistics activities at the port.

Wal-Mart in South China has long-term contracted factories in Huizhou and Shenzhen that are very close to Yantian Port in the Pearl River Delta. Wal-Mart annually imports 576,000TEU to US from China, which is up to 10% of its imported products (Francis 2007). This has enabled Wal-Mart to have a special relationship with Maersk, which has purchased a minority of stakes in Yantian International Container Terminal Ltd (YICT) from Hutchison Whampoa. This means that the three large firms of Wal-Mart, Maersk and Hutchison Whampoa are strongly interlinked.

The purchasing power of large intermodal carriers, reinforced by strategic alliances between them, can play off one port or group of ports against another. Because of the sheer size of the port users, the loss or the acquisition of a customer such as a container carrier may in some cases imply losing or acquiring 10-20% of a port's container traffic, such as CAST to Zeebrugge and Antwerp (Notteboom and Winkelmans 2001; Notteboom 2006).

2.4.5 An increased focus on landside and intermodality

Traditionally, port competition concentrated on waterborne transport. It is no longer the case. From a carrier's standpoint, the maritime container battle will be won on land (Notteboom and Winkelmans 2001). Inland transport, which accounts for 40-80% of their total costs, is identified as one of the most vital areas left to reduce cost by smarter management (Notteboom 2006). Moreover, the port authorities can promote an efficient intermodal system to secure cargo from inland hinterlands. The logistics management of JIT inventory management, SC integration and logistics information system support can reduce the cost. Hutchison's focus on inland logistics in China is an example.

Robinson (2006) proposes a strategic framework for port-oriented landside strategy in Australia. The value has migrated from port operators to the logistics service providers (LSPs) such as 3PLs and 4PLs. He claims that inappropriate strategies may deliver wrong outcomes. The landside chains are supposed to be integrated by four fundamental patterns, namely, a rail/intermodal terminal path, a road/depot path, a direct road haul pattern and a truck-linked depot pattern that are mainly linked to the terminal.

Harding and Juhel (1997) note that the future of inland logistics centres or dry ports (moving the port to the inland area to get more cargo sources and larger hinterland area) for logistics operations is not limited to the seaport area. The port system serves not only as a transport system, but also as a major sub-system of the broader production, trade and logistics systems. The port core businesses then vary greatly and some ports even shift to non-ship/cargo related activities. The location of port activities has actually extended from the sea/shore interface to landside development for some ports.

Intermodalism is recognised as the main concept associated with supply chain integration in port (Bichou and Gray 2004). Intermodalism refers to interlinks between different transport modes and nodes, such as sea/road, sea/rail, sea/inland waterway links. In the intermodal transport networks, ports play a vital part to link transport by sea, road and rail (Klink and Berg 1998). Bichou and Gray (2004) see round-the-world trips, triangular routes, hub and spoke systems as patterns of sea-borne trade, whose development requires typical partnerships which are beneficial to all members in the intermodal chain.

The literature highlights the future of ports as nodes in the changing patterns of maritime and intermodal transport. Freight intermodality is increasingly considered as a major potential contributor to solving the problem of cutting cost for broader hinterlands transport. The shipping lines, the shippers and local logistics service providers are making efforts to make use of this strategic option to reach hinterlands by longer distance to get more resources of cargo and serve more customers at lower cost. Islam et al. (2006) promote development through multimodal (intermodal and multimodal are often used interchangeably) freight transport in Bangledesh. They found government play a key role in deregulation to promote this.

However, despite the efforts made, such as considerable investment in dedicated infrastructure, and despite the increasing awareness that a higher intermodal market share would generate economic and environmental benefits, road still remains the main transport mode for cargo transport in Asia and in Europe. Intermodal options have not been successfully employed. For example, in Europe, only 10% of the total volume of freight movements is carried out by intermodal options (Ricci and Black 2005). The poor market performance indicates an overall lack of competitiveness of intermodal transport services. Ricci and Black (2005) identify the reasons for limited intermodality as a combination of the inadequacy of the existing infrastructure, the intrinsic complexity of the industry, the extensive role of the private sector and the lack of an appropriate integration platform. Cargo interests should all have access to door-to-door services with multimodal transport (Islam et al. 2005).

The liner shipping market is an internationalised, service-provision and exceptionally unstable market (Robinson 2004). Transit time is often balanced against cost. As long as the customers are aware of a specified date or time of their goods' arrival, it may be possible to use less expensive and slower modes—vessels. Therefore, it is very important to facilitate and expedite the transfer of shipments between freight conveyances (for example, vessel–railroad, vessel–truck).

Klink and Berg (1998) find that gateways are in an excellent position to stimulate intermodal transport, as they can generate scale advantages in inland transport. For example, Guangzhou and Shenzhen are the gateways to compete against Hongkong because they have cost advantages in port operations, trucking and barging.

2.4.6 Port-centric logistics

In contrast to the shift of port activities to in-land dry ports, with the role changing, port-centric logistics is emerging and being promoted. Analytiqa (2008), a UK market analysis and business intelligence company, suggests that port centric logistics may be the next important thing in supply chains. Mangan et al. (2008: p.36) define port-centric logistics as "the provision of distribution and other value-adding logistics services at a port". They note wider profit margins come from non-core port activities other than providing terminals, berths. Port-centric logistics has the advantage of being close to the port and provides logistics operations from the ports, rather than moving containers on roads to inland distribution centres. Hutchison, for example, announced that London Thamesport provides integrated port-centric logistics as UK's only automated port with 70,000m^2 of warehousing space, good location, excellent facilities and good landside links by motorway and rail.

UK retailing and manufacturing are increasingly reliant on imports, whereas ports can provide import processing and distribution centres in the port bonded areas. One employment of this concept is to establish distribution centres at the port instead of inland. These can be exemplified by the Sainsbury Regional Distribution Centre (RDC) at Felixstowe and ASDA-Walmart RDC at Teesport. ASDA (the UK arm of Wal-Mart) and Baird Menswear, the two key UK retailers, have already been attracted to locate their distribution centres in Teesport's bonded area and hold the goods until required, then taking them direct to the end customer (Wall 2007). This practice of port-centric logistics contrasts with the prevailing UK logistics model of hauling containers to central distribution centres (DCs) and back-hauling empty containers to ports. It adds a green advantage of significantly reduced goods miles.

The port-centric logistics concept requires ports with deep-water capacity and spatial port-side land. Teesport has 15m depth in the main channel and excellent support infrastructure, a legacy from Teesside's chemical and steel production base. PD Ports would invest in infrastructure, services and equipment within Teesport, to position it as the northern gateway in the UK for containerised cargo traffic.

The electronic data interchange (EDI) development, tracking and tracing system should be improved in response to the port-centric logistics (Carbone and Gouvernal 2007). As port-centric logistics has enlarged the port activity area, it needs an advanced information and communication technology system to link different port stakeholders so that the communications between them are efficient.

2.4.7 Port ownership and privatisation

The relationships between ports and governments have changed profoundly (Brooks and Cullinane 2007). The government used to manage ports as state-owned property. Port privatisation started in the 1970s (UNCTAD 1999). Many ports have since then become privatised for better management and better investment. In the 1980s and 1990s, ports and ports authorities experienced structural and functional changes from public to privatized entities (Robinson 2002). Many ports have turned to privatisation as they believe that increasing private sector participation in port ownership and port operations can help them with the improvement of operational efficiency and performance. This is in line with the principal–agent theory that private ownership should be more efficient than public (Kangis and Kareklis 2001).

In the port sector, some empirical studies show that port ownership has an effect on port efficiency (Cullinane et al. 2002; Estache and Gonzalez 2002) while many other studies show no clear relationship between port ownership and port operations efficiency (Liu, 1995; Notteboom et al. 2000). To further investigate the efficiency of port ownership, Tongzon and Heng (2005; 2007) quantify the relationship between port ownership structure and port efficiency. The results show that private sector participation in the port industry could improve port operations efficiency to some extent, which in turn would increase port competitiveness. They find that full port privatisation is not an effective way to increase port operations efficiency and the best extent of private participation in container ports/terminals is the mode of private/public with privatisation percentage of 0.67-1.00. This means that port authorities should introduce private finance, operation and management instead.

Baird (1995), Cullinane and Song (2002) provide four models of port ownership and administration: public port, public/private port with the public sector dominant, private/public port with the private sector dominant, and private port. They note that port ownership may hinder the performance of the ports due to institutional differences. Cullinane and Song (2002) note that most of the top container ports in the world are public/private. Serebrisky and Trujillo (2005) note that restructuring and deregulation of ports in Argentina in 1990s increased the efficiency and service of the ports, and reduced the size and role of the public sector in ports. The reform resulted in significant improvement of efficiency and reduced 50% of the container terminal handling cost within five years.

Full privatisation sparks internal competition and facilitates cooperation with its immediate neighbours (Button 2008). Most Chinese ports are pure public ports while most UK ports are pure private ports. ABP (Associated British Ports), the UK's main private port operator, currently own 21 ports that account for 25% of the UK's port activity in terms of cargo volume. Singapore is a private/public port while Shanghai Port is an example of public/private port.

Investors are very interested in privatised ports (Mangan et al. 2008). For example, Hutchison has invested in the International Container Terminal in Haicang port, Xiamen, which is only 1.5km from the Xiamen Export Processing Park and 100m away from the largest Logistics Free Trade Zone. Hutchison has also invested a big share in Yantian (opposite to Hongkong) and Waigaoqiao & Yangshan port in Shanghai. PD ports were acquired by the Australian investment company Babcock and Brown Infrastructure Ltd in late 2005. They were sold to the Canadian Group, Brookfield Asset Management in Nov. 2009, and ABP was taken over by Admiral Acquisitions UK Ltd in 2006.

Carriers' ownerships change when they vertically integrate into ports; shippers have started to own and operate the ports/terminals; companies with financial strength may own ships and they are sometimes perceived as port managers at dedicated oil or car terminals, and have been acquiring terminals to create terminal operators, e.g. Wal-Mart. In these cases, the carriers, shippers and port/terminal operators have bargaining power and negotiation strength over the port authorities and have improved port performance.

Baird (2002) studied the survey on the world's top 100 ports by the International Association of Ports and Harbours (IAPH) and found the main advantages of privatisation are sharing investment, improving productivity, helping trade growth and management expertise, making terminals profitable, keeping carriers in a port, improving management and better facilitation of development. The disadvantages of privatisation are identified as loss of control, political and commercial ambiguity, difficulties in operator selection and lengthy process for securing concessions.

Looking at port performance by both private and public ports, pure public and pure private ports are not very successful. Partial public (for example, Shanghai) and partial private ownership (for example, Singapore) seems to be more effective.

2.4.8 Green logistics and the supply chain

Emissions such as carbon dioxide (CO_2) are widely known to have impact on the world climate and various technological means have been tried to reduce. Measures to curb future CO_2 growth are being sought with a high sense of urgency. Among the different transport modes, sea shipment has much lower emissions of CO_2 than air, road and train transport, according to Maersk lines. Reduction of emissions has become top priority for the world environment. Hence environmentally friendly logistics is promoted by many researchers such as Plambeck and Denend (2008), who conducted a case research of greening Wal-Mart. They found that putting pressure on suppliers to produce and promote environmental sustainability is one way to exert a positive influence on society.

As serious environmental problems have arisen from the tremendous economic growth, concerned citizens world-wide have increasingly reacted to the threat (Wu and Dun 1995). Both governments and businesses are urged to respond to the issues and environmentally responsible logistics is promoted. Working cooperatively with government and nonprofits is another way to promote a greener logistics and supply chain. Many countries in Europe have thus regulated emission standards and other environmentally related activities. Environmentally friendly logistics promotion will enhance sea and water shipment.

2.5 Challenges

Globalization has pushed ports to evolve rapidly from being traditional land/sea interfaces to providers of complete logistics networks. This means that ports have to face many challenges due to unpredictable environmental changes and trends in the shipping, port and logistics industries.

Load centres are locally generated and stimulated by ports' centrality regarding strong regional hinterlands (Notteboom and Winkelmans 2001). Inter-port competition has intensified and the European ports competition focuses mainly on the facility capacity to attract the maximum container volume to justify the direct calls.

Notteboom and Rodrigue (2005) note that ports are facing a wide array of local constraints which negatively influence their growth and efficiency, such as depth of water, land, local rail and road system constraint, environmental constraint, local community opposition to port development. There is substantial pressure for port facility improvement because deep-sea liners are often overly ambitious in ordering and deploying mega-containerships (Ng and Kee 2008). Ports are also facing challenges to be more secure. For example, regulations on security and environmental protection increasingly occur, such as the International Ship and Port Facility Security Code, which became effective from 2004 (Notteboom 2006).

Identifying the real chain manager/decision maker is a key challenge to port managers. If port authorities want to attract or retain the megacarriers, they have to position the port as an efficient intermodal hub and distribution service centre acting within extensive transport and communications networks. To be successful, port authorities have to think along with the customer, trying to figure out what his needs are, not only in the port but also throughout the logistics chains and networks (Notteboom 2006). This demands the creation of a platform in which various stakeholders (carriers, shippers, transport operators, labour and government bodies) are working together to identify and address issues affecting logistics performance. Port authorities can be a catalyst in this process, even though their direct impact on cargo flows is limited.

The port authorities need to adapt to the changing environment in which the port users are becoming more powerful. Much attention needs to be paid to the carriers that are trying to expand their supply chain to include terminal operations to improve their terminal operation performance and to integrate door-to-door transport (Notteboom 2006). This indicates that ports are customer-oriented property. Port authorities should have a good understanding of their customers' needs; otherwise they would lose the customer, e.g., PSA has lost its two most important clients (Yap and Lam 2006; Lam and Yap 2008).

Another challenge ports are facing is unbalanced freight movements, the outcome of a global reorganisation, which are leading to disequilibrium in the division of labour, trade, production and consumption (Notteboom 2006). The world's ports have to develop their physical infrastructures to expand their port hinterlands through introducing free trade zones with a hope of developing hub ports and international logistics centres to cope with the challenges. In addition, many ports have been carrying out port reforms such as port governance restructuring and deregulations, private and public partnership.

Bichou and Gray (2004) note that ports rarely control logistics channels, despite their important roles. They argue that global port operators (GPOs) may control logistics channels but they often have other business interests such as shipping lines. The ports as non-movable assets are facing growing pressure from shippers and shipping lines who are not bound to particular ports, which does not encourage a close collaboration or a long-term partnership among channel members in the port and shipping industry.

The port operators/authorities have concerns about the current practices by shipping lines and freight forwarders because they are showing less loyalty to specific ports (Slack et al. 1996). They may suddenly change the port of call or operations without notice. Ports face the constant risk of losing important clients, not because of lack of port infrastructure or poor quality of terminal operations, but because the client has rearranged its service networks or has engaged in new partnerships with other carriers (Notteboom and Winkelmans 2001). This has pushed ports to become interested in collaborating and having partnership with other ports to benefit all participants. Thus, this variable is not fully correlated with port specific variables, such as efficiency and reliability, so it should be included as an independent port competitiveness indicator.

Other challenges (UNESCAP 2005) that have emerged are as follows,

- *global trends of logistics network restructuring and reposition of regional and/or local distribution centre*
- *rapid growth in volume of world seaborne freight, both in volume and in container*
- *increase of transhipment cargo and competition among ports and terminal operators*
- *introduction of the super mega size containership*
- *emerging global terminal operators and their growing market share*
- *intermodal transport strategically between ocean, rail, road and inland waterway*
- *high cost and constraints for developing port facilities.*

2.6 Chapter summary

This chapter started with the definition of logistics and supply chain management. Then port activities, roles and functions, ownership, development and change were reviewed, which gave an overview of the port sector. This was followed by descriptions of the trends of maritime shipping industry to figure out where the current ports are going and how they should cope with the trends. Lastly, the challenges for ports were briefly addressed. The next chapter will focus on port selection and performance measurement.

3. MEASURING PORT PERFORMANCE AND FACTORS INFLUENCING PORT PERFORMANCE

The main objective of this chapter is to review the relevant literature on port performance measurement and the factors that influence port performance.

The chapter consists of six main sections. The first section reviews the components of the logistics system for ports, namely, institutions, infrastructure, participants and logistics service providers. The second section reviews the literature on port performance measurement, including the importance of performance measurement, national logistics measurement, trading logistics measurement and port performance measurement. The third section presents the factors leading to the success of some ports in history and nowadays, which builds experience for developing successful ports. The fourth section reviews the criteria of port competition and choice. The fifth section brings together the individual strands of the literature review and presents potential factors that influence port performance. The last section provides a chapter summary.

3.1 Components of a logistics system for ports

For the port system, to what degree it can reduce the system cost and improve the service level depends on the efficiency of port operations and port authority management, which not only determines the efficiency of the whole port system, but also induces the sustainable development of the port vicinity. For the port hinterland economy, port activities are of substantial importance, and the activities are geographically concentrated on a limited number of regions where the geographical conditions are favourable (De Langen 2003).

According to the Asian Development Bank (Banomyong 2007), macro level logistics systems consist of four components, namely, (1) shippers, traders and consignees; (2) public and private service providers; (3) regional and national institutions, policies and rules and (4) transport and communications infrastructure. Components (1) and (2) are the participants, component (3) provides conditions to support the regional logistics and component (4) offers the hard physical prerequisites for port performance. As ports need to work towards maintaining a competitive edge by developing an integrated approach to the logistics system, this section will introduce the four components.

3.1.1 Institutional framework

Ports that top the AAPA and LPI rankings are typically hubs and key players in the port sector in relaxed constitution, like Hongkong and Singapore. Ports at the bottom of the AAPA ranking are typically trapped in a vicious circle of overregulation. A comprehensive reform of logistics and trade facilitation is thus essential. This suggests that policymakers should initiate a strategic role to promote the regional port performance with government support, which includes ease of shipment, simple documents and effective port governance (Wang et al. 2004; Arvis et al. 2010)

Port governance refers to a set of institutions and actors drawn from and beyond government (Stoker 1998). The governance provides a useful analysis for a single port or a regional port system which has been deeply influenced by globalization, coupled with complex forces from region-specific or city-specific configurations of administrative structures and political systems (Wang and Slack 2004). The port authority should have a clear insight into market dynamics and avoid over-optimism, which leads to overcapacity, redundancies and cutthroat competition (Notteboom and Rodrigue 2005).

Preferential policies on customs, border inspection and tax

As the port economy has a very close relationship with the neighbouring countries, the port authority should provide special services of customs, salvage and admiralty court, apart from the general logistics services (Arvis et al. 2010). Government support is important to port performance. Government prepares for the logistics development scheme. Notteboom and Rodrigue (2005) note that port development results from logistics decisions and the subsequent actions of carriers, shippers and 3PLs. As for logistics decisions, the government is in the right position for the strategic logistics scheme. They should put appropriate port governance structures in place to face the challenges facing port-hinterlands development (Notteboom and Rodrigue 2005).

Preferential government policies will direct port development effectively. In international logistics, government plays a prominent role in the complex cross-border environment (Banomyong et al. 2008). Grainger (2007) raises the issue of wasteful transaction cost due to operations between business companies and government agencies. To improve port efficiency, the government should offer proactive policies to address these issues, reduce coordination failures, and build strong domestic constituencies to support reform. Government should offer preferential policies on customs and border inspection to simplify customs procedures and border inspection procedures to reduce transaction time and cost for cargo interests.

The free trade zone (FTZ) is one form of regional port development supported by government. FTZs are specialized areas for international trade, foreign investment, bonded warehouses, and export processing (UNCTAD 2006). They are considered as outside customs territory, to attract investment capital such as foreign direct investment (FDI) and create employment by providing a business friendly environment with incentives, good infrastructure and other advantages such as tax exemption. Almost all the key ports worldwide have set up FTZs, such as Klang in Malaysia, Rotterdam in Netherlands, Antwerp in Belgium, Hongkong in China, Busan in Korea and Singapore. The preferential policies improve port services in customs clearance, and border cargo inspection, and benefit shippers with lower cost. FTZs should thus be promoted.

Chinese government support to logistics contributes to port development. China's port facilities have been improved greatly since 1980. Korea is another convincing example that government support can enhance port performance. According to Yeo et al. (2008), the government of South Korea helped with the port investment in the early 1990s, when its maritime industry developed rapidly but its port infrastructure was poor. The source of South Korea's port construction funding was mainly from government. Private funds were proactively attracted as well. The government investment was mainly concentrated on the physical infrastructure such as banks, revetment, dredging works, bridge, special roads and rails for containers, while dock and terminal construction mainly depended on private capital. As ports would contribute to the regional economy, the Korean Government helped to speed up investment in the construction of ports and port-related infrastructure.

Investment in port development

Government investments in port development include physical infrastructure, port technical infrastructure and ICT, which are all capital intensive. The investment will improve the transport quality and port efficiency. The ports ranked at the bottom by LPI are found to be usually underinvested with poor quality services (Arvis et al. 2010). Government should help and invest in infrastructure as a public investor. On the one hand, it can share the risks with port operators; on the other hand, it can reduce the big financial burden on port authorities and operators. E-government needs to be promoted to link the different governmental departments such as customs, border agencies, border cargo inspection, tax payment, and financial payment. The ICT system could improve the port quality service and reduce time and cost by paperless documents.

Apart from the above supports, government should motivate openness to trade and provide assistance in local marketing and entry strategy alternatives. The banking policies/regulations for financial support ought to be provided to cargo interests. Port authorities can play an important role in the creation of core competencies and economies of scope by active engagement in the development of inland freight distribution, information systems and intermodality (Grainger 2007).

3.1.2 Transport and communications infrastructure

Since ports have become a prominent node in integrated logistics chains, quick and safe access to port facilities from an inland transport system becomes a basic factor in evaluating port performance. The ADB has included infrastructure as a key attribute of the logistics system, as enlarging the hinterlands has much to do with the landside links to the hinterlands to enhance the idea of the port belonging to a system (Bichou and Gray 2005). Notteboom and Rodrigue (2005) also note that inland distribution is becoming a foremost important dimension of the globalization and maritime transportation paradigm. Infrastructure investment can have both a direct and a complementary effect on economic production. It may result in greater travel time reduction, transportation cost reduction and business expansion encouragement (Talley 1996). For example, the Oresund has improved the infrastructure to merge Copenhagen Port and Malmo Port to benefit the cooperation between the two cities (Skjott-Larsen et al. 2003).

Containerization implies that increasing cargoes are from the hinterlands. On the one hand, this has inevitably increased pressures on port and inland connections to the hinterlands and other related systems. This has made the inland accessibility and port-hinterlands relationships a competitive factor in port improvement (Notteboom and Rodrigue 2005). The transport infrastructure has thus become more important to match port regionalization and expansion of port hinterlands. On the other hand, ports need to be linked to broader hinterlands for more cargo, which has stimulated the emergence of port regionalization to compete for a stronger hinterlands dimension with a greater geographical scope. Improving landside infrastructure can not only relieve container congestion, but also help with port regionalization to reach broader hinterlands.

Consequently, inland accessibility has become a cornerstone in port competitiveness (CEMT 2001).

3.1.3 Cargo interests

Cargo interests refer to consignors and consignees. They need to expand the market and obtain more trading orders so that more cargoes are available for the logistics movement. The economic status of the domestic hinterlands will decide whether there is sufficient cargo or demand to support port development, while the status of the international economy decides whether foreign countries have a strong demand for the cargo, so development of both the hinterlands economy and world economy are critical for port development. They are the actual logistics demand with increasing importance, which include port city GDP, port hinterlands GDP, hinterlands foreign trade in terms of volume and value, hinterlands nearness, and port-urban relative concentration index (Willingale 1981; Peters 1990; AAPA 2009). The demand for cargo volume by cargo interests will determine the logistics demand, which increases port performance.

3.1.4 Public and private service providers

Public and private service providers that provide port activities constitute another component of port logistics system as a system player. Services by LSPs include the services by shipping lines, the port authority, port operators, forwarders, warehousing operators and government agencies. All the services are related to port efficiency, which is critical for port performance. The service quality is highly related to their logistics skills, which are one critical factor to influence the performance of that sector (Gordon et al., 2005).

This section has explained the components of the logistics system at ports. The next section will review performance measurement for the logistics system components.

3.2 Measuring port performance

3.2.1 Importance of performance measurement

Ports are dissimilar in many aspects such as assets, roles, functions and institutional organisation (Bichou and Gray 2005). They are distinguished by the measurement of performance, which is important, because “what gets measured gets done” (Drucker 1962) and “the world-class behaviours are incentivised by world-class measures” (Frazelle 2002). Key performance indicators (KPIs) are used for evaluating performance and determining future courses of action (Gunasekaran et al. 2004). The indicators can provide management information for organisations, serving as a means of performance comparison and communication with relevant stakeholders (De Langen et al. 2007). Developing port performance indicators (PPIs) can guide resource allocation and deployment for improving port efficiency.

To ensure that indicators are appropriate, a set of criteria should be met: this should include both internal and external measures (Bowersox and Closs 1996), both qualitative and quantitative measures (Hastings 1996), and both financial and non-financial measures (Kaplan and Norton 1992; Gunasekaran et al. 2004). Multi-dimensional performance measures rather than a single dimensional performance measure (Doyle 1994; Mclntyre et al. 1998; Monaco et al., 2009) should be taken. Benchmarking is another important criterion (Camp 1989; Hanman 1997).

3.2.2 National and regional logistics key performance indicators

Logistics capabilities vary in different countries. According to China Development and Reform Commission (www.sdpc.gov.cn), and China Federation of Logistics and Purchasing, China's ratio of logistics cost over national GDP was 21.3% in 2004. In the same year, the ratios of the developed countries were 11.7% for the US, 10.2% for Japan, 11.3% for Australia, 9.8% for France, 9.9% for Germany, 9.9% for Canada and 10.4% for the UK.

Country variations in logistics performances stem from different logistics strategies and attitudes (Long 2003), different quality of logistics services (Hausman et al. 2005), different geographical locations and government policy (Long 2003), different physical and institutional infrastructure (Long 2003), and different social, cultural, economic and political environments (Bichou 2006). The review of factors that cause national logistics performance difference may build up knowledge of factors that drive different port performance.

According to Long (2003), US logistics is characterized by innovation and the logistics focuses on logistics customer orientation. Logistics in Japan highlights practical issues and focuses on cost control, sea shipment, a perfect physical logistics infrastructure, operations management skills, automation, service and green logistics. The logistics is supported by country policy. German logistics turnover accounts for 7% of German GDP and accounts for 28% of European logistics market share, benefiting from Germany's geographic location right in the heart of Europe, top infrastructure, logistics technology and the security and reliability of the German legal system as a conducive environment (Long 2003). The practice in various countries shows that logistics has played a key but different role in their economic development.

The countries and regions with excellent logistics assets and abilities usually contribute to their regional prosperity, while those with poor logistics assets and abilities suffer economically (Long 2003). The author suggests that logistics assessment should include geography, physical infrastructure and institutional infrastructure. Long (2003) and Skjott-Larsen et al. (2003) consider geographic features such as ports as natural aids. Flat land with firm ground provides the best access for land travel, while extreme mountains and marshes make travel very difficult or impossible. German industry benefits from the Ruhr Valley and the coastal Chinese areas benefit from natural ports such as Hongkong, Shenzhen, Ningbo, Shanghai, Qingdao and Dalian.

Long (2003), Skjott-Larsen et al. (2003) and Asian Development Bank (Banomyong 2007) claim that good physical infrastructures of roads, ocean ports, trains or airports require large investment and take years to build. When the physical parts of the logistics system are in place, the institutional infrastructure is needed, such as a legal system with rules of trade and commerce, customs officials, legal enforcement of business contracts, and banks to provide financing and other services provided by government and other businesses.

Some other KPIs are often employed in national and regional logistics evaluation. Logistics cost/GDP is often seen as an important measurement to assess logistics efficiency. China employs indicators such as trading volume, cargo rail freight volume per km, road/rail miles for per thousand people, congestion, road/rail/air/pipeline km, average speed, goods turnover, traffic mileage, goods damage and pilferage rate.

Skjott-Larsen (1999) considers the Oresund region as a successful example of developing regional logistics, making use of infrastructure, location and skilled personnel. Regional logistics has enhanced trading. However, some barriers are also found, such as cultural differences, bridge tolls, difference in legislation and political factors (Skjott-Larsen et al. 2003).

Banomyong et al. (2008) proposed creation of an ASEAN single market and strengthening of ASEAN economic integration by liberalization and facilitation measures in logistics services and support. The competitiveness of ASEAN production is based on the integrated ASEAN logistics environment. Banomyong proposed the following major policies and integration roadmap: encouraging the integration of

ASEAN national logistics systems and the progressive liberalization of logistics service providers; increasing trade, logistics and investment facilitation; building ASEAN logistics capacity; promoting ASEAN logistics service providers and multimodal transport capacity. These policies are the targeted logistics drivers.

3.2.3 Trading logistics KPIs

Hausman et al. (2005) note the importance and contribution of logistics indicators to trade: measurable and quantifiable logistics indicators improve the explanatory power of a gravity model for bilateral trade; efficient logistics in time and cost can contribute to increased trade; higher variability in processing time can be a deterrent to bilateral trade. They find logistics performance to be significant in influencing bilateral trade through the use of measurable and quantifiable logistics indicators.

A World Bank empirical research on trading logistics started in 2000 and was led by Ojala et al. (2007). Another research by the World Bank was in 2004. Questionnaires were distributed to 800 logistics professionals worldwide, including the operators or agents of the world's largest service providers, multinational logistics carriers and shipping companies. They gave an in-depth cross-country assessment of the logistics gap. The World Bank conducts the LPI survey every two years. The World Bank developed six dimensions for a LPI, which is a set of indicators to evaluate the national trading logistics, including custom efficiency, infrastructure quality, shipment ease, logistics competence, tracking capability and shipment frequency (Arvis et al. 2010). Table 3.1 presents specific examples of their indicators in their LPI surveys. As ports are part of the trading logistics, LPI is applicable to ports.

Table 3. 1 Indicators Worldwide Bank LPI

Time	Cost	Complexity	Efficiency
Total time for a trade transaction	Total cost for a trade transaction	Signatures for a trade Transaction	No. of containers unloaded Per berth hour
Document processing time	Port & terminal charges	# of doc. per transaction	Port shutdown days
Customs clearance	Document processing	% of containers inspected	Inland transport speed
Technical control	Customs clearance	Level of inspection	Frequency of vessel calls at port
Vessel waiting time for berth	Inland freight	Criteria for inspection	
CSI related time			

Source: World Bank Global Logistics Indicators Survey

The 2009 ranking results revealed that the top ten countries in global logistics by LPI are: Germany, Singapore, Sweden, Netherlands, Luxembourg, Switzerland, Japan, Austria, the UK, Belgium and Norway. Countries with a comprehensive approach perform well in all the key logistics, while those with a piecemeal approach do not have lasting improvement in LPI. The Enabling Trade Index gives trade rankings of regions based on their market access, border administration, transport and communications infrastructure and the business environment (Lawrence et al. 2010).

PPIs are related to national logistics KPIs and they are closely related to trading logistics LPIs. Thus the KPIs reviewed are applicable to PPIs, which will be reviewed in the next section.

3.2.4 Port performance indicators

Ports, as part of regional logistics assets, constitute an important link of the logistics chain. Many great cities are centred on natural ports such as Hongkong, Rotterdam, Bombay, Dubai, Shanghai and New York. The efficient management of ports is self-evidently important to the port users who care about the efficient flow of ships and cargoes through the docks, which determines the port prosperity (Robinson 2006). Improving port performance is beneficial to improve international trade, attract foreign investment and increase employment. Port performance is important to the hinterlands, as the hinterland's economy often has increased by the effect of port performance.

Port performance measurement is complicated, as a port is a cluster of economic activities where a large number of firms provide products and services and together create different port products (De Langen et al. 2007). Widely accepted performance measurements are unavailable, although there is a wide range of measures and indicators for port efficiency and performance, as ports are very dissimilar (Bichou and Gray 2004). This section reviews the literature and tries to identify PPIs systematically.

Port performance indicators

According to the Oxford English Dictionary, a performance indicator is "a variable by which the success or productivity of a venture, policy, or product can be gauged". This definition is applied to the current research of PPIs. A number of PPIs are used from different perspectives. The Belgian annual reports on the social-economic importance of the Flemish port are measured by value added, employment and investment (Lagneaux 2006). PPIs by the World Bank (Chung 1993) are categorised into operational performance indicators (labour productivity, channel depth management, berth utilisation), asset performance (berth throughput, berth occupancy rate, berth utilization rate) and finance performance [(income/expenditure) per GRT (gross registered ton) or NRT (net registered ton) of shipping, operating surplus per ton of cargo handled and rate of return on turnover)]. Besides the indicators of finance and operations aspects, the Department for Transport's (DFT) key PPIs include wider impacts (GVA/NVA, economic impact assessments, social impact, environmental reporting and safety reporting) to improve port efficiency and accountability (DFT 2009). The AAPA holds the view that ports can be evaluated by volume and value of trade, number of cruise passengers, revenues, storage capacity, size of a port, productivity, efficiency, or responsiveness to customers. AAPA focuses more on trade and offers the annual world port ranking by volume and TEU.

Apart from the maritime organisations, individual researchers have showed their constant interest in PPIs. De Langen (2003) proposes PPIs as throughput volume, ship waiting time, logistics value added and logistics space (m^2) and investment level in port related manufacturing. Bichou and Gray (2004) identify that throughput measures for internal performance are the second most commonly used (only next to finance measures) whereas productivity and economic-impact indicators are more prominent for external comparison with other ports. Robinson (2006) considers minimum elapsed time, acceptable cost and required quality as the three value variables for delivery to shippers and stakeholders.

Table 3. 2 Port performance indicators by Wu and Zong (2004)

	Level I PPI	Level II PPI
Port performance	Port natural conditions	Locational environment
		Navigation
		Coastal line conditions
	Port operations conditions	Port capacity
		No. of berths
		Throughput
	Hinterland environment	Scope of hinterland
		Natural resources
		Transport and distribution system
		Port city scale
		Hinterland
	Logistics information system	Information system hardware
		Information system software
	Policy support	National and local policies

Wu and Zong (2004) evaluate port performance by the approach of Analytical Hierarchy Process (AHP). They employed 4 level-II indicators and 15 level-III indicators, shown in Table 3.2. Xiao et al. (2005) and Ren et al. (2007) assess port performance employing AHP as well, and adopt similar indicators. They identify that port charges, free trade, customs services, ICT level and other financial or insurance services, infrastructure and logistics services are more important than geographical factors and port services quality such as speed and risks.

Bichou (2006) notes that most practical and theoretical approaches to port performance measurement benchmarking are three broad categories: performance metrics and index methods, economic impact studies and efficiency frontier approaches. He concludes that performance measures often fall into three categories: input measures (e.g., time, cost and resource), output measures (e.g., production/throughput, profit) and composite measures (productivity, efficiency, profitability, utilisation, effectiveness). Port impacts on the economy are measured to assess the direct, indirect and induced economic and social impacts on their respective hinterlands or forelands. Port performance is depicted to generate optimal output and economic wealth. Much empirical research is about port productivity or production function to compare actual output to optimum output by employing frontier method, which assesses port efficiency (Clarke and Gourdin 1991; Bichou 2006).

Carbone and Gouvernal (2007) find that some ports report additional PPIs (Table 3.3).

Table 3. 3 Additional port performance indicators

Port region	PPIs	Year
Vancouver	First of call	2007
Australia	Port dues real price index	2004
Queensland	Market share in State	2004
Long Beach	Value of goods shipped, customs revenues, local and state tax revenue from port	2003
Tacoma	Port related employment; average wage level in port compared to average country level	2004
Valencia	Water quality, regular calls of shipping lines	2002
Stockholm	Investment volume of port authority	2003
Antwerp	Private investment in port; EDI use of port traffic management	2003

De Langen et al. (2007) claim that specific PPIs rather than common PPIs should be applied to different types of ports. Moreover, they propose new PPIs instead of the traditional ones. For example, they suggest ship turnaround time and connectivity index should replace ship-waiting time for cargo transfer ports; throughput volume per m^2 should replace throughput volume as new PPIs, although ports do not report them systematically and structurally as they should. For logistics product, percentage of goods to which value is added in the port area is a relevant output indicator, which shows a logistics location. For port manufacturing product, the most relevant output indicator is the investment level in manufacturing facilities, which shows whether the investment is increasing or decreasing. Productivity of the industries and wage level are the two upgrade indicators.

Pettit and Beresford (2008) note that volume of trade, total value of commodity throughput and port-related employment are all possible indicators to assess port performance. However, they realize that the indicators are difficult to quantify. Ducruet et al. (2008) suggest that PPIs are throughput, value added, employment, intermodalism, attraction for firms and some other indicators.

As the various PPIs are too many to control, it is helpful to categorise the indicators, as addressed in the next section and shown in Figure 3.1.

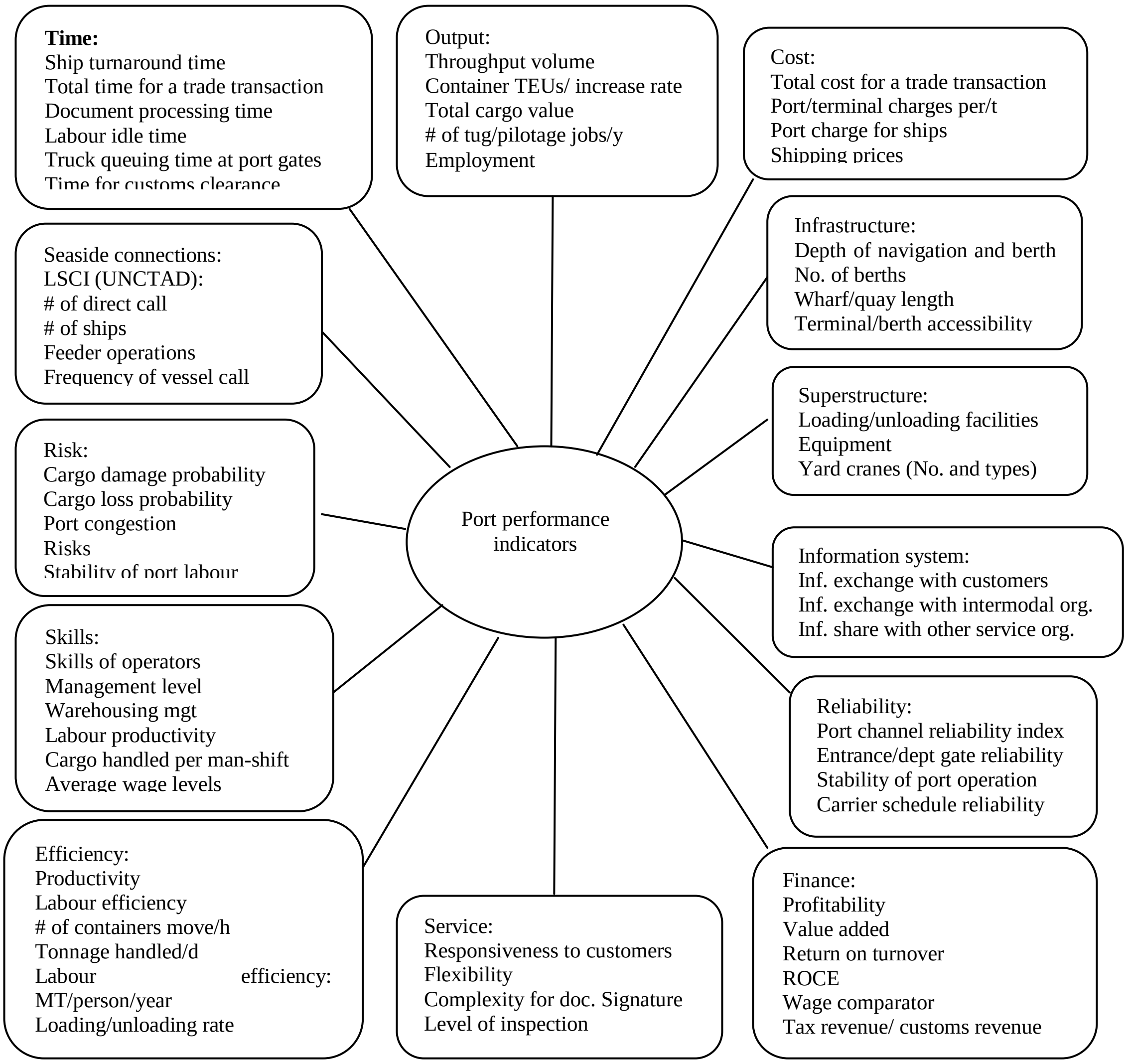


Figure 3. 1 Categories of port performance indicators

Categories of PPIs

<u>Output</u>

The major measures of economic impact of ports are output, household income and employment, according to Antioch (2000). Cargo output measures the port activities, such as output per worker, output per terminal/wharf or cargo handling productivity. A port's economic optimum throughput satisfies an economic objective of the port (Talley 2006). The port economic performance may be evaluated from the standpoint of technical efficiency, cost efficiency and effectiveness.

Throughput of goods shipping tonnage is often used as an indicator of port development (WorldBank 1991; Tongzon 1995; UNCTAD 2002; De Langen 2003; Slack 2007; Bichou 2006; Talley 2006; Wu 2008; Xiao et al. 2008; DFT), while TEU, a standard linear measurement used in quantifying container traffic flows) is often used to measure the container throughput (AAPA; DFT). Throughput is the most widely used by ports for comparison. Tonnage handled per ship day is a primary measure for vessel performance (Chung 1993). Talley (2006) considers that if a port's actual throughput approaches (departs from) its optimum throughput over time, its performance has improved (deteriorated) over time. He notes that cargo tonnage handled, truck queuing time at port gates and facility utilization are port-authority indicators which may be both efficiency and effectiveness indicators to reflect port utilization and throughput.

Besides cargo tonnage and TEU, throughput includes value of goods shipped, total retail sales of consumer goods, number of cruise passengers, number of tug jobs per year, number of pilotage jobs per year, number of loadings and unloading and departures, employment, berth throughput, throughput per linear meter of wharf. The throughput is provided by most port authorities and usually comparable, but it is difficult to compare different cargo traffics and lack of precision of traffic totals (UNCTAD 1976; Tongzon 1995; Slack 2005). Income and employment are also often treated as output indicators (WorldBank 1991; Stopford, 1997; Trujillo and Nombela 1999; UNCTAD 2000; De Langen 2003; Talley 2006; Ducruet 2007).

Time

Time includes ship turnaround time, ship waiting for berth time, cargo dwell time, labour idle time, time between cargo unloading and ship leaving, truck queuing times at port gates, waiting to service vessel time ratio, total time for a trade transaction, document processing time, time for customs clearance, vessel/working time at berth, minimum elapsed time, turnaround times for processing information and documents about ship arrivals, loading and unloading and departures (WorldBank 1991; Chung 1993; Nombela 1999; De Langen 2003; Gordon et al. 2005; Trujillo and Talley 2006; Bichou 2006; Robinson 2006; Arvis et al. 2010). The time indicators show how efficiently or inefficiently the ports serve the customers of carriers, shippers, consignees and PSPs.

The ship turnaround time refers to the time between ship arrival and ship departure. It has not been systematically reported, although it has long existed in the literature (De Langen et al. 2007). The World Bank claims that the vessel turn-around time is a primary measure of vessel performance (Chung 1993), which is broken into average vessel time at berth, average waiting (idle) time, tons per gang hour, TEUs per crane/hook hour, and dwell time.

Cost

Price is always an important factor for customers to consider when they decide to choose which product or service to buy. Similarly, as businesses are profit oriented, when port customers decide at which port to call, they will compare the port cost, which includes charge for carriers and charge for shippers by port authority or port operators. Ports, as practical business entities, undoubtedly seek profitability. To maximize profit, the ports need to minimize cost. The indicators on cost are unexceptionally treated as important indicators. Cost has rich components in the literature, see Table 3.4.

Table 3. 4 Cost components

Component	References
total cost for a trade transaction	Bichou and Gray 2004; Bichou 2006; Robinson 2006; Arvis et al. 2010
port & terminal charges per throughput ton	Brooks 1985; Talley 1996; Gordon et al. 2005; Arvis et al. 2010
port charge and port dues of ship	UNESC AP 2005; Talley 2006; Arvis et al. 2010
the charge per TEU	Trujillo and Nombela 1999
document processing cost	Arvis et al. 2010
customs cost	Tongzon 2007
expenditure	Word Bank
inland freight	Arvis et al. 2010
port tariffs	Willingale 1981; Slack 1985; UNCTAD 1992
freight rate	Tongzon 2007
total logistics cost	Notteboom and Rodrigue 2005
pilotage fees, storage cost, rental of port property and land	Brooks 1984; 1985; World Bank 1993; Talley 1996; Trujillo and Nombela 1999; Gordon et al. 2005; UNCTAD 2006; Bichou 2006; Robinson 2006; Talley 2006; Arvis et al. 2010

Both carriers and shippers think that port charges account for a significant part of their total transportation costs. Gordon et al. (2005) find that the port charges of Singapore account for about 20% of freight charges. As shippers are facing fierce competition in the shipping market and trade market respectively, they have to minimize their total transportation cost to gain competitive advantages. They prefer ports that offer relatively lower service charges. A port with a lower charge is more competitive than its rivals, holding other factors constant. Apart from port charges, the other costs are also important factors to consider as they constitute the total logistics cost from suppliers to customers.

A cost trade-off analysis between functions, processes and even supply chains is often adopted to measure the performance in business logistics and supply chain, and this approach is beneficial to port efficiency (Bichou and Gray 2004). Ports compete for customers such as carriers and freight forwarders, focusing on cost and price.

Seaside connections

Seaside connections include a variety of shipping routes and options, frequency of vessel calls, ship direct calling, number of ships, feeder operations, container transport routes, and port connectivity worldwide (Brooks 1985; Slack 1985; Joly 1999; Gordon et al. 2005; Arvis et al. 2010; Carbone and Gouvernal 2007). The indicators show how ports are linked with other deep-seaports and feeder ports. They indicate where the customers are, and how often they need the cargoes to come and go.

UNCTAD generated the Liner Shipping Connectivity Index (LSCI) by country in 2004, including the number of ships, TEU carrying capacity, the number of services, the number of shipping companies and the maximum vessel size. The LSCI index is proposed to quantify how well a port is connected to overseas and domestic destinations, measuring both overseas accessibility and hinterlands accessibility. Figure 3.2 presents the trends of LSCI from 2004 to 2009.

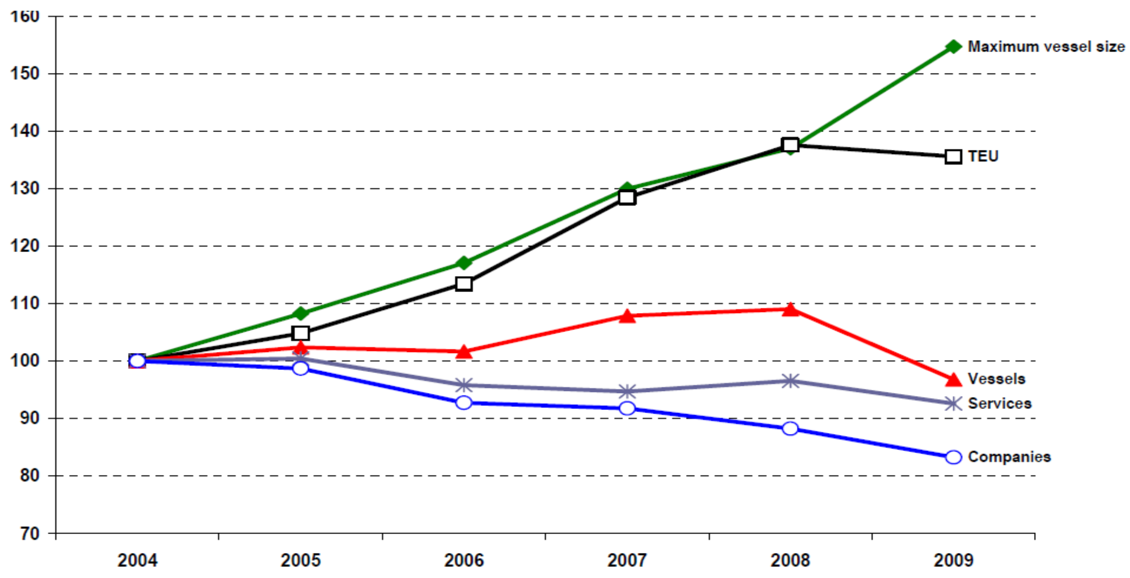


Figure 3. 2 Trends in connectivity indicators-Index of country

Source: UNCTAD, based on data from Containerisation International Online

The indexes are calculated based on the quality of connections to other ports and intermodal terminals in the hinterlands. In 2009, China continued to have the highest LSCI, followed by Hongkong, Singapore, the Netherlands, Korea and the UK. Developing countries are found to have significantly improved their LSCI ranking since 2004 (www.UNCTAD.org).

Landside connections

Bichou and Gray (2004) note that recent port measures not only focus on seaside performance but also landside efficiency, including intermodalism, transport efficiency, availability and efficiency of transportation, inland transport speed, and highways and railways in miles in port hinterlands (Slack 1985; MaCalla, 1994; Joly and Martell, 2003; Bichou and Gray 2004; Arvis et al. 2010). These indicators show how well the port is linked with the hinterlands by rail, road, air, waterway, pipeline or intermodalism.

Infrastructure

Most ports regard accessibility as an important marketing element (Pettit and Beresford 2008). Trujillo and Nombela (1999) distinguish port superstructure (buildings and equipment on ports) from port physical infrastructures (subordinate parts and a foundation of a port) and information system.

Port physical infrastructure refers to the length of bound lines, navigation distance (Willingale 1981), water channel and channel/berth depth (DFT 2009), ground slots (Gordon et al., 2005), wharf/berth/draft/terminal's number, length and depth (UNCTAD 2006; Gordon et al. 2005; Wu 2008), terminal/berth accessibility, area and size of storage, and locks (AAPA; Talley 1996; Wu 2008). Port infrastructures offer the natural conditions for ship calling. Increasing international trade and economies of scale have driven the emergence of increased scale of vessel size. The large vessels need deeper channels and more dredging work to allow their calling.

Port superstructures include loading and unloading facilities, equipment of quay cranes, yard cranes (number and types) and warehousing facilities (Murphy et al. 1988; 1989; 1991; 1992; Gordon et al. 2005; Wu 2008; World Bank). The superstructures offer the physical conditions and port facilities for port operations efficiency. Talley (2006) notes that the equipment perspective indicators are cargo handling rate, number of ships and amount of cargo handled, containers handled per crane and cargo handled per man-shift.

Port information system includes the port ICT system, information interchange with customs and between the intermodal (UNCTAD 2006). The relevant indicators reflect the quality of the information system, which is composed of networks and systems between different components of port systems and relevant government department.

Finance

Many ports treat financial indicator as the most important indicator of port performance. Finance indicators include value added, profit, revenues, customs revenues, local and state tax revenue, return on capital employed, return on turnover, weighted average cost of capital, gearing, capital required to load/unload from a ship, wage comparator (De Langen 2003; Bichou 2006; Carbone and Gouvernal 2007; Ducruet et al. 2008; AAPA; DFT; World Bank). Value-added indicators refer to expenses on labour, depreciation and profit, which reflect the value of changes passing through the port, but they are difficult to measure and compare because of the diversity of the activities involved (e.g. cargo reprocessing, packing, repacking, labelling and inspection) (De Langen 2003; Ducruet et al. 2008).

Bichou and Gray (2004) find that financial measures are the most commonly used indicators of port performance. Deng et al. (2008b) note that service quality and customer satisfaction are principal drivers of financial performance. Therefore, it is critical for a port to improve customer satisfaction in today's competitive global marketplace, as customer satisfaction increases customer loyalty (Matzler et al. 2004). Port managers should thus increasingly focus on evaluating customer satisfaction with port services and identifying critical service performance factors.

Efficiency

Efficiency is a critical indicator for port services. Good performance in efficiency will attract more customers. Table 3.5 presents its detailed indicators.

Table 3. 5 Efficiency indicators of port performance

Efficiency component	References
Custom efficiency	Arvis et al. 2007; Chiu (1996); Bichou (2006)
Labour efficiency: No. of containers unloaded per berth hour	Talley 1996; Arvis et al. 2007
Number of containers move per hour	Gordon et al (2005)
Tonnage handled per ship day	World Bank
Labour efficiency: handle MT/person .year	Chinese
Port operations efficiency	Chinese; World Bank
Ship loading/unloading service rate (for a given type of cargo)	Talley (1996)
Loading/unloading service rate for port vehicles of inland carriers	Talley (1996)
Containers handled per crane	Talley (1996)
Pick up and delivery service	UNCTAD
Responsiveness to customers	AAPA2005
Flexibility	Gordon et al (2005)
Port utilization (berth, facilities, etc.)	DFT; Talley 1996; Bichou 2006; Trujillo and Nombela (1999); World Bank

Trujillo and Nombela (1999) proposed three broad categories to measure port efficiency: physical indicators, factor productivity indicators and economic and financial indicators. Physical indicators generally refer to time measures. Factor productivity indicators focus on the maritime side of the port, measuring both labour and capital required to load or unload cargoes from a ship. Economic and financial indicators are usually related to sea access, e.g. operating surplus or total income and expenditure related to

GRT or NRT, or charge per TEU. Port impacts on the economy are sometimes measured to assess the economic and social impacts of a seaport on its respective hinterlands or foreland.

Services

The port service indicators include responsiveness to customers, flexibility, complexity for documents (signatures for a trade transaction, number of documents per transaction, percentage of containers inspected, level of inspection and criteria for inspection) (Arvis et al. 2007; 2010) and reliability (port channel reliability, port berth reliability, entrance gate reliability and departure gate reliability) (Talley 2006; Tongzon 2007). Efficiency of customs clearance has become a key factor in the port to attract shippers. Port customers want simplification of signatures, inspection and documents. They also like to choose a port based on whether the port service is reliable and quickly responsive. Singapore has achieved the advanced paperless customs clearance, which has greatly improved the customs efficiency (Tongzon 2007).

Other service indicators include confidence in port schedules, port availability and accessibility, port shutdown day, port service capacity, port reputation and loyalty, assistance in claims, quality of jobs, labour and capital required to load or unload from a ship, processing capability, distribution capability, tracking capability, logistics competence, effectiveness, customized service, technical control, ship maintenance and supplies (Brooks 1985; Slack 1985; Murphy 1992; UNCTAD 1992; Talley 1996; Trujillo and Nombela 1999; Bichou and Gray 2004; UNCTAD 2006; Bichou 2006; Robinson 2006; Wu 2008; Arvis et al. 2010; DFT 2009).

Risk

Risks include ship/cargo damage probability, risks, port congestion, percentage of congestion, cargo loss/damage probability, safety, and probability of damage/loss to inland-carrier vehicles (Brooks 1984; Brooks 1985; Slack 1985; Murphy et al. 1989; Murphy et al. 1991; Murphy et al. 1992; Talley 2006). The indicators for ship risks include average delay to ships waiting for berths and average delay to ships while alongside berths (Talley 2006). Port risk and safety are closely related and important for port management. Unsafe is part of port risks. Such unpredictable factors as strikes, equipment breakdown and weather make carriers and shippers suffer loss. If such occurrences are frequent, the carriers and shippers will leave for other ports.

Human resources

Human resources include skills of port operators, stability of port labour, management level such as warehousing management and port management, labour productivity, cargo handled per man-shift, average age of employment at port, and average wage level in port related industries compared to the average of other countries (Clarke and Gourdin 1991; Trujillo and Nombela 1999; Bichou and Gray 2004; Gordon et al. 2005; Carbone and Gouvernal 2007; Wu 2008). Talley (2006) notes that the labour perspective indicators include number of employees, average age of labour force, average hours worked per week by employees and labour idle time. Human resources are critical, as all operations and management need personnel to make them happen. Skjott-Larsen et al. (2003) find that easy access to qualified people is one of the most important drivers that developed the Oresund regional logistics. Gordon et al. (2005) identify that well-educated and hard working labour force is one attribute of Singapore's good port performance. The capability of human resources and logistics skills determine operations efficiency to some extent.

Potential development

Port investment, cost of infrastructure, investment volume of port authority, private investments in port, development in turnover, increase in port city GDP, volume growth rate, international trade increase rate and container increase rate are indicators that evaluate a port's potential development (Gordon et al. 2005; Carbone and Gouvernal 2007).

Apart from the indicators reviewed above, there are plenty of other indicators, such as change of social environment, international politics, regulations, such as environmental issues, geographical location, image marketing and communications, water quality in the ports, and market share in the State (Peters 1990; Guy and Urli 2006; Carbone and Gouvernal 2007; Comtois and Dong 2007).

Problems with some key port performance indicators

As there are many activities and participants involved in the complex port environment, it is not appropriate to evaluate port performance with a limited number of indicators, as each indicator has its own constraints, and PPIs are not fully satisfactory (Carbone and Gouvernal 2007).

De Langen (2003; 2007) criticized a few important indicators: ship turnaround time, berth occupancy rate, throughput, and employment. He explained that: 1. Ship turnaround time can be used to evaluate the ship efficiency, but it is influenced by the cargo volume, port facility availability and cargo composition. This idea is consistent with Trujillo and Nombela (1999) and the World Bank (1991); 2. The berth utilization rate seems more useful than the berth occupancy rate, but it also varies according to the type of cargo handled (general cargo, container, bulk); 3. The throughput relates to cargo handling but does not reflect productivity; 4. Average profitability is a problematic indicator, as clustering does not necessarily lead to higher profits of firms in a cluster. Moreover, high profitability of firms in the cluster could indicate a lack of internal competition; 5. Productivity is not a good indicator, as it is a partial measure and does not consider decline or increase in the number of firms in the industry.

Employment is a direct indicator of port economic impact on the local/regional areas, but it is difficult to assess the effective linkages between port activities and various industries (Stopford 1997; De Langen 2004). Ducruet et al. (2008) challenge the indicator "number of employees" as one PPI. The number of employees does not explain the role of ports in advanced economies (Haynes et al. 1997). In the context of increasing containerization and mechanization, ports no longer generate employment as much as they used to. Therefore employment may be inversely related to productivity and not future oriented. Income/expenditure is a very common denominator for comparison, yet it is very difficult to obtain accurate figures.

Ducruet et al. (2008) argue that the quality of jobs in terms of average wage level is a better indicator to assess the role of ports in realizing economic wealth. Their arguments are supported by economists who assume labour markets should work relatively efficiently. This is also identical with Porter's (2003) view of wage levels as the main indicator to assess regional performance for all industries. Porter (2003) claims that wage levels indicate the wealth of a given area and reflect the education level, skills and knowledge, which are regarded as human capital that fosters regional economic growth and ports' economic and social environments (Howells, 2005; Ducruet et al. 2008). It is a preferred indicator as it varies with the nature of jobs and therefore indicates the wealth of a given area (Blanchard 2000). However, due to ethical issues and confidentiality, the indicator is not easily accessed.

Some indicators are very difficult to obtain in order to assess port performance. Firstly, there are different terminals in a port area with different performance. Secondly, the port authority may not disclose the data, especially financial or efficiency indicators.

Brooks and Pallis (2008) further note that a number of ports do not undertake comprehensive performance measurement due to the complexity of port activities.

It is also noted that PPIs change as time passes on. For example, De Langen et al. (2007) reviewed the different PPIs in Rotterdam from the beginning of the 20th century to 2004. The indicators at the beginning of the 20th century were number of ships and throughput volume. In 1990s, port related employment, value added, and port value added as a percentage of regional GDP were introduced. In 2002, development in turnover and profitability of firms in port were introduced. Investment level of private firms in a port area and establishment of new companies in port area were introduced in 2003 and 2004.

It is hard to distinguish the determinants and the indicators of port performance. For example, productivity is a determinant of port operation efficiency, while productivity is measured by speed of cargo handling and the vessel turnaround time; the indicator of time is regarded as a determinant of cargo handling speed; cost is an important indicator in logistics, meanwhile it is a determinant of operational efficiency. This is why this research employs PPIs as foundations of determinants of port performance.

3.3 Factors contributing to success of ports

Logistics is a network system composed of many echelons and routes. Historically and currently, there have appeared some successful ports in the port logistics system. This section reviews factors causing their success.

Historically, the history of Italy, Portugal, the Netherlands and the UK in port development as sea powers benefited from a number of factors. According to Yue and Zhang (2006) and Hong (2007), the ports share the following common features. Firstly, the ports enjoyed a favourable geographical location. Secondly, the ports were well-known for skills in seamanship and rich navigation knowledge. This further promoted the development of relevant sectors such as shipbuilding, construction, manufacturing and navigation. Thirdly, except for Portugal, they developed hinterlands well. Fourthly, when these nations explored shipping routes, their overseas colonies expanded and they controlled the sea channels for trade. The activities and development of the port relevant sectors promoted trade, local and regional economy. Finally, the ports received institutional support from government on foreign trade.

Currently, as addressed earlier, different ports have different performance. According to AAPA, Rotterdam, Hongkong, Singapore and Shanghai are top ports in port throughput, by cargo volume and by container TEUs. Table 3.6 presents their background.

Table 3. 6 Background of some ports with good performance

	Throughput (AAPA, 2009)	Output/GDP	# of carriers # of ports connected	Employmt	% of emp. Over national population	Source
Rotterdam	386,957,000mt 9,743,290Teu	10% www.yicang.com	500 1,000	70.000 (2007)	1.4%	National Bureau of Statistics of China in 2005;
Hongkong	242,967,000mt 21,040,096Teu	5.2%	500	204,000	6%	http://www.mardep.gov.hk
Singapore	472,300,000mt 25,866,600Teu	9.4%	200 130 (countries)	8,000	6%	Logistics Development Research Report of 2008; Gordon et al. 2005
Shanghai	505,715,000mt 25,002,000Teu	NA	200 300	NA	*12% of China total containers	www.stats-sh.gov.cn

Logistics is one of Hongkong's four pillar industries (finance service, tourism, trade and logistics, discipline professional service and other supporting services). Singapore's 200 different shipping lines sail daily to every major port worldwide (Tongzon and Heng 2005). Shanghai accounted for 12% of total China freight (Comtois and Dong 2007). Some common factors leading to favourable port performance are concluded as follows.

3.3.1 Unique geographical conditions

Rotterdam, located in the South of the Netherlands on the North Sea, is the biggest seaport city in Europe. Rotterdam is directly situated on the estuary of the rivers Rhine and Maas. The strategic location has made Rotterdam a gateway to the densely populated European market. Being the third busiest port after Singapore and Shanghai worldwide, Rotterdam is well-known as the trade and transport centre of Netherlands and by far the busiest port in Europe. With natural deep water (24 metres, 75 feet) and no locks, the port can serve very large ocean-going vessels unrestrictedly for 24 hours a day, 7 days a week (www.portofrotterdam.com).

Hongkong, an island sitting just south of Guangdong Province, with the South China Sea surrounding its southern coast, enjoys the reputation of China's south door. Covering an area of 1,100km^2 with over 6.8million population, it is in the central region of rapidly developing Southeast Asia. With wide harbours protected by mountains, the region is favourable for transhipment. Its geographical location between the Taiwan Straits, the South China Sea, and the Pacific Ocean makes it a strategic port for sea transport connection worldwide (Peng et al. 1999).

Singapore is located at the entrance and exit of the Malacca Strait, the world's major shipping routes linking the Indian Ocean and the Pacific Ocean. Being one of the world's maritime crossroads, Singapore has developed its logistics sector and become a key global transhipment hub for goods moving between the East and the West with its geographical advantage (Souza et al. 2003). Singapore is a natural logistics hub, benefiting from its strategic position in the Asia Pacific, excellent infrastructure, and various goods and services tax (GST) relief schemes (Eng and Keong 2005). The World Economic Forum, in its Global Enabling Trade Report 2008, ranked Hong Kong and Singapore as the top two ports.

Shanghai is located at the edge of YRD mid-way along China's east coast, facing the East China Sea. The west-east Yangtze River and the north-south coastline form a T-shaped waterway and Shanghai is right at the centre of this waterway system. This makes Shanghai an important transhipment port for China's participation in world trade. Depending on Shanghai city, backed up with YRD, Shanghai ports handle around 20% of China's trading (Xu 2009).

The strategic locations of these ports enable them to get easy access to rich cargoes and international shipping lines, which have a positive influence on their port performance. Ports strategically located close to the main global trade networks with good landside connections increasingly offer carriers and shippers a more appropriate option (Fleming and Baird 1999).

3.3.2 Landside connectivity linking hinterlands

Rotterdam has well-connected regional, national and international transport systems by extremely high quality multi-modes. The physical infrastructure links the port, hinterlands and foreland by road, rail, air, waterways, pipe and sea, providing excellent logistics services. Rotterdam sets a good example of intermodal transport, which is an important strategy for different facility operators, logistics company and service providers.

High-density rail transport network and fast highways link Rotterdam to the heart of Europe. The corridor project between Rotterdam and Germany, the freight-only rail, is one of the priority transport projects of the EU. Eleven railway stations within the Rotterdam boundaries and a light rail system (Randstad Rail) link Rotterdam with other cities. It is known that one in three trucks running on European motorways is Dutch (Analytiqa 2009). Several international connections for Rotterdam's road system can take cargoes to inland Germany, Belgium, France or Great Britain the same afternoon. The efficient road transport provides door-to-door services and the network of waterway and the spread of the air, oil and gas pipeline are easily accessible. One reason for Rotterdam's success is that Rotterdam provides all imaginable facilities for cargo handling, distribution, industry and many auxiliary services (Yue and Zhang 2006).

Hongkong's economic and social prosperity is underpinned by a well-developed infrastructure that includes transport, telecommunications infrastructures and public utilities, which ensure cargoes to be transported to the final destination rapidly. The transport network such as railway, road, cargo dock, inland water dock and across border transport provides perfect physical infrastructure. The infrastructure can not only reinforce Hongkong's logistics but also contribute to its trade and economy.

Singapore's target is to become a comprehensive logistics hub that integrates services by sea, road, air and distribution. Singapore started the physical infrastructure scheme in the 1990's and improved its infrastructure later on. Singapore's airport has been regularly rated as the World's Most Popular Airport and the Best Airport in Asian-Pacific for many years. Its transport systems use a very effective IC (Identification Card) card for charge to link all the transport data and the central data controlling centre (Yue and Zhang 2006).

Shanghai has favourable landside connections between ports and other important cities in the upper/middle reach of the Yangtze River, by railways or waterways. The connections have improved Shanghai's transport and distribution system, going further to the inland river logistics network. Connections have linked Shanghai with cities all over China (Yang 2008).

3.3.3 Port technical infrastructures

Rotterdam, Hongkong, Singapore and Shanghai all have many specialized and multi-purpose port facilities, advanced cargo-handling, storage, distribution, transportation equipment with high degree of automation and mechanization and first class transport facilities and transport networks.

3.3.4 Efficient port services

Rotterdam functions as a hub of international goods flows, storage and distribution as well as an industrial complex. It has sufficient deep-sea and feeder services. The Delta Terminal particularly is one of the most advanced terminal operations worldwide with full automation. Rotterdam integrates all kinds of information networks for easy and efficient service for customers, including the application of global positioning satellite

(GPS) in the parking areas (www.portofrotterdam.com). Rotterdam implements a system of "bonded warehouses" where shippers can handle cargoes free of tax.

Hongkong is well-known for its port services, with high speed of cargo handling, transparent customs, efficient and simple documentation. Hongkong’s financial regulations and transparent information service have enabled it to have a globally-recognised highly efficient financial platform. It has become part of a tripartite confederation worldwide together with London and New York (Bing 2007). Hongkong boasts of its services in container liners’ registration, finance, insurance, broker, ship inspection and maintenance. Hongkong has absorbed the cultures of both east and west and integrated the advantages of ancient China and foreign countries. It is open to attract worldwide expertise. Hongkong’s success in seaport business relies on talented people who have basic essential international knowledge (Zhuang and Wang 2005).

Singapore benefits from its efficient logistics service in container stacking and cargo distribution. To satisfy the relevant logistics companies, Singapore has set up four distribution centres near the ports with a total area of over 500,000m^2 (Gordon et al. 2005). New technology is highly promoted to improve productivity. Shanghai provides services that are more efficient to the port customers than other ports in China, with faster port operations, quicker customs clearance and fewer formalities to reduce logistics complexity.

3.3.5 Logistics demand in the hinterlands

The key to port performance is whether the port can become an important echelon of the integrated logistics chain and win more cargo sources. Yeo et al. (2008) find that hinterland condition, which decides logistics demand, is important for port competitiveness. Wiegmans et al. (2008) consider large hinterland as one of the three most important criteria for port choice.

Rotterdam’s hinterlands are Europe, which is a broad economic hinterland providing a great space for developing Rotterdam’s industry and logistics. Rotterdam’s Port Authority has been trying to strategically invest in the sea transport, barge and rail to form a logistics chain together with the hinterland industry in order to consolidate the position of Rotterdam as a world port leader, to promote more effective hinterlands transport and to enhance port competitiveness (Zhuang and Wang 2005).

Hongkong’s main hinterland is PRD, which is rich in all sorts of products. Seventy percent of the exports and transhipment cargoes in Hongkong are from PRD, which has great influence on Hongkong's logistics and economic development. Hongkong has been known as the "front shops" and PRD as the "back factories" since the 1970s. The rapid development of PRD has sufficiently ensured the development of Hongkong as an international shipping and trade centre. Hongkong's excellent transportation facilities and the PRD's high productivity enabled Hongkong to develop into a logistics hub to link mainland China with the world. Southern China has been developing with Hongkong acting as the dragon head, Shenzhen as the deep-sea route port, Guangzhou and PRD river ports as the feeder ports (Wang 2004).

Shanghai includes over 20 provinces and regions of the whole Yangtze River area as its hinterlands, both a strong direct hinterland near Shanghai and a vast indirect hinterland of the middle and upper reaches of the Yangtze River. This drives the growth of Shanghai ports, which are the most dynamic economic regions in China. These regions have great potential to feed containers to the port of Shanghai and transhipment to international destinations. Through the T-shaped waterway system, the direct and indirect hinterlands of Shanghai ports may cover the regions of the Yangtze River Delta (YRD), the middle and upper reaches of the Yangtze River, and the eastern coastal regions.

The YRD covers Shanghai and 15 other municipalities in the neighbouring Jiangsu province and Zhejiang province. According to the China National Bureau of Statistics, with less than 6% of the population of China, this region produces about 20% of China's GDP, 30% of its foreign trade and attracts about 50% of FDI in China. Shanghai has manufacturing industry clusters whereas Jiangsu Province and Zhejiang Province concentrate on light industry. This economic structure has created a large demand for energy and natural resources, which have to be imported from international markets or other parts of China. The raw material imports and large volume of foreign trade require ever-increasing capacity in the gateway port of Shanghai. Actually, the port of Shanghai handles not only the freight of 99% of foreign trade generated in Shanghai, but also 60% of the foreign trade in Zhejiang and 40% of the foreign trade in Jiangsu province (Sun and Zhao 2006).

The middle reaches of the Yangtze River, with Wuhan as the main gateway port, are rich in natural resources, especially minerals and ores. Exports from this region are mainly mineral, chemical, agricultural, iron and steel products. 30-60% of the containers generated from this region are transhipped through Shanghai. The upper reaches of the Yangtze River include Sichuan and Chongqing, whose main products are automobiles, motorcycles, chemical products and food products. Chongqing is the regional gateway port and 30% of this region's containers are exported via Shanghai.

3.3.6 Government support

A port is a system with huge investment. It cannot be available without far-sighted government planning and legislation as well as huge investment in infrastructure. Government support is important in influencing port performance in the form of preferential policies on land use rights, tax concessions, investment and other support.

"Rotterdam Municipal Port Authority" manages the port on behalf of the municipal government. It is responsible for infrastructure and waterway development, construction and maintenance to promote the port development. The customs officials work with clients to expedite the customs clearance process. Due to limited land access to the terminal, the government has managed to shift the access modes to more rail and barge. Moreover, the government offers flexible labour market legislation, beneficial tax regulations for highly skilled workers, and straightforward visa requirements to attract overseas experts and qualified companies.

Hongkong government is well known for its structure simplification, high efficiency, high transparency and fairness, with perfect legislative regulations and low/free tax, which promotes international and regional logistics business for Hongkong. The government provides transparent information, stable politics, and good bank and financial facilities that are key factors for investors to consider when they make decisions on investment. Most investors are satisfied with the way the Hongkong government is addressing development of its logistics business seriously (Wang 2004).

The Singapore government has vigorously promoted the development of port performance. It has made efforts on infrastructure, capital injection and technological development. Singapore Logistics Association has developed a series of Singapore Logistics Upgrading Schemes to enable the one-stop service for transport, warehousing and distribution. They provide preferential policy on tax by introducing various schemes to suspend the tax payable on import cargoes. The FTZs are reflections of government support for port development. The government provides efficient customs procedures to attract transhipment via Singapore (Zhuang and Wang 2005).

To improve the efficiency of the relevant government departments, Singapore has promoted e-government. The public e-corridor is available to promote the industry's low-cost EDI. The multiple nodes involved in logistics have realised paperless and automatic operations to save the human and financial resources for business and to improve the operations efficiency. The Singapore government provides service networks such as Trade net, Port Net and Marinet, which are all supported by ICT for e-government (Wang 2004).

The Shanghai government has taken a proactive role in port development at great expense. The government has invested hugely in port infrastructure, such as deep-water terminals and container terminal construction at Yangshan port, integrating the EDI platform and simplifying customs so that port services can be improved. The Waigaoqiao Logistics Park has been accelerated to develop value added services.

Section summary

Historical ports in Italy, Portugal, the Netherlands and the UK and current ports such as Hongkong, Rotterdam, Singapore and Shanghai have been recognised as successful ports in terms of cargo volume and container TEUs. Their logistics strategies on international trade with the support of government have attracted a huge volume of logistics cargoes. The port infrastructure investment ensures their efficient port facilities to provide efficient port services. Quality port connectivity attracts logistics demand from broader hinterlands. The deep-water harbours enable large vessels to call, and the technology functions as a stimulus for port performance improvement in ICT. The four ports' success is attributable to their geographical conditions (locations and water depth), port connectivity, quality port services, government support, good port facilities and sufficient logistics demand from the hinterlands.

3.4 Criteria for port competitiveness and port choice

The impacts of globalisation, deregulation and privatisation have enhanced port competition. Benito et al. (2003) note that strong competition probably plays an important role to enable the maritime sector to grow fast. As Porter (1990) states, competitive advantages are created in the interplay between the rivalry, demanding customers, and the quality of related and supporting sectors.

It has long been recognised that port competition is not just between ports and transport carriers but also between the "total logistics chains" (Fleming and Baird 1999). The analysis of port competitiveness has mainly focused on port selection criteria. Yeo et al. (2008) reviewed the components of port competitiveness in the 1980s and 1990s, covering Europe, America and South-east Asia. In the 2000s, additional criteria were added to their review. The criteria are considered as competitive components, a summary of which is presented in Table 3.7.

Table 3. 7 Components of port competitiveness (adapted from Yeo et al. 2008)

Author (year)	Components identified
Pearson (1980)	Confidence in port schedules, frequency of calling vessels, variety of shipping routes, accessibility of port
Willingale (1981)	Navigation distance, hinterland nearness, connectivity to ports, port facilities, availability of port, port tariffs
Collison (1984)	Average waiting time in port, confidence in port schedules, port service capacity
Slack (1985)	Calling frequency, tariffs, accessibility to the port, port congestion, inter-linked transportation networks
Brooks (1985)	Port costs, frequency of calling vessels, port reputation and/or loyalty, ship direct calling, experience of cargo damage
Murphy et al. (1991, 1992)	Has loading and unloading facilities for large and/or odd-sized freight, allows for large volume, shipments, has low freight handling shipments, provides a low frequency of loss and damage, has equipment available, offers convenient pickup and delivery times, provides information concerning handling, offers assistance in claims handling, offers flexibility in meeting special handling requirements
Peters (1990)	Internal factors: service level, available facility capacity, status of the facility, port operation policy External factors: international politics, change of social environment, trade market, economic factors, features of competitive ports, functional changes of transportation and materials handling
UNCTAD (1992)	Geographical location, hinterland networks, availability and efficiency of transportation, port tariffs, stability of port, port information system
Kim (1993)	Sea transportation distance, number of liners calling-in, annual volume imported and inland transportation charges per unit distance, distance between origin and destination, annual cargo handling volume, loading hours, average detention hours at port, goods value per ton and inland trucking cost per kilometre
McCalla (1994)	Port facilities, inland transportation networks, container transport routes
Starr (1994)	Geographic location of ports, Inland railway transportation, investment of port facilities, stability of port labour
Rimmer (1998)	Door-to-door service, lower price, reliable, safe, prompt and low cost transport system
Hoyle (1999)	Good facilities, efficient operation, up-to-date technology
Bookbinder and Tan (2003)	Political and currency exchange stability
Lirn et al (2003)	Port basic physical characteristics, port geographical location, port management and carrier's cost perspective
Song and Yeo (2004)	Cargo volume, port facilities, port location, service level and port expenses
De Langen (2003)	Ship turnaround time, wage, throughput, connectivity, investment
Comtois and Dong (2007) and Cullinane et al. (2005)	Price, quality of service, central government policies on regional development, natural endowments, inland transport infrastructure, logistical systems, cargo resources,
Ng (2006)	Accessibility of the port, time efficiency, cases of delay, cost (terminal handling charge and port dues), speed, geographical location
Guy and Urli (2006)	Port infrastructures (depth, quay length, cranes, intermodal, interface), total transit cost, service (turn-around time), geographical location (immediate/extended hinterland, possibility to serve other ports within the same service loop)
Lee and Rodridge (2006)	Competitive labour costs, the open-market policy, and a substantial amount of capital investments
Tongzon (2007)	Port (terminal) operation efficiency level; port cargo handling charges; reliability; port selection preferences of carriers and shippers; the depth of the navigation channel; adaptability to the changing market environment; landside accessibility; product differentiation
Wiegmans (2008)	Reveals that port selection mainly depends on the criteria of handling speed, handling cost, reliability and hinterland connections
Lam and Yap (2008)	Government support, good connectivity, feeder services, more space, lower cost, acquisition

In the 1980s, Pearson (1980), Willingale (1981), Collison (1984), Slack (1985) and Brooks (1985) proposed various port selection criteria in Europe, the US and South-east Asia. The criteria include availability and frequency of shipping lines, accessibility of ports (navigation), hinterland nearness, connectivity to ports, port facilities, waiting time, port service capacity, congestion, experience of cargo damage, port costs, reputation and port tariffs.

In the 1990s, Peters (1990), Murphy et al. (1991; 1992), UNCTAD (1992), Kim (1993), McCalla (1994), Rimmer (1998) and Hoyle (1999) revealed various attributes and major factors influencing port selection and competition. More criteria were identified, such as the geographic location of ports, hinterlands networks, external factors (international politics, change of social environment, trade market, economic factors and features of competitive ports), investment in ports, stability of port labour, safety, custom services, speed of cargo handling, door-to-door service, documents simplicity, reliability, lower cost and up-to-date technology.

Geographic location is one of the key determinants of port competitiveness (Skjott-Larsen et al. 2003; Song and Yeo 2004; Gordon et al. 2005; Yeo et al. 2008). Geographical conditions are the most decisive factor for the localisation of ports, although this does not exclude competition between areas with geographical conditions favourable for a port. Port activities are found to be more dependent on geographic localisation than on other economic activities (De Langen 2004). The location of a port indicates its location in the global network. It will decide the distance to the industrial manufacturing region and the distance to the main lines; hence, it will decide the hinterland areas of the port (UNCTAD 2006).

Song and Yeo (2004) find that location plays the most important role in the evaluation process of a port's competitiveness in China. They identify a close relationship between geographical location and cargo volume. They find that location and port facilities are the two most important competitive factors, and service level has a lower priority for competitiveness. This indicates that the port sector is still a traditional sector, where service quality does not play such an important role as hard aspects.

UNCTAD (1992), Starr (1994) and Gordon et al. (2005) all recognise that geographical location is strategically important for the port sector, especially trade development, in the global network. Good location helps trade growth as a multiplier effect and economies of scale effect. Economic growth influences the surrounding areas. Conversely, the economic prosperity of the surrounding area would promote port development and its relevant sectors by investment and more cargo sources.

Industrialisation and substantial capital inflows lead to a demand for an integrated global logistical system to handle increasingly containerised cargoes moving door-to-door from consignors to consignees (Rimmer 1998). The shippers require a reliable, safe, prompt and low cost transport system that the ocean liner shipping companies are supposed to offer. In response to the need for door-to-door services, since the late 1960s, deep-sea liner shipping companies have established the necessary globe-spanning transport and communications networks and marketing arrangements.

Price competition is remarkable in port competition and selection. Transport costs have been increasing in relative importance for export competitiveness (Sanchez et al. 2003). To meet price competition, partnership on vessel sharing arrangement and reorganisation started from independent shipping operators in the early 1990s (Rimmer 1998). The liner shipping companies attain prominence by competitiveness in mainline and feeder container movements, intermodal rail and truck movements, depot operation, long haul, container shipping networks and feeder shipping networks, banks and insurance (Rimmer 1998). A port can be a facilitator to encourage regional development, if it is well-equipped with up-to-date technology (Hoyle 1999).

In the 2000s, Notteboom and Winkelmans (2001), Lirn et al. (2003), Song and Yeo (2004), Cullinane et al. (2005), Ng (2006), Guy and Urli (2006), Lee and Rodridge (2006), Comtois and Dong (2007), Tongzon (2007), Lam and Yap (2008) and Wiegmans (2008) added more components of port selection and competitiveness, covering East Asia, North-east Asia, South-east Asia and other research areas. The recent port selection and competition criteria include port management, cargo volume, service level, port expenses, government policies on regional development, natural endowments, logistical systems, cargo resources, port infrastructure, labour cost, open-market policy, reliability, port/terminal operation efficiency level, port charges, port selection preference of carriers and shippers, hinterlands connections, terminal productivity, a port's reputation, adaptability to the changing market environment, product differentiation, feeder services, more space and acquisition.

The studies of the past 10 years concentrate on Asia, as it is developing rapidly in terms of both economy and port development. The research of this area represents the development trend in the maritime and port sector. The following presents some particular studies in these areas.

Inter-port competition has intensified (Notteboom and Winkelmans 2001) to attract more customers as cargo sources are limited. If ports fail to attract traffic in a context of inter-port competition, they will fail and decline. Ports which have already invested heavily in port technical infrastructure would struggle to keep up with the growing volume of trade. When new ports emerge, the neighbouring ports would feel the effects of competition. Some ports would cooperate while they compete, such as Shanghai versus Ningbo, and Fuzhou versus Xiamen.

Lam and Yap (2008) investigate inter-port competition between port Kelang, Tanjung Pelepas and Singapore. The three ports are all situated in strategic locations along the Straits of Malacca, Southeast Asia. They are major container ports. Half of all containers handled there are transhipment containers, which account for 30% of the world's transhipment traffic. The authors noted the container port competition dynamics for transhipment cargo.

Singapore's market share declined as Port Klang and Tanjung Pelepas emerged as credible alternatives for transhipment operations, which encouraged some shipping lines to relocate their transhipment hubs to these ports from Singapore. The competition among the three ports had a negative impact on Singapore's transhipment performance. Firstly, the Malaysian government policies attract Malaysian national cargoes through Port Klang rather than through the Port of Singapore (Robinson 2004). Secondly, Tanjung Pelepas has good connectivity in terms of shipping network, the availability of feeder services, more space available and lower port operations costs. Pelepas has attracted more lines to call. Thirdly, the pressure of the reduction of charges or the enhancement of efficiency have already motivated Maersk and Evergreen to move their transhipment business from Singapore across the border to the Port of Tanjung Pelepas in Malaysia (Cullinane 2004). The acquisition of P&O Nedlloyd by Maersk Sealand also caused Singapore to lose much transhipment freight to Tanjung Pelepas, where Maersk Sealand has opened an office.

Comtois and Dong (2007) and Cullinane et al. (2005) analyse the inter-port competition between Shanghai and Ningbo, which share the same hinterlands. The competition is intense with the adoption of market-based reforms and the increasing globalisation of the Chinese economy, as the open-market reform, continued economic development in the hinterlands and China's accession to the WTO all contribute to the growing demand for port services. The two neighbouring container ports were evaluated on the basis of price, quality of service and central government policies on regional development. Shanghai's throughput is largely domestic cargo, with international transhipment still in its infancy. Ningbo would gain greater market share as the result of advantages in its natural endowments (particularly depth of water), lower price and quality of service improvements, good inland transport infrastructure and logistical systems, as the growing cargo resources come from the west stimulated by China's policy of development of the western provinces. Quite a few leading liners have already moved their regional hubs to Ningbo.

Lee and Rodridge (2006) note that competitive labour costs, the open-market policy, and a substantial amount of capital investments have enabled China's ports to compete against ports from Asia depending on its export-based economy. China's economy boom has generated a huge volume of cargo sources for export to countries worldwide and has aroused large demand for import from foreign countries via ports.

Before China's economic boom, Korea's trade was mainly with Japan and U.S. from the Southeast ports. However, the growth and expansion of the trans-Yellow Sea supply chain aroused by the "China effect" made Korea, China's neighbouring country, start to reorient its regional maritime industry and port system (Yeo et al. 2008). Korea has had to adapt to the "China effect" and reposition its capital and facility investment to attract Chinese cargoes to enlarge its market share. This shift has resulted in a high level of integration of Sino-Korean manufacturing supply chains and substantial changes in the regional logistics network have happened by organizing new flows of raw materials and final products, which accordingly has brought regional port competition within Korea by creating diverse links.

The prominence of Busan in the port system is challenged by this reorientation, as Busan has a shipping distance problem and inefficient inland logistics within Korea. However, Busan still has a significant hinterland and a gateway location for global and regional trade, with the exception of northern China. In this context, Busan will still benefit from the growth of Northeast Asian maritime traffic and its hinterlands.

Tongzon (2007) proposes eight key determinants of port competitiveness: efficiency, port charges, reliability, port selection preferences of carriers, navigation depth, adaptability to change, landside links and product differentiation. He did an empirical survey of some manufacturers and 3PLs in Singapore concerning the important factors that influence their choice of countries as location for their investment. The factors were identified as market potential/purchasing power, domestic economic and political environment, related and supporting industries, technology base, government policy and regulations, social and cultural environment, executive procedures and services, incentive procedures and services, incentives for foreign investors, business practices and operation systems, infrastructure development, supply and logistics chain management strategy, and others (including local partner, total cost of operations, competitive environment, availability of trained people, financial/foreign currency stability).

Later on, Tongzon (2007) revealed the determinants of competitiveness in logistics in the ASEAN region (Section 1.1.2). Song and Yeo (2004) identify that cargo volume, port facilities, port location, service level and port expenses are the five most important criteria for the competitiveness of port business in Asia. However, due to lack of data on expenses, they did not include this important criterion in their empirical research.

Lirn et al. (2003) analysed the Taiwan case on transhipment port selection and decision making behaviour. Lirn et al. (2004) analysed transhipment port selection from a global container carrier's perspective, employing the technique of Analytical Hierarchy Process (AHP). They categorised port selection criteria into four major criteria and 12 sub-criteria: port physical and technical infrastructure (basic infrastructure condition, technical infrastructure and inter-modal links), port geographical location (proximity to import and export areas, proximity to feeder ports and proximity to main navigation routes), port management and administration (management and administration efficiency, vessel turn-around time and port security/safety) and carriers' terminal cost (handling cost of containers, storage cost of containers and terminal ownership/exclusive contracts policy). The five service attributes most significant to port selection were identified as handling cost of containers, proximity to main navigation routes, proximity to import/export area, basic infrastructure conditions and existing feeder network, among which three attributes are subject to the main criterion of geographical location.

Wiegmans (2008) reveals that port selection mainly depends on the criteria of handling speed, handling cost, reliability and hinterlands connections. He concludes the following strategic considerations are influential in port choice: availability of hinterlands connections, attainability of consumers (large hinterlands), maximum depth of port approaching route, feeder connectivity, environmental issues and total portfolio of the port, port ship time (high productivity), reliability (absence of labour disputes), reasonable tariffs and degree of congestion.

Some studies on port competitiveness in China have been conducted. Ma (2007) provides indicators for port competitiveness in China, which are shown in Table 3.8. The indicators were categorised into two levels. He adopts AHP methods to investigate China's ports competitiveness.

Table 3. 8 Port competitiveness index by Ma (2007)

	Level 1 indicator	Level II indicator	Selected ports
Port competitiveness	Cost	Freight rate, time cost and free charge	Port A-N
	Services	Service insurances, service levels/quality and operations capability	
	Support system for relevant sector	Laws and regulations, criteria, preferential policies	
	Information system	Hardware, software, information support platform	
	Natural conditions and infrastructure	Natural conditions, port hardware, port financial status, management level	

This section has addressed the criteria for port selection with the support of general literature and detailed cases from Asia. The criteria have been found similar to PPIs.

3.5 Factors influencing port performance

The above sections have considered factors influencing port performance. Section 3.1 gives the components of a port logistics system. As PPIs are closely related to influencing factors, Section 3.2 reviewed PPIs in detail for up to date knowledge. The indicators imply which factors to measure and sometimes the indicators themselves reflect factors. Reviewing factors resulting in successful ports historically and currently (Section 3.3) gives hints of what factors can improve port performance. Section 3.4 presents components and criteria for port competitiveness and choice, which are also found highly related to factors influencing port performance. These sections build the foundation of potential factors influencing port performance.

The factors include natural endowment (geographical location and navigation depth), seaside links (deep-sea shipping services, feeder services), landside links and port connectivity between ports and hinterlands (transport infrastructure), port physical infrastructure (# of berths, quay length), port superstructures (buildings, equipment and other facilities), port technical infrastructure such as ICT, logistics demand from economic activity, efficient operations, port services, logistics support including government support and other services, development potential, port management such as risks, safety, etc. which can be classified and presented in Figure 3.3.

Tongzon (1995) found that only a few studies have attempted to explain and identify the various factors underlying a port's performance. He employed throughput and efficiency as PPI. He selected location, frequency of ship calls, port charges, economic activity and terminal efficiency as factors influencing throughput; and he selected container mix, work practices, crane efficiency, vessel size and cargo exchange as factors influencing efficiency. His research found that terminal efficiency and crane productivity are vital determinants of improving port performance, by quantifying the contribution of each factor to the overall determinants of port performance.

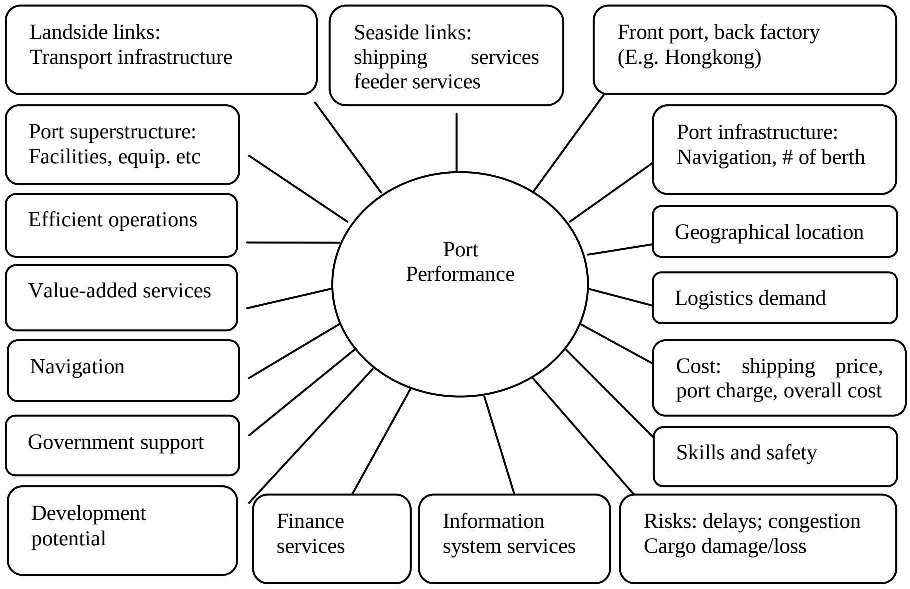


Figure 3. 3 Categories of factors influencing port performance

Economic activity and logistics demand are highly related and they strongly influence port performance, as the types of import and export products depend on the economic development level, product structure and world economy status. The wealthier the local economy is in the hinterland, the greater the volume of throughput. The stronger the world economy, the better the international trading, as there will be more demand for international products when the economy is booming. The world economic crisis in 1929-1933, the Asian financial crisis in late 1990s and the world economy recession starting from 2008 have seriously influenced international trade and port performance.

The support of the local economy for port performance depends on the scope of hinterlands, the population within the scope, and the industries in the hinterland. The scope of hinterlands is highly related to cargo volumes, which explains why hinterlands are important (Section 2.3.6). For population, larger populations have bigger demand for consumption. For example, Shenzhen developed from a village into a modern city of more than 100 million citizens and 200 million people from all over China within 20 years. People who are attracted here have brought huge consumption demand. The consumption would require different products imported or domestically produced, which would influence port cargo volume accordingly. As for industries, electronic industries provide cargoes with higher value than light industries.

Pettit and Beresford (2008) examine port performance by annual cargo tonnage. They find that EU expansion, increasing use of unit loads and a move towards Far East sourcing are the important factors influencing UK port’s long-term performance from a regional perspective. Analysing Shanghai’s port economy produces the influencing factors as hinterlands economy, international trade, port capacity, port investment and operations capacity (Ren and Wang 2007). Bichou and Gray (2004), Wiegmans (2008), and Yeo et al. (2008) note that interconnectivity of the port (sailing frequency of deep-sea and feeder shipping services) is an important criterion for port choice strategy and decision-making. References can also be referred back to Sections 3.1-3.4.

Government policy and regulations are identified as a determinant of a country selection by international manufacturing firms (Tongzon 2007). Port efficiency is influenced by public policies (Sanchez et al. 2003). Government can intervene in port operations. Different government policies would be adopted in different institutions. The more open the economy, the better the volume and value of imports and exports, which largely depends on the policy. In China, as it is at the stage of transitional economy, government behaves like a "visible hand" to intervene in the market to certain degree, including what products to produce, and how many to produce for certain products. The Chinese government also intervenes in the port market, with national and provincial policies on how ports should perform.

The factors reflect the improving quality of port services, the changing business environment and fierce port competition (Yeo et al. 2008). Based on the components of port system by ADB (Banomyong 2007), twenty factors were selected from the literature for further investigation and analysis. However, some determinants were found to be interrelated. To eliminate overlapping and less important determinants, interviews were conducted with 40 port experts from various port stakeholders, including shipping lines, cargo interests, PSPs, port managers and other port stakeholders. First 15 factors were extracted during the interviews as shown in Table 3.9.

As all the studies listed in the reference column have been validated, the variables have content validity. The references can also be traced back to Sections 3.1-3.4 for all the 15 factors. Besides the factors reviewed above, there are other factors that influence port development. The new trend of environmental protection requests green logistics, which is one factor that influences port performance, such as emerging regulations on environmental issues and requirement of water quality in the port. Other factors influencing port performance are identified as political stability (Peters 1990; Lirn et al. 2003), cultural difference (Luo et al. 2001), change of social environment (Peters 1990; Tongzon 2007; DFT 2009), port reputation (Wiegmans et al. 2008), regulations (Comtois and Dong 2007) and image marketing (Rozenblat 2004). However, these factors are not included in the questionnaire survey due to time and funding constraints, data availability and difficulty in quantification.

Table 3. 9 Factor choice for empirical research

	Factors	References
F1	Availability of shipping services (destinations, frequencies, etc)	Bichou and Gray (2004), Carbone and Gouvernal (2007), World Bank Survey (2005), Wiegmans (2008), Slack (1985), Wiegmans (2008), Arvis et al. 2010
F2	Price of shipping services	Gordon et al. (2005)
F3	Port/ terminal handling, warehousing and other charges	Tongzon and Heng (2005), Arvis et al 2007, Talley 1996, Gordon et al 2005, Brooks 1985
F4	Feeder connections to the deep-seaports and the major shipping lines	Carbone and Gouvernal (2007), Wiegmans (2008), Yeo et al., 2008
F5	Port / shipping service is on the cheapest overall route to the destination	Notteboom and Rodrigue 2005, Arvis et al 2007, Bichou and Gray 2005, Bichou 2006, UNCTAD 2006
F6	Speed of port cargo handling	Wiegmans et al. 2008, Gordon et al. 2006, Talley 1996, UNCTAD 2006
F7	Congestion, risks and other risks	Wiegmans et al. 2008, Slack 1985, Talley 1996
F8	Port/ terminal security and safety	Wiegmans et al. 2008, DFT
F9	Technical infrastructure of the port (handling equipment, ICT, etc)	Murphy 1991, 1992, McCalla1994, World Bank 2005, Wu 2008, Gordon et al 2005, UNCTAD 2006, Xiao et al. (2008), Arvis et al 2007
F10	Proximity of the port to your customers and / or sources of supply	Lirn et al. 2004, Wiegsmans et al. 2008, UNCTAD 1992, Gordon et al 2005, Starr 1994, Yeo et al. 2008
F11	Availability of skilled employees in the region	Wu 2008
F12	Quality of landside transport links (inter-modal links)	Wiegsmans et al. 2008, Bichou and Gray 2004, Slack 1985, UNCTAD 1992, McCalla 1994, Joly & Martell 2003, Xiao et al. (2008), Arvis et al. 2010
F13	Availability and quality of logistics services (warehousing, freight forwarding, cargo handling, etc)	Bichou and Gray 2004, Slack 1985, Talley 1996, Robinson 2006, AAPA, Wu 2008, UNCTAD 2006, Arvis et al 2007
F14	Government supports for logistics activities and new developments in the region	Arvis et al 2007, Wang & Oliver 2003
F15	Depth of navigation channel	Wiegsmans et al. 2008, DFT
F16	Ship turnaround time	De Langen et al. 2007, Trujillo and Nombela (1999); World Bank; Carbone and Gouvernal (2007); Gordon et al (2005); Xiao et al. (2008)
F17	Customs services	Bichou (2006); Arvis et al. 2010
F18	Efficiency	Gordon et al. 2005; Tongzon 1995
F19	Tracking capability	Arvis et al. 2010
F20	Adaptability to the changing market environment	Tongzon 2007

Note: F: factor

3.6 Chapter summary

This chapter firstly reviewed the components of a logistics system for ports. This was followed by reviewing logistics performance indicators. The PPIs were categorised. Then the factors resulting in some ports' good performance were reviewed, and criteria for port competitiveness and choice were addressed. The literature came up with factors influencing port performances. As a port is a node in a supply chain to provide services to the shipping lines and shippers, the factors selected in Section 3.5 are all virtually related to port services from different perspectives. The next chapter will address the research methodology and how the empirical research was conducted.

4. METHODOLOGY

The preceding chapters reviewed the literature on port position in logistics chain, port functions, port selection, trends in maritime freight transport, the historical and current successful ports, port performance and factors influencing port performance. The literature review also considered the theory underpinning this research. This chapter builds upon this work and describes the background to this research from a methodological point of view.

This chapter consists of seven sections. The first section presents the research objectives, as the methodology used is to provide data to investigate the objectives. The second section explains and provides a rationale for the research design, which was implemented through the use of mixed methods by interviews and a questionnaire-based survey. Specifically, an overview of the research design is given. The section also discusses a number of methodological considerations on research philosophies, research approaches, research strategy, research methods, research context as well as research process. It aims to make explicit the assumptions of the researcher's philosophical stance and provide assurance that appropriate procedures were followed. The decision to combine qualitative and quantitative approaches is justified. The third section explains the procedures of conducting the semi-structured interviews, questionnaire surveys and other methods for data collection in this research. This section also considers issues related to the design and delivery of the survey, including piloting and conducting interviews/questionnaires. The fourth section describes the procedures used to define the population for this research. Sampling techniques, choice of research locations and interviewees are explained. The fifth section introduces the methods used to analyse the data in this research. The research validity and reliability are also presented. The sixth section addresses importance-performance analysis. The seventh section explains ethical issues. The last section provides a summary of the chapter.

4.1 Summary of research objectives

It is important to address the research objectives before coming to the research methodology, as the nature and context of research objectives will determine the specific research methodology to follow (Saunders et al. 2009). As explained earlier in Chapter 1 and the literature review, there has been little research on the factors that determine port performance and little empirical comparison between Asian and European port performance has been made, although some research has been done on port competition and port performance. This research aims to fill this gap and explore the factors that determine port performance and investigate in what aspects different port regions perform differently, and how differently they perform. To achieve these aims, the objectives of this research are to:

1. *Identify the key factors that drive port performance and choice*
2. *Investigate the differences in importance and performance among these factors*
3. *Analyse how the factor importance and performance vary for different ports*
4. *Analyse the role port hinterland plays in port performance and choice*
5. *Illustrate the usefulness of the key findings from the analysis for port stakeholders*

The extant limited knowledge of factors influencing port performance in the context of global supply chain management demands the use of research tools that are likely to yield fruitful data, both qualitative and quantitative, to achieve the objectives. This need is met by employing an appropriate research design that consists of a number of methodological considerations on research philosophies, research approaches, research strategies, research methods, research context and research process.

4.2 Research design

A research design is a plan and the procedures for an investigation to be conducted, based on the nature of the research problem or issues being addressed and the researcher's personal experience (Creswell 2009).

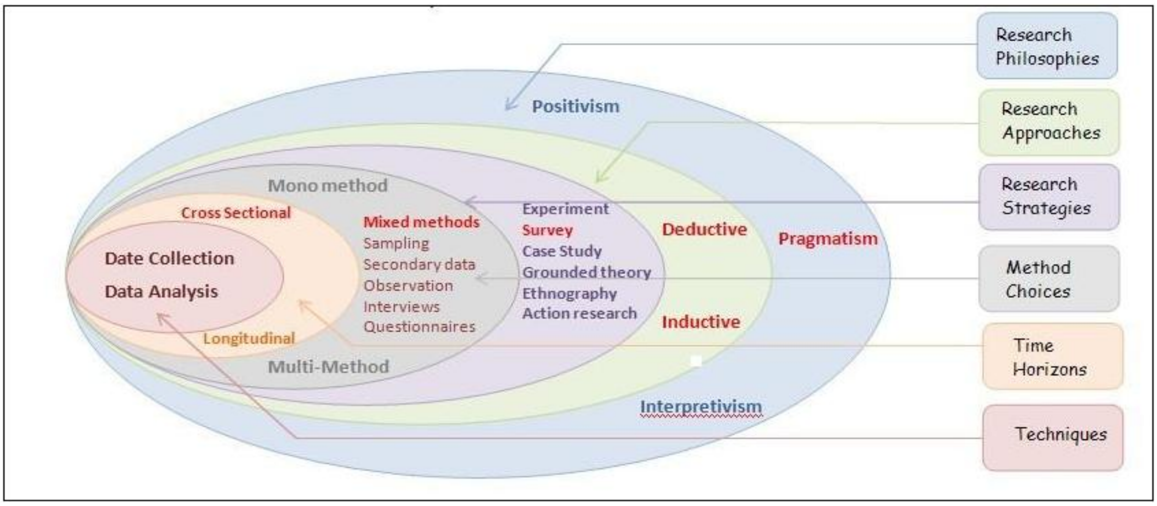


Figure 4. 1 The research design "onion"

Source: adapted from Saunders et al. (2009)

The research methodology tells readers how the researcher chooses the available methods and conducts the research. It should reflect the overall process, in which the research philosophy, research approach, research strategy, data collection methods and data analysis are consistent (Saunders et al. 2009). The "Onion" proposed by Saunders et al. (2009), depicted in Figure 4.1, was used as a guide to the research design.

4.2.1 Research philosophies: positivism, interpretivism and pragmatism

Before deciding on the methodological issues, it is useful to understand different research paradigms and it is important to be explicit about philosophical perspectives, because they shape the way that researchers conduct research and influence how data are collected, analysed and interpreted.

A paradigm, basically a "world-view", is central to the process of research in all areas (Saunders et al. 2009). It is a set of basic beliefs that defines the nature of the world and the individual's place within it and guides action (Guba and Lincoln 1994; Denzin and Lincoln 2000). This research belongs to the field of business and management, where there are often two main research paradigms or philosophies, labelled positivism and interpretivism (Hussey and Hussey 1997; Collis and Hussey 2003). Table 4.1 shows the alleged differences between the two paradigms.

Table 4. 1 Positivism vs. interpretivism

Metatheoretical assumptions	Question	Positivism	Interpretivism
Ontology	What is the nature of reality?	Person (researcher) and reality are separate.	Person (researcher) and reality are inseparable (life-world).
Epistemology	What is the relationship between the researcher and the researched?	Objective reality exists beyond the human mind.	Knowledge of the world is intentionally constituted through a person's lived experience.
Research object	Is research object independent or dependent?	Research object has inherent qualities that exist independently of the researcher.	Research object is interpreted in light of meaning structure of person's (researcher's) lived experience.
Method	What is the process of the research?	Deductive process cause and effect. Statistics, content analysis.	Inductive process Hermeneutics, phenomenology
Theory of truth	Singular or multiple?	Correspondence theory of truth: one-to-one mapping between research statements and reality.	Truth as intentional fulfilment: interpretations of research object match lived experience of object.
Validity	Is it valid?	Certainty: data truly measures reality.	Defensible knowledge claims.
Reliability	Is it reliable?	Replicability: research results can be reproduced.	Interpretive awareness: researchers recognise and address implications of their subjectivity.

Source: adapted from Weber (2004), Hussey and Hussey (1997) and Creswell (2009)

Positivism entails an ontology that researcher and reality are separate and reality is universe made up of atomistic, discrete and observable events, while interpretivism entails that researcher and reality are inseparable and reality is internal & socially constructed (Weber 2004). The interpretative paradigm is viewed as qualitative, inductive and subjectivist, while the positivist paradigm is described as quantitative, deductive and objectivist (Burrell and Morgan 1979; Hussey and Hussey 1997; Denzin and Lincoln 2000; Gummesson 2000). Positivism and interpretivism are often known as the opposing ontological and epistemological perspectives of research (Weber 2004).

Positivism

Positivism seeks to solve major practical problems and discover precise causal relationships through statistical analysis (Kim 2003). Positivism argues that reality or knowledge is objective, independent, external and singular (Hussey and Hussey 1997). Ontologically, positivists believe that deductive reasoning, scientific inquiry and replicable findings will converge upon objective truths (Plack 2005). In its epistemology, knowledge is derived from sensory experience by experimental or comparative analysis, and concepts and generalizations are shorthand summaries of particular observations (Blaikie 1993).

Positivism supports the idea that the emphasis of science is on scientific objectivity (Dupuis 1999). In order to obtain objective and accurate data, researchers must separate subject from object, and things such as selves, personal experiences and emotions should be removed (Dupuis 1999). In other words, the social world should be measured through objective and quantitative methods to obtain quantitative data, and theory testing is emphasized.

Positivism has had a profound influence on the development of research traditions in the natural and social sciences (Plack 2005). It is widely applied in social science to generate more accurate, measurable and objective data (Burrell and Morgan 1979). This research belongs to the social sciences, because it aims to grasp the social dimensions and management behaviours in ports.

Interpretivism

Interpretivism originates from the intellectual traditions of hermeneutics and phenomenology (Kim 2003). Bryman and Burgess (1999) define interpretivism as a strategy of social research concerned to interpret social phenomena in terms of meanings. The emphasis in interpretivism does not focus on the measurement and prediction of phenomena, but on social actors' own language, experiences and perceptions (Lee 1991). In an interpretivist's epistemology, knowledge is derived from everyday concepts and meanings (Blaikie 1993).

Interpretivists attempt to understand not only what is happening, but also why it is happening. In the areas of social science research, influential contextual factors, and personal experiences and emotions, which are often ignored in natural science research, should be taken into consideration, given the inter-subjectively created meanings of the social world (Lee 1991; Dupuis 1999; Kim 2003). This is why qualitative methods and theory building/generation are preferred to theory verification in exploring the social world to obtain qualitative data.

The positivist approach and the interpretive approach appear to be in opposition, as the positivists claim that methods of natural science are the only truly scientific ones, while the interpretivists counterclaim that the research of people and their institutions calls for methods that are altogether different from those of natural science (Lee 1991). While the positivist position may continue to dominate natural and social sciences, more and more interpretivists generally view reality as being socially constructed (Punch 1998; Denzin and Lincoln 2000; Silverman 2000; Vaus 2001).

Pragmatism

Pragmatism is not committed to either of the above philosophies and views of reality (Creswell 2009). Pragmatists hold the view that pragmatism is neither interpretivist nor positivist, and that it is perfectly possible to work with both philosophies (Creswell 2009; Saunders et al. 2009). This philosophy claims that mixed methods, both qualitative and quantitative, are possible and highly appropriate within one research to provide more comprehensive evidence and strength than one method (Blaikie 2009).

The researcher's philosophical stance depends on the nature and objectives of the research. In this research, to address the research objectives in Section 4.1, the researcher needed to collect both qualitative data (which deal with more depth and insightful exploration with limited number of interviewees) and quantitative data (which can be collected from wider samples for generalization). This implies that the researcher is a pragmatist. The philosophy of pragmatism underpins the researcher's choice of mixed methods in this research, which will be addressed in Section 4.2.4.

4.2.2 Research approaches

Generally speaking, there are two main dimensions of choices on research design: one is deductive research or inductive research, the other one is considerations over concrete methods (Collins and Cordon 1997). The research approach addresses choice of deductive or inductive. Corresponding to philosophies of interpretivism and positivism, inductive research (theory is an outcome of research) involves the construction and explanation of models and theories while deductive research (theory guides research) involves the testing of a theoretical and conceptual framework by empirical studies (Vaus 2001).

Strauss and Corbin (1990) indicate that primarily the choice of research approaches depends on the nature of the research problem and research purposes. The research purposes are categorised as exploratory, explanatory and descriptive (Creswell 2009; Yin 2009). Exploratory research is undertaken when an issue or phenomenon is little understood and little research has been done on it (Creswell 2009). Punch (1998) claims that an inductive approach is suitable for an area lacking appropriate theories. Normally, an inductive approach is suitable for exploratory purpose to look for patterns and ideas (Hussey and Hussey 1997), and it is employed in exploratory research to arrive at a set of assumptions on which to base the research design (Crimp 1990). Some exploratory studies may have a legitimate reason for not having any proposition but it is necessary to state clearly the research purpose (Yin 2009). This applies to the current research.

Descriptive research is conducted to describe the features of the variables of interest in a situation (Sekaran and Bougie 2010), and to portray the profile of situations (Robson 2002). A deductive approach is suitable for descriptive research (Neuman 2006; Sekaran and Bougie 2010). An explanatory study is used to establish relationships between variables, and both deductive and inductive approaches can be applied to it (Saunders et al. 2009).

As the differences between deductive and inductive research are narrowed down, an approach that combines these two is becoming popular (Gummesson 2000). A combined approach can provide a better understanding of a specific research topic rather than two separate ones.

The main problem with the interpretive paradigm and inductive approach is concerned with the lack of generalisability of the qualitative data. Malhotra and Birks (2003) argue that an inductive process means that researchers might reach conclusions without complete evidence. Denzin (1983) and Punch (1998) argue that generalization should not necessarily be the sole objective of all research projects; and the purpose of research should depend on the context within which it is embedded.

From an interpretive perspective, other researchers do not have to agree completely with the claims one researcher has made (Weber 2004), given that interpretivism is inherently subjective, and contextual factors and the researcher’s personal history, experiences, and emotions often have a great impact on the result of the research. Interpretivists are intended to uncover and address the issue of a specific reality and learn more of a phenomenon within the social world. Therefore, interpretivist research and inductive processes may not necessarily lead to any universal concept or theory.

In terms of research purposes, the current research has exploratory, descriptive and explanatory purposes. Firstly, this research is exploratory. As addressed in section 4.1, since there are no well-established theoretical frameworks for factors determining port performance and little research has been conducted on the factors, an inductive approach is proper for scrutinizing and exploring the research issues. This research thus employed an inductive approach in Phase 1. Secondly, this research is descriptive, as it describes the factor importance and factor performance in different regions. A deductive approach is appropriate to address the comparison in Phase 2 and test the results from Phase 1 (Sekaran and Bougie 2010). Thirdly, this research is explanatory, as it establishes the relationships between different factors, both within regions and across regions.

To address the different purposes, as explained earlier, a combination of inductive and deductive approaches is suitable to achieve the research objectives. The two-phase approach of inductive-deductive process is shown in Table 4.2.

Table 4. 2 Research phases

	Input	Output
Phase 1 inductive	Desk-based analysis Interviews with local port stakeholders Thematic analysis	In-depth insight into port importance factors; platform established for phase 2 research
Phase 2 deductive	Questionnaire developed and distribution to port stakeholders Data analysis using SPSS	Determinants of port performance Validation results of phase1

4.2.3 Research strategy: survey

According to Saunders et al. (2009), research strategies include experiment, survey, case research, grounded theory, ethnography and action research. The choice of the current research strategy was guided by the research objectives. This research excluded experiment because it is typically applied to studies where variables can be controlled, which is not the case of this research. Case research was excluded as it is confined to a specific context, whereas this research aims to seek some factors that may apply to general ports. Action research was excluded due to time, finance and accessibility constraints, because it requires that the researcher be part of the “organisation”. Grounded theory and ethnography were excluded as they are purely qualitative and cannot achieve the research objectives by providing required quantitative data.

According to Punch (1998), survey refers to any research method for data collection (quantitative or qualitative) from a sample of people. The survey strategy is known as a popular strategy and is widely used for exploratory and descriptive research in business and management research to answer who, what, where and how much questions (Saunders et al. 2009). The data from survey allow easy comparison, explanation and understanding. As this research needed to collect real world data from port stakeholders as addressed in Sections 4.1 and 4.2.2, survey suited the current research objectives and was therefore selected as the research strategy.

In terms of time-horizons, this research is cross-sectional as it seeks to collect necessary data to describe the different factors that influence port performance as a "snapshot" of the situation at a given time (Saunders et al. 2009). A longitudinal research was judged inappropriate and rejected for the research in the current situation. This research was not designed as a longitudinal one. Robson (2002) and Easterby-Smith et al. (2008) claim that cross-sectional studies often employ the survey strategy. This further supports the suitable choice of survey as the research strategy for this research. Having justified the research strategy, the next section will address the detailed research methods.

4.2.4 Research methods

Empirical methods are receiving increasing attention due to the growing calls to incorporate real world data in order to improve the relevance of business research. Quantitative and qualitative methods are the two basic methods of collecting empirical data in business and management. Quantitative refers to any data collection technique or data analysis procedure that generates or uses numerical data, while qualitative refers to any data collection technique or data analysis procedure that generates or uses non-numerical data (Saunders et al. 2009). Qualitative research is generally related to the interpretivist paradigm and inductive approach, while quantitative research is generally related to the positivist paradigm and deductive approach.

Qualitative and quantitative data are actually closely related to each other and the rigid distinction between qualitative and quantitative approaches is no longer popular, as all quantitative data are based on qualitative judgement while all qualitative data can be described and controlled numerically (Blaxter et al. 2001). With no significant difference between qualitative and quantitative, management research has tended to adopt mixed methods, which have come of age, and the practice of research has involved much more than philosophical assumptions (Creswell 2009). Naslund (2002) encourages using both qualitative and quantitative methodologies because research conducted within a narrow methodological domain would result in underachieving. Mixed methods can generate both quantitative and qualitative data that can complement or cross-validate each other.

Mixed methods have gained popularity as a result of approach development and have the strengths of both qualitative and quantitative research (Creswell 2009). Whilst all methods have limitations, mixed methods could neutralize, reduce or overcome the inherent bias and sterility of a single method or approach (Saunders et al. 2009; Creswell 2009).

According to Bryman and Bell (2007), qualitative research deals with words while quantitative research entails numerical data and quantitative terms, and exhibits a view of the relationship between theory and research. Both methods may be combined in one research project from an inductive and deductive point of view to create a theory which is then tested with a survey (Bryman and Bell 2007; Creswell 2009). This means a combination of both qualitative and quantitative methods may be used in one research.

In terms of concrete methods choice, the available techniques are field observation, secondary data, a questionnaire survey, interviews or combination of the two (Saunders et al. 2009). In-depth interviews are often used as the preferred research methods by the interpretivist to obtain qualitative data while questionnaire surveys are preferred methods by the positivist to obtain quantitative data. Again, the appropriate methods to choose depend on the researcher's goal and the nature of the research objectives (Creswell 2009).

Table 4. 3 Research methods used in port research

Author	Methods used				Data
	Interview	Question-naire	Case research	Secondary data	
Yeo et al. 2008, 2010		√			AHP+ compromise weight, port stakeholders
Islam et al. 2006		√			Delphi, local experts
Lam and Yap 2008				√	analyse annual slot capacity (1999-2004)
Wiegmans et al. 2008	√				12 deep-sea container operators
De Langen 2007	√		√		Four port regions with different clusters
Tongzon 2007		√			Survey with Singapore manufacturers
Comtois and Dong 2007				√	Hinterlands
Ng, 2006		√			global top 30 liner shipping companies
Guy and Urli 2006			√		Montreal-New York Alternative
Lee and Rodridge 2006				√	
Cullinane et al. 2005				√	
Song and Yeo 2004		√			surveys on a group of experts
Lirn et al. 2003 2004		√			Global top 20 shipping lines
Bookbinder and Tan 2003				√	European vs. Asian logistics system
Tongzon 2002		√			shippers from Southeast Asia
Mangan et al. 2002	√	√			Irish port/ferry choice in RoRo

Table 4.3 shows that in the literature of port performance and choice, most researchers have adopted quantitative research by questionnaire survey or secondary data. Interviews and case studies have also been employed in port studies, although they have not been used so often as questionnaires and secondary data collection. This gives evidence to support Mentzer and Kahn (1995) and Mangan et al. (2004) who identity that the majority of research in logistics and SCM is dominated by quantitative methodologies through a positivist lens. Langen (2007) and Mangan et al. (2002) employ mixed methods. At the mean time, the evidence in the literature also indicates different methods have been used in research in the port sector.

As explained earlier, this research is exploratory, descriptive and explanatory. Exploratory research merits a qualitative approach for gathering data (Neuman 2006; Sekaran and Bougie 2010). This means that qualitative methods are appropriate when the topic needs to be explored, and the research questions, often beginning with "how" or "what", focus on describing what is happening in this area (Creswell 1998). Saunders et al. (2009) add that both qualitative and quantitative data can be collected to address an explanatory research, and this is underpinned by a combined approach of inductive and deductive, as explained in Section 4.2.2. They also note that cross-sectional studies can employ both quantitative and qualitative methods and a survey strategy was justified for this research in Section 4.2.3. In addition, questionnaires, interviews and observations often fall into the survey strategy (Saunders et al. 2009). Therefore, interviews and questionnaires were employed in this research for data collection in two phases to match the inductive and deductive approach, as justified in Section 4.2.2.

In the light of the above considerations, this research employed mixed methods to obtain both insightful qualitative data and generalisable quantitative data, as neither data alone could fulfil all the research objectives. The mixed methods were adopted by a sequential exploratory strategy, which was characterized by an initial phase of qualitative data collection and analysis, followed then by another phase of quantitative data collection and analysis. The data collected through these two methods can complement each other to reach more valid findings.

Specifically, exploratory interviews were adopted in phase 1 to yield valuable initial insights into factors influencing port performance based on the literature. Questionnaires were employed in phase 2 to generate quantitative data and validate the findings from interviews. The rationale for obtaining qualitative data from exploratory interviews followed by quantitative data from a quantitative survey method with a large sample was that a useful survey of factors that influence port performance could best be developed only after a preliminary exploration of factors (Creswell 2009). In this way, the researcher could generalize the results to a population.

The primary focus of this research was to explore the phenomenon of certain factors influencing port performance. The first phase resulted in some elements of an emerging theory, and the second phase was intended to generalize qualitative findings to different samples and enhance the findings of Phase 1. The two-phase approach has the advantages of being easy to implement and straightforward to describe and report, and is useful when a researcher wants to explore a phenomenon and wants to expand on the qualitative findings (Creswell 2009).

The rationale for and use of individual methods will be discussed fully in Section 4.3. However, before this, the research context and an overview of the whole research process will be provided.

4.2.5 Research context

This research was empirically conducted in the UK and China. The following justifies why the two countries were selected.

As the research gap justified in Chapter 1 and from the literature reviewed in Chapter 3, no cross-cultural study has been previously conducted on factors influencing port performance and choice with reference to Europe and Asia, although there were some studies within Europe (Ng 2009) and Asia (Yap and Lam 2006; Yeo et al. 2008) themselves. Asia-Pacific, Asia-Atlantic and Europe-Far East are well known as the three busiest sea shipping routes, as the Asian economy has been booming in the past two decades. For the reason that the two regions are important for international trade but lack empirical cross-culture study, Asia and Europe were chosen. In addition, the UK and China were selected as the sample countries for the following reasons:

Firstly, the UK represents a developed country with maritime history. The UK is the earliest industrialised country, which developed on the basis of international trade, while China is the biggest developing country and it has developed the most quickly in the past 30 years, relying on international trade. The UK is a mature market economy while China is in the process of transformation from planned economy to market economy. The UK was ever the strongest economy in 200 out of the recent 500 years; China is currently the current strongest economy in the world. Its export by value is No. 1 and import is No. 2 in the world (World Bank 2010). Thirty-seven percent of UK

GDP was derived from international trade while seventy percent of China GDP was derived from international trade in 2004 (UNCTAD 2004). Both countries have strong trading backgrounds, which is inseparable from ports.

Secondly, UK and China are good for port research as there are rich port sources of information in these two countries. The UK offers a good opportunity for port research as around 200 ports by Lloyds' report in 2005 and 600 ports by Oxford Economic in 2009 (the number of ports are different because of different classification) are well distributed around Britain's coast and 95% of its international trade freight is handled at the ports. Sea shipment is the main channel to connect the UK with other countries. Its ports play a very important role in economic development in terms of international trade. China can boast of a long coast line with rich port resources and a number of large ports – 6 out of the top 10 ports worldwide are in China according to the AAPA in 2009. 90% of China's international trade freight is handled via the ports (Li and Guo 2007; Huang 2009). As the largest developing country with the fastest growing container port industry in the world today, China fits well as a case for detailed investigation.

Thirdly, in terms of availability of shipping services, short-sea business and rapidly growing links with low-cost Far East trading partners have largely replaced the UK's traditional trade routes in response to European Union (EU) expansion (Pettit and Beresford, 2008). In China, due to the booming international trade in the past three decades, international deep-sea shipping lines have been operating worldwide. Research in these two countries can investigate the different employment of deep-sea and short sea services.

In the UK, the Humber was chosen because it accounts for a large share of UK's international trade. Xiamen was chosen because it is located in one of China's special zones. This is further explained in Section 4.4.1.

These facts demonstrate the UK's and China's seaport market position and they are two important countries to study port performance and choice in terms of a developed country and a developing country, and in terms of a European country and an Asian country.

4.2.6 Research process

It cannot be overemphasized that an empirical research should be conducted in a structured way. Table 4.4 shows the stages of this research, applying Stuart et al.'s

(2002) five-stage research process model. In this research, stage one consisted of defining the research objectives, and was addressed in Section 4.1. Stage two was research instrument development. Stage three was collecting data from the field in two phases, as specified in Section 4.2.4: Interviews (January-March 2009) and questionnaire survey (May-July 2009). Stage four involves the researcher making sense of the data to extract patterns and themes by data analysis. This included three aspects: 1. interview data analysis, which helped refine the research objectives on factors influencing port performance and helped with the survey design; 2. questionnaire data analysis; 3. Cross-data analysis. At the final stage, the researcher disseminates the research findings by writing up the thesis.

Table 4. 4 Stages of this research (adapted from Stuart et al. 2002)

Stages	Objectives	Time
Stage 1: Research objective	Develop research objectives	Oct. 2006- Jul. 2008
Stage 2: Instrument development	Develop a survey protocol	Aug. 2008– Dec. 2008
Stage 3: Data gathering	Interviews Questionnaire surveys/interviews	Jan.-Mar. 2009 May to Jul. 2009
Stage 4: Data analysis	Within and cross regional analysis	Aug. 2009 to Feb. 2010
Stage 5 Dissemination	Thesis writing up.	March 2009 to Nov. 2010

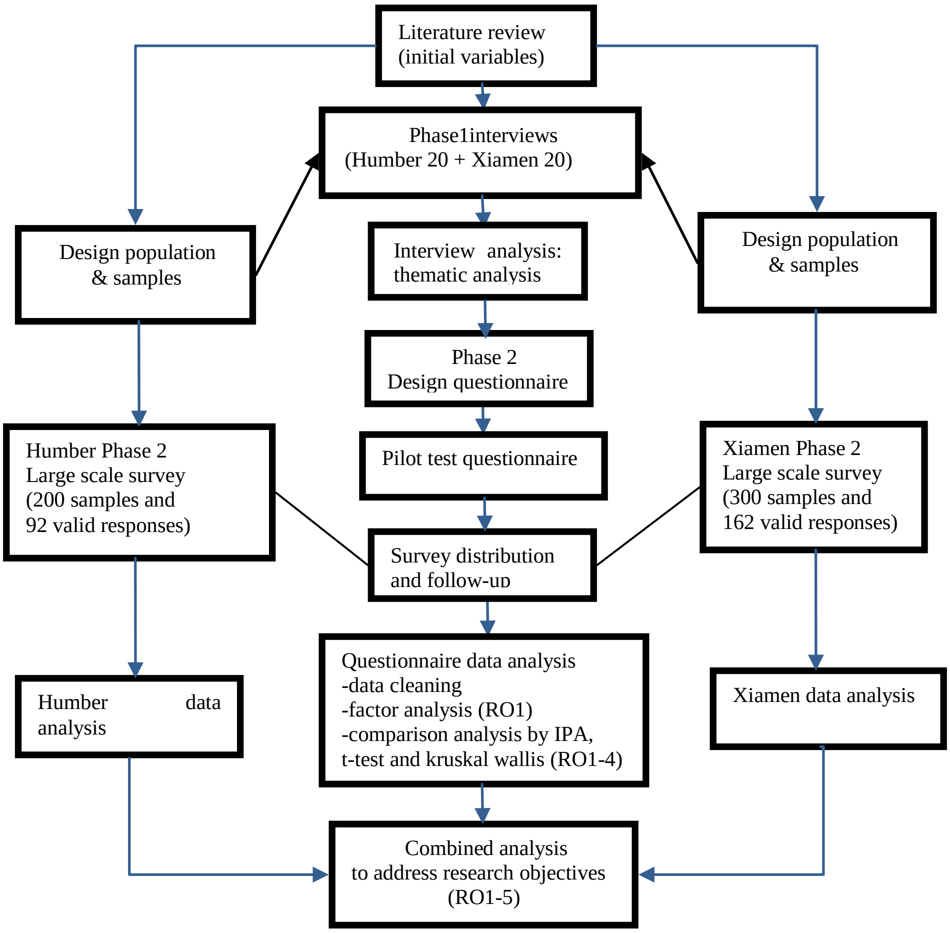


Figure 4. 2 Research process

(RO1-5 refer to research objectives 1-5)

For more focus on the empirical procedures, the process is presented in Figure 4.2. Factors that may influence port performance were extracted from the literature. As addressed in Section 4.2.4, empirical data were collected in 2 phases. In Phase 1, piloting was done before interviews. Then face-to-face semi-structured interviews were conducted with 40 (20 in the Humber and 20 in Xiamen) port stakeholders to obtain qualitative data (Section 4.3.1). The researcher sought to explore what was happening in the field, listen to participants and build an understanding based on what was heard (Creswell 2009). This phase was exploratory, qualitative and inductive, as explained in Section 4.2.2 and earlier in this section. It aimed to result in a firm grasp of the essential character and purpose of the specific research survey to be conducted (Chisnall 2001).

The literature and the themes drawn from Phase 1 formed the foundation of the questionnaire. After the design of questionnaire, pilot tests were conducted for validity, as suggested by Saunders et al. (2009). This was followed by questionnaire amendment. Then Phase 2 consisted of a cross-sectional research by questionnaires with port stakeholders to discover whether the findings from the interviews could be generalized. Five hundred questionnaires were distributed (Section 4.3.2).

Following the response collection, data analysis was conducted, including data cleaning, normality test, factor analysis, descriptive analysis, comparison test and IPA. As the data were collected from two different port regions, the analysis was conducted separately and collectively for interviews and questionnaires, depending on the research objectives. The data were also cross analysed as they may cross validate each other. For example, to achieve a holistic view of the empirical research, combined data analysis was conducted for factor analysis. Data analysis will be discussed in detail in Section 4.5.

This section has provided an overview of a clear and rigorous research design. Section 4.2.1 explained the researcher's pragmatic philosophical stance. This underpinned the combined research approach of both inductive and deductive approaches in this research, as explained in Section 4.2.2. A survey strategy was justified in Section 4.2.3 and the use of mixed methods of both qualitative and quantitative data collection by interviews and questionnaires were explained in Section 4.2.4. The research context was given in Section 4.2.5. A detailed picture of the research process was given in Section 4.2.6, to show clearly conditions of each element of the design. The individual methods used are explained in the next section.

4.3 Discussion of current research methods

As explained in earlier sections, interviews and questionnaire surveys were chosen for the main data collection. This section will discuss the detailed considerations for their application.

4.3.1 Semi-structured interviews

Advantages of interviews

In qualitative data collection, the interview is the most widely used research method (Fielding and Thomas 2001). In-depth interviews and group discussions are two of the most commonly used methods for interviews, and are used to obtain a first-person description of some specific domain of experience (Cope 2005). Interviews are conducted to allow a free range of responses to emerge in the participants' own words and produce a rich source of data (Zoltan and Laszlo 2007). Being a conversation with a purpose (Marshall and Rossman 1999), the interview encourages respondents to become involved in active interactions and talk about the research subject, leading to negotiated, contextually based results (Fontana and Frey 1998). Hence, it is an extremely flexible research tool. Saunders et al. (2009) note that a principal way of conducting exploratory research is to interview "experts" in the subject. That is why interviews were first used to explore port stakeholders' views on factors influencing port performance.

Justification of semi-structured interview

Interviews are classified into structured interviews, unstructured interviews, semi-structured interviews and focus groups. In a structured interview, there is generally little room and flexibility for variation in response because of its 'closed-ended' questions. Given the research objectives posed in the preceding chapters, structured interview was rejected as it cannot explore in-sight factors. Unstructured interview was also rejected because it is too open and free for the interviewees to deviate from the research objectives, as the interviews are conducted without a planned sequence of questions. Although group discussion has some benefits of cost and time advantage, and new idea generation (Crimp 1990), this, too, was excluded from this research, given the fact that interviewees might not be willing to talk freely within groups and it would be difficult for the researcher to arrange for a group of people to meet together at the same time. The questions were designed to be as open-ended as possible in a careful and theorizing way in order to gain spontaneous information, as suggested by Feilding and Thomas (2001).

Malhotra and Birks (2003) define in-depth interview as an unstructured, direct and personal interview to uncover underlying motivations, beliefs, attitudes and feelings on a topic. It results in a free exchange of information and enables elicitation of rich and detailed data that can be used in a later stage of research or qualitative analysis (Gilbert 2001; Malhotra and Birks 2003). Silverman (2000) argues that the term in-depth semi-structured interview has become common parlance, as it has the advantages and avoids the disadvantages of both structured-interview and unstructured interview.

Therefore, taking into consideration the research objectives, and the strengths and weaknesses of these four qualitative methods, semi-structured in-depth interviews were employed to extract the interviewees' personal opinions and access the interviewees' knowledge, experience and personal perceptions to address the research objectives.

Interview protocol

The protocol included key open-ended interview questions and a number of subject areas to keep in mind. The interview protocol was prepared with the aim of eliciting critical incidents. The questions evolved and were formulated based on the literature review and began with "what", "how" and "why". Before the interview, a sample interview schedule was designed. Brief and clear questions were prepared to allow lengthy and more detailed descriptions from the respondents. The key questions were about the factors that they considered important for their port performance; factors that influenced their port performance, including their regional advantages and disadvantages, the issues and challenges they were facing and their knowledge on potential tools to improve the current issues.

Interview conduct

Four pilot interviews were conducted with port stakeholders. The issues that arose during piloting were discussed and amended to become the final interview questions.

Prior to the interviews, the interviewees were contacted either by email or phone call or both. The interview questions were sent to the interviewee if requested. All the interviews were conducted by the researcher herself to build rapport, uncover possible insights and achieve a standardized approach, in order to reduce or at least systemize any interviewer effect. Interviewing different port stakeholders aimed to explore the factors and confirm those factors from the literature. Thus, the interviews improved the credibility of the research.

In order to encourage interviewees to express their views openly and freely, interviews were conducted individually, either in the interviewee's company, or at a place agreed by the researcher and the interviewee. Most interviews were conducted at the interviewee's own office so they did not feel detached from their working environment.

The interviews began with encouraging interviewees to talk about their company and their job roles to make them feel at ease. This was followed by an introduction to the research and some background questions to create a friendly atmosphere for free communication. Then they were motivated to speak out their views about the questions the researcher was interested in by a semi-structured interview. When asked about port performance, all interviewees were guided to offer their views on the advantages of their local port performance by talking about important factors that drive their port performance. They were also encouraged to address their perceptions on the disadvantages of their local ports, including the issues and challenges they were facing. Both the advantages and disadvantages are understood as factors that influence or determine the regional port performance.

During the interviews, the major questions covering the prepared list of themes were asked in the same way each time, but the order of questions varied depending on the flow of the conversation, as suggested by Saunders et al. (2009). Follow-up questions that might be helpful for obtaining further information were asked to explore some of the issues under discussion, or to explore emerging issues related to the research objectives. Most of the interviews lasted for 45-90 minutes. The interviews were recorded subject to the participant's permission. After each interview, data was transcribed as soon as possible to avoid unnecessary memory loss. Each interview transcript was reviewed, and the interview schedule was altered or amended based upon the issues arising in the previous interviews.

Limitations of the interviews

Interviews are very time-consuming and expensive to conduct. One problem the researcher had to face is that the interviewees were not easily accessible and were usually busy. It took the researcher about 3 months to complete the Phase 1 interviews. Sometimes, finding potential interviewees and waiting for their availability was frustrating. Conducting the interviews entailed many efforts and difficulties, including walking in heavy snow and darkness and getting lost.

Some interviewees could only concentrate for 40-50 minutes before being interrupted by other commitments. Therefore using the given time efficiently and effectively was crucial to complete the interview questions. Generally speaking, the interviews proceeded more easily in the Humber than in Xiamen. The Humber interviewees switched off their mobile phones during the interview or left the phone aside, although sometimes the interviews were interrupted by phone calls and so forth. In Xiamen, the interviews were more often interrupted by phone calls and other occurrences. The interviewees seemed to feel untroubled when the interviews were interrupted, answering the phone calls in the researcher's presence. This might be due to cultural differences. Lack of generalisability is another limitation for interviews, as explained in Section 4.3. However, this limitation did not affect the interviews' validity.

Despite some frustration and interview limitations, the researcher considered herself fortunate in being able to obtain a private room to make phone calls for interview arrangement after a long time negotiation with the administration. She was also fortunate enough to obtain an office in Xiamen which enabled her to conduct some interviews within a professional environment. It is appreciated that many interviewees showed their interest in this research and accordingly offered information to the best of their knowledge.

The interviews will be presented and analysed in Chapter 5.

4.3.2 Questionnaire survey

The questionnaire is an important instrument of research as a tool for data collection and measurement (Oppenheim 1992; Gall et al. 2003). The questionnaire survey is a highly structured data collection technique by which the same set of questions are asked to the different respondents (Vaus 1996). It provides a relatively simple and straightforward approach to research of attitudes, values, behaviours, beliefs and motives (Robson 2002). Cross-sectional studies using questionnaires for data collection are often conducted with the intent of providing a quantitative or numeric description of attitudes or opinions of a population and generalizing from a sample to a population (Creswell 2009). The questionnaire survey in this research aimed to explore and measure the respondents' attitudes towards the factors influencing port performance, to investigate differences in importance and performance among the factors, to describe and analyse differences in factor importance and performance for different ports.

Using questionnaires has the advantages of being cheap and time saving, being more objective than other methods such as interviews, and the responses can be collected in a standardised way (Gall et al. 2003). A questionnaire may be adaptable to collect generalizable information and its anonymity can encourage frankness when sensitive areas are involved (Robson 2002). Meanwhile it enables the researchers to obtain information that is not easy to observe (Remenyi et al. 1998).

Robson (2002) adds four advantages of questionnaires. 1. There is no interviewer bias caused by unauthorized comments about the research, questions and respondents; 2. There is no interviewer effect and respondents do not have to relate to characteristics of the researcher; 3. The researcher being absent, it is easier for respondents to handle sensitive questions with anonymity; 4. They can be answered at low cost.

Questionnaire construction

The aim of the questionnaire, respondents, the reason for selecting them, time, place and manner of distribution, and how to analyse the data should be considered when designing the questionnaire (Vaus 1996). According to the research objectives, 20 factors potentially influencing port performance were extracted from the literature (Section 3.6). After Phase 1 interviews, 5 factors were deleted. Based on the 15 selected factors, a 3-page questionnaire survey (Appendix) was constructed, as 3-4 pages are appropriate for the general population (Neuman 2006). The structure and presentation aimed to reduce the potential error and increase the potential participation.

No cover page was provided, to save the interviewees' time, but a brief introduction to the research and a statement about anonymity and the sharing of results were given. The organisations with which the survey is affiliated and supervisors were identified before the main part, thus adding credibility to the survey. The main part of the survey consisted of three sections. Section A sought opinions on the importance of the 15 factor. Section B provided concerned performance on the 15 factors for the selected ports. Section C sought evaluations of the 15 performance factors for other ports with which the respondents were most familiar. The survey finished with "thank you" and a reminder of the return address.

The questions in the questionnaire used a Likert-type scale. This scale is appropriate as the scales have been found to communicate interval properties to the respondent, and therefore produce data that can be assumed to be intervally scaled (Easterby-Smith et al. 2008). As discussed by Churchill (1995), there are controversies about the number of points to have on a Likert scale. These controversies mainly fall into two categories: those concerned with the total number of points, and those concerned with the decision to have an even or odd number of points. An even number of points does not allow the respondent to identify a middle or neutral position. This research did not design scales with an even number of points, as this would make it difficult for respondents who held a neutral position to express their views. Instead, the questionnaire was designed with an odd number, as it is easy for a respondent with a neutral position while even numbers try to force respondents to adopt a position.

With regard to the total number of points, it is argued that more points give the respondent a better selection from which to make a choice. However, it is also argued that this greater choice may confuse the respondent, and does not necessarily produce richer data. Therefore, in this research, for balance, a fairly minimalist and simple approach was taken in that a neutral position was available from within the five point scales offered. A five-point scale is also found to be the most popular scale.

The language in the questionnaire was tailored to the level of understanding of the respondents. The choice of words depends on the level of education of the respondents. The researcher made sure that wording of questions was precise, clear, succinct and unambiguous (Bell 1993).

As this is a cross-cultural research, the researcher endeavoured to trace the similarities and differences in the behavioural and attitudinal responses of participants at various levels in different cultures. Surveys were therefore tailored to the different cultures, for example by language back-translation, which is addressed in Section 4.5.3.

Questionnaire piloting

Hussey and Hussey (1997) emphasize that a questionnaire should be piloted as fully as possible before distribution. Hoinville and Jowell (1978) made it further clear that a good questionnaire is created not only based on the researcher's perspective but also on the process of piloting. The pilot test helps the researcher to see how the questionnaires will be conducted and how long it takes the respondents to complete them, and to locate any ambiguities (Aldridge and Levine 2001). Piloting aims to increase the reliability, validity and practicality of the questionnaire (Oppenheim 1992), identify any further unexpected problems with the original questionnaire, and refine the questionnaire (Saunders et al. 2009). Vaus (1996) claims that a good questionnaire involves careful thinking and goes through evaluation and many pilot tests. Oppenheim (1992) holds a similar view that questionnaires have to be created, adapted, fashioned and developed to maturity after many try-outs to make sure they work as expected.

The questionnaires were piloted with fellow PhD students, academics and port stakeholders, ten interviewees in the Humber and Xiamen respectively. As China and the UK are two countries with different cultures, the factors were analysed deeply to see if the content of the items was basically the same. As questionnaire constructs were extracted from the literature and confirmed by interviews in both of the port regions, analyses from pilot questionnaire surveys show that the factors were appropriate for use in both China and the UK.

Forms of questionnaire survey and distribution

Questionnaire designers are supposed to make an early decision on how to distribute the questionnaire. There are four main types of surveys: face to face, postal, telephone and internet, each of which has its own advantages and disadvantages. In the present research, participants were offered a choice of media, in order to encourage participation.

Before the distribution, the researcher made phone calls to the potential respondents one by one, to confirm they were within the right population and establish their intention to participate, to maximize the response rate. The researcher took note of the potential respondents' preference for mode of completion while she was making the phone calls. This communication with potential respondents before questionnaire distribution was found very effective in increasing the response rate.

Emails followed by phone calls were mainly adopted to obtain a higher response rate. The questionnaire was emailed to the potential respondent with a brief introduction to the research and questionnaire. Self-completion instruments such as e-mail questionnaires have the balancing advantage of allowing and encouraging respondents to complete in their chosen time, significantly reducing intrusiveness (Aldridge and Levine 2001). Thirty interviewees in the Humber and fifty-two interviewees in Xiamen requested the researcher to visit their companies and completed the questionnaire face-to-face. The researcher did her best to meet the respondents' request and got 82 responses by face-to-face completion. Three companies requested the researcher to fax the questionnaire.

Post was not adopted as the main response mode due to some disadvantages of postal administration, such as a longer time to get the feedback, and comparatively lower response rate. Even after the phone calls, only two out of twelve postal responses were received. The respondents might not be fully representative because the characteristics of non-respondents are unknown. Moreover, the respondents may not treat the questionnaire seriously (Robson 2002). However, these limitations were tested by non-response bias. The test results revealed no response bias based on the independent t-test and the reliability test result revealed that the responses were highly reliable (chapter 6).

The questionnaires were sent out with envelopes and real stamps rather than a reply-paid envelope, because reply-paid envelopes may result in lower response rate due to being regarded as too "official" and "commercial". With a traditional stamped envelope, the respondents may be more motivated to reply and they would feel they have been trusted (Oppenheim 1992). The researcher ensured the return address was on the envelopes to save the respondents' time and energy and show them her sincerity.

Follow-up e-mails/letters were sent and phone calls were made to non-respondents as reminders at the end of the third, fifth and eighth weeks after the questionnaire distribution, emphasizing the importance of the research and the value of the respondent's participation, and enclosing a further copy of the questionnaire to increase the response rate, as suggested by Robson (2002).

Responses to the questionnaire survey will be presented and analysed in Chapter 6.

4.3.3 Other data collection

Considering data accessibility, it is inappropriate to rely on a single source of information. This research employed the principle of data triangulation to obtain the data from different sources in investigating particular phenomena. Triangulation is defined as the combination of methodologies in the research of the same phenomenon (Denzin 1970). There are four types of triangulation, namely, theoretical triangulation, method triangulation, data triangulation and investigator triangulation (Easterby-Smith et al. 2008). The data collected through multiple sources of evidence can triangulate with each other to reach more valid findings and ensure construct validity. The primary aims of triangulation are to validate research findings, to present a more complete overview of social reality, and to reduce bias (Bryman 1988). For this reason, apart from interviews and questionnaires, documents and direct observation were used to collect secondary data.

Documents include two categories: specific documents and contextual documents. Specific documents refer to those directly relevant to the topic of the research, such as publications and memoranda. Contextual documents encompass such multiple sources as company brochures, data from the internet, databases, documentation and reports of industrial associations, which provide an understanding of the company and port background and hints of possible broad differences or similarities between two port regions. This allowed for triangulation of information gathered.

The researcher spent six months (January-March and May-July of 2009) in the two port regions and conducted some direct observations at the ports to gain an insight into port performance and understand the different contexts. During her stay on sites, the researcher formed relationships with port stakeholders on an informal basis. Direct observations were made throughout the whole data collection process. It should be noted that observational evidence is useful in providing additional information about the topic being studied (Yin 2009). The direct observations of interviewees' responses and interview sites, informal discussions with interviewees and reflections were documented in the field notes, following Miles and Huberman (1994).

It is expected that the multiple sources of evidence could improve the richness of the data and the credibility of the research. It is also expected that the research objectives be met by combining the comparative advantages of interviews, field notes and participant comments into the same research. These supplementary secondary data together with the interviews and questionnaire surveys corroborated each other to help acquire a more complete and balanced picture of the ports, and so enhanced the validity of the research findings (Punch 1998; Bryman and Bell 2007).

4.4 Choice of research locations and interviewees

In order to achieve the research objectives discussed in Chapter 1 and Section 4.1, the research location, interviewees and number of regions were carefully selected.

4.4.1 Selection of research locations

This research employed purposive sampling for research location selection, as it is viable for exploratory research purposes, and quick and convenient information can be attained at less cost, although it does not allow confident generalization to the whole population (Sekaran and Bougie 2010).

Purposive sampling means selecting cases to research on the basis of their relevance to the research objectives, theoretical position, and most importantly the explanation or account that is to be developed (Mason 1996). Purposive sampling strategies were designed to enhance understanding of the selected regions and to provide the greatest insight into the research objectives, which needed sustained access and a high level of cooperation from the parties involved in the port regions.

Purposive sampling is related to the logic of literal replication, which means that the research port regions were also selected to predict similar results. This selection requires prior knowledge of the outcomes, with the inquiry focusing on how and why the exemplary outcomes might have occurred and hoping for literal replications of these conditions from case to case (Yin 2009). The research of the selected region is supposed to predict contrasting or similar results for theoretical replication.

Choice of research locations

Criteria for location selection

Different locations were selected for the empirical research to enable comparison between the relevant dimensions of different locations. The researcher wished to discover to what extent results are related to the local context and to what extent they could be generalized. The location selection was based on four criteria other than port performance to avoid a focus on 'success stories', as suggested by De Langen (2003). The criteria are: Firstly, the ports should be located in different social, economic and institutional environments. Secondly, research in the location should be feasible in terms of language and accessibility. Thirdly, the port activities should be important for the regional economy. This implies that ports in very large cities not be selected, as such ports cannot account for a large proportion of the regional economy. Lastly, the port should have competition.

Ports selection

Within the context of China and the UK, as justified in Section 4.2.5, the choice of fieldwork location was initially targeted at the Humber ports and the Xiamen ports based on the above criteria. Xiamen, as one of the most important ports in China, is one of the first four special zones in China. It is targeted to become the regional and international logistics centre in Southeast China. Xiamen port performance closely reflects China policies. In 2008, it was ranked 19 in the world in terms of container TEU (AAPA 2009). In the past 10 to 20 years, Xiamen has valued logistics development and has been trying to propagate logistics as the new focus for Xiamen's development so that logistics has developed rapidly with the city's economy support.

Xiamen's logistics has contributed to around 9% of Xiamen GDP (Huang 2009). At the same time, Xiamen's logistics is prominent in the Chinese logistics pattern, which can be recognised in the "China Logistics Development Plan"- Xiamen was listed as one of the 17 first class logistics cities; the southeast coastal area with Xiamen as the centre and between Pearl River Delta and the Yangtze River Delta was positioned as one of the 9 developing areas nationwide. Xiamen port was ranked No. 8 among China's ports in 2006 based on comprehensive evaluation on port investment, throughput, capability, financial statement and natural conditions (Shipping China 2006). From Xiamen's economic development status and its development requirement, it is important to explore Xiamen's port performance further.

The Humber port region was selected because this region owns superb natural assets in terms of ports. It is host to the largest port region in the country, accounts for 25% of all international trade and some 16% of UK seaborne trade in 2008, and handles coastal shipping movements for the UK, according to DFT. In the Humber estuary, the economy is heavily dependent on the ports sector (Mangan et al. 2008).

The Humber ports are the UK's largest ports complex in terms of tonnage handled: 91 million tons and 6% of UK container TEUs in 2008, over 15% of GB total, the fourth largest in northern Europe (after Rotterdam, Antwerp and Hamburg), and with potential for much more shipment (www.dft.com). 71% of tonnage is bulk (such as oil, coal) and 22% is unitised. The ports and waterways in the Yorkshire and Humber Region directly contributed £250 million and indirectly £500 million and employed 47,000 people in 2009 (www.official-documents.gov.uk).

There are three issues that may lead to increased traffic through the Humber ports. Firstly, the UK government's "Northern Way" initiative seeks to reduce the imbalance in economic development between the South and the North. Greater economic activity in northern England may lead to higher traffic through the Humber ports. Secondly, road freight transport has already aroused concern about its social and environmental impact, which may bring more pressure on road transport and will increase sea transport. Currently, the majority of UK containers come and go via the southern ports, for example, Felixstowe takes about 38% (3m TEUs over 8m TEU) of all UK container TEUs, while Southampton takes about 18% of UK containers. As 60% of them are for customers in the northern or Midlands areas, they are transported by road in UK. These containers may be driven to transit at the Humber ports due to congestion of the southern ports. Thirdly, Pettit and Beresford (2007) analysed container distribution patterns in the UK and concluded that it may be cheaper to serve Northern England via feedering from major ports in the European continent, such as Rotterdam or Antwerp, into a gateway such as the Humber, rather than via a mainline direct call at Felixstowe or Southampton.

IBM Global Business Services (2006) made an assessment of the Hull and Humber region, and identified that value added logistics is one of the three target sectors for regional economic activity. If the Humber ports can vigorously develop value added logistics, the advantages of the Humber ports would become prominent, given the drivers mentioned earlier. The Humber ports used to be prosperous. The position of Humber ports has declined. To match the "Northern Way" initiative, the Humber ports need to restore their past glory. This research sought to discover the reasons for the decline and try to identify factors influencing port performance and improve port performance of the Humber.

Both the Humber ports and Xiamen ports are crucially important for their regional economies. The port throughput, population, port employment and other relevant port statistics are presented in Table 4.5:

Table 4. 5 Characteristics of the Humber and Xiamen ports

Port	Volume throughput	Container throughput	The population in 2008	Employment	Employment % of the region	Contribution to GDP
The Humber	81,057,000 (dft, 2007)	19,146 (dft, 2007)	912,200 (Humberep.co.uk)	361,694 (2008, Humbersep.co.uk)	16.2% of Y&H	16% of Y&H
Xiamen	97,000,000(Xiamen Statistics Bureau, 2008)	5,034,622 (AAPA, 2009)	2,520,000(Xiamen Statistics Bureau)	61,170 (Xiamen Statistics Bureau)	8.7% of Xiamen employees	9%

In terms of location, both the Humber and Xiamen share some similarities. They are both located midway along the country's east coast. Xiamen is a Taiwan Strait inlet facing Taiwan while the Humber is a North Sea inlet facing the European continent. Both are the major port estuary in their own country. The Humber faces continental Europe to the east while Xiamen faces Taiwan to the east. However, there are some differences between the locations. The UK has a large number of small-scale ports while China has a number of large-scale ports. Xiamen's water depth is deeper than that of the Humber. The Humber is a short seaport due to the expansion of EU. It is supposed to be a feeder port to Rotterdam and Antwerp in Europe. However, Xiamen is targeted to become a regional transhipment port, although it used to be a feeder port to Kaohsiung and HongKong. Xiamen is in the special economic zone. Its port performance is strongly related to the Chinese policy. With the economic decline of Taiwan, Kaohsiung may become a feeder port of Xiamen. Besides Kaohsiung, Xiamen already has some feeder ports such as Zhangzhou, Quanzhou, Sanming, Longyan and sometimes Fuzhou.

Both the Humber and Xiamen are in very different contexts and they allow different lessons to be learnt. In the Humber's context of UK, the government and port managers have clear responsibilities and positions for port construction and investment. They do not heavily intervene in the port market. New projects cannot be carried out without favourable public opinion. For example, the government approval process for the expansion of Felixstowe has lasted over 10 years, as the public are concerned about environmental issues. In contrast, in Xiamen's context of China, the roles of government and port managers have not been thoroughly clarified. Decisions are more bureaucratic with less concern for public opinion. For new port projects, the leaders will play an important role in the approval, which may give rise to resource waste and sacrifice of the environment, which will be further discussed in Chapter 5.

This section has explained that selection of the Humber ports and Xiamen ports is in line with the criteria by De Langen (2003) in terms of port selection. The Humber and Xiamen have some useful experiences or lessons to learn from each other. Finding out the differences in operations between them may benefit their port development; discovering the similarities may develop the theory of port performance.

4.4.2 Selection of interviewees

Sampling procedure and sampling frame

Sampling is the process of choosing samples from which data is collected that is potentially relevant to the research being conducted (Aldridge and Levine 2001). Sample selection is vitally important, considering cost, time, feasibility and quality (Lynn 2002). The ultimate purpose of survey sampling is to select a set of members from a population so that a description of those members accurately describes the whole population from which they are drawn (Vaus 1996). There are two kinds of sampling: probability sampling (or random) and non-probability sampling (Remenyi et al. 1998). Which way to choose depends on the researcher's aim. Some researchers select samples to provide the maximum theoretical understanding, while others are concerned about a sample to represent the whole population (Arber 1993). In quantitative research, the sample should be representative of the population from which it is drawn (Oppenheim 1992). Probability sampling provides a method to meet this criterion. Random selection enables researchers to access a body of probability theory that provides the basis for the estimates of population parameters and estimates of error (Gall et al. 2003).

The researcher tried to make the samples sufficiently accurate, free from omissions and duplications and up to date, as advised by Saunders et al. (2009). In order to ensure that the selected samples were as representative as possible, the researcher adopted a disproportionate stratified random sampling technique[1], which gives a greater degree of representation and decreases the probable sampling error that would occur with a simple random sample of the same size (Vaus 1996).

Specifically, the sampling frame of port stakeholders was categorised into five groups based on Murphy et al. (1992), Murphy and Daley (1994) and Notteboom and Winkelmans (2001) who identify and categorise port stakeholders into shippers, forwarders, shipping lines and port managers. Bichou and Gray (2004) find that shipping lines, freight forwarders, shippers, inland transport providers and port operators are the important port customers/suppliers. They also note that ports have diversified clients and no client holds a dominant role.

The current researcher prefers to use the term consignors/consignees rather than shippers, to refer to local port related manufacturing industries, retailers and distributors, because apart from shippers, receivers (consignees) are also important port customers. Transport operators (railways, truckers), port labour and stevedores, warehousing providers and vessel/cargo agencies/forwarders are referred to as port service providers. Port managers refer to port authorities and port operators. Local environmental groups, local residents, local/regional and national government and government agencies, academic professionals, consultants are considered as one group of port stakeholders - other port stakeholders. Hence, in this research, port stakeholders are categorised into five groups: consignors/consignees, PSPs, carriers, port managers and other port stakeholders.

The aim in selecting these broad categories of questionnaire respondents was to cover port stakeholders as comprehensively as possible. Certain samples were randomly selected from each of these groups, not by equal number but in different proportions as their sample sizes vary from port to port. With this technique, the target groups that

[1] Stratified random sampling is a procedure which first categorises a population into subgroups and then randomly selects from each subgroup until a desired number is reached, either proportionately or disproportionately, from each subgroup- www.setda.org/web/guest/glossary.

were closely related to ports were identified on the basis of literature review, previous surveys, interviews and networking with professional and trade bodies. The reason for collecting data from various groups is that each group of port stakeholders has a distinct interest and role in the global logistics pipeline (Murphy and Daley 1994).

Selection of interview interviewees

Sample selection refers to a more general process of focusing on a portion of the population. Eisenhardt (1989) claims that a key approach to limit the bias of interviewees is using numerous and highly knowledgeable interviewees who view the focal phenomena from diverse perspectives. Good interviewees are those who not only have knowledge and experience the researcher requires but also are able to reflect, have the time to participate, and are willing to participate (Morse 1994). The quality of port interviewees is crucial for the quality of the outcomes of the interviews in the empirical research. That is why the interviewees were carefully selected to avoid bias.

Empirical research which attempts to improve strategy is likely to benefit from the involvement of managers who actually participate in their organisations' strategy formulation. This implies that an appropriate methodology should be based on groups of managers who have the experience and expertise to understand the products and services of their organisations (Slack 1994).

As qualitative research does not aim to draw statistical inference, purposive sampling is often employed in the investigation (Sekaran and Bougie 2010). In this research, the interviewees were purposively selected on the basis of in-depth knowledge and expertise of performance in the port. Three criteria were used for interviewee selection: job position, working experience in the port sector and involvement in port management. Experts in various high positions from five key port stakeholders were interviewed, which is a very important way to validate the findings. This means that qualitative data from interviews for this research was collected using a key interviewee approach. The technique of snowball sampling was also employed to help with the selection of appropriate interviewees.

As this research was conducted on the basis of mixed methods, the large number of interviewees that are needed in quantitative research was not a central issue for the qualitative research (Malhotra and Birks 2003). The number of interviews depends on when the researcher feels he/she has reached a point of theoretical saturation or stability (Sekaran and Bougie 2010), and no new information or major points emerge from the interviews (Patton 2002). Perry (1998) indicates that 35-50 is the appropriate number of interviews for a doctoral research. Based on the above arguments, forty interviews in Phase 1 from January to March of 2009 were conducted (Section 4.3.4). The detailed profile of interviewees is given in Table 4.6.

Table 4. 6 Profile of interview participants

Column	Mfg/retailer /distributor	PSP	Shipping line	Port manager	Other stakeholder	Director	Manager	Sub-total
Humber	5	4	3	4	4	10	10	20
Xiamen	5	4	3	4	4	10	10	20
Total	10	8	6	8	8	20	20	40

Selection of questionnaire respondents

As discussed for the selection of interview interviewees, the selection of questionnaire respondents should also apply the same criteria: experts from various port stakeholders to provide invaluable data and avoid respondents bias, also using a key interviewee approach. Therefore, the questionnaire surveys were sent to top management of five groups of port stakeholders.

For the number of questionnaire respondents, Sekaran and Bougie (2010) propose that sample sizes of 30-500 are appropriate for most research. The sample size can be flexible, given the uncertainties (e.g. resources, time, and funds limitation) of the proposed research under specific situations. For this research, the questionnaire sample size was decided by referring to the table provided by Sekaran (1970; 2000) that offers general scientific guidelines for sample size decisions. The number of the main port stakeholders in the Humber was estimated to be around 400 and that in Xiamen was estimated to be around 1300. According to Sekaran and Bougie (2010), when the population size is 400, the sample size should be 196; when the population size is 1300, the sample size should be 297. Therefore, 200 questionnaires in the Humber and 300 questionnaires in Xiamen were distributed.

A random sampling frame of 500 companies was then selected to reflect the shares of five different types of organisations involved in port activities. Then 500 specialists who had rich experience with ports and who knew ports well (one from each company) were drawn from the "population". The numbers of respondents in the five sample categories were not equal because the "populations" were not equal. As port stakeholders are not defined clearly and in detail, and the numbers of port stakeholders were not available in the public statistics, the researcher had to estimate the number of main port stakeholders who would be representative of the ports in the two regions, based on the interviews with port managers.

As indicated earlier, the questionnaire survey was conducted in the Humber estuary (UK) and Xiamen (China) from May to July of 2009. In the UK, the first company list was obtained from the port authority when interviews were conducted with ABP, the regional port authority, port owner and sometimes a port operator as well. The ABP handbook provides a list of the regional port stakeholders such as port users and port service providers. The second list was obtained from the Chamber of Commerce, which includes the regional importers and exporters that are port end users. Then some association members such as members in NETTA (North East Timber Trading Association), Team Humber Marine Alliance, Yorkshire Forward (the Regional Development Agency), Humber World Trade Centre, the local City Councils, UK Trade and Industry, BIFA-British International Freight Association, RHA (Road Haulage Association) and British Services (Hull Shipping Services) were contacted to try to find appropriate respondents. The lists provided the sampling frame which represents all the elements in the population from which the sample is drawn (Sekaran and Bougie 2010). 200 companies were selected from these lists by means of stratified random sampling.

In Xiamen, the Xiamen Logistics Association and Xiamen Industrial and Commercial Administrative Bureau provided the researcher with company lists, which included all organisations involved in Xiamen ports and logistics. The list of Xiamen University Alumni also helped the researcher to select some interviewees who were working for the ports or port related companies. Based on these lists, the researcher selected 300 companies by stratified sampling techniques. Table 4.7 shows the company profile for questionnaire distribution.

Table 4. 7 Questionnaire distribution profile

Region	The Humber					Xiamen					Total # (HB/ XM)	% of resp.
Company type	# of Distr	# of valid resp.	Valid % over distr.	% over resp.	Cum. %	# of Survey Distrib	# of valid resp.	Valid % distr.	% over resp.	Cum. %		
Cargo interests	60	25	41.7	27.2	27.2	90	26	28.9	23.2	23.2	51	25
LSPs	60	29	48.3	31.5	58.7	65	33	50.8	29.5	52.7	62	30.4
Shipping lines	25	12	48.0	13.0	71.7	50	20	40.0	17.9	70.5	32	15.7
Port managers	50	24	48.0	26.1	97.8	80	25	31.3	22.3	92.9	49	24
Others	5	2	40.0	2.2	100	15	8	53.3	7.1	100	10	4.9
Total	200	92	46.0	100	100	300	162*	54.0	100	100		50.8
Res. method	Face-to-face		30	Self-com.	62	Face-to-face		52	Self-com.	110		

* 50 of them are missing data.

In the Humber, 92 valid responses (valid response rate=46%) were received, while in Xiamen 162 valid responses (valid response rate=54%) were received. This response rate was satisfactory as the usual questionnaire survey response rate in logistics and supply chain management is between 10-30%. Aryee’s (2005) PhD thesis on supply chain integration performance had a response rate of 12%; Adeleye's (2002) PhD thesis on manufacturing agility had a response rate of 18.3%, Hoek's (2001) journal paper on the contribution of performance measurement to the expansion of third party logistics alliances in the supply chain had a response rate of 27%, Gordon and Sohal's (2001) research on assessing manufacturing plant competitiveness had a response rate of 26%. Lirn's (2004) research on port selection had a very high response rate of 90% from global carriers, but its sample frame was small (only 20). Murphy et al. (1991) achieved a response rate of 21.1% with an effective sample size of 383 (industrial companies in the US) and 81 useable responses for their survey on international water transportation.

It should be acknowledged that the results represent the knowledge and interpretations of individuals from the different port stakeholders rather than their company views, although this research has tried to select the respondents to be as representative as possible of their companies. Interviewees for both interviews and questionnaires were considered adequately qualified to answer the questions from the questionnaires and interviews. This approach was considered appropriate for the population and was considered adequate to produce reliable and valid data.

4.5 Data analysis and interpretation

Once the selected research methods have been applied, it is necessary to select and interpret data, and then integrate all the data into a rich descriptive report (Strauss and Corbin 1998). The data gathered from the real world can be analysed by quantitative analysis, qualitative analysis or a combined analysis to address the research objectives.

4.5.1 Qualitative data analysis

This section explains how the process of data analysis was conducted and how the findings came out from the qualitative data by interviews. For qualitative data analysis, the researcher adopted an interpretivist philosophy (Gibbs 2002), which is a continuous and interactive process. A number of approaches to analysing and interpreting qualitative data have been proposed by researchers (Punch 1998; Silverman 2000), and there is no single standardized and commonly agreed approach.

However, despite the diverse approaches, the process of qualitative data analysis is fundamentally a non-mathematical analytical procedure to examine the meaning of people's words and actions (Maykut and Morehouse 1994). The process of qualitative data analysis is presented in Figure 4.3.

The researcher employed thematic analysis for the qualitative data, following Miles and Huberman (1994) who suggest a three-stage process of qualitative data analysis: data reduction, data display and conclusion drawing and verification.

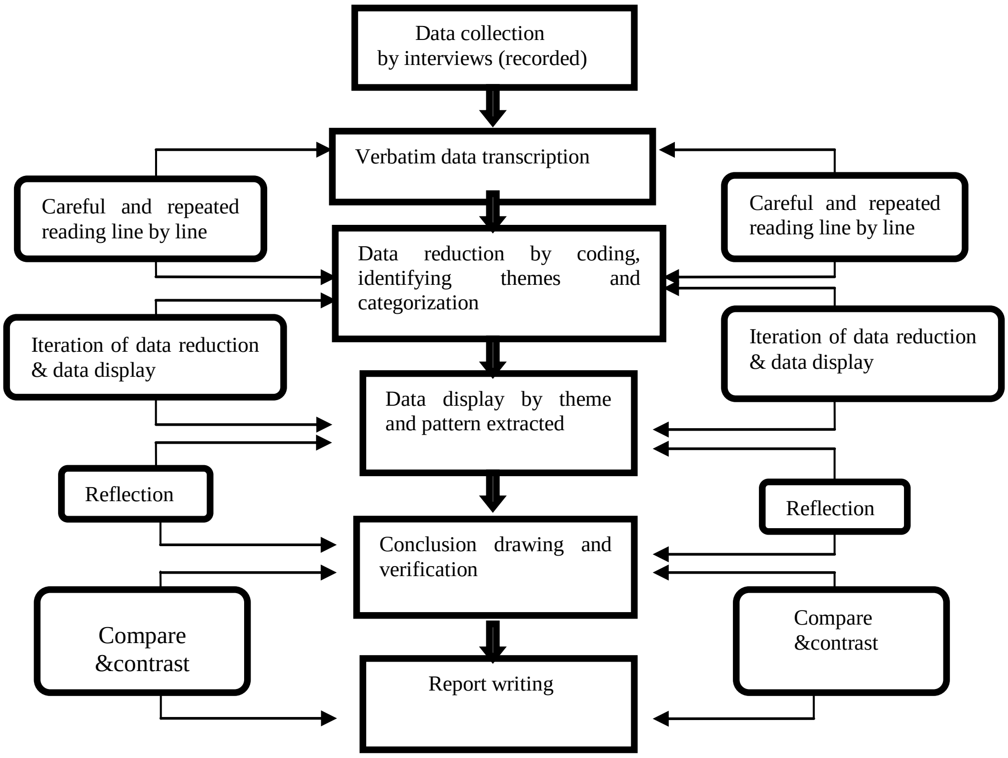


Figure 4. 3 Process of qualitative data analysis

Data reduction

Data reduction (Stage 1) refers to the process of selecting, focusing, simplifying, abstracting and transforming the data that appear in written-up field notes or transcripts (Miles and Huberman 1994). The qualitative data from interviews were analysed manually. The researcher printed the full verbatim interview transcripts together and read them several times to familiarise herself with the contents.

The reduction activities consist of coding, writing summaries, and identifying themes and clusters (Miles and Huberman 1994). The researcher wrote the codes against lines and paragraphs. Notes were taken in the margin. Then the transcripts and notes were selected, focused and simplified based on the research objectives. Data reduction happened during and after the data collection until final conclusions were drawn and verified. This approach refines and organises the data in preparation for conclusion drawing and verification.

Codes are efficient data labelling and data-retrieval devices and they can empower and speed up analysis (Miles and Huberman 1994). The codes came from the research objectives, problem areas and key factors that the researcher brought to the research from the extant literature. A coding list was then developed. After data coding, the codes were categorised according to common characteristics, which produced the cluster contextual variables. Based on the summary, themes were constructed. The main themes of the responses were collected and arranged into categories, and then interpreted, following the research objectives.

Data displays

Data display (Stage 2) allows data to be organised and condensed in a way that permits conclusion drawing. The purpose is to reduce complex information into selective and simplified or easily understood configurations. Extended text, matrices, graphs and charts are often employed for data displays to justify the final conclusions (Miles and Huberman 1994). They help the researcher with themes and patterns for further analysis and to derive further conclusions. In the current research, the researcher displayed the codes in diagrams to identify the themes and patterns. Then the frequency was tabulated, the complexity was examined and the information was summarised in order. In practice, data reduction and data display were conducted iteratively throughout the data analysis. The iteration reduced the data because it involved data selection, focusing, simplification, abstraction and transformation. The analysis proceeded in an iterative manner, simultaneously with data collection, interpretation, and narrative report writing.

Conclusion drawing and verification

Stage 3 analysis was conclusion drawing and verification. In order to provide solid proof and valuable insights into the main issues investigated, the presentation was focused on maintaining the personal meanings expressed by the interviewees, and on locating these personal meanings within the different port contexts. The researcher did not draw conclusions until the data collection was over and verified as plausible and valid, because the researcher was aware that cause and effects might not be the same as the research progressed. Moreover, the researcher was aware that moving too soon to conclusion may result in premature conclusions (Miles and Huberman 1994). This argument is consistent with Thompson et al. (1994) who claim that a process of iteration is necessary because the initial understandings of a text can be modified and improved as later readings provide a more developed sense of the whole text, and a holistic understanding of a text would be developed over time.

This research therefore followed a similar part-to-whole and whole-to-part mode of interpretation to that suggested by Thompson et al. (1989). Each interview was treated as a "part" of the "whole" qualitative data. As the data were collected from two different regions, separate analysis was conducted for each port region first, and then followed by combined analysis. The cross region combined analysis aimed to explore patterns across regions, enhance generalisability, and deepen understanding and explanation.

The whole process of analysis was repeated as many times as it was needed. The iterative process helped in gradually verifying, modifying and refining the research results until finally an explicit and grounded conclusion was reached and verified. Finally, a report of the qualitative data analysis was written based on findings from the whole analysis process. This will be presented in Chapter 5.

4.5.2 Quantitative data analysis

Computer friendly pre-codes were added in the notebook. All or most of the items were pre-coded questions to simplify and speed up the data process by computer based on Simmons (2001). As the questionnaire was well constructed, the time needed to code and analyse responses was short, particularly as computing coding or analysis is available today (Robson 2002). For the data collected from the questionnaire survey, the data entry and data coding were input into computer.

All data analyses were conducted with the Statistical Package for the Social Sciences (SPSS) version 17. Data analysis involved tests of normality, selecting statistical techniques, preparation of working data files, and computing statistics and relevant indicators to detect underlying relationships among variables. Internal consistency reliability was evaluated by computing Cronbach's α. Then three statistics (means, standard deviations and frequencies) were calculated to further aid in interpreting the data.

To reduce the number of factors, factor analysis was conducted to draw out the main factors (which are defined as aggregate factors[2] in this research, or A-factor for short) that influence port performance. Subject to the results of factor analysis, comparative analysis was conducted. Specifically, an independent-samples t-test was used when two regions were compared; paired-samples t-test was used to compare mean scores with

[2] "Aggregate factors", "A-Factor" for short in this thesis, refer to the factors extracted by factor analysis. This term is used to distinguish an extracted factor from a questionnaire factor to avoid confusion. A questionnaire factor refers to the factors selected from the literature and first phase interview. If not particularly explained, factors in this thesis refer to questionnaire factors. A factor here refers to "an element which enters into the composition of anything; a circumstance, fact, or influence which tends to produce a result", according to the Oxford English Dictionary.

matched pairs for the same group of people: the Humber (importance vs. performance), Xiamen (importance vs. performance), the Humber (performance vs. other ports' performance), Xiamen (performance vs. other ports' performance), importance (Humber vs. Xiamen), performance (Humber vs. Xiamen), performance difference (Humber vs. Xiamen). Kruskal-Willis H Test was conducted to detect whether there were significant differences among the company groups, as the number of groups is more than two, and the number of respondents were not equal.

IPA was employed. IPA offers a number of advantages for evaluating customer acceptance of a service strategy and has been a popular tool for understanding customer satisfaction and prioritizing service quality improvement (Bacon 2003). As this is an important analytic technique in this research, it is worth addressing in a separate section of 4.6.

4.5.3 Validity and reliability

Reliability is basically referred to as consistency (Punch, 1998) and repeatability of the research results (Bryman and Bell 2007). Validity refers to the extent to which a test measures what it claims to measure (Antonius 2003), or the extent to which the research findings represent accurately what is actually happening in the situation (Collis and Hussey 2003). Yin (2009) states that four tests, namely construct validity, internal validity, external validity (the results should be applicable to external context) and reliability (if identical results are generated based on the same research process), have been commonly used to establish the quality of any empirical social research. Similarly, Bryman and Bell (2007) note that the quality of an empirical study depends on the validity and reliability of items. Replication is often used to test the reliability of survey results (Collis and Hussey 2003). Face validity is the most common validity, which refers to the assurance that the tests or measures used by the researcher actually do measure or represent what they are supposed to (Collis and Hussey 2003). Construct validity is also important for business research.

For the interview data, the validity and reliability were realised by sending back the transcriptions to the respective participants for their endorsement. A few participants made amendments involving additions or omissions. For interview process validity, a well-designed interview protocol was followed during the interviews to enhance validity. For example, the key interviewees were asked to review the draft report to see if they agreed with what was in the report or not, in order to validate the interview content.

Concerning questionnaire validity and reliability, to ensure the analysis and results represent the views of the respondents, the reliability and validity of the survey should be tested before describing the statistics. Besides reviewing literature for evidence of reliability and validity among the questionnaire components, a pilot test was conducted and a reliability test was conducted, which showed the Cronbach's α was high, which indicated high internal consistency of the responses (Pallant 2007).

For the construct validity of the questionnaire, the researcher relied on an in-depth review of relevant literature. In the process of determining the questionnaire items, the content validity was ensured, which was an important measure to ensure a survey instrument's accuracy. As item content validity provides a solid foundation on which to methodologically and rigorously assess a survey instrument's validity (Lirn 2003), the content validity of the questionnaire used in this research was tested through a literature review and interviews with port stakeholders. The literature and previous surveys referred to when constructing the questionnaire are Slack (1985), Murphy (1991, 1992), UNCTAD (1992), Notteboom and Winkelmans (2001), Lirn (2003), Lirn (2004), Tongzon (2004; 2007), Cullinane et al. (2005), Yeo et al. (2008), and Lam and Yap (2008). Academics and experts in ports were also approached to check the items for the content validity during pilot tests. The interviews with academics and port experts resulted in amendment of some items. The items after amendment were input to the final questionnaire survey to ensure the construct validity.

For the entire data collection fieldwork, the construct validity of methods was achieved by using multiple sources of evidence, namely, interviews, questionnaire, observation and documentation. Convergent validity and discriminant validity are two subcategories of construct validity, which will be reflected in Chapter 6 for the data analysis. In addition, back-translation of the questionnaire was employed to ensure the language was equivalent to the original copy.

The current research was undertaken in different countries. This cross-cultural research involved two different languages: English and Chinese. The questionnaire was originally designed in English. It was first translated from English to Chinese by a local expert in Xiamen. Then another bi-linguist translated the questionnaire from Chinese back to English. The process of back translation aimed to ensure vocabulary equivalence, as suggested by Sekaran and Burgie (2010). For the interview questions, the same procedure was undertaken to ensure equivalence. Quotations from the interviewees were also selectively back- translated by an academic and compared with the original Chinese transcript. Since Chinese was used in Xiamen, the transcripts were selectively back-translated by an expert to compare with the original for data validity.

As this is a cross-cultural research, attention was paid to two issues. Firstly, to ensure response equivalence, uniform data collection procedures were adopted in the different cultures. As a bi-linguist, the researcher herself collected the data by identical methods from the research introduction, introduction of herself as the researcher, task instructions, questionnaire administration, and interview process to closing remarks. Secondly, the time frame for the data collection was controlled to within 4 months each for interview and questionnaire data collection from both countries. This is an acceptable time frame recommended by Sekaran and Burgie (2010) to avoid much change taking place during the data collection.

Lastly, mixed methods and data triangulation also enhance the reliability and credibility of this research in terms of data sources and research methods.

4.6 Importance-performance analysis

This section will explain how the factors can be analysed by employing the method of IPA in empirical research. It will review the literature on IPA, including the origin of this tool, the research areas in which this approach has been employed and the development of IPA. The traditional and revised models of IPA will then be reviewed to justify why it was selected as an effective tool for analysing the factors from Section 3.5.

4.6.1 Origin of IPA

Martilla and James (1977) initiated the simple technique of IPA to identify key attributes for the development of an automobile marketing programme. They put mean customer ratings of each attribute’s performance in quantization value on the horizontal axis, and then put mean customer ratings of each attribute’s importance in quantization value on the vertical axis. A two-dimensional graph, with the mean importance and performance scale constituting the two axes, was constructed. The values for each attribute were plotted as points on the importance-performance grid. The plots on the grid indicated the appropriate strategy for each attribute. In this technique, the attributes are plotted against each other and the resulting importance-performance space is divided into four quadrants, as shown in Figure 4.4.

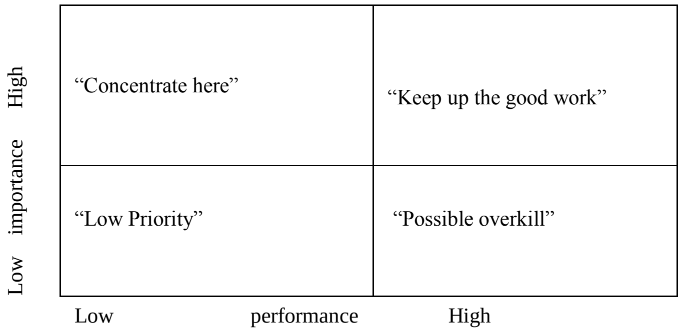


Figure 4. 4 Importance-performance grid

Source: Martilla and James (1977)

Martilla and James (1977) interpret the quadrants into "concentrate here" (high importance with poor performance, items in this quadrant have high priority for the improvement of service quality), "keep up the good work" (high importance with good performance), "low priority" for actions (low importance with poor performance) and "possible overkill" (low importance but good performance, which might be considered as a waste).

4.6.2 Employment of IPA

Ever since Martilla and James (1977) demonstrated the technique of IPA, it has been widely used for prioritising service improvements. It has attracted the interest of various academics and researchers so that different IPA variations have emerged over the years. Table 4.8 presents some of the areas of interest and application of IPA.

IPA has been applied in different research areas, such as manufacturing (Platts and Gregory 1992), operations and engineer services (Slack 1994), education services (Ford et al. 1999), hospitals (Yavas and Shemwell, 2001), professional associations (Johns 2001), freight transportation (Mangan et al. 2002), financial service provider of banks (Yeo 2003), highway transportation (Huang et al. 2006), human resources (Eskildsen and Kristensen 2006), hotels (Deng 2008), retailers (Shieh and Wu 2009) and tourism (Lai and To 2010). Brooks et al. (2010) used IPA to examine port users' evaluation of port effectiveness. However, being so important and popular, IPA has not been applied to the port sector to identify factors influencing port performance yet.

Table 4. 8 Literature on importance and performance analysis

Author	Research area	Year	# of factors	Response(rate)	Imp-perf/perf dif.
Martilla and James	automobile	1977	14	44.80%	imp-perf
Crompton and Duray	profile market	1985	28	97%	imp-perf
Slack	operations& engineer service	1994	7	4 focus group	imp-perf dif.
Ford et al.	Education service marketing	1999	22	68.2%+focus group	imp-perf dif.
Johns	professional association	2001	22	22%	imp-perf dif.
Yavas and Shemwell	medical service-hospital	2001	15	72.70%	imp-perf relative
Slack et al.	operations	2001	7	xx	imp-perf dif.
Mangan et al.	freight transportation	2002	15	xx	imp-perf dif.
Matzler et al.	bank	2003	12	153 responses	imp-perf
Bacon	15 datasets	2003	x	2nd hand data	imp-perf
Yeo	banks-financial service	2003	17	31.20%	imp-perf dif.
Huang et al.	highway transportation	2006	24	98.40%	imp-perf
Eskildsen and Kristensen	job satisfaction	2006	30	20%	imp-perf
Deng et al. Taiwan	hot spring hotel case research	2008	20	412 responses	imp-perf
Siniscalchi et al.	training	2008	18	xx	imp-perf
Pezeshki et al.	mobile communication industry	2009	6	74.40%	imp-perf
Lin et al.	human resource	2009	52	82%	imp-perf./gap
Riviezzo et al.	service management	2009	20	275 responses	imp-perf
Shieh and Wu	retailer	2009	18	2x150 responses	imp-perf
Lai and To	tourism	2010	28	23.30%	imp-perf

4.6.3 Development of IPA

Traditional IPA

As reviewed above, after Martilla and James (1977), quite a few other studies have followed the same approach of analysing attribute importance and attribute performance with self-stated measures, which is known as traditional IPA. In these traditional IPA studies, the quadrant values are from factor importance and factor performance, as the authors find it more meaningful to research the data of importance and performance simultaneously than only to research the data of importance or performance separately. Aaker and Day (2004) reported the importance-performance model. Traditionally, the four-quadrant matrix can identify areas needing improvement and areas of effective performance (Shieh and Wu 2009).

Deng et al. (2008b) argue that the traditional IPA has two implicit assumptions: 1. Factor importance and factor performance are two independent variables. 2. The relationship between factor importance and factor performance is linear and symmetrical. They claim that the two assumptions are wrong, because: 1. The two variables are not independent. 2. The authors note that the relationship between them is not linear but causal (Matzler et al. 2004). This implies that the traditional IPA approach can be misleading (Bacon 2003; Matzler et al. 2004). Some researchers have tried to revise the traditional IPA.

Revised IPA by gap analysis

Apart from plotting items on a four-quadrant matrix, gap analysis is used to simultaneously consider importance and performance and identify the areas for improvement. There are two types of gap analysis in IPA.

The first type of gap is measured as performance minus importance. Platts and Gregory (1992) conducted IPA by employing the rating of importance and performance difference in manufacturing for strategy formulation. Ainin and Hisham (2008) applied the IPA to information systems in Malaysia. They indicated that the gap between the importance and performance implies the opportunities for improvement and guides the prioritization of resources and management intervention. Ford et al. (1999) developed a "gap-based" approach that compared importance with performance to implicitly set improvement priorities. They regarded the gap of performance minus importance as the room to improve and applied IPA in the educational service. Two case studies were undertaken in New Zealand and the USA to develop a strategic tool for education service market improvement. Two important contributions they made to this research: 1. They identified the problematic attributes by the importance-performance difference. If the mean performance minus mean importance is negative, the attribute shows a potential problem. The bigger the difference is, the bigger the problem is with that attribute. 2. They identified a significantly different factor structure between the two countries, although they investigated the same attributes. The results suggest that trying to develop a single model of important facts to apply in a cross-cultural context might be a mistake. Two years later, Johns (2001) noted that "quality= performance score – expectations score", which is similar to the view of Ford et al. (1999).

The second type of gap is measured as focal performance minus competitor or bench marker's performance. The competitors' performance is treated as an explicit benchmark by which to judge the operation's performance. The performance difference (Δperformance) is treated as the gap of the focal organisation to improve. This is different from traditional IPA that only considers focal performance.

Yavas and Shemwell (2001) extended the traditional IPA model by integrating competitor's performance. They state that a respondent's index score for a given attribute is equal to his evaluation of the importance of an attribute times the difference between his assessment of the competitor and the focal object performance. The X axis presents performance from low/left to high/right; the Y axis presents the relative performance score. Those means that are significantly higher than the grand means (mean importance rating for all the factors taken collectively) are considered as salient. In their modified IPA matrix, if both performance and relative performance index are high, the activity is a competitive edge and should be “keep up the good work”; if both are low, there is a competitive disadvantage, a red alert is given and urgent actions should be taken; if performance is high and importance is low, that activity falls in the quadrant of vulnerability and competitive watch; if performance is low and importance is high, it indicates false security and opportunity alert. The entity needs to stay alert to actions.

Other researchers and authors such as Slack (1994), Johns (2001), Yeo (2003), and Lin et al. (2009) hold a similar view that traditional IPA should be integrated with gap analysis. They understand that service quality is the degree of discrepancy between customers’ expectations (importance) and perceptions (performance) of the service. The gap between the competitor’s performance and focal performance needs improving, if the result of competitor performance minus focal performance is positive. The bigger the gap is, the more effort is needed to improve the focal performance.

Shieh and Wu (2009) apply IPA to the retail sector to examine how services in convenience stores could be improved. They evaluate the performance by the mean value and evaluate importance by the variance-based methods. The basic idea of variance-based importance is that the larger variance a variable has in its ratings, the more important the variable is. This method is particularly useful when the importance is not directly available from the survey.

Re-dividing the quadrants of the IPA model

Slack (1994) and Slack et al. (2001) analyse the relationship between importance and performance and modify the traditional IPA to reflect managers’ perceived relationships between “importance”, “performance” and “priority for improvement”. They note that derivation of a ranked list of competitive factors is crucial for a business operations strategy and the importance-performance matrix is important for both internal and external service improvement. They segregate the importance-performance matrix into four zones instead of four quadrants, namely, the “appropriate” zone, the “improve” zone, the “urgent action” zone and the “excess” zone, which implies very different strategies. The four zones are separated by three lines: lower bound of acceptability, distinction and approximate boundary. The manager’s views of “better than competitors” are treated as the boundary line of acceptability, which distinguishes what is acceptable performance and what is unacceptable performance. The authors consider that "importance" and "performance" act together to determine "priority for improvement", as there are some interesting indications of the links between importance, performance and perceived improvement priority. The priority which managers give to improving particular competitive criteria depends on their importance, and managers are concerned only with performance levels that are clearly below those of their competitors.

Slack (1994) argues that the 2x2 zoning does not hold for intermediate points and suggests a 9x9 zoning for the importance-performance relationship analysis. The 9x9 format (Figure 4.5) is quite different from the 2x2 format because the boundary lines are quite different, although it follows the same intuitively acceptable rationale. The boundary might be low in practice as managers would tolerate poor performance if that activity is relatively unimportant (8 or 9 on the importance scale), as shown in the area of "appropriate".

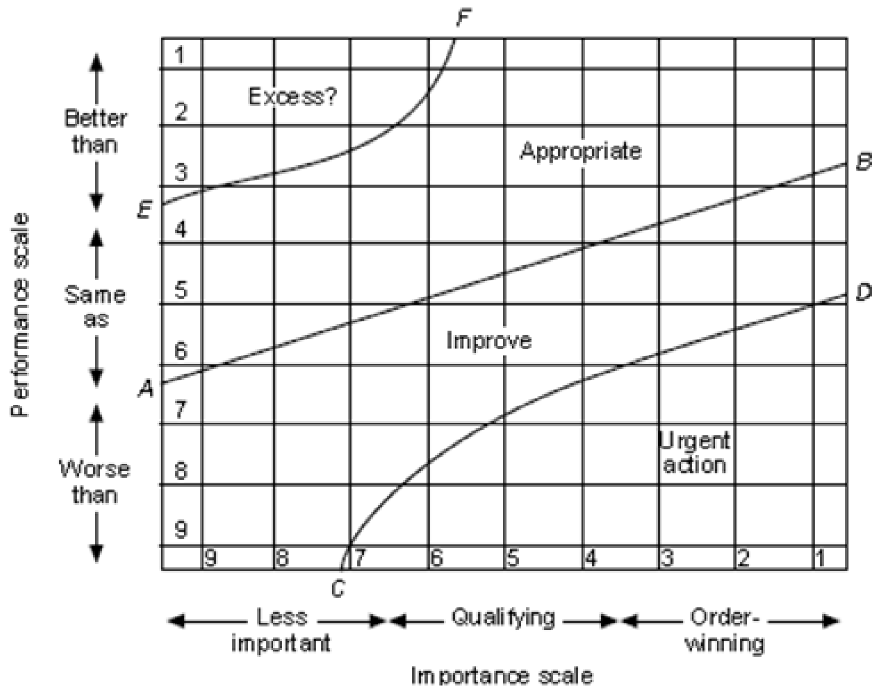


Figure 4. 5 Importance-performance matrix zones

(Source: Slack 1994)

The minimum boundary line of acceptability (line AB) is the competitors' performance. Above it is appropriate except factors of "excess" (separated by line EF between "appropriate" and "too good") that are over-performed with low importance. Below the boundary line are factors that need improving except the factors of "urgent action" (separated by distinction line CD between "urgent priority zone" and "less urgent improvement zone") that are very important with very low performance. The short-term objective is to raise the performance of "urgent action" up to the "improve" zone.

The 9x9 tool is theoretically better than the 2x2 matrix as it distinguishes the grid more concisely. Low performance is tolerable when the importance is low, while performance needs improving even though the performance is not poor, as the benchmark is competitors' performance. However, the boundary line between acceptable and unacceptable is blurred and difficult to define, as managers' views are quite subjective and competitors' performance is hard to define. This tool is difficult to employ practically. In the current research, as the competitors were hard to define, it was more difficult and not possible to define an accurate value for the boundary line of AB. For lines CD and EF, it is even more difficult to get the value to form the lines. Hence this research did not employ the 9x9 formats with four zones.

The factors with high importance and a big gap of performance difference are called "salient factors" by Brooks (2000). Mangan et al (2002) identify the "salient factors" on port/ferry choice in RoRo freight transportation. The authors employ the Aaker and Day Model (2004), which was applied by Deng (2008) later on. Based on their work, an importance-Δperformance model is developed as Figure 4.6 shows.

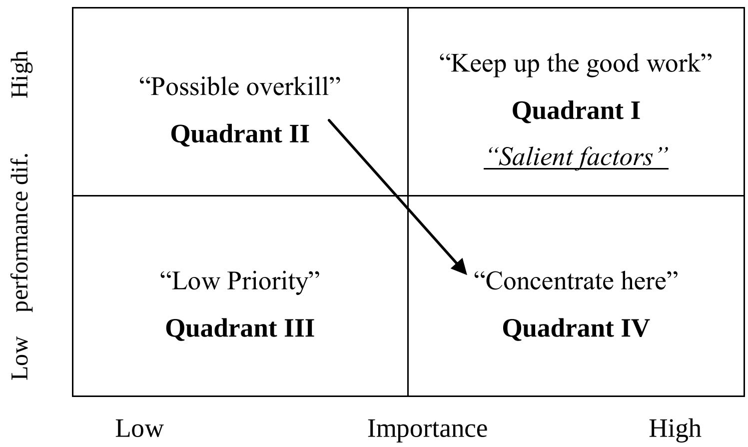


Figure 4. 6 Importance-performance analysis

Source: adapted from Martilla and James 1977, Mangan et al.2002, Deng et al. 2008

Each quadrant provides management information or service strategies. Variables in quadrant I (high importance and high performance) represent competition and are deemed major strengths; the service should be maintained, leveraged, and heavily promoted (Lambert & Sharma, 1990). The organisation should "keep up the good work" because it shows the focal performance meets customers' satisfaction. Items here are identified as "salient" factors. Quadrant II represents low importance but high performance, which means the resources are over allotted. The organisation can thus allocate a portion of the resources to the variables with high importance and improve the other variables, for example Quadrant IV variables ('concentrate here') to achieve a more efficient flow and allocation of the port's resources. Quadrant III represents low importance and low performance. Thus, the organisation should consider stopping or decreasing the resources to these variables. Quadrant IV represents high importance but low performance; these items are major weaknesses and should be top priority and targeted for immediate improvement efforts.

<u>Revised IPA employing the three-factor theory</u>

Matzler (2003), Deng (2008) and Deng et al. (2008) question traditional IPA by employing the 3-factor theory. The three factors refer to basic factors, performance factors and excitement factors. According to Matzler et al. (2003), the basic factors are minimum requirements that cause dissatisfaction if not fulfilled but do not lead to customer satisfaction if fulfilled or exceeded. They are basic requirement and of utmost importance. Performance factors lead to satisfaction if fulfilled or exceeded and lead to dissatisfaction if not fulfilled. They cause satisfaction or dissatisfaction depending on their performance level. They are the second most important. Excitement factors can increase customer satisfaction if delivered but do not cause dissatisfaction if not. They are the least important as they comprise augmented or enhanced services.

The authors argue that this theory has two features: 1. Importance of a basic or excitement factor is based on its performance. Basic factors are crucial when performance is low and excitement factors are crucial when performance is high (Matzler et al. 2004). 2. The relationship between factor performance and overall customer satisfaction is asymmetrical.

Various ways of positioning the grid lines

IPA is a graphic technique and the interpretation of the "Action Grid" depends on the quadrant where the factor is accurately placed (Crompton and Duray1985). The correct positioning of the factors is critical to derive the marketing strategy.

The literature has reviewed different ways of positioning the grid lines. Firstly, Martilla and James (1977) suggest that the positioning of the boundary lines is a matter of judgement. They note that the value of IPA lies in determining relative rather than absolute levels of importance and performance. That is why they practically move the axes in case of the absence of low importance and low performance ratings. Secondly, Guo and Zhang (1997) treat the centre of the scale as the grid lines. For example, if the data is collected by a 5-point Likert scale, the centre is 3, so the matrix is divided by 3 on the X axis and 3 on the Y axis. Lastly, Martilla and James (1997) adopt grand mean instead of medians as the grid lines to avoid discarding the additional information contained. Following that, Ford et al. (1999) and Huang et al. (2006) employ grand mean as the grid lines, which is the overall average of all the attributes on importance and on performance. They use the means of overall service expectation and satisfaction as the boundary lines to separate the grid into four quadrants. However, they explain that median values are theoretically preferable to means, as a true interval scale might not exist.

Although a few options exist in the literature to use median, mean and centre of scale, the grand mean is the most widely adopted way for the boundary. This explains why this research adopts grand mean as the gridline.

Various methods of measuring attribute importance

A variety of methods have been employed to measure variable importance. Basically, there are two types of importance: explicit self-stated importance and implicitly derived importance.

Explicit self-stated importance

Griffin and Hauser (1993) compare three different measures of explicit importance, namely, direct rating, constant-sum scale and anchored scale. They find no significant differences between these methods. Crompton and Duray (1985) investigate two self-stated methods: plotting by mean values and plotting by median values. Their empirical investigation show little difference between the two self-stated methods. Matzler et al. (2003) employ three explicit methods (direct rating of importance on a five-point rating scale, a partial ranking method and the mean ranking). A comparison of these rankings shows a strong correlation between the three methods. These results suggest a low sensitivity of importance weights to the measures of explicit (self-stated) importance.

Implicitly derived statistical importance

Self-rated importance rating has some shortcomings: 1. The researchers tend to include attributes salient to the customers (Chu 2002); 2. Self-rating of importance is subject to response bias due to the influence of social norms and the importance is not predictive of satisfaction (Brooks et al. 2010). Implicit importance, which aims to incorporate the determinant attribute of performance into importance, can complement the shortcoming.

Researchers have presented different methods to generate the implicit statistical importance and develop the revised IPA, including regression analysis, partial correlation, bivariate correlation and composite ranking (Bacon, 2003; Matzler et al., 2003; Deng et al., 2008a; Huang et al., 2006; Slack, 1994). They use the different methods to infer the priorities for improvement from the importance-performance space as well as different methods to measure the importance of the attributes. Matzler et al. (2003) note that when some form of implicit measurement of importance is used (e.g., the variable correlation is with an external criterion like overall satisfaction), implicit importance is derived, given the current level of variable satisfaction. The implicit importance measures are derived based on performance perceptions (Van Lttersum et al. 2007). The implicitly derived importance might reduce the errors arising from the subjective judgement by customers who give self-stated importance (Deng et al., 2008b).

Crompton and Duray (1985) investigate two statistical methods to derive implicit importance: plotting by Pearson correlation coefficient and plotting by Spearman correlation coefficient. They find little difference between the two statistical methods. Deng (2008) uses weightings from partial correlation coefficients instead of mean or median for the analysis. The value of performance is presented in percentage (%) instead of mean/median. He claims that the use of relative importance and relative performance is more suitable for strategy analysis. The partial correlation coefficients are used as implicitly derived importance weights, which are gained by correlating variable performance (satisfaction) with overall customer satisfaction (OCS), as Oliver (1997) states that implicitly derived importance relies on an actual assessment of how each variable is related to overall satisfaction.

Chudasama (2009) derives importance weights from the factor loadings of the principal component analysis. Lin et al. (2009) employ a method of ratio to produce the implicit importance. They use relative importance (RI=importance/average importance) and relative performance (RP=performance/average performance) and combine them with the traditional IPA to produce a revised matrix of importance-performance gap analysis (IPGA). The revised IPGA matrix is similar to the traditional IPA model. The RI and RP measures are represented by the Y axis and X axis respectively to form a two-dimensional matrix. These two axes divide the IPA grid into four quadrants through which the crosshairs are set at the grand means of RI and RP. In this way, each attribute can show up according to its mean rating value respectively.

As Crompton and Duray (1985) and Matzler et al. (2003) identify that implicit importance by difference methods result in similar results, employing one method to derive implicit importance can be representative of implicit importance. Van Lttersum et al (2007) note that derived importance should not replace stated importance and the two measures are complementary, each providing a different perspective on the value of the criterion.

Bacon (2003) reviews different approaches used to undertake IPA and compares them across 15 databases. He finds that using direct measures of importance instead of correlation coefficients is better, as the underlying assumptions of correlations are often not met. However, Matzler et al. (2003) identify that statistical methods are more appropriate than explicit importance as they correlate more closely with actual perceptions (Crompton and Duray, 1985; Neslin, 1981). To make this research rigorous, both explicit importance and implicit importance are considered, so that subjective and objective importance are addressed and compared to avoid biases.

Revised IPA model with explicit and implicit importance

The above gives the growing evidence that both explicit importance and implicit importance are important and should be considered simultaneously to produce the factor structure of customer satisfaction.

Matzler et al. (2003) propose a model importance grid that distinguishes the factors of customer satisfaction into three categories and places them into four quadrants in the matrix. The three-factor theory suggests that customers' evaluation of variable importance does not adequately measure the implicit importance of variables. Based on the three-factor theory (Section 2.3.4), based on the work done by Matzler et al. (2003), Deng (2008), Deng et al. (2008), Lin et al. (2009), and based on the underpinning of IPA, a new model is put forward as Figure 4.7 shows.

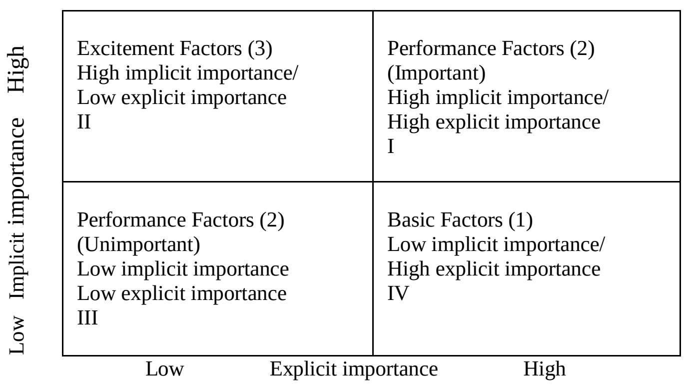


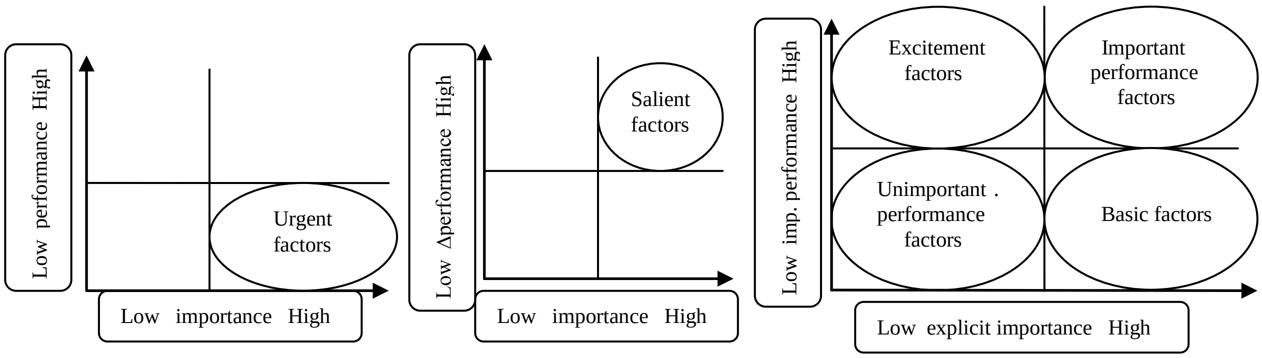
Figure 4. 7 The importance grid

In this model, the horizontal axis represents explicit importance while the vertical axis represents implicit importance. Different methods can be employed to produce the values of the explicit importance scale and implicit importance scale, as presented earlier. Items that fall in Quadrant IV (low implicit importance and high explicit importance) are basic factors. Items that fall in Quadrant I (high explicit importance and high implicit importance) and III (low explicit importance and low explicit importance) are performance factors. Items that fall in Quadrant II (low explicit importance and high implicit importance) are excitement factors.

4.6.4 Summary of IPA

IPA is a simple, effective technique and effective managerial strategy that can assist practitioners to develop a new marketing strategy, to evaluate an existing strategy, and to identify improvement priorities for service attributes and develop the business performance (Crompton and Duray 1985; Hansen and Bush 1999). IPA aims to research customer satisfaction as a function of expectations related to both importance and performance (Martilla and James 1977). Employing IPA allows companies to yield important insights into which aspect of the marketing mix they should devote more attention to achieve customer satisfaction and identify areas consuming too many resources (Matzler et al. 2004).

The rich literature on IPA has indicated that it can become a valuable and effective tool for strategic management and decision-making. The framework to employ traditional IPA, IPA by gap analysis and revised IPA by 3-factor theory is shown in Figure 4.8.



(a) Traditional IPA (b) Revised IPA by gap analysis (c) Revised IPA by 3-factor theory

Figure 4. 8 Integrated importance-performance analysis framework

This research employed the framework to identify key factors influencing port performance. The traditional IPA (explicit importance against explicit importance) is employed to identify factors for urgent actions; revised IPA by gap analysis (explicit importance against explicit performance difference) is employed to identify salient factors and revised IPA by 3-factor theory (explicit importance against implicit importance) is used to identify basic factors.

Based on these findings, improvement priorities are set, and areas of ‘possible overkill’ and areas of ‘acceptable’ disadvantage are identified (Matzler et al. 2004). Hence, following a survey with IPA analysis, ports can make rational decisions about how to best deploy scarce resources to attain the highest degree of customer satisfaction. This research employed this approach to analyse the importance and performance of the selected 15 factors from the literature review and interviews to produce a management strategy for ports.

4.7 Ethical issues

Researchers have responsibility for ethical issues such as interviewees' interest, sensitivity and privacy and ensure their physical, social and psychological well-being. Four ethical issues were considered through the whole research: harm to participants, lack of interviewees' consent, invasion of privacy and deception, as identified by Bryman and Bell (2007).

Specifically, before conducting interviews, phone calls were made to ensure the interviewees were willing to participant. The interviews were recorded with the interviewee's consent. For the questionnaire, it was also freely decided by the respondents whether they would like to participate or not. The research purposes were explained clearly to the interviewees who were assured the data would be used only for research purpose and not used for any other purpose. The interviewees were assured of the right to withdraw at any time. For interviews, the transcripts were given to the interviewees if they so requested, to check whether the transcripts accurately and fairly reflected their thoughts. Confidentiality and anonymity were ensured and private questions were avoided.

4.8 Chapter summary

The overall research design employed for the current research combined qualitative and quantitative methods for data collection and data analysis. It is widely recognised that both qualitative and quantitative methods have their own strengths and weaknesses. Neither is deemed to be superior to the other. This "pragmatist paradigm" rejects the incommensurate view and the either/or choice between qualitative and quantitative research methods. The utmost importance was given to the nature of the research and the research objectives, rather than being constrained by a specific philosophical paradigm.

This chapter started by explaining the importance of choosing an appropriate research methodology, and the research objectives were emphasised. Then the two extremes of research philosophies (positivism and interpretivism) and their different preferences for data collection and analysis were discussed. The researcher's personal philosophical stance of pragmatism was identified. Then the research approach, strategy and methods deployed in this thesis were identified and discussed. Both in-depth interviews and questionnaires were employed because of their distinctive strengths. In-depth interviews were utilised to yield deep and generalized information, and questionnaires were developed to verify and refine the findings and gain new insights in the real-life context.

The chapter then moved on to explain why interviews and questionnaire surveys were chosen as the research methods for this research and the rationale for the research design was explained. A detailed account of the research process was given. Then each data collection method was explained. Finally, quality criteria were discussed in relation to this research. In particular, this research applies mixed methods to ensure the validity of the findings.

Having outlined and justified the methodological concerns in conducting this research, the thesis will move on to examine the findings of this research. These are presented in two chapters: interview analysis and questionnaire analysis. The next chapter will present the interview data and discuss the findings of the first phase of research based on interviews. Chapter 6 will put forward and examine the findings of the second phase of research by questionnaires. The findings of these two phases of empirical research will be combined and discussed, and the research aims and objectives will be reflected and highlighted in Chapter 7. Through the examination of research findings by using these evaluation criteria, it is hoped that this thesis may reach a contextually rich and reasonable conclusion. Finally, this thesis will conclude with key findings, contributions, implications, limitations and recommendations for future studies.

5. EXPLORING THE DEVELOPMENT OF PORT PERFORMANCE: PORT STAKEHOLDERS' VIEWS

This chapter deals with interviewees' perceptions and experiences of factors influencing port performance in both China and the UK. The presentation and discussion of findings within this chapter are elicited from empirical evidence collected in the first research phase of in-depth semi-structured interviews. The data collected are presented and elaborated in terms of important factors that determine port performance, which are closely related to the research objectives presented in Chapter 1. Comments are made on findings that are both expected and unexpected.

This chapter addresses the factors that influence port performance one by one from the interviewees' point of view. For discussion purposes, the interviewees' responses were classified into eleven categories, as shown in Table 5.1. A discussion of each category is given to explore the factors that influence port performance.

Table 5. 1 Number of interviewees who raised factors that drive port performance

Factor		Loca -tion	Gov. supt	Port infr.	Trans. Inf.	ICT serv.	Cust& border service	Service	Log. De-mand	Cost	Sea-link	Other factors	Total infor-mentts
No. of informt	XM	18	20	14	16	6	16	18	18	10	8	18	20
	HB	16	12	14	6	6	3	14	10	16	6	16	20
% of informt	XM	90	100	70	80	30	80	90	90	50	40	90	100
	HB	80	60	70	30	30	30	70	50	80	30	80	100

Row 1 gives the factors raised by the interviewees. Rows 2 and 3 give numbers of interviewees who raised the factors for Xiamen and the Humber respectively. Rows 4 and 5 present the percentage of interviewees (numbers in Rows 2 and 3 respectively, divided by total number of interviewees) for each region.

5.1 Geographical location and proximity

Figure 5.1 presents the relative location of the Humber and Xiamen in the world, as stated in Section 4.2.5. The Humber is on the east coast of the UK while Xiamen is on the southeast coast of China.

The Humber is situated centrally on the east coast of the UK (Figure 5.2). It is a large tidal estuary on the east coast of Northern England and drains a catchment area of some 24,472 km^2, around 20% of England is total land surface. It forms part of the boundary between the East Riding of Yorkshire on the north bank, and North Lincolnshire and Northeast Lincolnshire on the south bank, being 120km long and 14km wide at its broadest.

Figure 5. 1 Location of the Humber and Xiamen in the world

A: Xiamen; B: the Humber Source: Google-Map

The Humber has the UK's largest port complex, including Hull, Grimsby, Immingham, Goole, New Holland and Killingholme. It has 40,000 ship movements per year and its ports and wharves handle 14% of the UK's international trade (YH Strategy 2006). Industrial sites alongside the estuary include chemical works, oil refineries and power stations that dominate ports of the shore area.

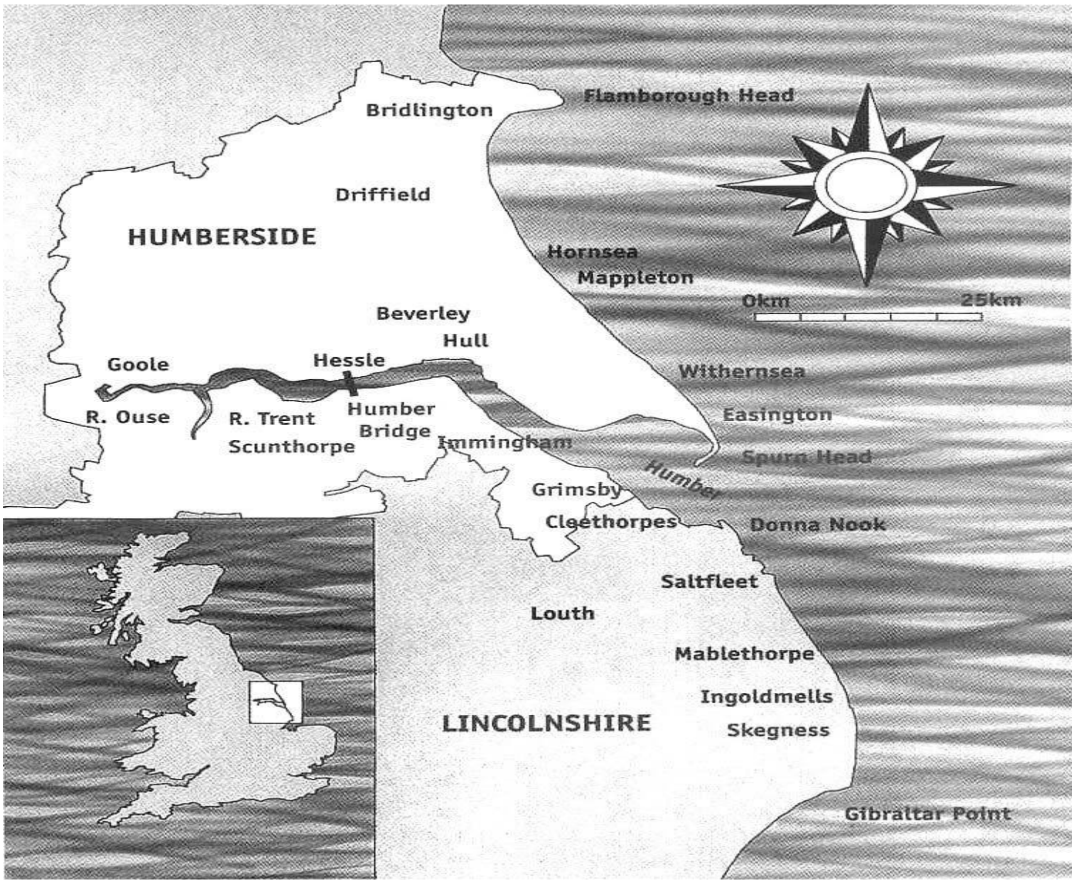


Figure 5. 2 Location of the Humber (source: Google-Map)

Facing the European continent, the Humber has strategic importance as the gateway site to the North Sea. The director of ABP highlighted the Humber as the UK's "centre of gravity" for seaborne trade. During the interviews, 16 (80%) of the Humber ports' interviewees commented on the Humber's strategic location. Here are typical quotations:

> *"The critical point for Humber to development logistics is its location, location and location!"*
> *Humber Interviewee 5*
>
> *"The most important benefit of this area is its location. The Humber ports are highly significantly located to link east and west. Within 4 hours of drive, there are 40million population of UK."*
> *Humber Interviewee 4, a Port Manager*
>
> *"Strategic location of the Humber ports is capable of providing overnight shipping services of less than 12 hours to and from the continent. It is centrally east-coast located with equal distance to London, Edinburgh and Rotterdam."*
> *Humber Interviewee 3, a City Council Officer*
>
> *"60% of all freight tonne kilometres of containers and trailers passing Felixstowe and Southampton are to and from the three Northern Way regions. The Humber ports could provide relief to the congestion in the southern ports with shorter times and at lower costs"*
> *Humber Interviewee 11, a CEO of Consultancy*

Xiamen is a port city, located in the southeast of China (see Figure 5.3), connected with YRD in the north and PRD in the south, and separated from Taiwan by the Taiwan Strait. More specifically, Xiamen is on the southeast of Fujian province, at the mouth of the Jiulong River. It is backed by the Zhangzhou and Quanzhou Plain, and faces the island of Kinmen in Taiwan. Xiamen is composed of Xiamen Island, Gulangyu, Tongan and the inland northern coastal parts of the Jiulong River, with a land area of 1,565km^2 and sea area of 300km^2. Xiamen is well known as an international port city with a rich landscape. Xiamen ports have 234 km of winding coastline (Zhang 2009).

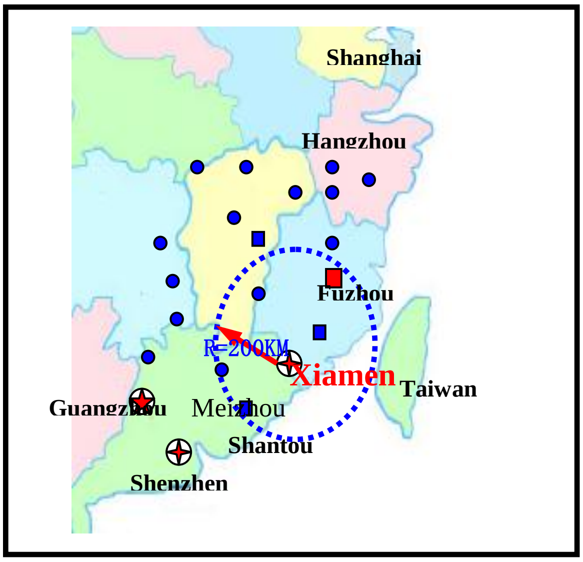


Figure 5. 3 Locations of Xiamen

(source: Google-Map)

Outside the ports are scattered islands and the port area is surrounded by hills. The ports are superior natural harbours with deep water that is ice-free all year-round. As Xiamen is important for trading with Taiwan and other international ports, Xiamen ports are important to handle trade with their favourite natural endowments. Xiamen has a mild subtropical climate. The annual average temperature is 21 degrees, with no seasonal extremes of heat or cold. The location, weather and unique historical background are conducive to Xiamen port performance.

Concerning location, some interviewees thought Xiamen had a location advantage, some interviewees thought Xiamen's location was not good, and other interviewees thought location was not important for port performance improvement. Specifically, twelve (60%) of Xiamen respondents considered geographical location was an advantage to develop a port. Being equidistant from Shanghai (supported by YRD) and Hongkong (supported by PRD), Xiamen is an important city in Southeast China.

Xiamen's proximity to Taiwan, Hongkong and Macao grants Xiamen a strategic political location. Xiamen has its unique advantages over Taiwan in terms of location, economy and politics. Xiamen's proximity to Taiwan is well known: the closest distance between them is less than 3km. Socio-economically, one tenth of Taiwanese nationals whose ancestors came from mainland China have Xiamen citizenships. The geographical proximity, common language and customs, and ethnic relationships between Taiwan and Xiamen play an irreplaceable role in promoting cross-strait economic and trade cooperation and cultural exchanges to attract Taiwanese investment. Politically, Xiamen is strategically positioned to promote the peaceful reunification of Taiwan with mainland China. Among the five special economic zones (Shenzhen, Zhuhai, Shantou, Xiamen, Hainan), Xiamen is the only zone to be approved to implement certain Freeport policies. This unique policy advantage has enabled Xiamen to be a special economic zone with the highest degree of openness (Huang 2009). The location advantages bring the economic and political advantages to Xiamen.

The interviewees commonly recognised the location as a very important factor for Xiamen to develop its logistics, either due to its geographical position or its political position in relation to Taiwan, for example:

> *"Xiamen is strategically located close to Taiwan. When the weather is fine, you can see clearly Kinmen Island (of Taiwan) from Huandao Road (of Xiamen). Xiamen is absolutely the best place to conduct the trading between mainland China and Taiwan."*
>
> *Xiamen Interviewee 1, a 3PL manager*
>
> *"Xiamen has a strong point to develop port performance with a Haixi (West to the Taiwan Straight) frontier position. It has both a political and economic meaning."*
>
> *Xiamen Interviewee 7, a Carrier Manager*
>
> *"Xiamen lies to the west of Taiwan Straight, which gives the preferential consideration by the government to build the relationship between Taiwan and Xiamen"*

Xiamen Interviewee 15, a professor in one maritime institute

Xiamen's proximity to Taiwan gives Xiamen an advantage in trading with Taiwan, not only in high volume but also small-scale trade. The small scale trade with Taiwan in 2009 amounted to 110 million USD, said one interviewee. He further explained,

> *"The small scale trade with Taiwan has become one of the major highlights of cross-strait trade in 2009. It has the advantage of flexible operation to facilitate fast and efficient customs clearance. The cargo would come and go between Taiwan and Xiamen small scale trading ports by Taiwan boats. Then the logistics companies deliver cargoes to customers. This special "fast mode" provides services of small volume with frequent batches, efficient and flexible distribution. The customers can get cargo delivered within 2-3 days, which the large scale trade cannot compete with."*

The importance of Xiamen's location stems not only from its proximity to Taiwan, but also from its strategic location for eastern China and eastern Asia.

> *"For the development of port performance, the important factor is location, location, and location! As it is in the middle between Shanghai and Shenzhen, it can attract the hinterland cargoes between Yangtze River Delta and Pearl River Delta."*
>
> *Xiamen Interviewee 12, a Director of port authority*
>
> *"Geographically, Xiamen is in the centre between Japan, South Korea and Southeast Asia. All the ships in the western Pacific and central/Northern China go to the South China Sea and those for the Indian Ocean must go via Xiamen."*
>
> *Xiamen Interviewee 18, a LSP manager*

Six (30%) interviewees, however, considered that Xiamen's location was not favourable. Another three interviewees claimed that although the location is important, it cannot be improved, since the ports are naturally geographical resorts. To their understanding, location is beyond the control of terminal operators and port managers.

Xiamen's location has both advantages and disadvantages. As addressed earlier, 30% of interview interviewees assessed its location as not good, compared with other port cities that have better performance, such as Shanghai, Shenzhen, Hongkong, Guangzhou. They thought those ports are better located, with stronger hinterlands.

The findings on Xiamen's location indicate that Xiamen has a location advantage over Taiwan, eastern China and eastern Asia. Its location in relation to Taiwan is geographically, politically and economically important, which enables Xiamen to have advantages to improve its port performance.

Interviewees from both regions clarified that their regions benefited from a strategic geographical location that was conducive to their port performance, although Shanghai and Shenzhen comparatively over shadowed Xiamen's location. This finding is consistent with the literature (Skjott-Larsen et al. 2003; Song and Yeo 2004; De Langen et al. 2007; Yeo et al. 2008; Tongzon 2009), and particularly supports Lirn et al. (2004) who found that three out of the top five transhipment port selection sub-criteria are location-related. However, the finding also supports Lirn et al. (2004) who note that port location is a factor beyond control.

5.2 Government support

All thirty Xiamen interviewees considered that government support is important to influence port performance. As one interviewee said,

> *"Government support is the most important thing in China to develop port performance. It is definite that port cannot develop without government support, although developing port performance may not work if only depending on government …"*
>
> *Xiamen Interviewee 20, a Manager in a shipping company*

Firstly, government support to logistics is reflected in preferential policy on tax reduction or tax exemption. This point was also made by one interviewee,

> *"Our company is located in the bonded zone, hence enjoys the policy of tax benefit. We can save tariff and VAT (value-added tax) to reduce our cost and make us more competitive in the market."*
>
> *Xiamen Interviewee 6, a Manufacturer Logistics Manager*

Eight (40%) interviewees noted that the interaction between the bonded zone and port together with the bonded port policy would promote Xiamen's port performance. Preferential policies are intended to promote Xiamen as a regional transhipment port. As one port director said,

> *"The resource integration and interaction between Xiangyu Bonded Zone and Dongdu Port, and a new bonded zone in Haicang Port Area will help to create a favourable environment for the development of port, improve logistics efficiency and quality, enhance the Xiamen Harbour Management and service levels, leading to improve opening up at new levels of Xiamen."*

However, in many areas, although there are policies, they are not well implemented. For example, manufacturers do not benefit from the preferential policy, as illustrated in the following comments:

> *"We have to waste more time and energy to prepare more documents to meet those extra requirements as we are in the bonded area. The extra burden may drive us off the bonded area…"*
>
> *Xiamen Interviewee 4, a Manufacturer Vice Director*
>
> *"The concept of 'Zone-Port Interaction' (interaction between tax-free-zone and port) has been raised for years, however, the scheme has not come to action. There is a big gap between the strategy/scheme and actions."*
>
> *Information 13, a consultant Expert*

There is a common gap between expectation and satisfaction. What is important is to shrink the gap and make the expectation come true. This depends on the efforts of both government and the enterprises.

Secondly, government support to logistics can be reflected in investment in physical infrastructure and port technical infrastructure, as one interviewee explained:

> *"Xiamen government has invested a lot in the physical infrastructures, such as highway, railway, bridge, port facilities and information system. Three new railways will be put into use by 2015 to*

connect Xiamen and inland China. More highways and more bridges to connect Xiamen and outside will be available in two years. The government has contributed to the infrastructure. "
Xiamen Interviewee 7, Maersk Line Manager

Thirdly, the Xiamen government has a logistics scheme that targets Xiamen as a logistics city; this is evidence that the Xiamen government supports port performance. Xiamen government has won a good reputation of being open and transparent. The interviewees realised the importance of government support to port performance, as Interviewee 3 from government claimed:

"We have promoted the image that Xiamen will be developed based on the port, become prosperous based on the port and become competitive based on the port. Xiamen's future development and strategy will be based on this conception."

However, sometimes the scheme may not be appropriate. Concerning the regional strategy, in "Xiamen City and Port Development Scheme" in 2004, Xiamen targeted to become an international transhipment port. However, Interviewee 17, one APL Manager, commented that Xiamen is not suitable for developing an international transhipment port. He said,

"According to the common rule that an international transhipment port should handle more than 20% of transhipment cargoes, Xiamen, which has only 0.4% of transhipment cargoes, is far from becoming an international transhipment port because of its location constraint, historical constraint and policy constraint".

Fourthly, central government support is of key importance. Interviewee 14 explained,

"The local government's measures depend on central government's direction. As central government has positioned Xiamen as one of the 9 logistics cities in China, Xiamen government has put lots of efforts to improve port performance."

The Central Government are clear about the importance of Xiamen to Taiwan and promoting the policy of "three big links" which means three strong direct connections between mainland China and Taiwan: connections by air/ship, connections by trade and connections by post. Obviously, "three big links" improve Xiamen's logistics by trade and transport, as indicated by one interviewee:

"'Three big links' has promoted the communications between Taiwan and Xiamen, not only in terms of passengers, but also in terms of cargoes. The trade has increased sharply between Taiwan and Xiamen since the first trial of 'three big links'. The direct vessel and direct flight between Taiwan and Xiamen have reduced the logistics cost and saved time dramatically."
Xiamen Interviewee 16, a COSCO Manager

Nowadays it takes a direct vessel only two days from Xiamen to reach Taiwan. Before 'three big links', vessels had to tranship via Hongkong to Taiwan, which took about 10 days. Direct shipment not only reduces shipping time but also reduces transport costs. According to statistics from the Xiamen Logistics Association, the cost reduction from cargo and passengers is up to millions of United States dollars a year. The information flow between Taiwan and Xiamen has also been improved significantly.

Since China's State Council raised the concept of the "Haixi Economic Zone" in May, 2009, both Taiwan and Xiamen have been proactive in the communications of logistics trade cooperation and culture exchange. Six out of the 20 interviewees (30%) spoke about the "Haixi" policy. They thought this policy would encourage physical infrastructure improvement and cross-region cooperation so that trade and logistics would be greatly improved. The interviewees believed that the "Haixi policy" would attract much FDI. For example, many Taiwan companies have located their factories or offices to Xiamen since Xiamen started to offer preferential policies to investors from Taiwan, Hongkong and overseas.

However, Xiamen does not offer such preferential policies as other ports such as Shenzhen and Shanghai. Even with the current preferential policy, shippers and other port users cannot really enjoy the benefit. As one interviewee explained,

> *"We will see if Xiamen can make good use of the policy to attract Taiwanese business and investment. Xiamen did not perform so well as Suzhou and Hangzhou that have attracted similar amount of investment from Taiwan in the past 5 years as Xiamen has done in the past 20 years, which implies that Xiamen has some room to improve. The government is supposed to do more and coordinate between different departments and improve the services..."*
>
> *Xiamen Interviewee 15, a Manufacturer Manager*

The regional logistics scheme is part of government policy. As explained by the interviewees, Xiamen had three scheme problems: 1. The layout of port performance is the main problem. There is no clear separation between residential, port and office areas. This results in congestions in rush hours. 2. Overinvestment in Xiamen's port technical infrastructure is recognised as another scheme problem. Xiamen has seven ports whose production capacity reaches 13.8 million TEU in 2009, three times the actual shipping volume. By 2011, the capacity will amount to 18 million TEU. The over-capacity due to uncoordinated development of ports has caused a serious waste of resources and higher operations cost. As one interviewee commented, Dalian and Xiamen are known as the two big ports with most overinvestment, which result in fierce competition. 3. Fujian provincial government put forward a port development plan, "Liang Ji Liang San", which means Fujian will focus on two container ports in Xiamen and Fuzhou which target 20-30m TEUs and two bulk ports in Meizhou Gulf and Luoyuan Gulf which target 200-300m metric tonnes' development. This scheme of over-capacity will increase the competition between different ports, which will result in worse profit and poorer efficiency. This scheme violates the trend of integration. The irrational competition is not conducive to regional ports' efforts to upgrade overall competitiveness, and will weaken competitiveness in the long term.

Based on the interview analysis, government support to Xiamen ports is complicated. On the one hand, government is trying to support port development with preferential policies. On the other hand, the support is limited and hindered by the relationship between Taiwan and mainland China. Moreover, the logistics scheme drawn by the government might be problematic due to lack of experience and expertise.

According to the Humber interviewees, government support is not very positive. For example, the interviewees complained about the very slow planning process, as indicated below:

> *"We need a better planning approval process, better and faster, and more transparent. The whole process itself is too slow, lengthy and cumbersome."*
>
> *Humber Interviewee 16, a Port Authority Director*
>
> *"The Port of Hull has eventually got consent for a container terminal, which is called Quay 2005, it was originally called Quay 2000. Till now it has not started construction yet. I am afraid it will be renamed as Quay 2010…."*
>
> *Interviewee 7, a Regional Development Agency Manager*
>
> *"We cannot develop new facilities because of restrictions in the planning process. We want to develop new berths in the river, but we face considerable difficulties in terms of the challenge of obtaining planning permission. In terms of constraints and challenges, No. 1 is the planning process."*
>
> *Humber Interviewee 4, a Port Manager*

The UK's slow planning process is one factor that negatively influences port performance. The Hull container terminal project is a convincing example. Other projects in Grimsby also face the same problem. The issue of slow process also applies to other UK industries. One example is the Heathrow Terminal 5 project. The project was approved by the Secretary of State in 2001, after the longest public inquiry in British history (46 months). The planning process itself cost nearly £63m over a period of 14 years (http://www.designbuild-network.com).

In contrast with this example, it took less than one year for Beijing Terminal 3 (which has a similar scale and facilities) to be approved. The cases imply fast change in China and slow change in the UK. According to one Xiamen interviewee,

> *"Our China headquarters is in Shanghai. Whenever I go to Shanghai (once every three months), I am surprised at the changes there. It's amazing to experience the changes!"*

According to the Humber interview interviewees, the UK's slow planning process is caused by too many interest bodies that change frequently, which results in inefficiency. As one port director pointed out,

> *"It has Yorkshire Forward as the RDA (regional development agency). Different public sectors were formed and named as the Humber Forum, Humber Trade Zone (HTZ), World Trade Centre (WTC), Humber Economic Partnership, Hull Forward and so on. But most people do not know what they do and when they will disappear and appear by a different name."*

Some interviewees questioned the four unitary authorities, namely, Hull City Council, Lincolnshire Council, North Lincolnshire Investment and East Riding Investment in the

Humber estuary, as the four local councils did not have a consistent strategy to follow, which hinders local development, as Interviewee 15 complained:

> *"When I came to set up a business in this region, I did not know where to go and whom to speak to. I had to try every possible organisation. This was like the trial exercises. Such kind of cumbersome process would discourage investors from coming."*

The interviewees were unhappy with the support from government and local authority, as Humber Interviewee 2 said,

> *"The government support in the region is very limited."*

The interviewees stated that the government should help the port users to grow and offer them more help. The Humber local government was expected to attract business by grant funding or tax incentives, as it had done in the case of a huge TESCO Regional Distribution Centre (RDC) at Goole. Interviewee 18 said,

> *"The local government should encourage firms to set up distribution centres through either grant funding, low rent for a couple of years or incentives in terms of tax. They should help any business that can bring jobs to this area."*

Government support to the Humber infrastructure investment was also considered unsatisfactory. The interviewees noted that the region had suffered from a lack of strategic infrastructure investment, especially in terms of the regional transport network. A legacy of past under-investment served to constrain the region's potential development, having an adverse impact on logistics performance. The interviewees hoped that investment on infrastructure would be available from government.

One logistics manager complained that it is a pity and a shame that logistics is not one of the sectors that RDA is working intensively to assist. To RDA's understanding, logistics does not produce something people consume. It was not regarded as a value-added sector, so it was not considered as high priority at the regional level. This indicates that RDA cannot pay sufficient attention to the Humber estuary and this region lacks an overall regional logistics strategy.

When asked why the Humber lacked funding, one interviewee explained that South Yorkshire was classed as objective 1 for the European Social Fund (ESF), and European money was available to regenerate this area. However, according to the national strategy, most Humber and Yorkshire areas were objectives 2 or 3, so the subsidy funding available was less and less. This is why the Humber critical problems are still awaiting solution, like the bottleneck of Castle Street. As one interviewee complained,

> *"Road infrastructure, port facilities and other physical infrastructure are big challenges in this area due to insufficient investment."* *Humber Interviewee 4, a Port Manager*

There is a big difference in the infrastructure investment between the Humber and Xiamen. In Xiamen, the government invests quickly in infrastructure to attract business. If the local government cannot provide support, the central government will invest or help with financing to get the project done, or central government, local government and private entities will share responsibility for the investment. The difference comes firstly from the different institutional systems and secondly from cultural difference, which will be discussed in Chapter 7.

So far, the government's roles on logistics support have been addressed based on the interviewees' responses. From the interviewees' feedback on government support, generally speaking, Xiamen interviewees thought the government was very supportive while the Humber interviewees thought otherwise. Both Xiamen and the Humber findings reflect that government support is very important to port performance, whether the government has played a positive role or not. The difference is that strong support improves port performance while inadequate support hinders port performance.

The finding that government support is critical to port performance is in line with claims in the literature that government plays a prominent role in the complex cross-border environment in international logistics (Banomyong 2005), and in investments in ports including physical infrastructure, port technical infrastructure and ICT (Arvis et al. 2010).

5.3 Port technical infrastructure

Port technical infrastructure refers to port facilities, size of the container terminal and the information technology status of the port (Lirn et al. 2004).

5.3.1 Port facilities

Up to 2009, Xiamen's port technical infrastructure included 16 terminals, 122 berths, 5 anchorage areas and mooring buoys, 625 items of mechanical equipment, and a storage yard of 1,826,196m^2 (Huang 2009).

According to Xiamen Logistics Development Scheme (2008), at the end of 2008, there were 40 berths. The ports were facilitated with specified terminals for containers, oil, coal and other products. Sixth generation container ships were able to call at the container terminal and berthing operations could be directly done there (Wang and Chen 2008).

According to Xiamen interviewees, good port technical infrastructure and natural conditions are one of the factors to improve Xiamen port performance. With the superior natural conditions, the Xiamen gulf was formed with wide harbour waters by some islands including Big Kinmen Island and Small Kinmen Island. As the ports developed late, the facilities included high-tech equipment such as the gantry cranes, bridge cranes. The terminals and berths were well constructed with the help of advanced technology. Fourteen (70%) Xiamen interviewees gave very positive appraisals of Xiamen port infrastructure and facilities. For example,

> *"Xiamen has very complete and convenient logistics facilities and the ports were born of very good conditions with deep water, strong wind protection, no silting and no freezing season…"*
> *Xiamen Interviewee 3, a vice director of a Port Operator*

The director of Xiamen port authority recognised the importance of port infrastructure,

> *"The supply of good quality infrastructure must be ahead of the demand. Otherwise, customers cannot be attracted."*

On the Humber, according to the interviewees and ABP website, the Humber ports have 17 quays with water depth ranging from 4.5m to 14m. The estuary has oil, gas, bulk and general cargo terminals to handle different sorts of cargos. Immingham has fourteen 100-tonne capacity mobile harbour cranes (one privately owned), two 15-tonne electric grabbing cranes, two 10-tonne electric cranes, two 40-45-tonne ship-to-shore container gantry cranes, two 40-60-tonne capacity mobile harbour cranes, one privately owned mobile grain loader and privately owned mobile cranes with a capacity in excess of 100 tonnes are available. Hull port has a wide range of supportive industries, such as marine engineering and ship repairing, for which both dry docking and wet berths are available. In Grimsby, a wide range of privately owned specialised handling equipment and privately-owned mobile grain elevators are available. Immingham has 20,000m^2 of high-quality bulk warehousing and 10,000 m^2 of high-quality general purpose warehousing. Grimsby and Hull have a wide range of covered and open storage. Goole has two dry docks and some specialized facilities providing ro-ro services.

The Humber's technical infrastructure, however, was not highly rated. The Humber interviewees noted that in the Humber estuary, only Immingham has deep water. The navigation depth constrained the Humber to serve container vessels and the Humber ports are targeted as feeder ports instead of transhipment ports. One manufacturer logistics manager expressed his concern that the ports could not provide suitable facilities for bigger vessels to call.

"Our business needs to bring bigger vessels due to our increasing business; however, only smaller vessels can come through the locket gate. The beam restriction of 25.5m wide prevents the bigger vessels entering the gate".

Humber Interviewee 1, a Manufacturer Manager

Some other interviewees such as the port users were not happy with the port facilities, either, as illustrated by Humber Interviewee 17, a director of a shipping company,

"The facility and equipment have quality problems and sometimes they don't work. I do not think they (the port owners) provide good facilities. The port technical infrastructure here is not good, especially compared with the ports in Europe."

Interviewee 17 commented that the port facilities were old and out-of-date,

"The equipment such as cranes here are very old, 35 years old, like third world equipment."

When asked about why the facilities were not satisfactory, most interviewees explained that port owners had some concerns about the investment in new facilities, which is capital intensive investment. Another example of poor facilities was given by Interviewee 1, who said,

"Being one of the biggest port customers, Drax Power Station needs huge coal demand increase, however, the current coal terminal cannot satisfy the demand. The coal terminal expansion project has been approved, but, due to lack of investment and maybe some other reasons, the new terminal won't be in place shortly. Same is true with the new container terminal. The government should work closely with port owners on the financing of the infrastructure improvement."

As the Humber ports are privately owned by ABP, they would make the assessment based on the payback period; meanwhile they would make sure of the long-term commercial deals with the customers to guarantee the return, according to one ABP manager. As ABP has not obtained the contracts with customers, the projects have been postponed. This is the problem with investment and private monopoly ports.

In terms of land availability, 90% of the Humber interviewees considered the land is very limited and there are restrictions on permission for land use. Lack of land availability is a very broad issue in the Humber estuary, as addressed by Interviewee 7 from RDA,

"We don't have sufficient land to support the logistics development in this area. The influence is the regional policies in terms of allocation of land and other resources."

The Port of Hull at the Humber estuary is threatened by the local community's demand for commercializing the port area, introducing housing, waterfront parks and other commercial developments. The interviewees hoped that the government would help them with land for their business development. In Hull, one manufacturer interviewee complained that they could not increase productivity due to lack of land, although they had sufficient capital.

The port infrastructure also includes depth of navigation channel, which is a very important determinant of port competitiveness in the literature (Tongzon and Heng 2005; Tongzon 2007). Xiamen has deep water while the Humber does not. Insufficient water depth is a constraint for Humber's port development. Good technical infrastructure benefits Xiamen and poor port technical infrastructure hinders the Humber ports. They exemplify that port infrastructure is important for port performance.

5.3.2 Information and communication technology system

Seven interviewees (33%) highlighted the importance of the information system. Six (30%) interviewees noted that the IT system in Xiamen does not work effectively, although Xiamen has set up a logistics information platform with promotion and help from the Xiamen government. The application of the information system so far is limited to the very basic and primary functions such as e-booking and e-billing, and even these limited functions are confined to big companies. The information platform has not covered a wide enough scope, as the overall operations level and skills are poor. The supporting logistics information system has not become effective yet. These issues are reflected in a mixed explanation of IT problems and customs service problems, provided by Interviewee 6 from the manufacturing sector:

> *"The information system has become the bottleneck of Xiamen port development. The link between shippers and customs is not smooth. Our company has tried for many years to link to the customs; however, it still does not work well. The government may declare how advanced the system is, actually it is not. The system may work well with big companies such as Dell. Xiamen wants to retain Dell and they provide a special team to serve Dell, however, not every company can enjoy this privilege. Another example is BAX GLOBAL INC (Xiamen) that enjoys the 2 hours green customs service that means Bax can get custom clearance completed within 2 hours after cargo arrival. However, it must be noted that most other customers cannot enjoy this service."*

This finding is consistent with the view of Tongzon (2009) that lack of an adequate information system would slow down the documentation process and the smooth functioning of a port.

5.4 Landside transport infrastructure

Xiamen Island is connected to the outside by Xiamen Bridge and Haicang Bridge. Xiamen interviewees had a common understanding that poor infrastructure to connect ports and hinterland is one of the main factors that hinder Xiamen's port performance. Actually, 16 (80%) of the 20 interviewees commented on the poor physical infrastructure connecting Xiamen ports and the hinterland, especially the inadequate railways. Here are some quotations:

"Xiamen is blocked by mountains around. Currently there is only one rail to connect Xiamen and other places. The communication infrastructure is poor. Almost all of our customers would not consider railway for transport, as it is too slow. Almost all links to ports rely on road, and the highways are limited due to natural conditions."

Interviewee 1, one 3PL Manager

"There is hardly any intermodal in Xiamen. People know it as a concept but also know it does not work in Xiamen, because the physical infrastructure is not in place. Many companies even do not have loading/unloading platforms for containers, which makes intermodal quite difficult."

Interviewee 6, a retailer Manager

"The infrastructure in the whole Fujian Province is rather poor. There is not sufficient quality infrastructure from the ports to the hinterland. The poor rail and highway infrastructure cause higher transport cost to the shippers than other ports."

Interviewee 15, a manufacturer Manager

The interviewees noted that insufficient rail and road had caused slow transport in the whole province. Most of the cargoes from inland China do not come from or go to Xiamen due to lack of proper transport infrastructure. The province needs to improve the transport infrastructure very urgently as it is very critical to develop port performance. Xiamen is similar to Shanghai in that neither port has sufficient cargo sources in the city itself. However, Shanghai has attracted much more cargo than Xiamen because Shanghai has good quality infrastructure that brings cargo easily from hinterlands. As Interviewee 11, a port manager, pointed out,

"Although Xiamen has a good traffic system by sea and by air, and the sea-rail transport has already been put into use to connect Jiangxi economic hinterland and Xiamen, there are few cross-provincial railways and they are low-grade. The main highways have not been connected to the port areas; there are few main roads to support, which has caused too much pressure on communications and there is serious bottleneck between ports and the city. The lack of transport capacity has constrained the extension of Xiamen's economic hinterlands towards the inland, and constrained the logistics distribution efficiency within the region accordingly."

However, Xiamen interviewees had a positive assessment of Xiamen's aviation. Gaoqi International Airport has enabled Xiamen to link with other cities in China and worldwide. Interviewee 7 said,

"The distance between Gaoqi International Airport and port is about 10km. To my knowledge, no other ports are so close to the airport. This has brought convenience for intermodal development".

Although the current landside links of Xiamen ports are poor, Xiamen has set off an upsurge of urban construction, including ports, railways, highways, urban transport, which has made a significant improvement. These changes are initiating new opportunities for Xiamen.

As for the Humber ports' physical infrastructure, some interviewees commented that the general framework was good. The Humber estuary had good communications and good shipping links to the close continent. As interviewee 12 stated,

"The most important aspect in this area is location, good access by rail and road, good access for marina access, and ports can handle large ships."

Trade and industry in the Humber were boosted by the arrival of the rail link with Leeds and other railways including the Hull, Grimsby and Barnsley Railway and opening of associated docks to break the perceived local monopoly of the North Eastern Railway in the 1840s, according to one interviewee. The Humber case exemplifies that transport is important for trade and port performance.

However, the shipping lines that link the Humber and other ports in the world are not satisfactory. There is no direct line to link the Humber and the Far East or Middle East. This is why the Humber local companies would choose the southern ports for trading.

Regarding landside links, the interviewees had some negative comments on the port related road and rail in Hull, and port-related rail in Immingham.

> *"The basic framework of port related infrastructure is quite good. However, it is widely known that some roads need improvement, like A63 Castle Street in Hull, Hedon Road and M62 and M1 improvement. The rail to connect Hull port to the power station needs improving as well."*
>
> *Interviewee1, a ManufacturerManager*
>
> *"A160/A180 near Immingham is poor and needs improving, this has been proposed to the Highways Agency for review to take action."*
>
> *An Interviewee from the City Council*
>
> *"The physical infrastructure in north bank is weak around Saltend. As all traffic from the ports by road will go through central Hull, it is very congested. We have some concerns about building a bio-fuel plant in Hull due to the road access problem".*
>
> *Humber Interviewee 2, a Manufacturer Manager*

In terms of the main road, the Humber does not have motorway advantages. The Humber estuary is not in the heavy industry and major motorway region, which is why it does not have very good physical infrastructure, an interviewee said:

> *"The heavy density of industry is in west Yorkshire. They've also got the cross roads of M1, M62 which are major motorway networks for England. There is much more investment in west Yorkshire than in east Yorkshire in the M62 corridor."*
>
> *H6, Director of Road Haulage Association*

The river with the estuary, as one transport mode of physical infrastructure, is a gateway into the region. The interviewees noted that the Humber region has rich waterways with its canals and tributaries. However, 60% of the respondents claimed that the waterways were under-utilized, as there was a doubt about the demand for the waterway. Since the waterways in the Humber were more expensive than in any other English regions in investment, the government would not invest until they were sure about the actual demand. The RDA manager and some other interviewees raised the concern that waterway investment is an issue of "chicken and eggs". However, they believed that as people were becoming increasingly concerned with the environment, the waterways would be promoted eventually.

Some interviewees noted that Yorkshire Forward did not understand the importance of the waterway, which is the richest in this area, to connect the sea to Leeds, Goole and Sheffield, as Interviewee 16 said:

> *"They understand the importance of Manchester airport, but they wouldn't see the same importance of the Humber ports. The Humber is actually the access where goods are imported, but people don't really appreciate the importance of ports."*

As for road infrastructure, most interviewees were aware that Hedon Road and Castle Street have been bottlenecks, but the problems are still ongoing. Although proposals have been repeatedly raised, they have not been improved due to lack of investment. People in Hull have witnessed no change in road conditions for over 20 years. Interviewee 3 complained that,

> *"The only changes we see are the changes of proposals. With time passing by, the project proposal has become more and more expensive. More budgets are needed for the actions."*

As for the link between South Bank and North Bank, the great width of the river has prevented unified economic development on both river banks. A bridge was finally built in 1981 to help stimulate industrial and commercial growth in the area. The bridge has connected the industrial complexes around the Humber ports. However, the toll has been heatedly discussed over years. It is argued that regional communications would become better if the toll were abolished. The local citizens have had a long campaign against the expensive toll, as its abolition would make their lives much easier. For example, patients from the south bank travelling to Hull hospitals would save much money. The possibility of abolition has been investigated and found feasible, as the tolls on both the Forth and Tay bridges (in Scotland) were abolished in 2008.

The infrastructure is important, because the size of the hinterland depends on the quality and availability of transport infrastructure. Accordingly, the logistics demand depends on the size and economy of the hinterland. Many ports have been seeking intermodal links to expand their hinterland. However, the finding is that there are no intermodal links in the Humber and Xiamen.

The finding that physical infrastructure is important for port performance is in line with Tongzon and Heng (2005) and Tongzon (2009). Sanchez et al. (2003) note that adequate infrastructure leads to high level of productivity and efficiency. The second finding on infrastructure shows that although intermodal transportation has been advocated for many years, neither the Humber nor Xiamen has put this idea into practice. The third finding on infrastructure is that waterways are not well-developed, although the trend is to demand more waterways, due to environmental concern.

5.5 Seaside connections

Seaside connections include deep-sea shipping services and feeder services. By the end of 2007, Xiamen had around 96 shipping lines including container liners to connect over 60 ports from over 40 countries worldwide (Wang and Chen 2008; Huang 2009). Most of the top 20 carriers in the world, such as Maersk, American President Lines, the Mediterranean Sea, P & O Nedlloyd, Evergreen, COSCO, and China Shipping, have set up branches or agencies in Xiamen. Xiamen cargoes can go to America, Europe, Mediterranean, Australia, Japan, Singapore, South Korea, Hongkong and Taiwan, over 40 countries worldwide.

Xiamen interviewees gave a favourable assessment of the shipping frequencies and Xiamen's links to other major ports and feeder ports, as stated by Xiamen Interviewee 7, a carrier manager, whose view is identical with the literature by Huang (2009),

> *"So far (2009) there are over 120 lines to connect Xiamen and other port destinations in over 60 countries around the world."*

Another carrier manager in Xiamen, Interviewee 20 said,

> *"Shipping frequency is one major factor for us to consider whether we would select the port or not. The ports with more shipping frequency would attract the carriers more easily so that the shipping frequency will be increased. On the contrary, ports with less shipping frequency would develop more slowly. More carriers call at bigger ports and the container TEUs increase sharply."*

The Humber interviewees showed their dissatisfaction with the Humber seaside links. Due to lack of deep water, big containers cannot call at the Humber estuary. There is no direct ship to the Far East. However, as feeder ports, Immingham and Hull can support the call of short-sea container vessels.

Eight interviewees in Xiamen and nine interviewees in the Humber claimed that frequency of shipping lines is critically important for port performance. The finding is consistent with the literature by Slack (1985), De Langen (2007) and Tongzon (2009).

5.6 Logistics cost

Monash Marketing Dictionary defines logistics costs as costs involved in the acquisition and transportation of materials required for production, and for the storage, handling, and shipment of finished goods to customers. Low cost is the necessary strategy at the initial stage of port development. It aims to attract more cargo sources to build the customer networks. Ports have tried many measures to reduce the port cost to attract the transhipment cargo for the long-term benefit. Port users, whether they are carriers or shippers, seek cost minimization to survive in the current fierce competition.

Generally, the cost was divided into three sub-sections by the interviewees: shipping prices, port charges and overall logistics cost. Port charges in Xiamen were considered not very important, as all the ports in China are required to use the same standard for port charges. Ten (50%) of the twenty Xiamen interviewees held the view that Xiamen port terminal charges to carriers were low, which is a good factor that attracts shipping lines to call.

> *"Xiamen port charges are lower than the country average level. For example, the THC (Terminal Handling Cost) in Xiamen is 15% lower than the country's average cost. Xiamen also charges less than other ports for the container storage. The container charge in Xiamen is the lowest among all China ports. We call at Xiamen partly due to the lower port charges, sometimes the port even provide services free of charge for container storage…"*
>
> *Xiamen Interviewee 5, a carrier Manager*

The details of Xiamen port use charges are available on Xiamen official port website (www.portxiamen.com.cn), including the carrier cost, agency cost, tug and pilotage, cargo loading/unloading charges, man-hour rate, rental of boat, equipment, facilities and other operations cost, domestic line carrier cost, lump sum for domestic container cost, port construction fee, and port dues. They are also visible in the lobby of Xiamen Port Services Building.

Shipping freight and overall cost were considered very important. Seven Xiamen interviewees complained that port service costs are high, such as document change fee, security fee, inspection charge, storage cost. The general understanding was that Xiamen's overall cost is high compared to other top ports, although some costs like THC are low. As logistics cost includes a wide range (Section 3.2.3), it is very hard to tell whether the cost is high.

In the Humber, 80% of the interviewees state that the local port charges are higher than those of other ports. Humber Interviewee 1 complained that,

> *"The dock charge in Hull and Immingham is much more expensive compared to other ports in UK. Moreover, there is about 5% annual increase, which is unreasonable at the economy downturn."*

Port users saw the high port charges as burdensome. The port users complained about the cost, but they had no choice as some of them had long-term agreements with the port authority. Some interviewees explained that the high cost was because the port was purely privately owned with monopoly which resulted in no competition. Moreover, as the manufacturer said, it was not easy to remove the factory to another place once it had settled down. They had to accept the unfair charge.

Cost is a huge concern for port users, according to the interviewees. The Humber interviewees commonly thought that the tariff-charges for dock use are expensive, but business wanted low cost, which is why the port users complained about the charges. Consequently, many local companies would choose the southern ports rather than the Humber ports and not so many vessels would like to call at the Humber ports. Cargo interest's not staying with the Humber ports has influenced the local port development and the regional economy to some extent.

Another cost in the Humber is the business rate (taxes on using the port) which the national government imposed and of which the Humber interviewees strongly complained. Humber Interviewee 17 said,

> *"The business rates are not fair. Many other companies like us are facing difficulties with the extra cost because we are double charged. We pay according to agreement by tonnage to ABP, but VOA charges us for a second time. Our main issue is cost now. ABP are increasing charges which make us uncompetitive, and they increase the charge yearly, not allowing negotiation. This has made us unattractive to customers and our biggest problem now is we are losing customers."*

According to the interviewees and the desk research results, the Valuation Office Agency (VOA, a UK government body) decided to levy business rates from port users from April 2005 in some UK ports. However, it was not implemented until September 2008, when VOA started to instruct local authorities to issue long backdated and often disputed rates bills. The bills were backdated over three and a half years, and the demands could not have been anticipated or budgeted for by the companies concerned.

The unanticipated increases of cost have put 70 companies into serious financial difficulties. The result could be business closures, redundancies and loss of investment. The difficulty was explained by Interviewee 15, who said,

> *"Some companies have massive bills, which will damage their business. P&O has to pay 5million for business rate, Rix & Shipping has to pay 1.25m. They don't know where to get the money."*

One interviewee from the local city council agreed that the rate was unfair to business; however, the interviewee admitted that the local city council was not strongly involved politically in this argument. The companies at the ports have been deemed to be legally liable for tax, so they must pay what is due. Considering the difficulties businesses are facing, the resolution is that businesses can pay the backdates over 8 years by instalment.

The finding that cost is a key factor that influences port performance is in line with Murphy et al. (1991), Lirn et al. (2004), Tongzon and Heng (2005) and Tongzon (2009). Lirn et al. (2004) find that handling cost for containers is the first criterion for both carriers and port operators to consider when they choose a port. One interviewee notes that carriers have the decision-making power among port stakeholders. The researcher would argue that there must be some balance between the benefit of carriers and benefit of shippers.

The researcher could not obtain information on port charges from the port authority, as the interviewees explained that they were not allowed to disclose the charges due to confidentiality. However, the researcher identified the cost performance from other interviewees like the Humber port users, who complained strongly about the expensive port charges. The interviewees would not disclose how expensive or how unfair the charges were, compared with other ports, but they knew that different rates applied to different ports in UK and they were aware that different port users in the Humber paid different rates. This is an interesting finding that Humber port cost is not transparent while Xiamen port cost is transparent.

5.7 Logistics demand

As for logistics demand, which was backed up by the local economy and hinterland economy, eighteen (90%) Xiamen interviewees strongly highlighted its importance. They understood that logistics demand would be scant without the support of the economy. A developed economy ensures sufficient cargo resources for the trade, which makes the logistics demand high.

Six (30%) of the Xiamen interviewees noted that Xiamen had the obvious characteristics of an export-oriented economic development model. By 2007, 80% of the industrial output from the scaled companies had been created by foreign funded enterprises (Huang 2009). Foreign invested companies have played a key role in the rapid development of Xiamen's industrial economy and logistics development. Focusing on an export-oriented growth competitive strategy requires extensive port rationalization for export-led success and attracting import investment (Airriess 2001). The interviewees considered the export-oriented model as one of the factors that improve port performance, as the output by foreign invested companies would be exported via ports.

However, Xiamen's local economy is not strong enough to support port development. One interviewee noted that Xiamen GDP was ranked the 50th among China's top 70 cities in 2008. The interviewees highlighted that Xiamen's local economy is weak. As Interviewee 15, a logistics manager from manufacturing, said,

> *"Xiamen is not an industrial city. Its manufacturing is poor. Even for exports, the main products in Xiamen are light industrial products such as bags, clothes and shoes, which have low value. There are few high-tech products here. The product range is narrow, which indicates that there is not a variety of products from Xiamen to be shipped. The cargo value and volume cannot be very big."*

Some interviewees had concerns about the cargo types for trading at the Xiamen ports. One PSP manager, Interviewee 1said,

> *"One of the main products Xiamen transports is stone, which is heavy and has low value. Stone is known as a non-reproducible product. Xiamen is the port to ship the biggest share of stones in China. I don't know what would happen if Xiamen loses the stone shipment at the end of the day."*

Some interviewees were also concerned about Xiamen's hinterland economy. Xiamen has a very limited and constrained hinterland that is Fujian Province, east of Guangdong Province and south of Jiangxi Province. This is because Xiamen is stuck with Hongkong and Shenzhen in the south, Shanghai and Ningbo in the north and Kaohsiung to the east, which are known as international or regional container transhipment ports. In the west, Xiamen is constrained by poor infrastructure and mountains. The lack of logistics demand hindered port performance, as one interviewee said:

> *"Xiamen port's hinterland is small. It is not like Shanghai or Shenzhen/Guangzhou which have vase hinterland (YRD or PRD). River navigation provides cheap and convenient transport for the cargos from the broad hinterlands to go to Shanghai or Shenzhen. Xiamen is separated from the inland by mountains, and physical infrastructures are not in place to link the inland and Xiamen ports, which has resulted in scant cargo resources."*
>
> *Interviewee 18, a Marketing Manager of a 3PL*

In 2008, Fujian GDP was ranked 12th and Jiangxi GDP was ranked the 19th out of the 31 provinces in China (www.stats.gov.cn), which shows the weak economy of Fujian and Jiangxi. For Guangdong, although its GDP was first among all the provinces, most of the cargoes go to Shenzhen or Guangzhou instead of Xiamen. Moreover, it is not feasible to expand the hinterland to inland. On the one hand, the shippers would consider Shanghai or Shenzhen for their import/export as they provide better services with lower costs. On the other hand, the infrastructure connecting Shanghai or Shenzhen/Guangzhou is much better than that connecting Xiamen.

However, although Xiamen does not have strong hinterland to support its port demand, the trade between Xiamen (XM) and Taiwan (TW) supports Xiamen's logistics demand. In 2004, XM exports to TW were ranked No 5 of all the exports; TW exports to XM were ranked No. 2 of all the TW exports (Chen et al. 2008).

According to Humber interviewee 3, the Humber catchment area had strong logistics demand:

> *"75% of UK manufacturing industry is in 4-hour drive from Humber ports, which provide rich products for ports shipment."*

A large amount of the logistics demand in the Humber actually comes from West Yorkshire. This may be due to historical reasons that caused industry in the Humber to be different from that in West Yorkshire. The Humber estuary was a large fishing industry base while West Yorkshire had numerous manufacturers.

According to a MDS and Regeneris Consulting report (2006), 56% of the imported trade and 69% of the exported trade (average about 60% of the cargos handled in the south) through the UK southern ports are actually from and to the northern region. To relieve the pressure of congestion in the southern ports such as Felixstowe and Southampton, the Humber ports can take over much volume.

The Humber interviewees noted that the main products transported here are coal, timber, paper, ores and containers. The Humber ports had large potential logistics demand, as Interviewee 19, one regional LSP director, stated,

> *"We see a steady growth in the amount of freight coming into the northern port both in Humber and Tees, because both land and access are better in the north than those in the south."*

A government officer held a similar view. He learned from one consultant report that 60% of the cargo shipped from the English southern ports are actually coming or going to the three northern regions, which implies that the Humber ports had a great potential opportunity to improve their logistics.

This section has confirmed the literature that regional economy influences port performance (Song and Yeo 2004).

5.8 Logistics services

The quality and availability of logistics services such as customs and border inspection service, logistics personnel skills and management levels, speed of cargo handling, port risks, port safety and other services by LSPs were recognised as important factors for port performance improvement. This section will address the findings on the service elements one by one.

5.8.1 Customs and other border services

Customs service was highlighted by eighteen (90%) of Xiamen interviewees as a critical factor to influence port performance. The interviewees acknowledged that Xiamen customs service had somewhat improved. Big manufacturers such as Dell, Xiahua Electronics Group and You Da Guang Dian, which enjoyed the "green custom channel", were happy with Xiamen's customs services. Dell even claimed that they had a very cordial relationship with Xiamen customs and cooperated very well with them. Customs created and broke customs clearance records to satisfy Dell's production in

Xiamen. Border inspection is another service factor but is closely related to customs services to improve port performance.

However, 16 (80%) of the 20 interviewees strongly asserted that Xiamen's customs service was poor, although they admitted that certain progress had been made. The border agency requests more documents than in other ports, and more complicated procedures are followed, which has caused slow customs process. The shippers complained that the cost of custom was increased due to waste of time and human resources. The following are examples:

> *"The slow customs service has affected our company's efficiency."*
> *Interviewee 1, a 3PL Manager*
>
> *"Lack of direct access to the customs from the companies makes the custom inefficient. In Xiamen, only about 20 companies enjoy the green process to link Xiamen Custom. The advanced IT system is unavailable to integrate the different organisations. Also, as the different departments do not compromise with other departments on the standards, it is too difficult to integrate the system, which also causes customs inefficiency."*
> *Interviewee 6, a Manufacturer Manager*
>
> *"We are requested to provide more documents in Xiamen than in other ports. The customs officers do not trust the shippers, which has driven shippers away from Xiamen."*
> *Interviewee 15, a Manufacturer Manager*

The researcher understood from the interviewees that Xiamen customs used to be very stringent. They became strict after the "4.20 Case" which was the biggest smuggling case since the People's Republic of China was founded. About 600 important government officers from different levels were involved in the case and were dismissed from their posts, which had serious impact on Xiamen in various aspects. China lost over 83billion RMB over the case. The interviewees thought that customs supervision now is too strict and it has influenced the government work efficiency and slowed down the development of Xiamen. According to the interviewees, the poor customs service is a big problem that hinders Xiamen's port development. This is not only a matter of logistics development, but also a matter of politics.

The Humber interviewees did not highlight the importance of customs service, because most of the Humber cargoes go to Europe. For cargoes from one country to another within EU, customs is not necessary due to the duty-free trade. For cargoes to other destinations, customs service is not a problem in the Humber, either. One interviewee from a manufacturer said they declared customs and applied for customs clearance on the website by themselves instead of contracting it to freight forwarders as Xiamen did. To his understanding, the customs here is very efficient.

The empirical research finds that custom and border services in Xiamen are difficult while the services in the Humber of UK are not an issue at all. The finding that customs service is important for port performance is consistent with the view of Tongzon (2007) and Arvis et al. (2010) who assert the importance of customs policy. It is also found that customs services in UK and China are quite different due to different historic, political and economic contexts.

5.8.2 Skills

The Humber and Xiamen interviewees noted that logistics skills and management levels are important for port performance. With the increasing logistics demand, the demand for logistics personnel with skills and management expertise is increasing accordingly.

The management level plays an important role in logistics development. Whether the policy is implemented efficiently and effectively depends on the ability of the management team. For example, in the early 1980s, Shenzhen, Xiamen, Zhuhai and Shantou were the first four open special economic zones by the Chinese government and Xiamen actually had a better opportunity than Shenzhen. However, Xiamen has developed much slower than Shenzhen for three reasons: the political relationship between Taiwan and Xiamen; culture difference; and difference in logistics skills and management level. This section will address the last reason.

Table 5. 2 Age profile for Xiamen logistics management team

Level	Below 22	22-35	35-45	Over 45
Junior	22.30%	69.80%	7.20%	0.35%
Middle	8.23%	62.45%	20.31%	8.68%
Senior	0.48%	24.56%	60.35%	14.61%

Source: Wang and Chen (2008)

Regarding the age of logistics personnel, the interviewee from Xiamen Logistics Association noted that middle level management personnel are young and lack experience, although senior management level are reasonably experienced in terms of age. This is consistent with Wang and Chen (2008), as shown in Table 5.2.

As for educational qualification, most of the logistics personnel had qualifications from colleges and universities. However, among senior level managers or directors, few people held a Master’s or doctorate degree, but they actually had commercial experience which is more important than higher degrees. The finding is also consistent with secondary data by Wang and Chen (2008), as shown in Table 5.3.

Most logistics companies in both the Humber and Xiamen are very small with less than 30 staff. According to the statistics provided by the Logistics Office of the Xiamen Government, 70% of the logistics companies are small. Although some people have some knowledge about logistics planning, transport scheduling, warehouse management and freight forwarding, their knowledge is biased. Most of them do not know current logistics operations management, logistics system design and scheme, nor do they know logistics information systems. Two interviewees noted that logistics training lags behind and logistics skills are inadequate in Xiamen. At management level, the top levels do not have much knowledge and experience as well, as logistics developed late in China.

Table 5. 3 Education profile for Xiamen logistics management team

Level	Doctor	Master	Undergraduate	High school	Below high school
Junior	0	0	78.86%	21.12%	0.48%
Middle	0.52%	1.28%	85.65%	12.65%	0
Senior	2.13%	6.76%	89.85%	1.25%	0
Average	0.88%	2.58%	84.89%	11.67%	0.39%

Source: Wang and Chen (2008)

In the Humber, according to Skills for Logistics (2009), the Yorkshire & Humber region has around 215,300 employees (9% of the regional employment) working in the logistics sector. The investigation shows that there is a pressing need to improve levels of literacy and numeracy skills within the Humber logistics workforce. In terms of qualification, 52% of the workforces are below National Vocational Qualification (NVQ) Level 2, 14% have attained NVQ Level 2, and 33% are above NVQ Level 2. The report also shows that leadership and management skills need to develop across the sector to improve port performance.

Ten other interviewees held a similar view that this region lacks skilled people in logistics. The Humber region's skills are below the national average. Skills for Logistics are trying to promote high level of management skills and considering catching people at younger ages to ensure that logistics are basics in their career.

Skills and management capability were identified as important, although both The Humber and Xiamen lack the logistics personnel with skills and expertise.

5.8.3 Speed of cargo handling

Sixty per cent of Xiamen interviewees and fifty per cent of the Humber interviewees held the view that speed is very important in logistics services. Interviewee 13 said,

> *"Speed of cargo handling is critical. As the increasing scale of vessel size requires faster ship loading and unloading. The number of terminals is fixed. If the speed is slow, the ship would occupy the berth longer, which will delay the next vessel calling. If such cases happen frequently, the carriers would seek for other ports to call rather than wait."*

Interviewee 11 said,

"Yantian's operations efficiency with high speed has saved much time for the port and carriers, which has resulted in bigger profit for the port and carrier."

Speed of cargo handling is an important service factor. It could contribute to port efficiency at the vessel calling, departure and cargo movement. Speeding up handling can fasten the total loading/unloading speed and shorten the vessel stop time at the port.

5.8.4 Risks and safety

Sixteen (40%) of 40 total interviewees realised that risk (such as congestion, delay) and safety management were explicitly important for port performance. Some interviewees in Xiamen highlighted safety for long distance drivers, as most traffic accidents happened because of tired drivers. Due to time constraints, they did not explain the importance in detail. Although there are legal restrictions for drivers to take a break of 20 minutes after every four hours in China, in many cases, the regulations are not so well implemented as in UK. The interviewees understood risk and safety as a common sense of obvious and critical importance.

5.8.5 Services by logistics service providers

Both the Humber and Xiamen interviewees recognised the importance of services provided by LSPs, and they are happy with the services of warehousing, freight forwarding and cargo handling.

Interviewees from the two port regions acknowledged that logistics services such as customs, speed, skills, risk and safety management are important for port performance. The finding is in line with Murphy et al. (1991, 1992), UNCTAD (1992) and Tongzon (1995).

5.9 Port ownership

Port ownership was found to be important to influence port performance. Six (30%) interviewees pointed out that Xiamen port services had improved greatly in the past 20 years, partly because diversified port owners, multiple port operators and port managers had replaced the complete monopoly of port owner, operator and service provider. Xiamen ports used to be a state-owned monopoly. Nowadays, there are 11 port investors and 9 port operators, including the government agency, Maersk and Huchison. The multiple investors and operators actually contribute to improve services due to competition, according to the interviewees.

Xiamen ports have experienced the process of moving from an exclusive "complete monopoly" by the government to "oligopoly" by diversified ownerships. Taiwan has invested in a liquid chemical port; state-owned-enterprises such as Xiangyu Group, Guomao Group, Jianfa Group have treated the terminal construction and operations as their main businesses. Private enterprises such as Haiao Group are also involved in port ownership; the well-known international shipping line Maersk has 50% ownership of Songyu Terminal; Hutchison Port Holdings, the well-known international port operator, has gained 49% Xiamen International Terminal ownership.

The interviewees raised their concerns on operations diversification. The number of Xiamen investment entities and the regional oligopoly are growing in a non-rational direction, resulting in dispersion of port supporting services as well as the low efficiency of port operations due to a waste of resources. This has highlighted the absence of competition norms and rules. The irrational pricing strategy has become the main means of competition, which has made the port managers and the state-owned port operators unable to coordinate and balance the competition. Thus, the bargaining power of the main terminal operators against the shipping companies has weakened year by year. Consequently, the terminal operations benefit has been continuously low, and it is difficult for the terminal to invest in the port capacity and improve integrated services.

In the Humber estuary, the Association of British Ports (ABP) is an independent, municipally owned company responsible for the planning and maintenance of the port as well as tugging and dredging for the Humber ports. The Humber interviewees noted that due to monopoly, the port users did not have power against the port owners. The monopoly was considered unhealthy for port development. For example, ABP have problems with investment in the lock gate, coal terminal and container terminal, which needs big investment. As ABP is the sole owner of the ports, the investment is difficult to secure unless ABP is sure about the return.

The finding that port ownership would influence port performance is consistent with the claim of Borger et al. (2008). Further discussion will be given in Chapter 7.

5.10 Environmental concerns

In the Humber estuary, the main challenge facing the ports is to accommodate competing development pressures while safeguarding the internationally important environment of the estuary, because the Humber is a very healthy estuary that is important for nature conservation. Wildlife and birds here have international importance.

Large parts of the estuary are designated as nature reserves and are managed to maintain and enhance the bird interest. The estuary is healthy and there are many Nature Conservation areas and important Nature Reserves in and around it. That is why there are restrictions on land use. Interviewee 4 said,

> *"The restrictions have prevented many potential customers coming, hence impacted the development of the ports. It's expensive to develop a new plant nearby and it is too difficult to get approval for the project, it may take 2-3 years just for approval...The objections can come from any stakeholders."*

When a new port project is proposed, some stakeholders oppose it because of the potential impact on environment. For example, when Quay 2000 was proposed as a new container terminal, it was opposed by the key stakeholders: the Environment Agency, English Nature and the Wildlife Trust.

The Humber interviewees were aware of the environmental influence caused by logistics and they were concerned about the environment and emission reduction. They try to reduce emissions and develop green transport by promoting public transport, promoting a modal shift from the car and promoting the movement of goods by water and rail. The interviewees suggested that logistics need better environmental legislation.

Together with English Nature, the Environment Agency and the Wildlife Trust, ABP has provisionally identified the waterfront developments at each of its Humber ports for wildlife in response to the designation of nature reserves and recent environmental legislation and proposed port developments. The Humber estuary is expected to meet environmental and resource goals while serving the growing UK trade. The environmental relevant bodies highlighted sustainable development needs.

In China, there is increasing evidence that people are concerned about the environment, although China is still at the developing stage. For example, Xiamen rejected the PX project that had over 10 billion RMB investment and would bring output of 80 billion RMB a year. The project was rejected because of environmental concerns. As the distribution may have some negative externalities on costs and benefits, such as pollution. Some incentives have been promoted to reduce the negative externalities. For example, renovation of port machinery and equipment has been promoted to change from fuel-driven into power-driven to address environmental concerns. In January 2009, China introduced a fuel tax to match the international standards on fuel price, which is conducive to energy-saving and emission reduction. The economy and environment need assessment to keep a balance or make compensation. With government support, China has promoted energy-saving and emission reduction technology, advanced ship technology, and encouraged the development of inland navigation, especially in the Yangtze River.

That environmental concerns influence port performance is the new finding with the promotion of environmental protection.

5.11 Politics

Politics is recognised as one factor that influences port development. Xiamen has long been regarded as a city more important politically than economically. Most interviewees considered that Xiamen's development largely depended on mainland China's political relationship with Taiwan. They held the view that the politics in Xiamen was not stable, which hindered the development of Xiamen port performance for quite a long time. This is also the reason why Xiamen had not developed so well as Shenzhen and other cities. The FDI investors had some concerns about the stability of politics, which caused many investors to prefer not to invest in Xiamen.

The current poor landside links to the hinterland are to some extent due to political issues. Xiamen is very politically sensitive towards Taiwan while Taiwan is significant to the mainland China both economically and politically. When the relationship was tense, the transport infrastructure was not developed and port performance was poor; when the political relationship was improved, port performance became better.

The idea that political stability influences port performance is supported by the evidence of recent Xiamen-Taiwan relationship. In the mid 1990s, Xiamen hardly developed due to the tense cross-strait political relations. As Xiamen lacked the necessary logistics support from Taiwan when Taiwan transferred its first run of manufacturing to mainland China, Xiamen retained its poor port performance status. The Taiwan businessmen, who had come to Xiamen earlier due to kinship, have disappointed and left Xiamen for other cities, such as Dongguan and Kunshan.

When Shuibian Chen, the representative of the DPP (Democratic Progressive Party, Taiwan), was in power for eight years (2000-2008), an ideology of extreme manipulation, including radical "Taiwan independence" and a narrow populism, prevailed in Taiwan. Chen's policy provoked mainland China and undermined cross-strait relations.

The literature has hardly addressed politics in port performance development. Although Tongzon (2007) and Lirn et al. (2004) mentioned that political stability was one determinant of competitiveness in logistics, they did not include this determinant in his empirical research. The current finding supports Tongzon's view that politics is important for port performance and it enhances the literature by empirical analysis.

5.12 History

History was identified as a factor that influences port performance, as explained by Interviewee 10,

> *"The Humber and West Yorkshire have different sectors to support the local economy. It is probably because of the different historical industry in the two areas. The Humber estuary was a large fishing industry base while West Yorkshire has a long history of manufacturing. Teeside has a history of steel making while the Humber estuary has a chemical and oil focus in relatively recent times…"*

In the middle ages, The Humber developed as ports to export lead, grain, coal and wool to northern Europe and to import cloth, oil seed, iron-ore, timber, wheat, hemp and flax from the Netherlands, the Baltic, Sweden, Riga and Norway (YF 2008)). Timber and oil seed have continued to be major imports through the port of Hull to the present day. The estuary used to be prosperous due to trade. However, it suffered a trade decline during the British Civil Wars between the 16th and 17th centuries. Later on, the increasing trade was backed by the agricultural and industrial developments in Yorkshire and the East Midlands in the 18th century, when the whaling trade rose. Then the Humber experienced its period of greatest prosperity until the First World War.

The estuary declined in the 1920s and 1930s because of overproduction in the fishing industry and suffered the heaviest bombing second to London during the World War II. Consequently, the smaller and older docks were closed. The main loss of the Humber estuary was the fishing industry, which collapsed in the 1970s after the "Cod Wars" with Iceland (Teed 1992). However, many old industries which originally developed in Hull are still here, including pharmaceutical firms Reckitt Benckiser, Smith & Nephew, and millers Maizecor. The port of Hull is still a major importer of timber from northern Europe after over 700 years and the Humber estuary is still home to the largest fish market in the UK.

As historically this area was not a manufacturing area, the Humber does not have many local cargoes to support the trade and logistics demand. This explains why the Humber does not have much cargo volume. However, as a quarter of UK areas are within 4 hours' drive of the Humber, the Humber's hinterland is large enough to support the ports' potential logistics demand.

Xiamen started as a port in the Tang Dynasty and has a long history. In the late Ming and early Qing Dynasty, a large maritime trade team, founded by Chenggong Zheng, enabled Xiamen to start and complete the first historic voyage by ship to Southeast Asia, which led China to the world.

After the foundation of the PRC, Xiamen started serving the military, falling far behind the other coastal ports as a regional small port. In 1973, Premier Zhou Enlai called for "change the port profile within three years" and proposed that Xiamen would become a commercial-based port. Since then, large-scale port construction started. In 1981, under China's reform and open-door policy, Xiamen was nominated as one of the five special economic zones in China and became the biggest port enjoying the special zone policy. Xiamen was pushed to the forefront, made to open to the world again and entered a new stage of development. After experiencing ups and downs, Xiamen has become an important trade port on the south-eastern coast of China. History witnessed changes in port development. China did not start container business until the 1970s and Xiamen started to transport containers in 1983. During 2000-2005, Xiamen experienced rapid development.

The history of Xiamen and the Humber port development show that history builds up the port facilities and the relevant sectors generate logistics demand. The researcher would conclude that history is an important factor that influences port performance.

5.13 Culture

Apart from the historical reason, the unsatisfactory customs service in Xiamen may be explained by socio-cultural factors. People who work for the customs are known to have an "iron rice bowl", which means a permanent income they would never lose whether they work hard or not, their jobs are secured whatever their job quality is. Employees in these positions are like the people who used to work in the China state-owned enterprises (SOE). They do not care much about the services. To their understanding, they work for the country and not for themselves, so they do not work proactively. They lack the sense of service, because they get the same salary whether they work hard or not, whether the organisations achieve profit or suffer a loss. Lack of a sense of service has existed long in China due to the state-owned mechanism. Although China has changed sectors from state-owned to private-owned for about 30 years, the lack of service sense still exists in many people's ideology. This is particularly true in the public sectors, like customs and government departments.

At the beginning of China's reform, Xiamen had a better opportunity than Shenzhen to develop its economy and port performance. However, the fact is that Xiamen fell far behind Shenzhen. In the 1980s, Taiwan's manufacturing developed very fast from labour-intensive textile industry and capital-intensive petrochemical industry to technology-intensive industry. The manufacturers had a huge transfer from Taiwan to mainland China under China's open door policy and the great pressure of appreciation of the New Taiwan dollar. Compared with the opportunity provided by Hongkong to Shenzhen, what Taiwan brought to Xiamen were not only trade orders but also a complete industrial chain, which had a strong demand for localization procurement and human resources. Moreover, Hongkong is a free trade port relying on transit cargoes and Shenzhen was just one of Hongkong's cargo hinterlands, while Taiwan did not have many exports and Xiamen was almost its only destination for its industry transfer.

The slow development was attributed largely to the Xiamen leisure culture and not appreciating change, Xiamen interviewee 11 said,

> *"In the early 1990s, when Shenzhen engaged in economic development, Xiamen engaged in policy argument. Due to fear of risk, Xiamen dared not stand out. After 2000, Xiamen was decimated and ever lost the opportunity to compete against Shenzhen. Many people know the meaning of "闽' (min, short term of Fujian Province). It is a dragon when it goes out of the door, but it is a worm when it remains inside. Xiamen's culture made it choose to sit back and wait for opportunity, that's why it cannot get the opportunity to become a dragon."*

Xiamen culture is symbolized by the tea culture. Xiamen is a unique God-given Natural Liveable City with a beautiful environment and pleasant weather. It enjoys a name as "the city on the sea, the sea in the city." Most of Fujian's rich end up buying properties in Xiamen and enjoy the tea culture. The researcher observed many teashops and teahouses, which best reflect the character of the city's comfort. As a cultural centre of southeast China, Xiamen cultivated the habit of drinking tea. Although there are no specific statistics, Xiamen's "leisure economy" is much stronger than that of most other cities. The researcher herself experienced the tea culture when she collected data from the field. Twelve interviewees made tea and offered it to the researcher in a very skilful and leisurely way during the interview and face-to-face questionnaires.

Other than the tea culture, Xiamen culture is essentially a kind of immigrant culture. Xiamen's "leisure culture" is related to the cultural heritage. Historically, people moved from the Central Plains in the 4th century (Jin Dynasty) and the following 800 years, to escape from the wars. They still kept the farming culture that values the relationship between man and land, because farmers cannot easily leave the land. On the other hand, as they had to make a living in a new environment, they do not lack fighting genes.

Most residents settled down in Zhangzhou and Quanzhou. People in Zhangzhou emphasized agriculture, hating to leave their native land. People in Quanzhou had the limited land for survival and had to seek new living space through emigration. Quanzhou residents had to go out by sea to make a living due to the lack of fertile soil, and so a maritime culture was formed. Many people went to Southeast Asia, including Taiwan, the Philippines and Malaysia. They were the earliest people to accept commercial and cultural enlightenment. This is how the commercial risk awareness was integrated into partial Xiamen culture.

In such a cultural background, Taiwan and Xiamen formed a special business relationship intentionally or unintentionally. In Xiamen, the majority of Taiwan companies are small and medium enterprises. They came to Xiamen because of kinship, so they do not require a special investment environment but rely on convenience related to their kinship. As the ecosystem is relatively stable, economic vitality continues today.

In the late 1990s, such big companies as BenQ and Asus grow up with globalization. They had new company values and paid more attention to non-kinship factors such as cheap land, cheap labour and better industry supporting facilities. Thus they went to Dongguan, Kunshan where there was a better investment environment. As a result, Xiamen is no longer a place for them to realize their business dreams.

The confrontation between immigrant culture and farming culture, the collision between farming and maritime cultures, the coexistence of contradictions in comfort and struggle constitute the character of Xiamen citizens. This contradictory character is reflected in the 30-year history of Xiamen’s economic reform and opening up, and also reflected in the transfer routes to undertake foreign investment. However, the main stream of Xiamen culture is a leisure-driven instead of profit-driven economy.

An interviewee gave a typical example reflecting Xiamen’s culture. The Xiamen government spent years in getting the PX project sanctioned by the State Council. After its final approval in 2007, the project was supposed to be built in Xiamen. It was the largest ever project (13.7billion RMB) approved in Xiamen. This project was expected to bring enormous business opportunities and dynamic economic growth to Xiamen. The expected annual production value was estimated equivalent to two-thirds of the entire Xiamen GDP. However, a university professor led a boycott against the PX project. Eventually, this project was refused due to environmental pollution potential.

The Xiamen culture is quite different from that of Shenzhen. Shenzhen is a completely new city with a culture of "time is money, efficiency is life," while Xiamen has a lot of historical heritage and it needs the process of change. The city has pursued transformation by advantages of land, finance and taxation, manpower, industry and business services.

5.14 Other factors to improve port performance

According to the interviewees, some other factors also influence port performance, such as unbalanced containers due to unbalanced trade, port image, social community interruption and a nearby competitor.

One challenge the Humber region is facing its weak image. Most of the interviewees agreed that the regional profile is a big problem. They thought the Humber estuary was very poorly known, as Interviewee 8 said,

> *"I have been to many countries in the world. When I tell people where I am from, nobody seems to know the Humber. The image should be raised as a marketing strategy."*

As for unbalanced containers, there is a vast amount of empty containers due to much more export than import in Xiamen, while the Humber ports are facing the problem of more imports than exports. The unbalanced trading has been a big problem for many countries which results in high logistics cost. Interviewee 19 explained,

> *"There is serious imbalance of Xiamen import and export (the ratio of exports and imports value is close to 2:1), together with the low value of exports. The containers for imports cannot meet the needs of export shipping. Xiamen has to call in large quantity of empty containers, which virtually increases the logistics costs and reduces the port's competitiveness."*

In order to encourage more imports, the Xiamen government has decided to offer subsidies to the companies that import ten resource materials such as farming, foresting, fisheries and mining. This is another form of government support.

Another factor that influences port performance is local community interruption. For example, when Hull applied for the new Quay 2000 Project, the residents near the ports area were against the plan for a new container terminal as they had concerns about the potential impacts on their future life, such as more noise, and environmental impact.

Apart from the factors addressed, a nearby competitor has been identified to influence Xiamen port performance. Quanzhou, being close to Xiamen, is targeting developing a container port by huge investment. Interviewee 9 explained,

> *"Transit cargoes from Quanzhou now account for 35-40% of Xiamen throughput. When Quanzhou and other nearby ports manage to handle container cargoes, Xiamen will face big challenge and risk for developing a transhipment port."*

5.15 Chapter summary

Based upon in-depth interviews undertaken in the first research phase, this chapter addressed a number of findings identified from the empirical research. The findings provide an unambiguous view on the factors that influence port performance from port stakeholders' perspective, in both UK and China ports' context.

Geographical location, government support, logistics demand, physical infrastructure to link ports with hinterland, port infrastructure, information communication system, customs service and the port services provided by logistics service providers, logistics cost, political stability, port ownership were all identified as important factors that influence port performance. These findings are in line with literature addressed by Murphy et al. (1991, 1992), Song and Yeo (2004), Gordon et al. (2005), Notteboom and Rodrigue (2005), De Langen et al. (2007), Tongzon (2007; 2009) and Arvis et al. (2007; 2010). Both the Humber and Xiamen have a positive reputation for some factors, and some negative factors, and for most factors they have different performance from the interviewees' perspectives.

Both regions boasted of their risk management and safety management, which would ensure the efficient operation of port performance. Both regions showed dissatisfaction with their regional logistics skills that are below the average level nationwide. They generally felt somewhat disappointed about their logistics infrastructure as well. To put this more specifically, the port technical infrastructure in the Humber ports is not satisfactory and physical infrastructure to link the ports of Hull and Immingham is disappointing. However, the Humber interviewees acknowledged that their information system is good. In Xiamen, the port facilities are satisfactory but the physical infrastructure to link ports and the hinterland is very disappointing, and the information system is not effective and efficient enough to support the customers' requirements.

Among those factors on which the two regions have different performance, navigation depth, government support, customs service, logistics cost, and logistics demand are typical examples. While Xiamen has around 100 shipping lines connecting Xiamen and major ports worldwide, the Humber mainly have shipping lines connecting Europe as feeder ports due to lack of deep water. Xiamen ports have gained government support very positively from infrastructure investment (on technical, physical and information systems), and preferential policy on tax exemption or reduction. The Humber ports cannot get very positive support, a problem reflected in slow project approval, lack of infrastructure investment and high business rate.

Regarding customs service, Xiamen port users complained about the complicated documentation and cumbersome procedures while the Humber has no such concerns because of its efficiency or because it is not a necessity for European-European trade. Customs service is also the reflection of political issues. For logistics cost, Xiamen port charges are comparatively better assessed than the Humber whose charges were strongly criticized by the port customers. Regarding logistics demand, Xiamen interviewees expressed strong concern on the lack of logistics demand due to the weak local economy and small hinterland, while the Humber has some potential logistics demand which can be attracted to the Humber ports if port facilities are available.

This chapter has also identified some other differences in the factors between the two port regions. For example, the business rate was raised as a big issue in the Humber estuary while there was no complaint on this in China. Politics is an issue that hinders Xiamen's port performance, especially the relationship with Taiwan, while in the Humber stable politics is not an issue in relation to continental European. Xiamen is important to Taiwan more politically than economically. Politics and environmental concerns have influence on port performance. These are new findings of this research with empirical evidence.

Some new themes have emerged from the empirical research. 1. Customs efficiency has seldom been addressed in empirical research as an important factor that influences port performance, although it is mentioned in the literature and reports by the World Bank. The finding from the current research shows that customs efficiency plays a key role to influence port performance in Xiamen. 2. Logistics demand was hardly highlighted in previous empirical research as an important factor that influences port performance; however, this empirical research has found that it is strongly highlighted as a very important factor. 3. Port ownership in the Humber has hindered the development of port performance due to monopoly in terms of service provision and port charges. This finding is consistent with Tongzon and Heng's (2005) finding. 4. Politics, overinvestment and inadequate logistics scheme have been little investigated in empirical research from the perspective of development of port performance, nor were they profoundly addressed in the literature. This empirical research has found they are important to influence port performance.

Port services in China are not as strong as those in UK. This might be because Chinese ports lack a sense of service due to the influence of a long history of “iron rice bowl” (secure employment, a lifelong secure job or position). Infrastructures (including transport infrastructure, port facilities, natural endowment and technical and information system) are all important, but intermodalism is not available and waterways have not been promoted as expected in both UK and China.

The above findings have shed light on factors that influence port performance, which either enhance, extend or complement the literature by persuasive evidence from this empirical research. Building on the presentation and discussion, this chapter summarised and highlighted a number of main themes from the empirical research. In order to validate the above findings, analysis of questionnaire surveys will be elaborated in the following chapter. Further discussion will be presented in Chapter 7.

6. FACTORS INFLUENCING PORT PERFORMANCE: PORT STAKEHOLDERS' VIEWS–QUESTIONNAIRE ANALYSIS

This chapter presents the findings of the questionnaire survey. It summarises the results of questionnaire surveys of 254 port specialists whose views were sought on the importance of 15 factors that influence port performance and their evaluations on their focal ports' and other ports' performance regarding the same 15 factors. In particular, this chapter addresses the research objectives that were described in Chapters 1 and 4. It also describes the sample characteristics, the distribution of responses and the reliability and validity of key factors.

To this extent, the chapter consists of eight sections. Following the introduction, the first section explains the data screening and data cleaning. This section also describes the sample characteristics including the response rate and non-response bias. The second section justifies the techniques chosen for data analysis in this study. The third section provides descriptive statistics on the responses and will consider the distribution of responses for each factor. The fourth section reports factor analysis to extract "aggregate factors" from the 15 questionnaire factors. This section also tests the reliability and validity of a number of key factors and measures their internal consistency and convergent validity.

Based on the questionnaire factors, the fifth section applies a range of statistical methods to investigate the relationships between different factors and address the research objectives. The main analysis is focused on comparison for both combined data and separate data. Comparisons are firstly conducted in the perspectives of importance, performance, performance differences between case ports and other ports, and differences between two regional performance differences in turn. Mean differences are firstly given, followed by significant/insignificant tests between different regions. Secondly, importance-performance analyses are conducted, including traditional IPA (explicit importance vs. explicit performance) to identify urgent factors, revised IPA by gap analysis (explicit importance against explicit performance difference between case ports and other ports) to identify salient factors, and revised IPA by employing 3-factor theory (explicit importance against implicit importance) to identify basic factors. Thirdly, differences between respondent groups are investigated in terms of factor importance and factor performance.

The sixth section presents the respondents' replies to the open questions. The last section provides a summary of the chapter.

Figure 6.1 shows the structure of the data presentation. Analysis was conducted with the aid of the technique software of SPSS 17.0, which is simple, interactive and rich in alternative methods of data analysis (Shannon and Davenport 2001).

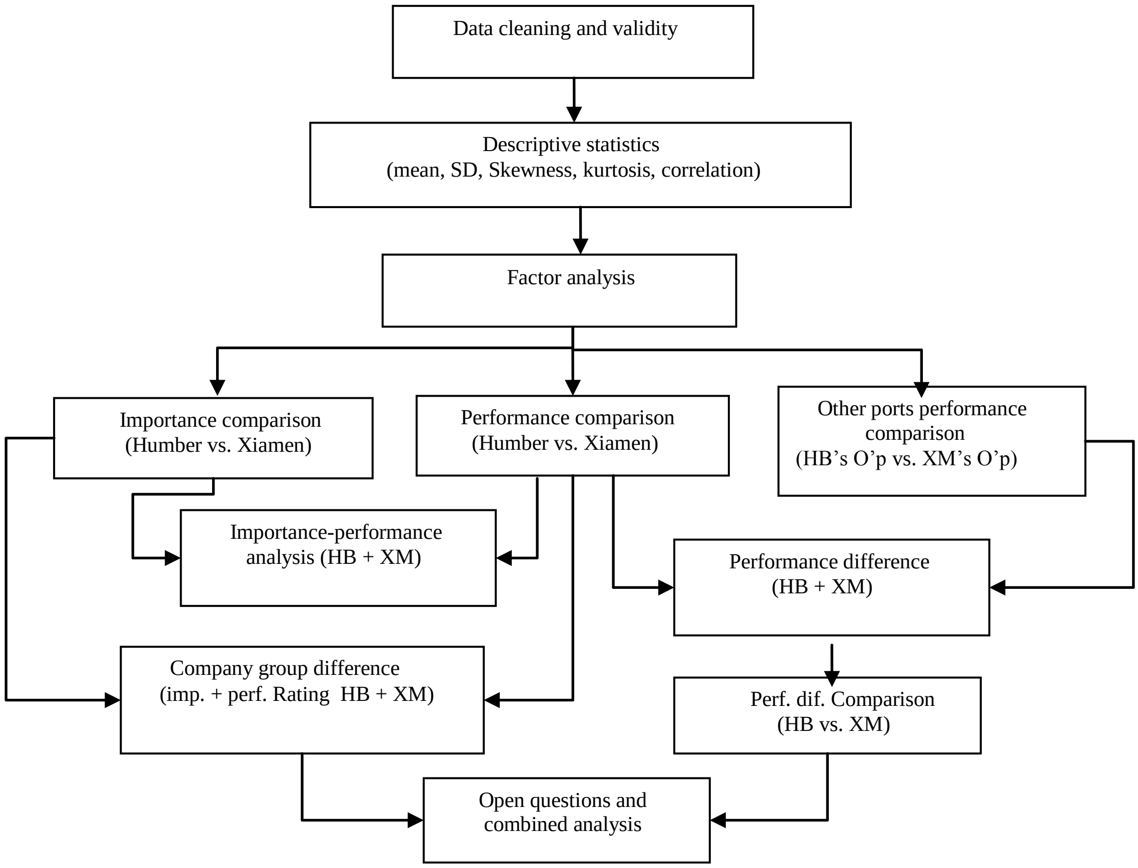


Figure 6. 1 Chapter structure

6.1 Data screening, cleaning and sample characteristics

6.1.1 Data screening and cleaning

In order to ensure the accuracy of questionnaire data analysis, the researcher screened and cleaned the data prior to data analysis. The categorical data, continuous data and the errors in the data file were checked. Correction was made when an error was found.

The missing data were then checked. According to Hair et al. (2010), cases with over 50% missing data should be deleted. Nine such poorly completed cases were excluded to reduce the incidence of missing data in statistical analysis, which could affect the reliability of the results (Gill and Johnson 1997). As the three parts of the questionnaire were independent sections, the missing values were treated separately.

Hair et al. (2010) claim factors with over 15% missing data should be deleted. No such factors were detected. The missing values were scattered randomly through the data matrix for Section A and Section B. They were not a problem in these two sections, as they only accounted for less than 3% of responses, given the large sample size. These missing values were replaced by mean values by employing the complete data approach, which is best used when the sample size is large and missing data level is low (Hair et al. 2010). For Section C, some respondents were not aware of the performance of other ports, so they did not answer Section C but provided complete answers to Section A and Section B. In such cases, Section C was considered invalid but the other parts were treated as valid.

Based on the data cleaning and data screening, 92 out of the 96 Humber responses and 162 out of the 167 Xiamen responses were found valid for data analysis of Section A and Section B; 78 responses from the Humber and 128 responses from Xiamen were found valid for Section C data analysis. Thus, 254 cases in total were used for data analysis involving Section A and Section B, and 206 cases in total were used for analysis involving Section C.

After checking the missing data, Boxplot diagrams by SPSS Statistics Explore were extracted to detect outliers. Less than 0.9% of the data were identified as outliers. When the outliers were confirmed, to avoid response bias and avoid the risk of losing generalisability, it was decided not to remove cases. The researcher decided to change the score to less extreme data as suggested by Field (2005) and Hair et al. (2010). As the percentage of outliers was very low, changing outliers to less extreme data did not interfere with the findings of the research to any major extent. The data after outliers' treatment were used for data analysis.

6.1.2 Sample characteristics

As presented in Chapter 4, the questionnaires were distributed to specialists in the Humber estuary (UK) and Xiamen (China) respectively. In the Humber, 200 questionnaires were distributed and 92 out of the 96 responses were found to be valid (valid response rate=46%), while in Xiamen 300 questionnaires were distributed and 162 out of the 167 responses were identified to be valid (valid response rate=54%). The total valid response rate was 50.8%. Table 6.1 presents the response rate by region. The questionnaires were distributed to five types of companies, including consignors/consignees, PSPs, shipping lines, port managers and other port stakeholders.

Table 6. 1 Questionnaire distribution and response

Region	Number distributed	Responses received	Valid responses received	Valid response rate
Humber	200	96	92	46%
Xiamen	300	167	162	54%
Total	500	263	254	50.80%

Table 4.7 presents an overview of response rate by company type and region. In total, 51 responses (20.08%) were from consignors/consignees, 62 responses (24.41%) were from PSPs, 32 responses (12.6%) were from shipping lines, 49 responses (19.29%) were from port managers and port operators, and 10 responses (3.94%) were from other port stakeholders. Another 50 responses (19.69%) did not disclose their company name so they could not be simply included into any company type but were treated as missing data. The composition of the sample by type of organisation shows that company selection was devoid of demographic bias and the response rate in the two regions was very good, with approximately equal response.

Figure 6.2 presents the response profile by company type frequency and percentage with combined data of the Humber and Xiamen. The bar chart gives the number of respondents while the pie chart shows the percentage of respondents in each group.

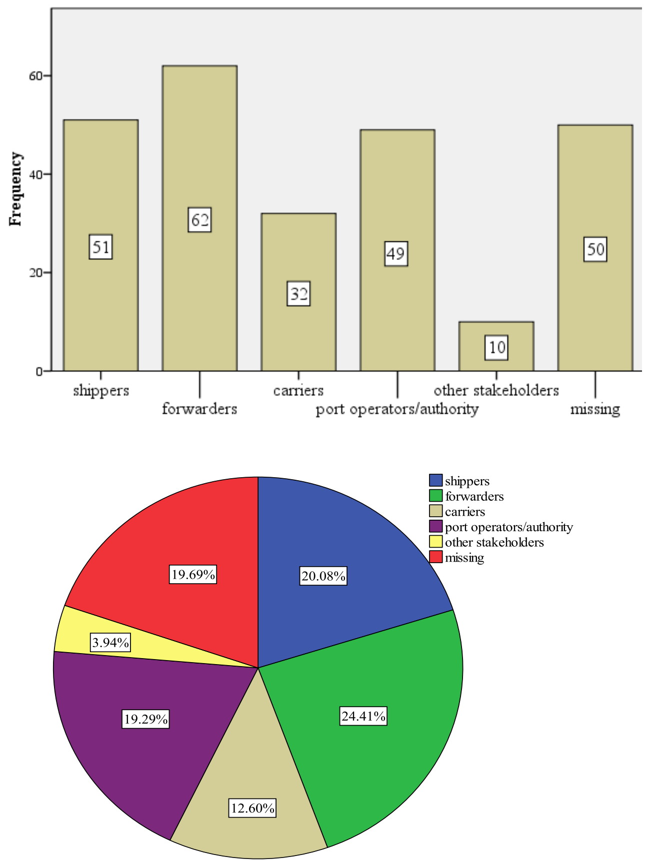


Figure 6. 2 Respondents profile by company type over all responses (combined samples)

Figures 6.3 and 6.4 present details of the response frequency and percentage by the Humber and Xiamen separately.

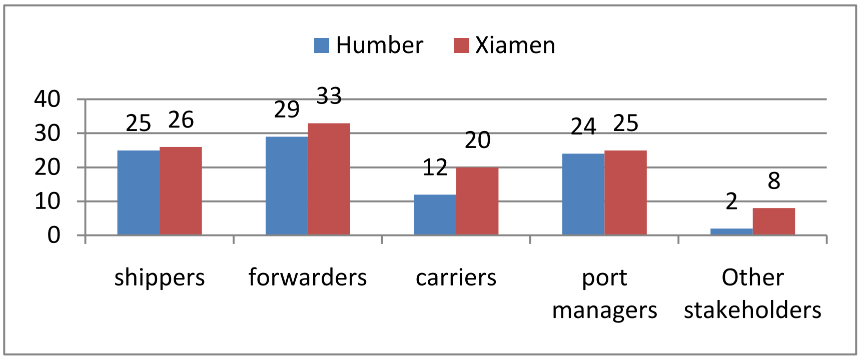
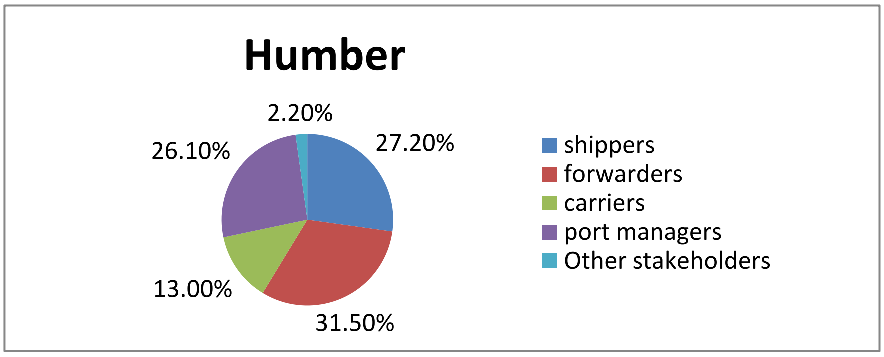


Figure 6. 3 Respondents profile by company type and region (frequency)



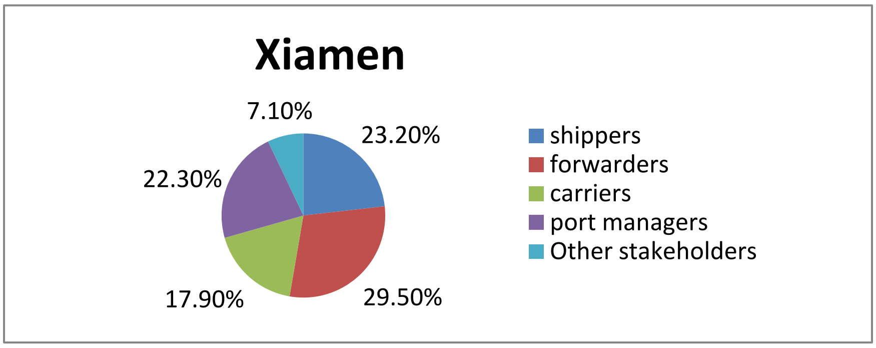


Figure 6. 4 Humber/Xiamen respondents profile by company type and region (%)

Table 6.2 presents the respondents' job positions. Most of them held senior positions in their organisations. 49 (19.3%) of them were directors, 125 (49.2%) of them were managers, including branch manager, general manager, shipping manager, terminal manager, transport manager, operations manager and the remaining 26 (10.2%) held other titles, such as principal consultant, master, and other port experts. 54 (21.3%) respondents did not disclose their positions. Among the 200 respondents who disclosed their job positions, 87% of them were directors and managers. This reflects that the respondents were in the right position to complete the questionnaire and provide useful, valid and insight responses.

Table 6. 2 Respondents by job roles (combined samples)

Job title	Frequency	Percent	Cumulative Percent
Directors	49	19.3	19.3
Managers	125	49.2	68.5
Others	26	10.2	78.7
Missing	54	21.3	100.0
Total	254	100.0	

Figure 6.5 presents the frequency and percentage details of respondents' job position.

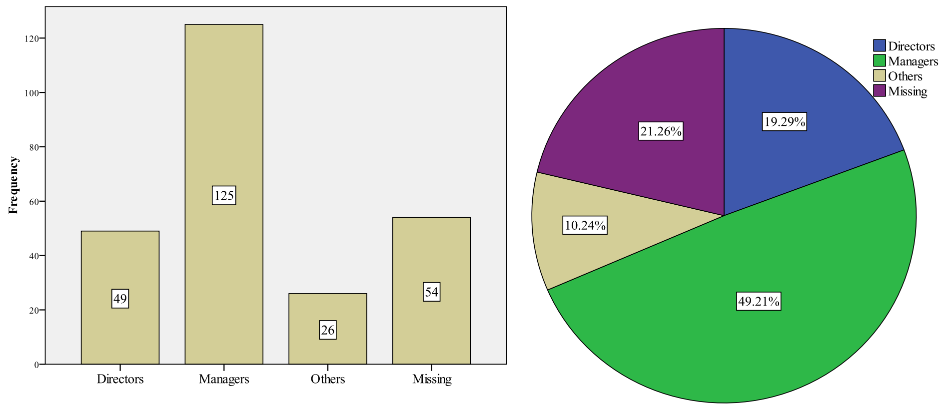


Figure 6. 5 Frequency/% of respondents with different positions (combined samples)

In terms of questionnaire response method, Table 6.3 and Figure 6.6 show that the majority of participants (172 and 67.7% of the total 254 respondents) responded with self-completion, mainly via email, supplemented by post or fax. The remaining respondents (82 with 32.3% of the total 254 respondents) responded by face-to-face survey.

Table 6. 3 Respondents by response method

Response method	Frequency	Valid %
face to face survey	82	32.3
self-completion by email, post and fax	172	67.7
Total	254	100

The self-completion respondents preferred to complete the questionnaire without disturbance in their own time, as they felt it more comfortable to do so. The face-to-face survey respondents thought it easier and more efficient to complete the questionnaire in the researcher's presence, so that they could clarify the questions with the researcher if they had some concerns or if they were not clear about the questions. Some respondents explained their willingness to offer comprehensive data for this research if needed.

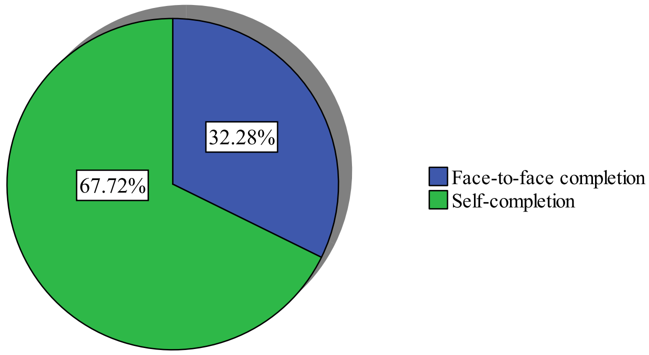


Figure 6. 6 Response method (combined samples)

Non-response bias

Non-response bias may arise when the characteristics of the respondents vary significantly from those of the non-respondents. It can be a problem when response rate is lower than 40% (Lambert and Harrington 1990). The bias may occur even when the response rate is high (Carter and Jennings 2004). This is why it is necessary to test the non-response bias, even though the response rate of the current study was over 40%.

Armstrong and Overton (1977) consider that later respondents have similar views to the non-respondents, as they respond due to additional stimulus. They assume that non-response bias does not exist if no significant differences exist on the survey factors between the early responses and late responses. Thus, this research tested the difference to examine the potential non-response bias problem by following the recommendation of Armstrong and Overton (1977) and Rada (2005).

The non-response bias was checked by the Mann-Whitney U test and the Kolmogorov-Smirnov (K-S) Z test of the SPSS software, as they are most popularly used to test whether two independent samples come from the same underlying population (Pallant 2007). In this study, the first and last 40 respondents were compared to assess the potential non-response bias for both the Humber and Xiamen separately. The results revealed no significant differences between the early and late responses, as all p-values were greater than 0.05, meaning that the means of the groups were not significantly different. Therefore, the tests confirmed that the results emerging from the data would be valid and devoid of chance.

This research also compared the number of respondents with the number of sampling frame by different respondent groups from different types of companies. The response rates were not equal. The general response rate of the Humber (46%) was lower than that of Xiamen (54%), and the response rates for different groups were not the same (Table 6.1 and Table 4.7).

Table 6. 4 Abbreviation and item explanation

Symbol	Abbreviation	Stand for
A	A	Section A, importance
B	B	Section B, performance
C	C	Section C, performance of other ports
1	1-shipping services	shipping services
2	2-shipping prices	shipping prices
3	3-portcharge	port charges
4	4-feeders	Feeders
5	5-overall cost	overall cheapest cost of logistics services
6	6-handlingspeed	speed of cargo handling
7	7-risks	port risks
8	8-safety	port safety
9	9-techinfras	port technical infrastructure, e.g. equipment and ICT
10	10-proximity	port location to the customer and supplier
11	11-skills	logistics skills for those working in port performance
12	12-landlinks	landside links, including air, rail and road
13	13-logservices	logistics services, e.g. Warehousing.
14	14-govs.upport	government support
15	15-navigation	depth of navigation
16	16-portservc	port services (A-factor)
17	17-logsupt	logistics support (A-factor)
18	18-cost	logistics cost (A-factor)
19	19-shipservc	shipping services (A-factor)
20	20-others	Other factors (A-factor)
A1-A15	A1-shipservices to A15-navig.	importance of factor 1to factor 15
B1-B15	B1-shipservices to B15-navig.	performance of factor 1 to factor 15
C1-C15	C1-shipservices to C15-navig.	other ports' performance of factor 1 to factor 15
Δ(C-B)	Perf. Diff. (C – B)	performance difference between other ports and selected port
XM		Xiamen
HB		Humber
A-Factor	A-factor	aggregate factor

However, differences in response rates were generally very small and were often influenced by the fact that some categories had only a small population. For instance, the response rate of Humber PSPs was 48.3%, which is higher than that of other Humber port stakeholders (40%). This is because the sample of other port stakeholders consisted of just five important government agencies, academics and consultants. This applies to a sample of 60 PSPs, of which 29 responded. Similarly, response rates of Xiamen are generally lower than those of the Humber. 16.7% of the Xiamen respondents did not disclose their identity.

Prior to presenting the analysis, to help with the understanding of the questionnaire and simplify the analysis presentation, Table 6.4 is given to refer to the terminology and abbreviations for the data analysis.

6.2 Techniques chosen for data analysis

The questionnaire was concerned with investigating respondents' attributes on the relevant factors which are important to port performance and port development. The respondents were expected to give their choice to the best of their knowledge, based on a five-point Likert scale.

The data collected from Likert scales are ordinal data (Keller 2005; Pallant 2007), which are now widely analysed by using parametric techniques (Lewis 2000). Parametric techniques were employed in this study for a number of reasons:

Firstly, ordinal data from Likert scales are widely treated as interval data, which is not only supported by famous statisticians such as Keller (2005), Pallant (2007) and Hair et al. (2010), but also supported by empirical studies, such as Labovitz (1970). Labovitz (1970) demonstrates that treating ordinal factors as interval has a few advantages which include: (1) the use of more powerful, sensitive, better developed and interpretable statistics, (2) more statistical manipulation, such as factor analysis, partial and multiple correlation and regression, and analysis of variance and covariance.

Secondly, Muthen and Kaplan (1985) note that factor analysis is often conducted on highly skewed and kurtotic ordinal data, which applies to the current research.

Thirdly, inferences based on parametric analysis of ordinal data are valid if approximately 68, 95 and 99.7% of the individual values of observed factors fall respectively within 1, 2 and 3 standard deviations from the mean (Shannon and Davenport 2001). In this study, approximately 77.8%, 100% and 100% of the Humber data collected were within 1, 2 and 3 standard deviations from the mean. Approximately 100% of the Xiamen data collected were within 1 standard deviation from the mean. This indicates that the current data met the criteria and were suitable for parametric analysis.

Lastly, the current data were identified as reasonably normal. As most parametric factor tests such as factor analysis are underpinned by the assumption of normal distribution (Shannon and Davenport 2001), the data collected for this research was therefore checked for departure from normality prior to the application of parametric tests:

Test of normality

The test of normality was conducted and assessed by SPSS Explore on the whole sample for all the factors. In the table labelled Tests of Normality, the results of the

Kolmogorov-Smirnov and Shapiro-Wilk statistic are given. Table 6.5 presents the test results.

According to Pallant (2007), if the Sig value is more than 0.05, the result indicates normality. In other words, a non-significant result (Sig value ≥0.05) implies that the distribution of the sample is not statistically different from a normal distribution. On the contrary, a significant result (Sig value ≤0.05) indicates that the data distribution from the sample is probably non-normal (Field 2005). The K-S test shows that all the Sig. values are 0.000, which is less than 0.05, suggesting violation of the assumption of normality. Then data transformations were tried for each factor to remedy non-normality. The researcher failed in all the transformations suggested by Field (2005) and Pallant (2007).

However, whether the data are normal or not does not simply depend on the test of normality by SPSS. There are a few other perspectives to consider. Firstly, according to Field (2005), it is not the significance value but the shape of the sampling distribution that matters. The actual shape of the distribution for each factor was therefore assessed visually by constructing histograms to detect cases with non-normal distributions. The data appeared to be reasonably and normally distributed with bell shapes. Secondly, normality or otherwise of the data was further supported by an inspection of the normal probability plots (labelled Normal Q-Q probability plots). Thirdly, Field (2005) and Weinberg & Abramowitz (2008) claim that when the sample is more than 30, the data tends to be normal or sufficient to compensate for the lack of normality; when the sample is 200 or more, the sampling distribution is normal regardless of the shape of the data actually collected. As the sample size in this research was 254, which is larger than 200, the data can be claimed as normal.

Hair et al. (2010) also claim that with a large sample size, the detrimental impacts from non-normality may be negligible. Fourthly, Field (2005) notes that if the Sig. P<0.001 with a large sample, which is the case with the current research, data normality can be assumed with skewness and kurtosis values up to 3.29. So, the skewness and kurtosis were inspected for each factor from the questionnaire. As Table 6.5 shows, all the values were within this range. This gave evidence and more confidence that the current research data could be treated as normal, which is the basis for further data analysis. Where the data were tested and found to be normally distributed, a test for homogeneity of variance (Levene's test) was conducted, as suggested by Field (2005). The results revealed no violation of the assumption of homogeneity.

Table 6. 5 Test of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk			Skewness		Kurtosis	
	Stats	df	Sig.	Stats	df	Sig.	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis
A-shipservices	0.319	254	0	0.765	254	0	-0.869	0.153	-0.275	0.304
A-shipgprices	0.263	254	0	0.807	254	0	-0.883	0.153	0.121	0.304
A-portcharges	0.207	254	0	0.866	254	0	-0.400	0.153	-0.701	0.304
A-feeders	0.242	254	0	0.849	254	0	-0.864	0.153	0.386	0.304
A-overallcost	0.209	254	0	0.854	254	0	-0.386	0.153	-0.751	0.304
A-handlingspeed	0.252	254	0	0.860	254	0	-0.275	0.153	-0.496	0.304
A-risks	0.253	254	0	0.853	254	0	-0.36	0.153	-0.445	0.304
A-safety	0.218	254	0	0.862	254	0	-0.465	0.153	-0.585	0.304
A-techinfras	0.248	254	0	0.864	254	0	-0.341	0.153	-0.559	0.304
A-proximity	0.219	254	0	0.888	254	0	-0.248	0.153	-0.597	0.304
A-skills	0.238	254	0	0.891	254	0	0.100	0.153	-0.443	0.304
A-landlinks	0.236	254	0	0.864	254	0	-0.482	0.153	0.078	0.304
A-logservices	0.253	254	0	0.858	254	0	-0.503	0.153	-0.155	0.304
A-governsupt	0.207	254	0	0.864	254	0	-0.523	0.153	-0.383	0.304
A-navig.	0.234	254	0	0.878	254	0	-0.570	0.153	-0.159	0.304
B-shipservices	0.231	254	0	0.872	254	0	0.039	0.153	-0.599	0.304
B-shipngprices	0.260	254	0	0.867	254	0	0.201	0.153	-0.515	0.304
B-portcharges	0.219	254	0	0.895	254	0	0.029	0.153	-0.57	0.304
B-feeders	0.214	254	0	0.885	254	0	-0.034	0.153	-0.586	0.304
B-overallcost	0.284	254	0	0.849	254	0	0.309	0.153	-0.214	0.304
B-handlingspeed	0.260	254	0	0.865	254	0	-0.176	0.153	-0.454	0.304
B-risks	0.240	254	0	0.863	254	0	-0.029	0.153	-0.456	0.304
B-safety	0.290	254	0	0.833	254	0	-0.346	0.153	-0.065	0.304
B-techinfras	0.280	254	0	0.856	254	0	-0.275	0.153	-0.362	0.304
B-proximity	0.244	254	0	0.864	254	0	0.082	0.153	-0.509	0.304
B-skills	0.250	254	0	0.852	254	0	-0.026	0.153	-0.344	0.304
B-landlinks	0.240	254	0	0.886	254	0	0.066	0.153	-0.313	0.304
B-logservices	0.259	254	0	0.856	254	0	-0.180	0.153	-0.444	0.304
B-governsupt	0.196	254	0	0.908	254	0	-0.232	0.153	-0.379	0.304
B-navig.	0.225	254	0	0.889	254	0	0.019	0.153	-0.494	0.304
C-shipservices	0.272	254	0	0.753	254	0	-1.018	0.153	-0.448	0.304
C-shipngprices	0.254	254	0	0.816	254	0	-0.865	0.153	-0.452	0.304
C-portcharges	0.232	254	0	0.833	254	0	-0.789	0.153	-0.566	0.304
C-feeders	0.253	254	0	0.769	254	0	-0.944	0.153	-0.579	0.304
C-overallcost	0.260	254	0	0.846	254	0	-0.722	0.153	-0.521	0.304
C-handlingspeed	0.285	254	0	0.776	254	0	-1.003	0.153	-0.378	0.304
C-risks	0.259	254	0	0.814	254	0	-0.875	0.153	-0.436	0.304
C-safety	0.277	254	0	0.766	254	0	-1.071	0.153	-0.184	0.304
C-techinfras	0.278	254	0	0.760	254	0	-1.072	0.153	-0.238	0.304
C-proximity	0.229	254	0	0.846	254	0	-0.716	0.153	-0.627	0.304
C-skills	0.260	254	0	0.786	254	0	-0.986	0.153	-0.319	0.304
C-landlinks	0.255	254	0	0.784	254	0	-0.984	0.153	-0.362	0.304
C-logservices	0.288	254	0	0.760	254	0	-1.076	0.153	-0.229	0.304
C-governsupt	0.215	254	0	0.834	254	0	-0.751	0.153	-0.682	0.304
C-navig.	0.255	254	0	0.800	254	0	-0.887	0.153	-0.575	0.304

As demonstrated, since all the four assumptions of parametric tests by Field (2005) and Pallant (2007) (normally distributed data, homogeneity of variance, interval data and independence) had been justified, the researcher felt comfortable to employ parametric techniques for the questionnaire data analysis.

Parametric techniques like t-test, analysis of variance (ANOVA) and factor analysis can be powerfully employed in exploring the nature and the competitive impacts of port performance enablers. Specifically, based on Field (2005), Keller (2005), Pallant (2007) and Hair et al. (2010), for the current data, Pearson tests and Spearman tests were conducted to test the correlation between two factors; Independent-samples t-tests were used when two groups were compared, which actually compared means; Paired-samples t-tests were used to compare mean scores with matched pairs for the same group of people. Being a parametric technique, a one-way ANOVA was supposed to conduct and detect whether there were significant differences between the groups when the number of groups was more than two. However, as the numbers of observations in the different groups were not equal and the ratio of largest number over smallest number was over 1.5, Kruskal-Wallis was employed instead of ANOVA because it was identified more suitable to test the differences in central tendency between the different groups within this context of unequal number of observations.

Before the parametric techniques were employed, descriptive statistics were used as appropriate to conduct some basic analysis. This is acceptable, as 66.7% of articles published in the *Journal of Business Logistics* between 1978 and 1993 employed descriptive statistics (Mentzer and Kahn 1995).

6.3 Descriptive and distribution statistics

Likert scales are often employed in questionnaire surveys and the mean values are often examined for comparison (Bacon 2003; Matzler et al. 2003; Levenburg and Magal 2005; Huang et al. 2006; Deng et al. 2008a; Deng et al. 2008b). For this reason, the means in this research were employed to project factor importance and performance, to indicate overall group views on how important the factors were to the performance of the Humber and Xiamen ports, how the two port regions actually performed in terms of these factors, and how other ports were perceived to perform for the same factors.

A mean score is the prototypical value (arithmetic average) of an observed factor, and it indicates the group opinion on average. The standard deviation (SD) is a measure of dispersion and variability around the mean. SD measures how widely the values spread, representing the amount of disagreement among the respondents. This section reports the distribution of scores on observed factors around their means, standard deviation, skewness and kurtosis for all the 45 factors of the questionnaire, which were processed by SPSS, as presented in Table 6.6 for both combined sample and separate samples.

This table shows that both the Humber and Xiamen ports seemed to have positive ratings of the factors, as the mean scores of all the 45 factors with one exception (the Humber government support performance: 2.36) were greater than the middle point (3) on the 1-5 Likert Scale. The SDs were rather high for some factors and low for some other factors. High SDs revealed significant differences between the responses and the means and significant differences amongst responses.

For the combined sample, the SDs ranged from 0.7-1.05. For the Humber, the SDs ranged from 0.7-1.2 of the mean scores. The SDs were over 1 for the importance of feeders, security, landside links, government support and depth of navigation; performance of the Humber feeders and depth of navigation availability, performance of other ports' seaside connections, location and depth of navigation. These high SDs indicate respondents showed big differences from the means for the corresponding factors. In Xiamen, the SDs ranged from 0.6-0.98 of the mean scores, indicating Xiamen responses were not so dispersed from their means as the Humber responses. Measures of distribution, such as skewness and kurtosis, indicate how much the data vary from normal distribution. Table 6.6 presents that skewness for most factors in the Humber and Xiamen were negative, indicating that the distribution was stretched on the left side and negatively skewed.

This means that most factors were highly rated. However, some factors were stretched on the right side and positively skewed, such as the Humber's B2, B5, B12, B15, C5, C11 and Xiamen's A11, B2, B5, B7, B10, C1, which were over 0.1. These factors were lowly rated and indicated the distribution had very few large scores and was tailed to the right.

Kurtosis refers to the peakedness or flatness of the distribution compared with a normal distribution. The values varied largely for different factors, indicating that there existed different concentration ratings over the factors. The negative values indicated that the data were spread out, and the distribution curve was flatter than a normal curve. The positive values indicated that the data clustered around the mean and the curve was highly peaked. As most of the kurtosis values were negative, the distribution was flat for most factors, indicating respondents have different views on the different factors, which provided indicators for the factor analysis later on.

Table 6. 6 Descriptive and distribution statistics

Region	Combined sample				The Humber				Xiamen			
	Mean	STD	Skew-ness	Kurto-sis	Mean	STD	Skew-ness	Kurto-sis	Mean	STD	Skew-ness	Kurto-sis
A-shipservices	4.32	0.81	-0.87	-0.27	4.50	0.75	-1.45	1.52	4.22	0.83	-0.62	-0.73
A-shipngprices	4.17	0.89	-0.88	0.12	4.48	0.67	-0.92	-0.29	4.00	0.96	-0.68	-0.28
A-portcharges	3.86	0.96	-0.40	-0.70	4.34	0.70	-0.58	-0.79	3.59	0.98	-0.10	-0.82
A-feeders	3.88	1.03	-0.86	0.39	3.67	1.20	-0.68	-0.39	4.00	0.91	-0.84	0.76
A-overallcost	3.92	0.94	-0.39	-0.75	3.82	0.88	-0.03	-1.00	3.98	0.97	-0.57	-0.55
A-handlspeed	3.83	0.83	-0.27	-0.50	4.15	0.74	-0.42	-0.51	3.65	0.82	-0.17	-0.46
A-risks	3.92	0.82	-0.36	-0.45	4.18	0.84	-0.59	-0.70	3.77	0.78	-0.37	-0.09
A-safety	3.89	0.95	-0.46	-0.59	4.14	1.01	-0.94	0.00	3.75	0.88	-0.28	-0.60
A-techinfras	3.83	0.87	-0.34	-0.56	3.83	0.90	-0.39	-0.54	3.83	0.86	-0.31	-0.55
A-proximity	3.64	0.95	-0.25	-0.60	3.73	0.97	-0.45	-0.40	3.59	0.94	-0.14	-0.64
A-skills	3.31	0.92	0.10	-0.44	3.71	0.92	-0.16	-0.81	3.08	0.83	0.11	-0.05
A-landlinks	3.84	0.88	-0.48	0.08	3.76	1.00	-0.65	0.27	3.89	0.81	-0.22	-0.62
A-logservices	3.91	0.86	-0.50	-0.15	3.91	0.93	-0.65	0.05	3.91	0.82	-0.38	-0.38
A-governsupt	3.88	0.98	-0.52	-0.38	3.51	1.12	-0.17	-0.83	4.09	0.81	-0.44	-0.65
A-navig.	3.74	1.01	-0.57	-0.16	3.64	1.24	-0.56	-0.68	3.80	0.85	-0.29	-0.50
B-shipservices	3.53	0.85	0.04	-0.60	3.66	0.96	-0.10	-0.96	3.46	0.76	0.02	-0.34
B-shipngprices	3.41	0.84	0.20	-0.51	3.49	0.92	0.08	-0.79	3.36	0.79	0.25	-0.30
B-portcharges	3.36	0.94	0.03	-0.57	3.37	0.93	-0.06	-0.57	3.35	0.95	0.08	-0.55
B-feeders	3.47	0.89	-0.03	-0.59	3.42	1.04	-0.03	-0.94	3.50	0.80	0.04	-0.43
B-overallcost	3.21	0.78	0.31	-0.21	3.18	0.80	0.32	-0.24	3.23	0.77	0.31	-0.16
B-handlspeed	3.61	0.82	-0.18	-0.45	3.89	0.82	-0.29	-0.49	3.46	0.78	-0.21	-0.44
B-risks	3.55	0.80	-0.03	-0.46	3.65	0.84	-0.16	-0.52	3.49	0.77	0.02	-0.36
B-safety	3.92	0.74	-0.35	-0.06	3.77	0.87	-0.26	-0.56	4.01	0.65	-0.15	-0.11
B-techinfras	3.62	0.81	-0.28	-0.36	3.48	0.87	-0.09	-0.65	3.70	0.76	-0.35	-0.09
B-proximity	3.54	0.81	0.08	-0.51	3.83	0.81	-0.31	-0.30	3.38	0.77	0.28	-0.23
B-skills	3.52	0.76	-0.03	-0.34	3.61	0.80	0.03	-0.46	3.48	0.74	-0.10	-0.29
B-landlinks	3.25	0.87	0.07	-0.31	3.36	0.87	0.24	-0.55	3.19	0.87	-0.04	-0.24
B-logservices	3.79	0.79	-0.18	-0.44	3.75	0.83	-0.20	-0.51	3.81	0.77	-0.16	-0.41
B-governsupt	3.18	1.04	-0.23	-0.38	2.48	0.92	-0.24	-0.82	3.57	0.88	-0.12	-0.65
B-navig.	3.37	0.90	0.02	-0.49	3.28	1.01	0.12	-0.59	3.43	0.83	0.00	-0.53
C-shipping lines	4.25	0.87	-0.96	0.05	4.03	0.95	-0.61	-0.64	4.39	0.80	-1.20	0.83
C-freight	3.65	0.82	-0.17	-0.46	3.53	0.88	0.04	-0.66	3.73	0.78	-0.28	-0.21
C-port charges	3.66	0.89	-0.20	-0.67	3.68	0.90	-0.18	-0.71	3.65	0.88	-0.22	-0.62
C-seasidelinks	4.17	0.95	-1.04	0.61	3.94	1.11	-0.87	0.09	4.32	0.81	-0.92	-0.06
C-overall cost	3.45	0.86	0.11	-0.61	3.31	0.89	0.15	-0.69	3.54	0.83	0.12	-0.55
C-speed handling	4.02	0.83	-0.72	0.71	3.88	0.97	-0.83	0.63	4.11	0.72	-0.30	-0.62
C-risks	3.63	0.81	-0.16	-0.42	3.63	0.90	-0.18	-0.68	3.63	0.75	-0.15	-0.24
C-security	4.02	0.72	-0.04	-1.07	4.08	0.75	-0.13	-1.20	3.99	0.70	0.01	-0.96
C-techinfras	4.16	0.76	-0.33	-0.96	4.06	0.81	-0.27	-1.03	4.21	0.72	-0.34	-1.00
C-location	3.67	0.94	-0.09	-0.92	3.54	1.00	0.09	-1.06	3.76	0.89	-0.17	-0.77
C-skills	3.83	0.76	-0.18	-0.37	3.63	0.84	0.26	-0.75	3.96	0.68	-0.41	0.47
C-landside links	4.04	0.82	-0.35	-0.76	3.88	0.84	-0.19	-0.75	4.14	0.79	-0.45	-0.71
C-logservices	4.12	0.75	-0.34	-0.74	4.03	0.77	-0.39	-0.31	4.18	0.74	-0.30	-1.10
C-govsupt	3.82	0.94	-0.36	-0.48	3.18	0.89	0.08	0.07	4.20	0.75	-0.35	-1.13
C-navi & land	4.00	0.92	-0.71	0.11	3.82	1.10	-0.65	-0.42	4.10	0.77	-0.39	-0.62

The mean scores were employed to generate Figure 6.7, which gives a more visually friendly mean comparison between the 45 factors.

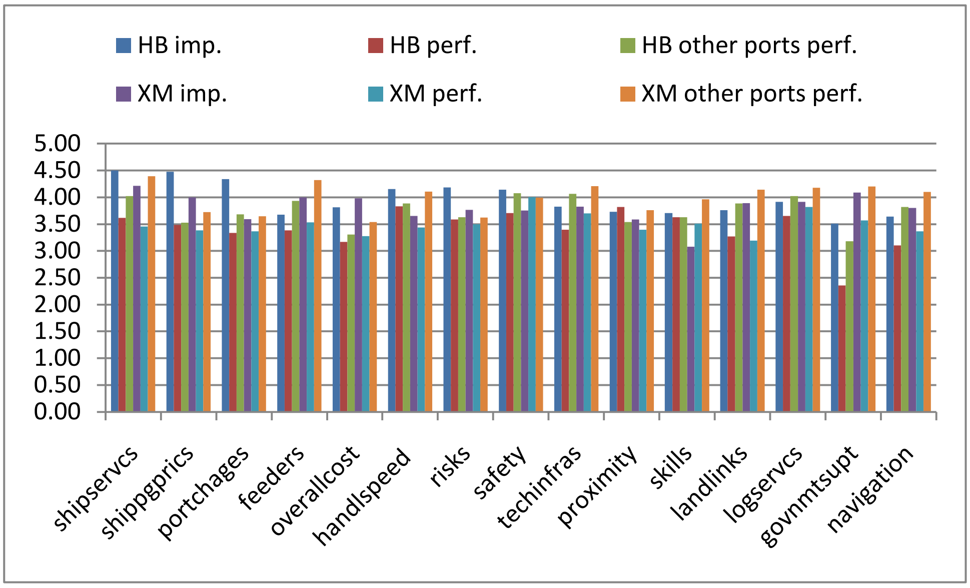


Figure 6. 7 Overview of mean comparison

Table 6.7 presents the means in descending order for combined sample and Table 6.8 presents the mean for the Humber and Xiamen separately. The mean scores vary widely and will be further employed for data analysis.

Table 6. 7 Mean descending order of 45 factors for combined sample

	D.O	Imp.	D.O.	Perf.	D.O.	Perf.B	D.O.	O' Perf.	D.O.	Imp.-perf.	D.O.	Perf. Dif.
1-shipservices	A1	4.32	B8	3.92	B8	3.89	C1	4.25	1	0.79	12	0.82
2-shippngprices	A2	4.17	B13	3.79	B13	3.76	C4	4.17	2	0.77	1	0.74
3-portcharges	A5	3.92	B9	3.62	B6	3.59	C9	4.16	5	0.71	15	0.73
4-feeders	A7	3.92	B6	3.61	B9	3.59	C13	4.12	14	0.70	14	0.70
5-overallcost	A13	3.91	B7	3.55	B10	3.56	C12	4.04	12	0.59	4	0.70
6-handlspeed	A8	3.89	B10	3.54	B11	3.55	C6	4.02	3	0.50	9	0.57
7-risks	A4	3.88	B1	3.53	B7	3.53	C8	4.02	4	0.41	6	0.44
8-safety	A14	3.88	B11	3.52	B1	3.51	C15	4.00	15	0.37	13	0.36
9-techinfras	A3	3.86	B4	3.47	B4	3.48	C11	3.83	7	0.37	3	0.31
10-proximity	A12	3.84	B2	3.41	B2	3.42	C14	3.82	6	0.22	11	0.28
11-skills	A6	3.83	B15	3.37	B3	3.35	C10	3.67	9	0.21	2	0.23
12-landsidelinks	A9	3.83	B3	3.36	B15	3.27	C3	3.66	13	0.13	5	0.22
13-logservices	A15	3.74	B12	3.25	B5	3.23	C2	3.65	10	0.09	8	0.13
14-govnmtsupt	A10	3.64	B5	3.21	B12	3.22	C7	3.63	8	-0.03	10	0.12
15-navig.	A11	3.31	B14	3.18	B14	3.11	C5	3.45	11	-0.22	7	0.09
16-portservices	A19	4.32	B16	3.68	B16	3.65	C19	4.25	19	0.64	19	-0.60
17-logsupt	A18	3.99	B19	3.53	B20	3.56	C17	4.03	18	0.46	17	-0.47
18-cost	A16	3.87	B20	3.53	B19	3.51	C16	3.96	17	0.34	16	-0.45
19-shipgservces	A17	3.85	B17	3.41	B17	3.37	C20	3.75	16	0.44	18	-0.38
20-others	A20	3.47	B18	3.33	B18	3.34	C18	3.59	20	0.14	20	-0.25
Grand mean		3.86		3.49		3.47		3.90		0.37		-0.43

Note: D.O=descending order; Imp=importance, perf=performance, o'perf=other ports' performance

Table 6. 8 Mean descending order of 45 factors for both Xiamen and the Humber

Mean descending order	**1**	**2**	**3**	**7**	**6**	**8**	**13**	**9**	**5**	**12**	**10**	**11**	**4**	**15**	14	MD	G.M
HB importance	4.50	4.48	4.34	4.18	4.15	4.14	3.91	3.83	3.82	3.76	3.73	3.71	3.67	3.64	3.51	0.99	3.96
Mean descending order	6	10	8	13	1	7	11	2	9	4	3	12	15	5	14		
HB performance	3.89	3.83	3.77	3.75	3.66	3.65	3.61	3.49	3.48	3.42	3.37	3.36	3.28	3.18	2.48	1.41	3.48
Mean descending order	8	9	1	13	4	6	12	15	3	7	11	10	2	5	14		
HB o' performance	4.08	4.06	4.03	4.03	3.94	3.88	3.88	3.82	3.68	3.63	3.63	3.54	3.53	3.31	3.18	0.90	3.74
Mean descending order	1	14	2	4	5	13	12	9	15	7	8	6	3	10	11		
XM importance	4.22	4.09	4.00	4.00	3.98	3.91	3.89	3.83	3.80	3.77	3.75	3.65	3.59	3.59	3.08	1.14	3.81
Mean descending order	8	13	9	14	4	7	11	1	6	15	10	2	3	5	12		
XM performance	4.01	3.81	3.70	3.57	3.50	3.49	3.48	3.46	3.46	3.43	3.38	3.36	3.35	3.23	3.19	0.81	3.49
Mean descending order	1	4	9	14	13	12	6	15	8	11	10	2	3	7	5		
XM o' performance	4.39	4.32	4.21	4.20	4.18	4.14	4.11	4.10	3.99	3.96	3.76	3.73	3.65	3.63	3.54	0.85	3.99
Mean descending order	14	2	3	1	5	7	12	8	15	9	6	4	13	11	10		
HB (imp-perf)	1.03	0.99	0.97	0.84	0.63	0.53	0.40	0.37	0.36	0.35	0.26	0.25	0.16	0.10	-0.10	1.13	
Mean descending order	1	5	12	2	14	4	15	7	3	10	6	9	13	8	11		
XM (imp-perf)	0.76	0.75	0.70	0.64	0.51	0.50	0.38	0.27	0.24	0.20	0.20	0.13	0.10	-0.25	-0.40	1.15	
Mean descending order	14	15	9	12	4	1	13	8	3	5	6	2	7	11	10		
HB perf. Dif (C-B)	0.82	0.72	0.67	0.62	0.55	0.41	0.37	0.37	0.35	0.14	0.05	0.04	0.04	0.00	-0.28	1.10	
Mean descending order	12	1	4	15	6	14	9	11	10	13	2	3	5	7	8		
XM perf. Dif (C-B)	0.95	0.94	0.79	0.73	0.67	0.63	0.51	0.45	0.36	0.36	0.34	0.28	0.27	0.13	-0.02	0.96	
Mean descending order	10	6	1	11	8	12	2	4	14	9	5	7	3	15	13		
dif (C-B) XM-HB	0.64	0.62	0.53	0.45	0.39	0.33	0.31	0.24	0.19	0.16	0.12	0.09	0.06	0.02	0.01	0.63	
Mean descending order	3	11	14	6	2	7	8	4	1	5	15	10	12	13	9		
(HB-XM) imp. dif	0.74	0.63	0.58	0.50	0.48	0.42	0.39	0.33	0.28	0.17	0.16	0.14	0.13	0.00	0.00	0.75	
Mean descending order	14	10	6	8	9	1	12	7	15	11	2	4	13	5	3		
(HB-XM) perf. dif	1.10	0.44	0.43	0.23	0.22	0.21	0.17	0.16	0.14	0.13	0.13	0.08	0.06	0.04	0.02	1.08	
Mean descending order	14	4	1	11	15	12	5	6	10	2	13	9	8	3	7		
(HB-XM) o'perf.dif.	1.02	0.38	0.36	0.33	0.28	0.26	0.23	0.22	0.22	0.20	0.15	0.15	0.08	0.03	0.00	1.03	

6.4 Factor analysis

Before researchers carry out IPA, they often conduct Factor Analysis to reduce the number of factors; Lai and To (2010) provide an example. The same approach was employed in the current data analysis.

The different questionnaire factors in Section A were found to be highly correlated. The factors could be grouped and reduced to a smaller number by employing Factor Analysis. According to Hair et al., a factor (referred to as "aggregate factor" in this thesis) is a set of factors that are highly interrelated and factor analysis is defined as an interdependency technique whose primary purpose is to define the underlying structure among the factors in the analysis (Hair et al. 2010).

6.4.1 Justification of factor analysis

Prior to conducting factor analysis, the suitability of data for factor analysis was assessed. Firstly, the ratio of observations to the factors should be 10:1 (Field 2005; Pallant 2007), at least a desired ratio of 5 observations per factor, and the minimum absolute sample size should be over 50 observations (Hair et al., 2010). The current research met the requirement, with 254 valid responses to analyse 15 factors. Secondly, Table 6.9 revealed the data matrix which shows that the factors in Section A were sufficiently correlated.

Table 6. 9 Correlations of factors in Section A

V	correlati	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
A1	Pearson	1	.130*	.168**	.214**	0.08	.226**	.128*	.199**	0.12	0.06	.240**	0.09	.209**	0.03	.182**
	Sig. (2-		0.04	0.01	0	0.18	0	0.04	0	0.05	0.32	0	0.14	0	0.59	0
A2	Pearson	.130*	1	.558**	0.09	.288**	.279**	.218**	.162**	.160*	0.08	.239**	0	.173**	0.04	.124*
	Sig. (2-	0.04		0	0.17	0	0	0	0.01	0.01	0.19	0	1	0.01	0.5	0.05
A3	Pearson	.168**	.558**	1	0.09	.198**	.495**	.352**	.272**	.331**	0.11	.323**	0.1	.163**	0.07	0.11
	Sig. (2-	0.01	0		0.15	0	0	0	0	0	0.08	0	0.11	0.01	0.29	0.08
A4	Pearson	.214**	0.09	0.09	1	.185**	.167**	.137*	.214**	.280**	0.05	.264**	.339**	.241**	.268**	.240**
	Sig. (2-	0	0.17	0.15		0	0.01	0.03	0	0	0.4	0	0	0	0	0
A5	Pearson	0.08	.288**	.198**	.185**	1	.278**	.165**	.177**	.157*	.127*	.134*	0.11	0.1	.174**	0.08
	Sig. (2-	0.18	0	0	0		0	0.01	0	0.01	0.04	0.03	0.08	0.12	0.01	0.21
A6	Pearson	.226**	.279**	.495**	.167**	.278**	1	.474**	.382**	.371**	.165**	.360**	.224**	.257**	0.12	.172**
	Sig. (2-	0	0	0	0.01	0		0	0	0	0.01	0	0	0	0.05	0.01
A7	Pearson	.128*	.218**	.352**	.137*	.165**	.474**	1	.456**	.360**	.159*	.312**	.210**	.179**	0.12	.199**
	Sig. (2-	0.04	0	0	0.03	0.01	0		0	0	0.01	0	0	0	0.06	0
A8	Pearson	.199**	.162**	.272**	.214**	.177**	.382**	.456**	1	.519**	.168**	.472**	.226**	.309**	.196**	.254**
	Sig. (2-	0	0.01	0	0	0	0	0		0	0.01	0	0	0	0	0
A9	Pearson	0.12	.160*	.331**	.280**	.157*	.371**	.360**	.519**	1	.253**	.409**	.400**	.369**	.295**	.373**
	Sig. (2-	0.05	0.01	0	0	0.01	0	0	0		0	0	0	0	0	0
A10	Pearson	0.06	0.08	0.11	0.05	.127*	.165**	.159*	.168**	.253**	1	.337**	.214**	0.11	.140*	.192**
	Sig. (2-	0.32	0.19	0.08	0.4	0.04	0.01	0.01	0.01	0		0	0	0.09	0.03	0
A11	Pearson	.240**	.239**	.323**	.264**	.134*	.360**	.312**	.472**	.409**	.337**	1	.402**	.444**	.126*	.274**
	Sig. (2-	0	0	0	0	0.03	0	0	0	0	0		0	0	0.04	0
A12	Pearson	0.09	0	0.1	.339**	0.11	.224**	.210**	.226**	.400**	.214**	.402**	1	.495**	.243**	.377**
	Sig. (2-	0.14	1	0.11	0	0.08	0	0	0	0	0	0		0	0	0
A13	Pearson	.209**	.173**	.163**	.241**	0.1	.257**	.179**	.309**	.369**	0.11	.444**	.495**	1	.330**	.207**
	Sig. (2-	0	0.01	0.01	0	0.12	0	0	0	0	0.09	0	0		0	0
A14	Pearson	0.03	0.04	0.07	.268**	.174**	0.12	0.12	.196**	.295**	.140*	.126*	.243**	.330**	1	.362**
	Sig. (2-	0.59	0.5	0.29	0	0.01	0.05	0.06	0	0	0.03	0.04	0	0		0
A15	Pearson	.182**	.124*	0.11	.240**	0.08	.172**	.199**	.254**	.373**	.192**	.274**	.377**	.207**	.362**	1
	Sig. (2-	0	0.05	0.08	0	0.21	0.01	0	0	0	0	0	0	0	0	

*Correlation is significant at 0.05 level (2-tailed). For each factor, line 1 refers to Pearson correlation.

** Correlation is significant at 0.01 level (2-tailed). For each factor, line 2 refers to Sig. (2-tailed).

Table 6. 10 KMO and Bartlett's Test for importance factors

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.789
Bartlett's Test of Sphericity	Approx. Chi-Square	969.27
	Df	105
	Sig.	0.000

Thirdly, the Kaiser-Meyer-Oklin (KMO) value can measure the appropriateness of factor analysis. The Bartlett test of sphericity is a statistical test for the presence of correlations. The KMO value extracted from SPSS (Table 6.10) was 0.789, exceeding the recommended value of 0.6 (Hair et al. 2010). A statistically significant Barlett's test of Sphericity (Sig. < 0.05) indicates that sufficient correlation exists among the factors to proceed. The value reached statistical significance (the Sig. value was 0.000, which was less than 0.05). The KMO and Bartlett's Test results together with the sample size of 254 support the factorability of the correlation matrix.

Fourthly, the data should be normally distributed, which has already been discussed in Section 6.4. Lastly, factor analysis has been employed recently as an appropriate methodology to validate measurements in port and transport studies (Yeo et al. 2008; Tracey 2004). Thus it is suitable to conduct factor analysis with the current data.

6.4.2 Choice of factor analytic techniques

Factor analysis is a data reduction technique with a family of factor analytic techniques. Principal components analysis (PCA) and factor analysis (FA) are known as the two main distinctive techniques. In PCA, the original factors are transformed into a smaller set of groups, with all the variance in the factors being used; while in FA, only shared variance is analysed (Pallant 2007). Hair et al. (2010) claim PCA is the most appropriate when data reduction is paramount, while FA is most suitable for well-specified theoretical applications.

PCA is often used to identify key determining factors as only a data reduction method (Pallant 2007; Hair et al. 2010). As the current research involved data reduction and there was no well-specified theoretical application, PCA was employed.

6.4.3 Extraction method

Factor extraction determines the smallest number of factors that best represent the interrelations among the factors (Pallant 2007). There are several methods for unearthing factors in the data collected. SPSS provides seven extraction techniques, namely, principal component, principal factors, image factoring, maximum likelihood factoring, alpha factoring, un-weighted least squares and generalised least squares. The method to choose depends on the purpose of the analysis. As this research aimed to explore the data, principal component and principal factors were preferred; as the two methods result in similar results (Field 2005), and as principal component is the most popular technique and set as the default technique in the SPSS system, PCA was used as the factor extraction method in the current research.

6.4.4 Choice of rotation method

Factor rotation is an important step to improve the factor patterns and help to interpret the result of factor analysis (Hair et al. 2010). There are two main approaches to rotation: orthogonal and oblique factor solutions. SPSS provides a few rotational techniques within the two broad approaches. Varimax is the most commonly used orthogonal technique while Direct Oblimin is the most commonly used oblique technique, allowing for factors being related rather than remaining independent. The former attempts to minimize the number of factors with high loadings on each factor and results in solutions which are more interpretable (Field 2005; Pallant 2007). It helps to obtain a simpler and more meaningful structure (Hair et al. 2010). The latter is often recommended to provide information about the degree of correlation between the different factors. The current research employed PCA with Varimax rotation, as it aimed to provide a clear and meaningful factor categorization. The Varimax rotation was supposed to help with the independent common key factors that influence the development of the port's factor performance. In order to find out the common factors influencing port performance, the combined valid data from both the Humber and Xiamen were used for the factor analysis, as the common factors would provide a comparable base for later comparative analysis.

6.4.5 Decision on the number of factors

Factor analysis aims to extract only a small number of the factors which can adequately represent the whole set of factors (Hair et al. 2010). The decision on the number of factors to extract is critical, as too many factors may cause difficulty in result interpretation while too few factors may conceal the important dimensions or correct structure and too few factors can cause serious problems. During the analysis, multiple criteria of eigenvalues, percentage of variance criteria, Scree Test criteria, interpretability, and internal consistency were combined and used to determine the appropriate number of factors, as suggested by Pallant (2007) and Hair et al. (2010).

Firstly, eigenvalue was employed as the criterion of eigenvalue has the advantage of simplicity and objectivity. According to Hair et al. (2010), if the number of factors is 20-50, factors with eigenvalues greater than 1 should be retained as they are regarded as significant; if the number of factors is less than 20, which applies to the current research, eigenvalues greater than 1 would result in too few factors. The researcher tried eigenvalues greater than 0.9 to get a more suitable number of factors.

Secondly, percentage of variance was considered. Hair et al. (2010) claim that enough factors should be considered to meet a specified percentage of variance explained, usually 60% or higher. In this research, the percentage of 60% was chosen, as Hair et al. (2010) claim that 60% of variance is regarded as satisfactory in social science due to the less precise information. This criterion was jointly considered with the criterion of eigenvalue. Table 6.11 presents the total variance explained from SPSS.

Table 6. 11 Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.375	29.165	29.165	4.375	29.165	29.165	2.486	16.575	16.575
2	1.695	11.298	40.462	1.695	11.298	40.462	2.234	14.894	31.469
3	1.108	7.389	47.851	1.108	7.389	47.851	1.718	11.452	42.921
4	1.041	6.939	54.79	1.041	6.939	54.79	1.419	9.463	52.384
5	0.945	6.297	61.087	0.945	6.297	61.087	1.305	8.702	61.087
6	0.894	5.96	67.047						
7	0.852	5.677	72.724						
8	0.725	4.832	77.556						
9	0.678	4.519	82.076						
10	0.626	4.171	86.246						
11	0.556	3.708	89.954						
12	0.478	3.19	93.144						
13	0.39	2.603	95.747						
14	0.349	2.325	98.072						
15	0.289	1.928	100						
Extraction Method: Principal Component Analysis. The rotation method was Varimax with Kaiser Normalization.									

Thirdly, the interpretability of the factors was employed as it explains whether a group of items loaded on a given factor makes sense. Fourthly, the Scree Test Criterion was employed. Figure 6.8 presents the Scree Plot drawn from SPSS. The graph was examined and reference made to the cut-off point to identify the number of factors to retain. The last substantial drop was considered as the appropriate number of factors. This is a subjective rule to decide the cut-off point. The figure shows that 7 is the maximum point before the graph straightens out.

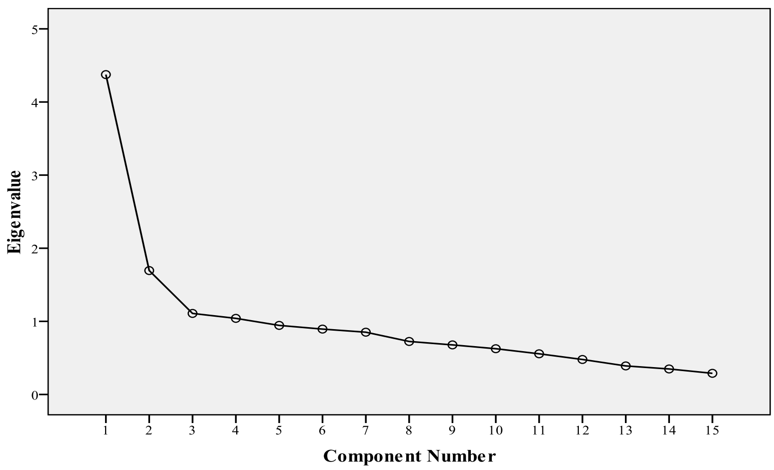


Figure 6. 8 Scree Plot

Lastly, the internal consistency was considered to determine the number of factors to retain. The Cronbach’s Alpha statistic was used to determine whether the factors under the corresponding A-factors were internally consistent and reliable. The reliability of the factor analysis was tested and the results of the reliability statistics revealed that the Cronbach's Alpha values were 0.749, 0.687 and 0.613 for the first three factors (Table 6.12). No reliability test was conducted for the last two factors as it is recommended that only variables constructed from three or more propositions be tested for reliability (Peter 1979). According to Hair et al. (2010), if the Cronbach's values range from 0.5 to 0.7, it indicates the factors under the factor have normal consistency and they are sufficiently reliable; if the Cronbach's values exceed 0.7, there is high consistency between the factors. As the Cronbach's Alpha values were all between 0.5 and 0.8, these computed factors indicate normal internal consistency.

Table 6. 12 Rotated Component Matrix with loadings on each factor (combined samples)

	Factors				
Factors	Port services	Log. Support	Cost	Shipping services	Others
A-risks	.787				
A-safety	.740				
A-handling speed	.636				
A-port infrastructure	.605				
A-government support		.772			
A-feeders		.591			
A-navi & land		.582			
A-landside links		.574			
A-logistics services		.468			
A-shipping prices			.788		
A-overall cost			.675		
A-port charges			.627		
A-shipping services				.789	
A-proximity					.886
A-skills					.495
% of variance	29.17%	11.30%	7.39%	6.94%	6.30%
Cumulative percentage	29.17%	4.046%	47.85%	54.79%	61.09%
Cronbach's Alpha	0.749	0.687	0.613	X	X
Extraction Method: Principal Component Analysis.					
Rotation Method: Varimax with Kaiser Normalization.					
a. Rotation converged in 9 iterations.					

Based on the above five criteria, five factors were extracted with eigenvalues exceeding 0.9. Orthogonal (Varimax) rotation of the factors yielded the factor structure given in Table 6.12. The final results of PCA revealed the presence of five components, explaining 29.165%, 11.298%, 7.389%, 6.939% and 6.297% of the variance respectively. The 5-component solution explained a total of 61.087% of the variance.

The Rotated Component Matrix presents five components. The five aggregate factors were named based on the nature of the constituent factors. The first A-factor "port services" is made of four factors, namely, speed of handling, safety, risks and port infrastructures with the corresponding factor loadings 0.787, 0.740, 0.636 and 0.605. The second A-factor "logistics support" consists of five factors: feeders, landside links, services of logistics, government support and navigation whose factor loadings are 0.591, 0.574, 0.468, 0.772 and 0.582 respectively. The third A-factor “cost” incorporates three factors: freight, port charges and overall logistics cost, whose factor loadings are 0.788, 0.627 and 0.675 respectively. The fourth A-factor “shipping services” contains only one factor (shipping services) with a factor loading of 0.789. The last A-factor “others” contains two factors of proximity and skills whose corresponding factor loadings are 0.886 and 0.495. This structure was used for further analysis. The factor with cross-loading was not deleted because the objective of the factor analysis is strictly data reduction (Hair et al. 2010).

6.4.6 The significance of factor loadings

The rotated solution revealed the presence of a simple structure, with the components showing a number of strong loadings. Factor loading actually is the correlation between a measured variable and its factor. The loadings are referred to in order to decide which factors should be incorporated into which aggregate factors (Field 2005). According to Hair et al. (2010), the higher the loadings, the more important the factors are in interpreting the result. They note that factor loadings from 0.3-0.4 are minimally accepted, factor loadings of ≥ 0.5 are practically significant and factor loadings of >0.7 indicate a well-defined structure.

The results of factor analysis are presented in Table 6.12, which presents a clear rotated component structure of five components based on overall samples. According to Field (2005) and Hair (2010), if the sample size is more than 250 (in the current study, the size was 254), the factor loading should be over 0.35 (Field suggested 0.364, Hair suggested 0.35), to be acceptable for interpretation of structure. Stevens (1992) also recommends that it is practical to interpret the factors whose loadings are greater than 0.4. As Table 6.12 shows, all the factor loadings are more than 0.49. This indicates that the extracted factors are very reliable.

The factor loadings in Table 6.12 show that the availability of shipping services, shipping prices, risks and logistics services were considered critical for their aggregate factors. The results indicate that key factors for port importance are service related, implying that the ports rely on efficient services.

6.4.7 Results of factor analysis

Supported by the Cronbach’s alpha, the factors within the A-factors are highly related, and the correlations between the factors are significant; hence it is necessary to create summated scales for each factor. The five summated factors were computed into SPSS as A16-port services, A17-logistics support, A18-cost, A19-shipping services and A20-others respectively for further analysis. The means of the five A-factors were simply output by averaging the scores of factors. The means were 3.87, 3.85, 3.99, 4.32 and 3.47 respectively, which indicated the factor importance hierarchy order was shipping services, cost, port services, logistics support and others. Correspondingly, B16-port services, B17-logistic support, B18-cost and B19-shipping services and B20-others were input into SPSS for Section B analysis; and C16-port services, C17-logistic support, C18-cost and C19-shipping services and C20-others were input into SPSS for Section C analysis. The structure of factors is shown in Figure 6.9.

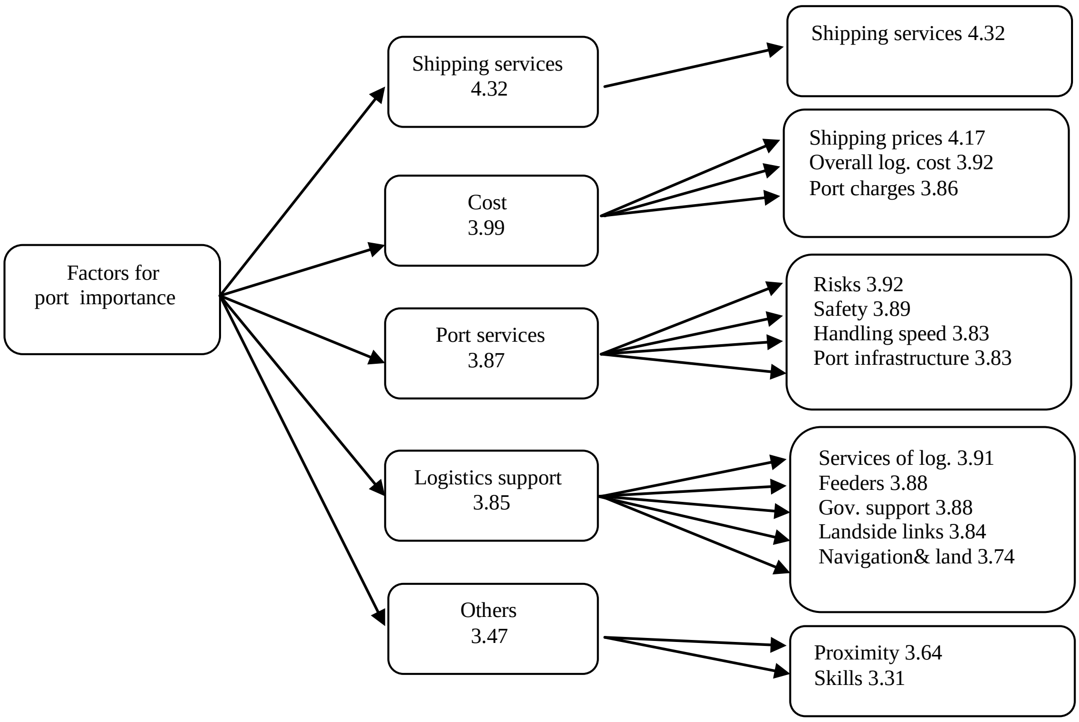


Figure 6. 9 Structure for factors influencing port performance

6.4.8 Factor validity

Before factor analysis but after confirming statistically that the questionnaire data were devoid of random effects, a test of reliability was conducted as a measure of the internal consistency of instruments to find out whether the data collected were reliable or not, as instructed by Pallant (2007). The Cronbach's coefficient alpha, which provides an indication of the average correlation among all of the items making up the scale, was employed to test the internal consistency of the combined data from both the Humber and Xiamen, and for the Humber and Xiamen responses separately. According to Pallant (2007), the scale has very good internal consistency if the Cronbach's Alpha coefficient is above 0.8. Nunnaly (1978) believes that coefficients greater than 0.7 indicate high credibility. In this research, as presented in Table 6.13, the Cronbach's alpha coefficient was 0.917 for the Humber, 0.941 for Xiamen, and 0.932 for combined data from both the Humber and Xiamen, suggesting a very good internal consistency and the scale was considered very reliable with the sample.

After the factor analysis, the convergent validity, which refers to the unit dimensionality, was confirmed by the test of reliability for the A-factors. The outcome was presented in Table 6.12. Then the discriminant validity was tested by the correlations between the five A-factors. Table 6.14 presents the correlations and interrelationships among these factors. All the correlations are significant at the 0.01 level, which means the factors are different and independent. This implies that the discriminant validity of the questionnaire is high. The results of correlations confirm the appropriateness of the decision to use Varimax as the rotation method.

Table 6. 13 Reliability Statistics

Region	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	# of Items
Humber	0.917	0.895	45
Xiamen	0.941	0.919	45
Overall	0.932	0.910	45

Table 6. 14 Correlations between aggregate factors

		A16-port servc	A17-logsupt	A18-cost	A19-shipservc	A20-others
A16-port servc	Pearson Correlation	1	.465**	.445**	.224**	.464**
	Sig. (2-tailed)		0	0	0	0
A17-logsupt	Pearson Correlation	.465**	1	.214**	.220**	.396**
	Sig. (2-tailed)	0		0.001	0	0
A18-cost	Pearson Correlation	.445**	.214**	1	.170**	.274**
	Sig. (2-tailed)	0	0.001		0.007	0
A19-shipservc	Pearson Correlation	.224**	.220**	.170**	1	.183**
	Sig. (2-tailed)	0	0	0.007		0.003
A20-others	Pearson Correlation	.464**	.396**	.274**	.183**	1
	Sig. (2-tailed)	0	0	0	0.003	
**. Correlation is significant at the 0.01 level (2-tailed).						

Table 6.15 presents the A-factor means by different sections and by mean hierarchy. Based on Table 6.15 and Figure 6.9, obviously, the importance of the factors was in descending order as shipping services, shipping prices, overall cost, risks, logistics services, safety, feeders, government support and port charges. The other six factors were considered unimportant, as their means were below the combined grand mean.

Table 6. 15 Factor comparison by mean in descending order (D.O.= descending order)

	Comb.	HB	XM	Comb. D.O.	Mean	HB factor D.O	Mean	XM factor D.O.	Mean
A16-port servc	3.87	4.08	3.75	A19-shipservc	4.32	A19-shipservc	4.50	A19-shipservc	4.22
A17-logsupt	3.85	3.70	3.94	A18-cost	3.99	A18-cost	4.21	A17-logsupt	3.94
A18-cost	3.99	4.21	3.86	A16-port servc	3.87	A16-port servc	4.08	A18-cost	3.86
A19-shipservc	4.32	4.50	4.22	A17-logsupt	3.85	A20-others	3.72	A16-port servc	3.75
A20-others	3.47	3.72	3.33	A20-others	3.47	A17-logsupt	3.70	A20-others	3.33
B16-portservc	3.68	3.70	3.66	B16-portservc	3.68	B20-others	3.72	B16-portservc	3.66
B17-logsupt	3.41	3.26	3.50	B19-shipservc	3.53	B16-portservc	3.70	B17-logsupt	3.50
B18-cost	3.33	3.35	3.31	B20-others	3.53	B19-shipservc	3.66	B19-shipservc	3.46
B19-shipservc	3.53	3.66	3.46	B17-logsupt	3.41	B18-cost	3.35	B20-others	3.43
B20-others	3.53	3.72	3.43	B18-cost	3.33	B17-logsupt	3.26	B18-cost	3.31
C16-portservc	3.96	3.91	3.98	C19-shipping	4.25	C19-shipping	4.03	C19-shipping	4.39
C17-support	4.03	3.77	4.19	C17-support	4.03	C16-portservc	3.91	C17-support	4.19
C18-cost	3.59	3.50	3.64	C16-portservc	3.96	C17-support	3.77	C16-portservc	3.98
C19-shipping	4.25	4.03	4.39	C20-others	3.75	C20-others	3.58	C20-others	3.86
C20-others	3.75	3.58	3.86	C18-cost	3.59	C18-cost	3.50	C18-cost	3.64

6.5 Comparative analysis

Since this chapter sought to examine the questionnaire factors and the samples are from two different port regions, it is useful to analyse data from both the combined sample and separate samples. To analyse combined sample enables this research to obtain common factors and their differences in importance and performance among these factors. To analyse separate samples enables this research to get separate results, whose comparison may result in different strategies for the different samples. Factor analysis has a disadvantage that by analysing factors, some of the richness in the data may be lost (Field 2005). Moreover, the factors in different port regions may vary (Ford et al. 1999). For these reasons, both combined and separate analyses were conducted, and the main analysis referred to the 15 questionnaire factors rather than the aggregate factors, also to avoid losing rich data and confusion. The comparative analysis is based on the 15 factors, which are reasonably controllable for comparison and presentation.

Besides the combined sample analysis, an Independent-Samples T-test was employed to test the difference between two different samples of people for the two sets of scores, as suggested by Howitt and Cramer (2003), Field (2005) and Pallant (2007). In this case, it was used to compare importance/performance difference and other ports' performance difference on the 15 factors between the Humber and Xiamen.

The output Independent Samples Test presents the results of Levene's test for equality of variances in its Sig. column. According to Pallant (2007), when the Sig. value is larger than 0.05, the first line in the table should be used, which refers to Equal variances assumed. When the Sig. value is equal to or less than 0.05, it means the variances for the two groups are not the same and the data violate the assumption of equal variance. Then the information in the second line of the t-test table was used, which refers to Equal variances not assumed. Sig. (2-tailed) values were then checked to assess the differences between the groups. If the value in the Sig (2-tailed) column is above 0.05, there is no significant difference between the two groups; otherwise there is significant difference between the two groups (Pallant 2007).

6.5.1 Importance comparison

Factor importance for combined sample, plus comparison between HB and XM

Factor importance was analysed by mean scores. Tables 6.6, 6.7, 6.8 and 6.15 were referred to reflect the different means and importance hierarchy.

In terms of A-factor importance, for combined samples, Table 6.15 shows that A19 - shipping services was the most important A-factor. This was followed by cost, port services, logistics support and others. As for separate samples, Table 6.15 shows that A19 - shipping services was the most important for both the Humber and Xiamen. Both regions considered that cost was more important than port services, which were more important than others. However, the Humber considered logistics support is the least important while Xiamen considered it the second most important. Following shipping services, the Humber considered cost, port services, others and logistics support as important in descending order, while Xiamen considered logistics support, cost, port services and others as important in descending order.

In terms of the questionnaire factor importance, Tables 6.7 and 6.8 present that the 15 factors were categorised into two groups: important factors and unimportant factors, which were distinguished by grand means. Table 6.7 presents factor importance in descending order for the combined sample: shipping services, shipping prices, overall logistics cost, risks, logistics services, safety, feeder services and government support. Table 6.8 presents factor importance in descending order for separate samples. Both the Humber and Xiamen considered shipping services the most important. Following that, the Humber considered the importance of shipping prices, port charges, risks, handling speed and safety in descending order, while Xiamen considered the importance of government support, shipping prices, feeders, overall cost, logistics services, landside links and port technical infrastructure important in descending order.

For the top five factors of importance, both port regions considered shipping services, shipping prices and overall logistics cost very important, and these three factors are all service quality-related. This finding is not consistent with Song and Yeo (2004) who find that traditional factors such as location and port facilities rather than service quality are important in China. Besides the common important factors, the Humber and Xiamen have some difference in the top five factors. The Humber considered two additional factors (safety and handling speed) important, while Xiamen considered another two factors (government support and feeders) important. Relatively, both the Humber and Xiamen considered proximity and skills not so important. Moreover, the Humber considered government support, navigation and feeders not so important while Xiamen considered port charges, cargo handling speed and port safety not so important compared with other factors.

Based on the mean values, Figure 6.10 illustrates the factors importance comparison, which gives a visual overview of the comparison both across regions and within regions.

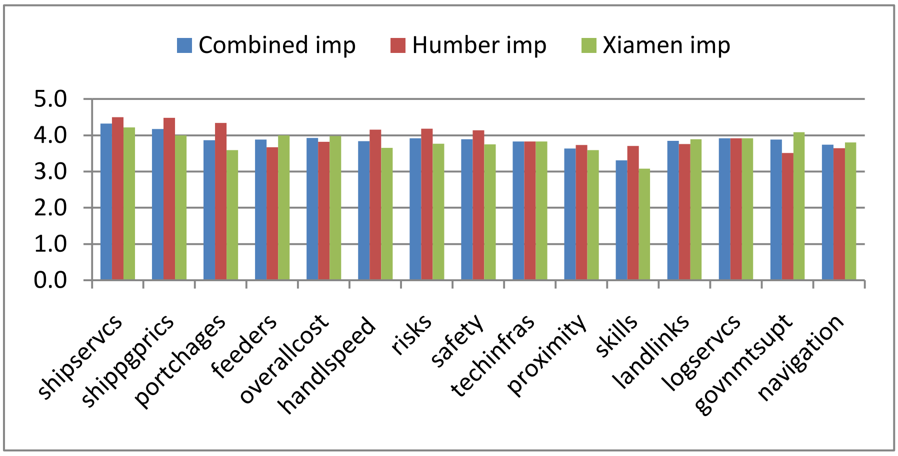


Figure 6. 10 Importance comparisons between HB, XM and combined sample

Table 6.16 gives an overview of the importance comparison between the Humber and Xiamen and within the region themselves, with both A-factors and questionnaire factors.

Table 6. 16 Overview of factor importance comparison

HB A-Factor imp. In D.O.	Q-Factor		XM A-Factor imp. In D.O.	Q-Factor		Factor dif. (HBvsXM)	Q-Factor	
	Imp.	Unimp.		Imp	Unimp.		Sig.	Insig. dif
A19-shipservc	A1		A19-shipservc	A1		A20-extservc	A11	A10
A18-cost	A2, A3	A5	A17-logsupt	A14, A4, A13, A12	A15	A18-cost	A3, A2	A5
A16-portservc	A7, A6, A8, A9		A18-cost	A2, A5	A3	A16-portservc	A6, A7, A8	A9
A20-others		A11, A10	A16-portservc	A9	A6, A8,	A19-shipserv	A1	
A17-logsupt	A13	A14, A15, A4, A12	A20-others		A11, A10	A17-logsupt	A14, A4	A12, A13, A15

The table reveals that although some A-factors were considered very important, not all the corresponding questionnaire factors were important. Similarly, although some A-factors were identified as not so important, not all the corresponding questionnaire factors were identified as unimportant. This also gives evidence to support why questionnaire factors were preferred for analysis instead of aggregate factors for detailed comparison. This table presents which factors and A-factors were identified as important/unimportant as well. It presents the factor difference in descending order.

Significant and insignificant differences between the Humber and Xiamen

An Independent-Samples T-test was conducted to test statistically the factor importance difference between the Humber and Xiamen. The test results in Table 6.17 reveal significant differences between the Humber and Xiamen over 9 factors, whose mean difference was in descending order: port charges, skills, government support, speed of cargo handling, shipping prices, risk, safety, feeders and shipping services availability. The test results revealed no significant differences over the remaining 6 factors. The "mean difference" column shows the extent of the difference. The test results clearly demonstrate that for the factors with significant differences, the scores given by the Humber respondents were significantly higher than those by Xiamen respondents, except for government support and feeders.

Table 6. 17 Factors with significant/insignificant difference between HB and XM importance

Item	The Humber		Xiamen					95% CI		ETA
	Mean	SD	Mean	SD	T value	P (Sig. 2-tailed)	Mean dif.	Lower	Upper	squared
A3-portcharges	4.34	0.70	3.59	0.98	7.012	0.000	0.74	0.535	0.953	0.171
A11-skills	3.71	0.92	3.08	0.83	5.390	0.000	0.63	0.397	0.856	0.143
A14-govs.upt	3.51	1.12	4.09	0.81	-4.310	0.000	-0.58	-0.839	-0.312	0.113
A6-handlspeed	4.15	0.74	3.65	0.82	4.948	0.000	0.50	0.294	0.702	0.084
A2-shipprices	4.48	0.67	4.00	0.96	4.231	0.000	0.48	0.256	0.701	0.066
A7-risks	4.18	0.84	3.77	0.78	4.020	0.000	0.42	0.214	0.625	0.060
A8-safety	4.14	1.01	3.75	0.88	3.203	0.002	0.39	0.149	0.627	0.039
A4-feeders	3.67	1.20	4.00	0.91	-2.267	0.025	-0.33	-0.61	-0.042	0.033
A1-shipservices	4.50	0.75	4.22	0.83	2.709	0.007	0.28	0.078	0.49	0.028
A5-overall cost	3.82	0.88	3.98	0.98	-1.354	0.177	-0.17	-0.408	0.075	0.007
A15- navig.	3.64	1.24	3.80	0.85	-1.111	0.269	-0.16	-0.448	0.126	0.009
A10-proximity	3.73	0.97	3.59	0.94	1.144	0.254	0.14	-0.102	0.386	0.005
A12-landlinks	3.76	1.00	3.89	0.81	-1.049	0.296	-0.13	-0.369	0.113	0.007
A13-logservices	3.91	0.93	3.91	0.82	-0.005	0.996	0.00	-0.223	0.222	0.000
A9-techinfrs	3.83	0.90	3.83	0.86	-0.009	0.992	0.00	-0.226	0.224	0.000

This section has addressed Research Objective One, which was to identify the important factors that drive a port's performance. It has also investigated the importance differences among these factors, which is part of Research Objective Two. Lastly, it has analysed how the factor importance varies for different ports by t-test, which is part of Research Objective Three.

6.5.2 Performance comparison

Factor performance for combined sample, plus comparison between HB and XM

Tables 6.6, 6.7, 6.8 and Figure 6.11 present the actual performance of the Humber and Xiamen ports and their combined data. In terms of the questionnaire factor performance, the 15 factors were categorised into two groups: good performance and poor performance, which were distinguished by the grand means. Table 6.7 presents factor performance in descending order for the combined sample: port safety, logistics services, port technical infrastructure, speed of cargo handling, risks, proximity, shipping services and skills. Table 6.8 presents factor performance in descending order for separate samples. The Humber performed well in the following factors in descending order: speed of cargo handling, proximity, safety, logistics services, shipping services, risks and skills, whereas Xiamen performed well in the following factors in descending order: port safety, logistics services, port technique infrastructure, government support, feeder services and risks. The remaining factors were identified as being poorly performed.

For the top five factors of performance, both the Humber and Xiamen had very good performance in logistics services, risks and safety. Besides these, the Humber performed well in handling speed, proximity and shipping services, while Xiamen performed well in port infrastructure, government support and feeders.

Relatively, both the Humber and Xiamen performed poorly in overall logistics cost, navigation, port charges and landside links, although they considered cost was a very important factor. This finding emerged from interviews and was validated by this questionnaire finding. This finding indicates that both regions need to improve the performance of port charges, overall cost reduction and landside links. Moreover, the Humber performed poorly in government support and feeder services, while Xiamen performed poorly in shipping prices and proximity. The Humber needs to improve these factors accordingly.

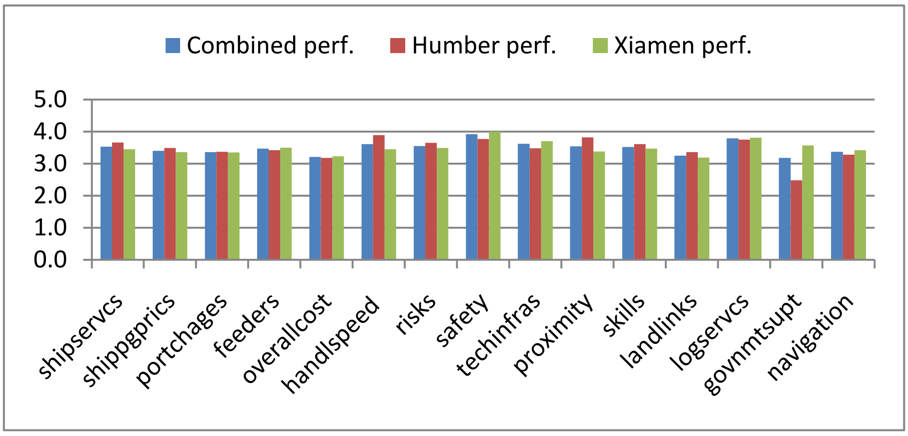


Figure 6. 11 Performance comparisons between HB, XM and combined sample

These two port regions had some differences in performance. The Humber rated itself good in feeder connections while Xiamen scored well on port technical infrastructure.

The Humber scored very poorly on government support, location and navigation while Xiamen did not.

Based on the mean values, Figure 6.11 illustrates the factors performance comparison, which gives a visual overview of the comparison both across regions and within regions, for both combined and separate samples.

Significant and insignificant performance differences between HB and XM

An Independent Samples t-test was conducted to test the performance difference in the 15 factors between the Humber and Xiamen. The test results are presented in Table 6.18 which reveals significant differences between the Humber and Xiamen in five factors.

Table 6. 18 Factors with significant /insignificant difference between HB and XM performance

	the Humber		Xiamen			P (Sig. 2-	Mean	95% CI		Eta
Item	Mean	SD	Mean	SD	T value	tailed)	dif	Lower	Upper	squared
B14-govs.upt	2.48	0.92	(3.57)	0.88	-9.409	0.000	-1.10	-1.325	-0.866	0.260
B10-proximity	3.83	0.81	3.38	0.77	4.324	0.000	0.44	0.241	0.645	0.069
B6-handlspeed	3.89	0.82	3.46	0.78	4.189	0.000	0.44	0.230	0.639	0.065
B8-safety	3.77	0.87	(4.01)	0.65	-2.265	0.025	-0.23	-0.439	-0.030	0.033
B9-techinfrs	3.48	0.87	(3.70)	0.77	-2.014	0.046	-0.22	-0.434	-0.004	0.023
B1-shipservces	3.66	0.96	3.46	0.77	1.761	0.080	0.21	-0.025	0.438	0.019
B12-landlinks	3.36	0.87	3.19	0.87	1.475	0.141	0.17	-0.056	0.391	0.009
B7-risks	3.65	0.84	3.49	0.77	1.516	0.131	0.16	-0.047	0.364	0.009
B15- nav&land	3.28	1.01	3.43	0.83	-1.225	0.222	-0.14	-0.374	0.087	0.006
B11-skills	3.61	0.80	3.48	0.74	1.341	0.181	0.13	-0.063	0.329	0.007
B2-shipgprices	3.49	0.92	3.36	0.79	1.146	0.253	0.13	-0.095	0.357	0.008
B3-portcharges	3.37	0.93	3.35	0.95	0.144	0.886	0.02	-0.225	0.260	0.000
B4-feeders	3.42	1.04	3.50	0.80	-0.607	0.544	-0.08	-0.324	0.171	0.002
B13-logservces	3.75	0.83	3.81	0.77	-0.567	0.571	-0.06	-0.262	0.145	0.001
B5-overallcost	3.18	0.80	3.23	0.77	-0.427	0.670	-0.04	-0.245	0.158	0.001

Government support differed most and Xiamen performed much better than the Humber. This was followed by proximity and speed of cargo handling, safety and port infrastructure, in descending order. Xiamen performed much better than the Humber in government support, safety and port infrastructure, whereas the Humber performed much better than Xiamen in proximity and handling speed. The test results revealed no significant differences between the performance of the Humber and that of Xiamen for the remaining factors. The findings are consistent with the qualitative findings from interviews, as presented in Chapter 5. Compared with the findings from Section 6.5.1, it is noted that some factors were important, but their performance was not good.

This section has investigated the performance differences by mean among the questionnaire factors, which is part of Research Objective Two. It has also analysed how the factor performance varies for different ports by t-test, which is part of Research Objective Three.

6.5.3 Performance difference between the case ports and other ports

In order to compare the performance between the case ports and other ports, the data of 78 responses from the Humber and 128 responses from Xiamen were used, as those respondents provided answers to both Section B and Section C.

Tables 6.7 and 6.8 presented the performance difference between the Humber ports, Xiamen ports, combined ports and other ports by mean. The results of gap analysis by mean scores show that big performance gaps exist the case ports and other ports. A paired-samples t-test was further conducted to compare the scores of port performance between case ports and other ports in the 15 factors.

Table 6.19 reveals the test results. There were significant differences in performance between the Humber and other ports in government support, landside links, port infrastructure, navigation, feeders, safety, logistics services, port charges, shipping services availability and proximity to the supplier and customers. The results revealed no statistically significant difference in performance between the Humber ports and other ports in the remaining factors. Among the 10 factors, only in proximity did the Humber perform better than other ports. For all the remaining 9 factors, the other ports performed much better than the Humber. The results from t-test are consistent with the results from mean comparison.

The results of gap analysis by mean scores shows that big performance gaps exist between Xiamen and other ports in 13 out of the 15 factors. There were significant differences between them in these factors. The performance difference of landside links between Xiamen and other ports was found as the biggest. This was followed by shipping services, feeders, navigation, speed, government support, port infrastructure, skills, proximity, logistics services, shipping prices, port charges and overall cost. For all the 15 factors, Xiamen performed better than other ports only in safety. For all the remaining 14 factors, the other ports performed much better than Xiamen.

The results of gap analysis by mean scores shows that big performance gaps existed between sample ports and other ports in 13 out of the 15 factors. A paired samples t-test was conducted to compare the scores of port performance between sample ports and other ports on the 15 factors. The test results revealed statistically significant differences in the 13 factors except proximity and risks, with other ports performing much better. The performance difference of landside links and shipping services between sample ports and other ports was identified as the biggest. This was followed by navigation, government support, feeders, port infrastructure, speed, logistics services, port charges skills, shipping prices, overall cost and safety.

Table 6. 19 Factor performance comparison

The Humber ports' performance vs. other ports' performance		Paired differences: Mean	Std. Deviation	95% Confidence Interval of the Difference: Lower	Upper	t	Sig. (2-tailed)	Eta squared
Pair 14	Government support	-0.821	1.066	-1.061	-0.580	-6.798	0.000	0.375
Pair 15	Navigation &land	-0.718	1.570	-1.072	-0.364	-4.039	0.000	0.175
Pair 9	Port tech infr	-0.667	1.192	-0.935	-0.398	-4.941	0.000	0.241
Pair 12	Landside links	-0.615	1.096	-0.862	-0.368	-4.960	0.000	0.242
Pair 4	Feeders	-0.551	1.601	-0.912	-0.190	-3.042	0.003	0.107
Pair 1	Shipping services	-0.410	1.583	-0.767	-0.053	-2.289	0.025	0.064
Pair 8	Safety	-0.372	1.082	-0.616	-0.128	-3.034	0.003	0.107
Pair 13	Logistics services	-0.372	1.094	-0.619	-0.125	-3.000	0.004	0.105
Pair 3	Port charges	-0.346	1.247	-0.627	-0.065	-2.452	0.016	0.072
Pair 10	Proximity	0.282	1.216	0.008	0.556	2.049	0.044	0.052
Pair 5	Overall cost	-0.141	1.066	-0.381	0.099	-1.169	0.246	0.017
Pair 6	Handling speed	-0.051	1.092	-0.297	0.195	-0.415	0.679	0.002
Pair 2	Shipping prices	-0.038	1.167	-0.302	0.225	-0.291	0.772	0.001
Pair 7	Risks	-0.038	1.232	-0.316	0.239	-0.276	0.784	0.001
Pair 11	Skills	0.000	0.953	-0.215	0.215	0.000	1.000	0.000
Xiamen ports' performance vs. other ports' performance								
Pair 12	Landside connections	-.945	1.082	-1.135	-.756	-9.887	.000	0.435
Pair 1	Shipping services	-.938	1.033	-1.118	-.757	-10.[illegible]	.000	0.454
Pair 4	Feeders	-.789	1.070	-.976	-.602	-8.346	.000	0.354
Pair 15	Navigation	-.734	1.039	-.916	-.553	-8.000	.000	0.335
Pair 6	Speed of handling	-.672	0.973	-.842	-.502	-7.813	.000	0.325
Pair 14	Government support	-.633	1.086	-.823	-.443	-6.593	.000	0.255
Pair 9	Technical infrastructure	-.508	0.988	-.681	-.335	-5.815	.000	0.210
Pair 11	Skills	-.453	0.812	-.595	-.311	-6.314	.000	0.239
Pair 10	Proximity	-.359	1.128	-.557	-.162	-3.606	.000	0.093
Pair 13	Services of logistics	-.359	0.903	-.517	-.202	-4.505	.000	0.138
Pair 2	Shipping prices	-.344	1.007	-.520	-.168	-3.861	.000	0.105
Pair 3	Port charges	-.281	1.183	-.488	-.074	-2.689	.008	0.054
Pair 5	Overall cost	-.266	0.992	-.439	-.092	-3.030	.003	0.067
Pair 7	Risks	-.125	0.896	-.282	0.032	-1.578	.117	0.019
Pair 8	Safety	0.016	0.763	-.118	0.149	0.232	.817	0.000
Combined sample -local ports' performance vs. other ports' performance								
Pair 12	landside links	-.820	1.096	-.971	-.670	-10.74	.000	0.361
Pair 1	shipping lines	-.738	1.291	-.915	-.560	-8.201	.000	0.248
Pair 15	navigation & land	-.728	1.263	-.902	-.555	-8.278	.000	0.251
Pair 14	government support	-.704	1.080	-.852	-.556	-9.358	.000	0.300
Pair 4	feeder links	-.699	1.298	-.877	-.521	-7.730	.000	0.227
Pair 9	technical infra	-.568	1.070	-.715	-.421	-7.621	.000	0.222
Pair 6	speed of handling	-.437	1.061	-.583	-.291	-5.911	.000	0.146
Pair 13	services of log.	-.364	.977	-.498	-.230	-5.348	.000	0.123
Pair 3	port charges	-.306	1.205	-.471	-.140	-3.642	.000	0.061
Pair 11	skills	-.282	.894	-.404	-.159	-4.523	.000	0.091
Pair 2	freight	-.228	1.078	-.376	-.080	-3.037	.003	0.043
Pair 5	overall cost	-.218	1.020	-.359	-.078	-3.075	.002	0.044
Pair 8	security	-.131	.915	-.257	-.005	-2.057	.041	0.020
Pair 10	proximity	-.117	1.200	-.281	.048	-1.393	.165	0.009
Pair 7	risks	-.092	1.034	-.234	.050	-1.280	.202	0.008

Gap analysis between the performance of sample ports and other ports revealed that there were more factors with significant differences than factors with insignificant differences, and big gaps existed between the sample ports and other ports in terms of performance difference. Both the Humber differences and Xiamen differences shared the same five factors (government support, landside links, feeders, navigation and port infrastructure) out of the top seven different factors. Additionally, big gaps exist in shipping services and speed of cargo handling for Xiamen. The big gaps indicate that both regions do not satisfy customers compared with other ports in these factors. Moreover, the results indicate that there were more factors that had significant differences between Xiamen and other ports than between the Humber ports and other ports. In other words, more differences between Xiamen and other ports were identified than between the Humber ports and other ports.

Section 6.5.3 and Table 6.19 imply that both regions performed poorer than other ports. The predictable results confirm that "the grass is always greener on the other side". Other ports perform much better than local ports in government support, feeders, port technical infrastructure, navigation, landside links and shipping services. The big gaps identified are the factors needing improvement. Hence, it has identified the key factors that drive port performance by gap analysis between sample ports and other ports. This is part of Research Objective One. This section has also analysed how factor performance varies for different ports, hence it has partially addressed Research Objective Three.

6.5.4 Difference between Δ(C-B) of the Humber/Xiamen and other ports

The Humber performance difference Δ(C-B) (performance difference between the Humber ports and other ports) and the Xiamen performance difference Δ(C-B) (performance difference between Xiamen ports and other ports) were calculated from the questionnaire data first. An Independent Samples t-test was then conducted to test if there was any statistically significant difference between the two regions' performance difference between the case ports and other ports. The test results are presented in Table 6.20, which reveals significant differences in proximity, speed, shipping services, skills, safety, landside links and shipping prices in descending order. Xiamen's differences were bigger than the Humber's except safety.

Table 6. 20 Performance difference comparison across regions by factors

Item	The Humber		Xiamen		T value	P (Sig. 2-tailed)	Mean difference	95% CI		Eta squared
	Mean	SD	Mea	SD				Lower	Upper	
difCvs.B10-proximity	-0.28	1.216	0.36	1.128	-3.844	0.000	-0.64	-0.970	-0.312	0.068
difCvs.B6-handlgspeed	0.05	1.092	0.67	0.973	-4.238	0.000	-0.62	-0.909	-0.332	0.081
difCvs.B1-shipgservic	0.41	1.583	0.94	1.033	-2.622	0.010	-0.53	-0.926	-0.129	0.055
difCvs.B11-skills	0.00	0.953	0.45	0.812	-3.634	0.000	-0.45	-0.699	-0.207	0.061
difCvs.B8-safety	0.37	1.082	-0.02	0.763	2.769	0.006	0.39	0.111	0.664	0.058
difCvs.B12-landlinks	0.62	1.096	0.95	1.082	-2.113	0.036	-0.33	-0.638	-0.022	0.021
difCvs.B2-shipgprices	0.04	1.167	0.34	1.007	-1.985	0.048	-0.31	-0.608	-0.002	0.019
difCvs.B4-feeders	0.55	1.601	0.79	1.070	-1.163	0.247	-0.24	-0.643	0.167	0.011
difCvs.B14-govsupt	0.82	1.066	0.63	1.086	1.212	0.227	0.19	-0.118	0.493	0.007
difCvs.B9-techinfra	0.67	1.192	0.51	0.988	1.034	0.302	0.16	-0.144	0.462	0.005
difCvs.B5-overall cost	0.14	1.066	0.27	0.992	-0.850	0.396	-0.13	-0.414	0.164	0.004
difCvs.B7-risks	0.04	1.232	0.13	0.896	-0.539	0.591	-0.09	-0.404	0.231	0.002
difCvs.B3-portcharge	0.35	1.247	0.28	1.183	0.374	0.709	0.07	-0.277	0.407	0.001
difCvs.B15- navig.	0.72	1.570	0.73	1.039	-0.082	0.935	-0.02	-0.413	0.380	0.000
difCvs.B13-logservcs	0.37	1.094	0.36	0.903	0.088	0.930	0.01	-0.265	0.290	0.000

Generally, there were more and bigger differences between Xiamen and other ports than between the Humber and other ports. Other ports performed much better than the Humber in all the factors except proximity and risk management, and better than Xiamen in all the factors except safety. Even for safety, Xiamen only performed slightly better than other ports.

This section has analysed how the factor performance varies for different ports, this has partly addressed Research Objective 3 from the perspective of performance difference.

6.5.5 Importance and performance analysis

This section presents importance-performance analyses. Various methods were employed, including gap analysis, traditional IPA and revised IPAs, as explained in Section 4.6.

Gap-analysis between importance and performance

A paired-samples t-test was conducted to compare the scores of importance and performance of the 15 factors for the combined sample, and separate samples. The results are presented in Table 6.21. The test results revealed a statistically significant difference between the factor importance and performance. Combined test results revealed significant differences in 13 out of the 15 factors. Only two factors (proximity and safety) did not have significant difference between their importance and performance. The mean differences revealed that overall logistics cost, government support, landside links, port charges and feeder services were the top five factors with significant differences in descending order. This was followed by other factors with big differences.

Table 6. 21 Significant/insig difference between factor importance and performance

		Paired differences				t	Sig. (2-tailed)	Eta squared
		Mean	Std. Deviation	95% Confidence Lower	Upper			
CombPair1	Avs.B shipping services	0.79	1.06	0.66	0.92	11.792	0.000	0.356
Pair 2	Avs. B shipping prices	0.77	1.14	0.63	0.91	10.757	0.000	0.315
Pair 5	Avs. B overallcost	0.71	1.16	0.57	0.85	9.736	0.000	0.272
Pair 14	Avs. B-governsupt	0.70	1.25	0.55	0.86	8.936	0.000	0.239
Pair 12	Avs. B-landlinks	0.59	1.18	0.45	0.74	8.009	0.000	0.202
Pair 3	Avs. B-portcharges	0.50	1.27	0.35	0.66	6.313	0.000	0.136
Pair 4	Avs. B-feeders	0.41	1.29	0.25	0.57	5.068	0.000	0.092
Pair 15	Avs. B-navig.	0.37	1.18	0.22	0.52	4.992	0.000	0.089
Pair 7	Avs. B-risks	0.37	1.14	0.23	0.51	5.133	0.000	0.094
Pair 6	Avs. B-handlspeed	0.22	1.05	0.09	0.35	3.354	0.001	0.042
Pair 11	Avs. B-skills	-0.22	1.04	-0.35	-0.09	-3.310	0.001	0.041
Pair 9	Avs. B-techinfras	0.21	1.11	0.07	0.35	2.995	0.003	0.034
Pair 13	Avs. B-logservices	0.13	1.01	0.00	0.25	1.988	0.048	0.015
Pair 10	Avs. B-proximity	0.09	1.16	-0.05	0.24	1.300	0.195	0.007
Pair 8	A-vs. B-safety	-0.03	1.07	-0.16	0.11	-0.410	0.682	0.001
HBPair 14	Avs.B-government support	1.03	1.39	0.74	1.32	7.104	0.000	0.357
Pair 2	Avs.B-shipping prices	0.99	1.08	0.77	1.21	8.750	0.000	0.457
Pair 3	Avs.B-port charges	0.97	1.17	0.73	1.21	7.920	0.000	0.408
Pair 1	Avs.B-shipping services	0.84	1.15	0.60	1.08	6.975	0.000	0.348
Pair 5	Avs.B-overall cost	0.63	1.09	0.41	0.86	5.565	0.000	0.254
Pair 7	Avs.B-risks	0.53	1.11	0.30	0.76	4.586	0.000	0.188
Pair 12	Avs.B-landside connections	0.40	1.19	0.16	0.65	3.251	0.002	0.104
Pair 8	Avs.B-security	0.37	1.08	0.15	0.59	3.293	0.001	0.106
Pair 15	Avs.B-navigation	0.36	1.38	0.07	0.64	2.494	0.014	0.064
Pair 9	Avs.B-infrastructure	0.35	1.18	0.10	0.59	2.826	0.006	0.081
Pair 6	Avs.B-speed of handling	0.26	1.03	0.05	0.47	2.439	0.017	0.061
Pair 4	Avs.B-feeders	0.25	1.48	-0.06	0.56	1.621	0.109	0.028
Pair 13	Avs.B-log. services	0.16	1.04	-0.05	0.38	1.503	0.136	0.024
Pair 11	Avs.B-skills	0.10	0.93	-0.09	0.29	1.013	0.314	0.011
Pair 10	Avs.B-proximity	-0.10	1.10	-0.33	0.13	-0.853	0.396	0.008
XMPair 1	Avs.B-shipping services	0.76	1.01	0.60	0.92	9.528	0.000	0.265
Pair 5	Avs.B-overall cost	0.75	1.20	0.57	0.94	7.983	0.000	0.202
Pair 12	Avs.B-landside connections	0.70	1.16	0.52	0.88	7.662	0.000	0.189
Pair 2	Avs.B-shipping prices	0.64	1.15	0.46	0.82	7.100	0.000	0.167
Pair 14	Avs.B-government support	0.51	1.12	0.34	0.69	5.815	0.000	0.118
Pair 4	Avs.B-feeders	0.50	1.16	0.32	0.68	5.488	0.000	0.107
Pair 15	Avs.B - navigation	0.38	1.06	0.21	0.54	4.532	0.000	0.075
Pair 7	Avs.B-risks	0.27	1.14	0.09	0.45	3.027	0.003	0.035
Pair 3	Avs.B-port charges	0.24	1.26	0.05	0.44	2.441	0.016	0.023
Pair 10	Avs.B-proximity	0.20	1.18	0.02	0.39	2.197	0.029	0.019
Pair 6	Avs.B-speed of handling	0.20	1.06	0.03	0.36	2.367	0.019	0.022
Pair 9	Avs.B-technical	0.13	1.06	-0.04	0.30	1.551	0.123	0.009
Pair 13	Avs.B-services of logistics.	0.11	0.99	-0.05	0.26	1.343	0.181	0.007
Pair 8	Avs.B-safety	-0.25	1.01	-0.41	-0.10	-3.205	0.002	0.039
Pair 11	Avs.B-skills	-0.40	1.07	-0.56	-0.23	-4.72	0.000	0.081

The Humber test results reveal that there were significant differences in 11 out of the 15 factors. Only four factors (feeders, logistics services, skills and proximity) did not have significant difference between their importance and performance. The mean differences revealed that government support had the biggest difference. This was followed by shipping prices, port charges, shipping services availability, overall cost, risks, landside links, safety, navigation, infrastructure and handling speed in descending order. Xiamen test results reveal significant differences in 13 out of the 15 factors between their importance and performance. The mean differences revealed that shipping services, overall logistics cost, landside links, shipping prices and government support were the top five factors with significant differences in descending order.

Performance gaps were identified by measuring the difference between importance and performance, according to O'Neill et al. (2001) and Johns (2001), who use score difference between performance and expectation to evaluate the service quality. The bigger the difference, the more attention needs paying to that factor.

Table 6.7 presented the mean gaps between the factor importance and performance for combined sample and Table 6.8 presented for separate samples (for the Humber and Xiamen respectively). The gaps indicate the difference between the customers' expectations of the port service quality and their satisfaction with the factors.

The most problematic areas for combined sample seemed to be shipping services, shipping prices, overall logistics cost, government support, landside links and port charges. The most problematic areas in the Humber seemed to be shipping prices, government support, port charges, shipping services and overall cost, while the biggest problem areas in Xiamen seemed to be shipping services, overall cost and landside links, shipping prices and feeders. It is important to note that this tool allows for the identification of specific problematic areas that can then be improved to help the port authority develop a more positive view of their ports.

Comparison between explicit importance and implicit importance

To help in understanding the explicit and implicit importance, it is necessary to recover the contents of IPA literature in Section 4.6. Explicit importance refers to the self-stated mean score from questionnaire respondents, while implicit importance is based on the factor's correlation with an external criterion.

The importance weights differ when different importance measures are taken between implicitly derived importance (statistically and implicitly derived from the factors, often by correlation) and explicitly self-stated importance (Matzler et al. 2003). As addressed in Section 4.6, there are no significant differences among the different methods to measure explicit importance and no significant differences among the different methods to measure implicit importance. So, in this study, direct mean rating was employed to represent the explicit importance and bivariate correlation of Spearman was employed to represent the implicit importance.

Bivariate correlation coefficients can be gained by Spearman correlation between factor importance and factor performance, as suggested by Oliver (1997). Spearman correlation were conducted and the results are presented in Table 6.22.

Table 6. 22 Spearman correlation between importance and performance

Pairs	Factors	Humber Paired Samples Correlations			Xiamen Paired Samples Correlations			Combined Paired Samples Correlations		
		N	Correla	Sig.	N	Correlati	Sig.	N	Correlati	Sig.
Pair 1	Shipservices – A1 vs. B1	92	0.214*	0.041	162	0.232**	0.003	254	.178	.004
Pair 2	Shippg rices - A2 vs. B2	92	0.092	0.381	162	0.156*	0.047	254	.143	.023
Pair 3	Port charges - A3 vs. B3	92	-0.008	0.936	162	0.148	0.061	254	.103	.101
Pair 4	Feeders -A4 vs. B4	92	0.101	0.336	162	0.125	0.114	254	.112	.074
Pair 5	Overall cost – A5 vs. B5	92	0.146	0.165	162	0.006	0.937	254	.103	.100
Pair 6	Handlspeed – A6 vs. B6	92	0.182	0.083	162	0.109	0.167	254	.191	.002
Pair 7	Risks – A7 vs. B7	92	0.155	0.139	162	-0.077	0.331	254	.021	.734
Pair 8	Safety – A8 vs. B8	92	0.344*	0.001	162	0.155*	0.049	254	.208	.001
Pair 9	Techinfras – A9 vs. B9	92	0.081	0.441	162	0.142	0.072	254	.130	.039
Pair 10	Proximity– A10 vs. B 10	92	0.252*	0.015	162	0.042	0.592	254	.143	.022
Pair 11	Skills – A11 vs. B11	92	0.489*	0.000	162	0.126	0.109	254	.238	.000
Pair 12	Landlinks – A12 vs. B12	92	0.175	0.095	162	0.022	0.780	254	.103	.101
Pair 13	Logservices–A13vs. B13	92	0.313*	0.002	162	0.205**	0.009	254	.257	.000
Pair 14	Govs.upt – A14 vs. B14	92	0.088	0.406	162	0.136	0.085	254	.229	.000
Pair 15	Nav&land-A 15 vs. B 15	92	0.309*	0.003	162	0.217**	0.006	254	.233	.000

*Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

The correlation coefficients were used as implicit importance weights. The rank order was then listed from top to bottom, represented by the rankings 1 to 15. Meanwhile the rank order for explicit importance was also given. Lastly, Spearman's rank order correlation between the rank orders of explicit importance and implicit importance was conducted to test the difference. The values of correlation and significance were then obtained, as shown in Table 6.23.

Table 6. 23 Comparison of importance rankings between explicit and implicit importance

Humber					Xiamen				
Factor	mean	rank	Spearman	rank	Factor	mean direct	rank	Spearman	Rank
shipservces	4.5	1	0.214	6	shipservces	4.5	1	0.232	1
shipprice	4.48	2	0.092	12	shipprice	4	3	0.156	5
portchgs	4.34	3	-0.008	15	portchgs	3.59	13	0.148	7
Feeders	3.67	13	0.101	11	feeders	4	4	0.125	10
overalcost	3.82	9	0.146	10	overalcost	3.98	5	0.006	14
handlspeed	4.15	5	0.182	7	handlspeed	3.65	12	0.109	11
Delay	4.18	4	0.155	9	delay	3.77	10	-0.077	15
Safety	4.14	6	0.344	2	safety	3.75	11	0.155	6
techinfr	3.83	8	0.081	13	techinfr	3.83	8	0.142	8
proximity	3.73	11	0.252	5	proximity	3.59	14	0.042	12
Skills	3.71	12	0.489	1	skills	3.08	15	0.126	9
landlinks	3.76	10	0.175	8	landlinks	3.89	7	0.022	13
logservcs	3.91	7	0.313	3	logservcs	3.91	6	0.205	4
govs.upt	3.51	15	0.011	14	govs.upt	4.09	2	0.229	2
nav&land	3.64	14	0.309	4	Nav&land	3.8	9	0.217	3
Spearman's	-0.111	2-tail	0.694		Spearman's	0.421	2-tail	0.118	

According to Cohen (1988), the correlation coefficient determines the strength of the relationship between two factors. Cohen's guidelines for interpreting correlations are presented in Table 6.24

Table 6. 24 Cohen's guidelines for correlation interpretation

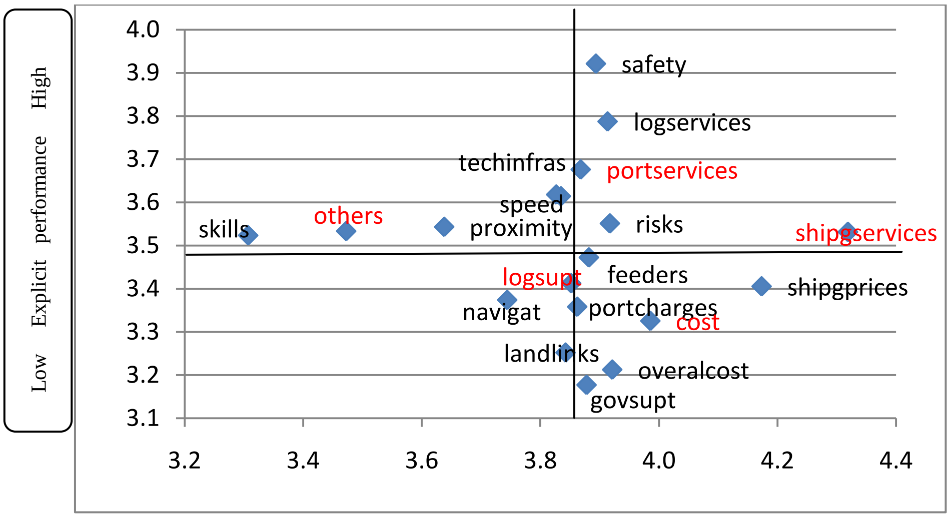
Small	r=0.10 to 0.29
Medium	r=0.30 to 0.49
Large	r=0.50 to 1.0

According to Table 6.24, there was a low, negative correlation between the Humber's explicit importance and implicit importance, r=-0.111, p=0.694. There was a medium, positive correlation between Xiamen's explicit importance and implicit importance, r=0.421, p=0.118. The test results validate the findings of Crompton and Duray (1985) and Matzler et al. (2003) that there is a difference between implicit importance weights and explicit importance weights, and that importance weights are sensitive and they differ depending on the method of measurement.

Importance-performance matrix

A. Traditional IPA (self-stated importance vs. self-stated performance)

The importance and performance means were employed for traditional IPA for combined sample, the Humber and Xiamen respectively. The boundary lines to separate the grid into four quadrants of the IPA matrix were defined by the grand means (total averages) of the 15 factors, following Martilla and James (1997), Yavas and Shemwell (2001), Huang et al. (2006), Deng et al. (2008) and Lin et al. (2009).



Low Explicit importance High

Figure 6. 12 Combined traditional IPA

Figure 6.12 presents the matrix of combined sample. 1. The "concentrate here" or "urgent action" quadrant (QI). The port stakeholders perceived that shipping prices, overall logistics cost and government support had the top priority for immediate improvement action. 2. The "keep up the good work" quadrant (QII). Shipping services, risks, feeder services, logistics services, port services and safety were good in both factor importance and factor performance. 3. The "possible overkill" or "excessive" quadrant (QIII). Skills, speed of handling, proximity and port technical infrastructure were considered unimportant but with good performance. 4. The "low priority" quadrant (QIV). Logistics support (A-factor), navigation, and landside links were the least important. Their performance was marginally inadequate.

Figure 6.13 presents the matrix of the Humber's factor importance and performance. 1. The "concentrate here" or "urgent action" quadrant (QI). The port stakeholders perceived that port charges had the top priority for immediate improvement action. 2. The "keep up the good work" quadrant (QII). Handling speed, safety, risks and shipping prices, were good in both factor importance and factor performance. 3. The "possible overkill" or "excessive" quadrant (QIII). Proximity, skills and logistics services were considered unimportant but with good performance. 4. The "low priority" quadrant (QIV). Government support, overall cost, navigation, feeders, landside links and technical infrastructure were the least important. Their performance was marginally inadequate.

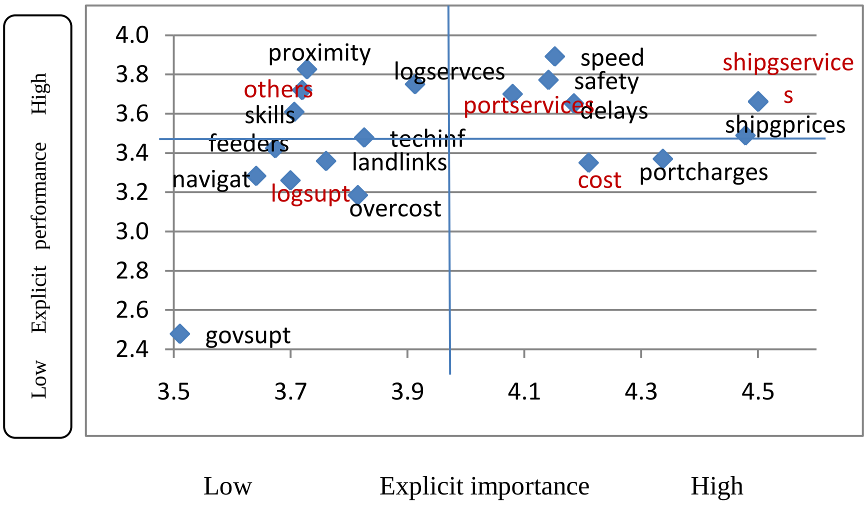
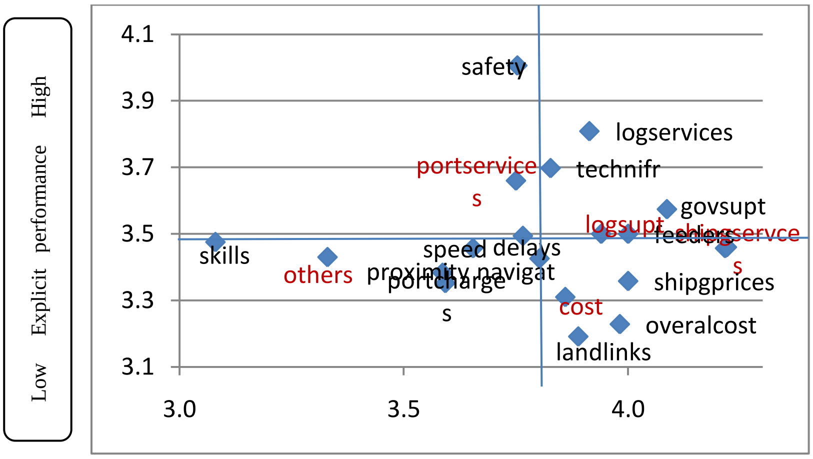


Figure 6. 13 The Humber traditional IPA

Figure 6.14 presents the matrix of Xiamen's factor importance and performance. 1. The "urgent action" quadrant. The port stakeholders perceived overall cost, shipping prices and landside links as essential areas for improvement. This result confirmed that cost and shipping services had a major impact on Xiamen ports' good performance. They had the top priority of immediate action for improvement. 2. The "keep up the good work" quadrant. Feeders, government support, technical infrastructure and logistics services were considered good in both importance and performance. However, it should be noted that feeders did not significantly differ from the grand mean ratings. This finding should therefore not be overly interpreted. It does not imply that feeders had very satisfying performance. Instead, they also need careful attention for improvement. 3. The “low priority” quadrant: risks, port charges, speed, proximity, navigation and skills were the least important. 4. The “possible overkill” or “excessive” quadrant. Safety was considered unimportant with good performance. This implies that resources for safety may be moved to other areas such as the factors in “concentrate here”.



Low Explicit importance High

Figure 6. 14 Xiamen traditional IPA

The category IPA is presented and summarised in Table 6.25 for both of the Humber and Xiamen.

Table 6. 25 Categories from traditional IPA

The Humber				Xiamen			
No.	Item	Importanc	Performance	No	Item	Importance	Performanc
High importance high performance (Good work: keep it up)							
F6	handling speed	4.15	3.89	F9	technical infras.	3.83	3.70
F7	risks	4.18	3.65	F13	logistics services	3.91	3.81
F8	safety	4.14	3.77	F14	government	4.09	3.57
F1	shipping services	4.50	3.66				
F2	shipping prices	4.48	3.49				
High importance low performance (Priorities for action, concentrate here)							
F3	port charges	4.34	3.37	F1	shipping services	4.22	3.46
				F2	shipping prices	4.00	3.36
				F5	overall cost	3.98	3.23
				F12	landside links	3.89	3.19
Low importance high performance (Possible over-employment of resource, excessive, overkill)							
F10	proximity	3.73	3.83	F8	safety	3.75	4.01
F11	skills	3.71	3.61				
F13	logistics services	3.91	3.75				
Low importance low performance (Low priority for improvement)							
F4	feeders	3.67	3.42	F3	port charges	3.59	3.35
F5	overall cost	3.82	3.18	F6	handling speed	3.65	3.46
F9	technical infrastructure	3.83	3.48	F7	risks	3.77	3.49
F12	landside links	3.76	3.36	F10	proximity	3.59	3.38
F14	government support	3.51	2.48	F11	skills	3.08	3.48
F15	navigation	3.64	3.28	F15	navigation	3.80	3.43

Note: In column No., “F” stands for “factor” from the questionnaire.

<u>B Explicit importance vs. performance difference analysis</u>

The analysis of importance versus performance difference (from competitors or other ports) aims to produce the key attributes or factors to determine improvement priorities by Slack et al. (2001), Slack (1994), Platts and Gregory (1992), Mangan et al. (2002), Johns (2001), Yeo (2003), Ford et al. (1999), Yavas and Shemwell (2001) and Lin et al. (2009). This section follows the same approach to identify the key factors that can improve port services.

Figure 6.15 shows the analysis of factor importance and performance difference with other ports for combined sample. 1. The “concentrate here”/ “urgent action” quadrant. Shipping services, government support and feeder services had significant performance difference from other ports. They were actually much worse than other ports. Hence urgent actions need taking for improvement. 2. The “keep up the good work” quadrant. Shipping prices, risks, safety, overall logistics cost and logistics services were good, as they did not show much difference from other ports. 3. The “low priority” quadrant. Landside links, navigation, technical infrastructure were here. They had the least importance and much worse performance compared with other ports. Being unimportant, they had low priority for improvement. 4. The “overkill” or “excessive” quadrant. Proximity, skills and speed were located here. The stakeholders considered them not so important, but their performances were similar to those of other ports. Efforts on them may need transferring to other factors that need urgent actions and concentration, as they were over performing in relations to their importance, compared with other ports.

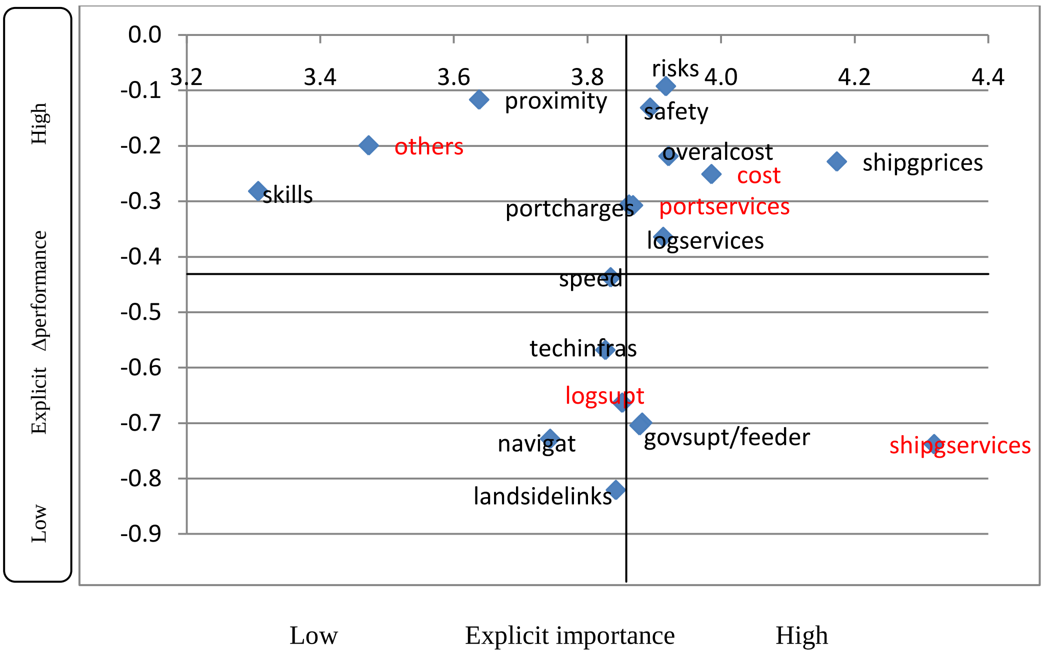


Figure 6. 15 Combined sample importance vs. Δperformance

Figure 6.16 shows the analysis of factor importance and performance difference with other ports for the Humber. 1. The “concentrate here”/ “urgent action” quadrant. Port charges, safety and shipping services had significant performance difference from other ports. They were actually much worse than other ports. Hence urgent actions need taking for improvement. 2. The "keep up the good work" quadrant. Shipping prices, handling speed and risk management were good, as they did not show much difference from other ports. 3. The "low priority" quadrant. Quite a few factors such as government support, navigation, technical infrastructure, landside links, feeders and logistics services were here. They had the least importance and much worse performance compared with other ports. Being unimportant, they had low priority for improvement. 4. The "overkill" or "excessive" quadrant. Proximity, skills and overall cost were located here. The stakeholders considered them not so important, but their performances were similar to those of other ports. Efforts on them may need transferring to other factors that need urgent actions and concentration, as they were over performing in relation to their importance, compared with other ports.

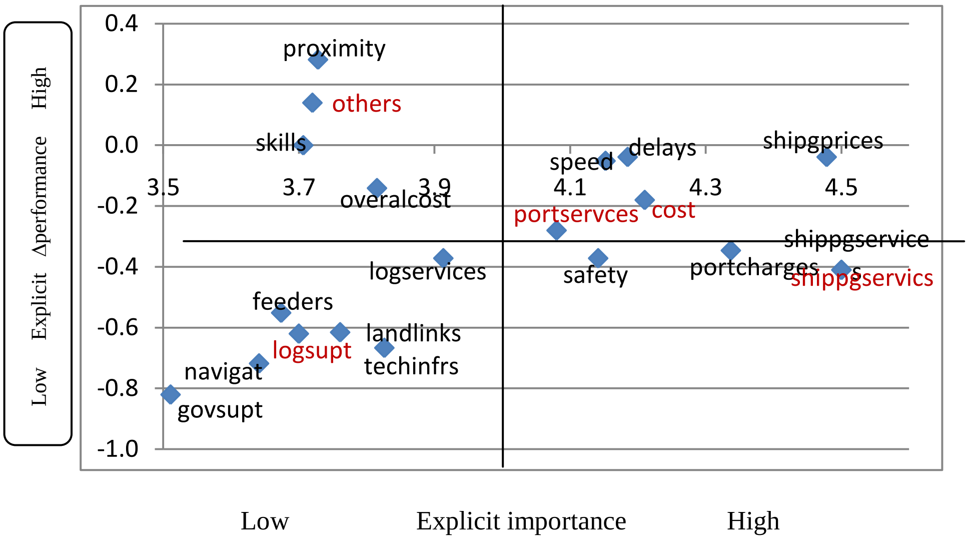


Figure 6. 16 The Humber importance vs. Δperformance (the Humber vs. other ports)

Figure 6.17 presents the factor importance and performance difference analysis for Xiamen compared with other ports. 1. The "concentrate here"/ "urgent action" quadrant. Shipping services, landside links, feeders, government support and technique infrastructure had significant performance difference from other ports. They were actually much worse than other ports. Urgent actions thus need taking for immediate improvement. 2. The "keep up for the good work" quadrant. Shipping prices, logistics services and overall cost were good in performance. They did not show much difference from other ports, but they need maintaining at a good standard as they are important at the same time.

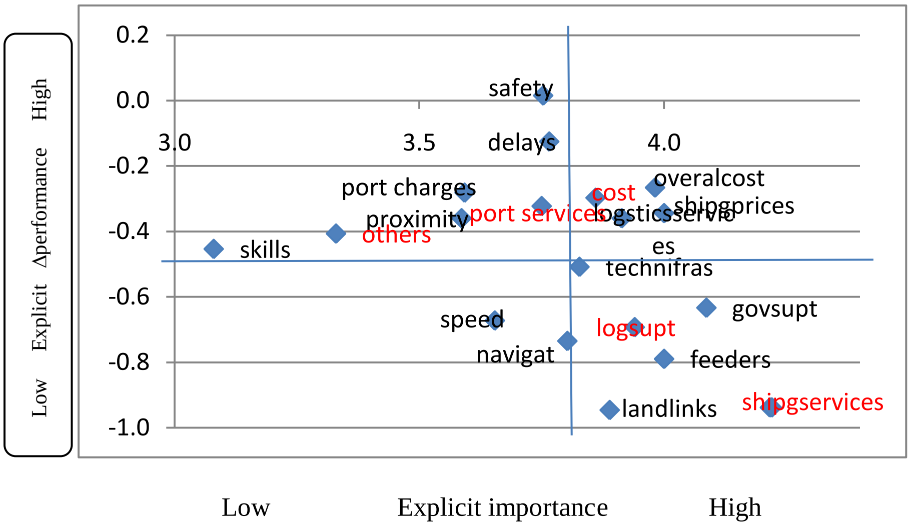


Figure 6. 17 Xiamen importance and Δperformance (Xiamen ports vs. other ports)

3. The "low priority" quadrant. Speed of cargo handling and navigation were located here. They had the least importance and much worse performance compared with other ports. Being not important, they had low priority for improvement. 4. The "overkill" or "excessive" quadrant. Skills, proximity, port charges, risks and safety were located here. The stakeholders considered them not so important, but their performances were similar to those of other ports. Efforts on them may need transferring to other factors that need urgent actions and concentration, as they were over performing in relation to their importance and compared with other ports.

Following the approach by Mangan et al. (2002), putting the IPA in another way, Table 6.26 presents the Humber analysis and Table 6.27 presents Xiamen analysis, regarding the 15 factors.

The data of mean importance, performance 1 and performance 2 were from SPSS, and were drawn from the descriptive analysis. The mean importance column lists the factor importance in descending order. "Perf.1" presents the mean performance rating of the respondents' own port. "Perf. 2" shows the mean performance of any other ports with which the respondents were most familiar with. "Perf. Dif" gives the performance difference between the focal port and other ports. "Salient" shows whether the ratings of "Perf. 1" and "Perf. 2" are significantly different or not. The salient factors are those which were not only rated important, but also rated significantly different in performance (Mangan et al. 2002). As for importance, only those whose mean importance is greater than the grand mean can be considered as "salient factors". S1 indicates that the factor is salient, S2 means the factor is potentially salient. If the difference is large but importance is low, the factor is not considered as salient.

Table 6.26 shows that shipping services, port charges and handling speed are salient factors for the Humber. Table 6.27 shows that shipping services, government support, feeder services and landside links are salient factors for Xiamen.

Table 6. 26 The Humber mean importance ratings and identifying salient factors

Factor	mean imp.	Perf.1	perf.2	perf. Dif.	Salient?	
1. Shipping services	4.50	3.62	4.03	-0.41	Yes	***S1***
2. Shipping prices	4.48	3.49	3.53	-0.04	No	
3. Port charges	4.34	3.33	3.68	-0.35	Yes	***S1***
4. Risks	4.18	3.59	3.63	0.04	No	
5. Handling speed	4.15	3.83	3.88	0.05	No	
6. Safety	4.14	3.71	4.08	-0.37	Yes	***S1***
7. Logistics services	3.91	3.75	4.03	-0.37	Yes	S2
8. Technical infrastructure	3.83	3.40	4.06	-0.67	Yes	S2
9. Overall cost	3.82	3.17	3.31	-0.12	No	
10. Landside links	3.76	3.27	3.88	-0.61	Yes	S2
11. Proximity	3.73	3.82	3.54	0.28	Yes	
12. Skills	3.71	3.63	3.63	-0.00	No	
13. Feeders	3.67	3.38	3.94	-0.55	Yes	S2
14. Navigation	3.64	3.10	3.82	-0.72	Yes	S2
15. Government support	3.51	2.36	3.18	-0.82	Yes	S2

Note: imp=importance; perf.=performance; perf.1=HB perf.; Perf2=other ports'perf

Table 6. 27 Xiamen mean importance ratings and identifying salient factors

Factor	mean imp.	Perf.1	Perf.2	Perf. Dif.	Salient?	
1. Shipping services	4.22	3.45	4.39	-0.94	Yes	***S1***
2. Government support	4.09	3.57	4.20	-0.63	Yes	***S1***
3. Shipping prices	4.00	3.38	3.73	-0.35	Yes	S2
4. Feeders	4.00	3.53	4.32	-0.79	Yes	***S1***
5. Overall cost	3.98	3.27	3.54	-0.27	Yes	S2
6. Logistics services	3.91	3.82	4.18	-0.36	Yes	S2
7. Landside links	3.89	3.20	4.14	-0.95	Yes	***S1***
8. Technical infrastructure	3.83	3.70	4.21	-0.51	Yes	S1
9. Navigation	3.80	3.37	4.10	-0.73	Yes	S2
10. Safety	3.75	4.00	3.99	0.01	No	
11. Risks	3.77	3.50	3.63	-0.13	No	
12. Handling speed	3.65	3.44	4.11	-0.67	Yes	S2
13. Port charges	3.59	3.37	3.65	-0.28	Yes	
14. Proximity	3.59	3.40	3.76	-0.36	Yes	
15. Skills	3.08	3.51	3.96	-0.45	Yes	

C. Revised IPA by employing 3-factor theory and implicit weights

Following the procedure of Matzler et al. (2003), when the implicit and explicit importance weights were combined in a two dimensioned grid, a four quadrant grid was produced. The explicit self-stated mean importance and implicitly derived importance weights by Spearman correlation (Section 6.6.5) were employed. Figure 6.18 presents the importance-performance grid for combined sample. Three factor groups were identified. Firstly, risks, port charges and shipping prices were considered as basic factors. They are minimum and essential requirements of port services. Secondly, shipping services, speed, logistics services and safety were identified as very important performance factors. Thirdly, landside links, overall logistics cost, feeder services, port technical infrastructures and proximity were identified as low important performance factors. Satisfaction increases linearly depending on the performance, which means higher performance will elicit higher customer satisfaction. Fourthly, government support, skills and navigation & land were considered as excitement factors. They are either highly unexpected or not expected to be delivered at such a high performance level, but they strongly enhance customer satisfaction.

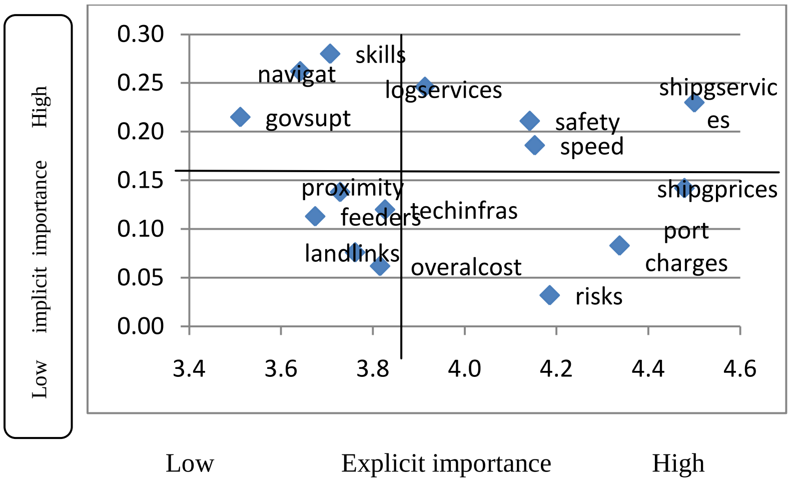


Figure 6. 18 Combined sample basic, performance and excitement factors (by Spearman)

Figure 6.19 presents the importance-performance grid for the Humber and its three factor groups. Firstly, speed of cargo handling, port charges, risks and shipping prices were considered as basic factors. They are minimum and essential requirements of port services. They are unimportant as long as their performance is satisfying, but become important once their performance is low. Secondly, shipping services and safety were identified as very important performance factors. Thirdly, government support, feeders, port technical infrastructure, overall logistics cost and landside links were identified as low important performance factors. Satisfaction increases linearly depending on the performance, which means higher performance will elicit higher customer satisfaction.

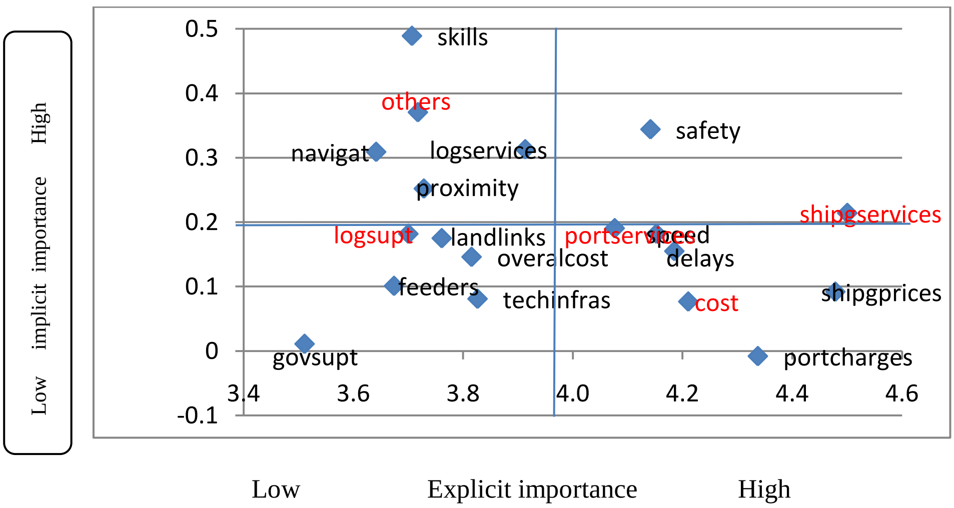


Figure 6. 19 The Humber basic, performance and excitement factors (by Spearman)

Fourthly, skills, navigation, logistics services and proximity were considered as excitement factors. They are either totally unexpected or not expected to be delivered at such a high performance level, but they strongly enhance customer satisfaction when their performance is high.

Figure 6.20 presents the three factor groups for Xiamen. Firstly, landside links and overall logistics cost with low implicit and high explicit importance were considered as basic factors. Secondly, shipping services, government support, logistics services, shipping prices, feeders and port technical infrastructure with both high implicit and high explicit importance were identified as very important performance factors. Thirdly, proximity and speed of cargo handling were identified with low implicit importance and low explicit importance as low importance performance factors. Satisfaction increases linearly depending on the performance, which means higher performance will elicit higher customer satisfaction. Fourthly, it should be noted that navigation is very close to the quadrant of excitement factors. They are either totally unexpected or not expected to be delivered at such a high performance level, although they strongly enhance customer satisfaction.

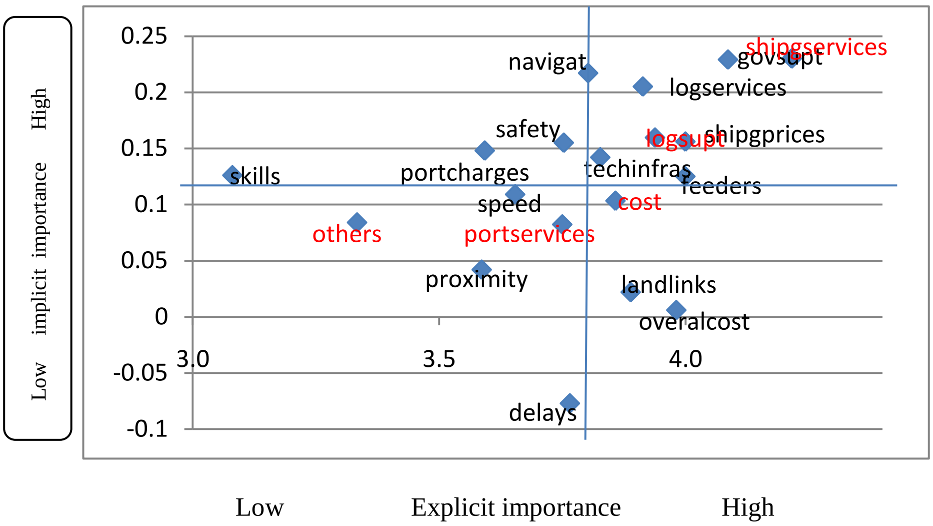


Figure 6. 19 Xiamen's basic, performance and excitement factors by Spearman

IPA summary

Based on the results of Figures 6.13-6.21 and Section 6.6.1, Table 6.28 is formed. The figures show that important factors consist of urgent factors, salient factors and basic factors from different aspects.

Comparing Figures 6.12, 6.15 and 6.18 for combined sample, comparing Figures 6.13, 6.16 and 6.19 for the Humber, and comparing Figures 6.14, 6.17 and 6.20 for Xiamen, the urgent factors, salient factors and basic factors are different. It is found that some basic factors in Quadrant I by revised IPA were considered as factors in Quadrant II by traditional IPA. However, the results are interpretable, as they are caused by different methods from different angles.

Table 6. 28 Summary of important and determinant factors

IPA	Figures	Factors for urgent Salient/determinant	Factors for keeping up the good work	Important factors
Traditional IPA (explicit importance vs explicit performance)	Figure 6.12	A2., A3, A5, A14	A1, A7, A13, A8	A1, A2, A3, A4, A4, A7, A8, A13, A14
	Figure 6.15	A1, A4, A14	A2. A5, A7, A8, A13	
	Figure 6.18	A3, A7	A1, A2, A6, A8	
Revised IPA (explicit importance vs performance difference)	Figure 6.13	A3	A1, A2, A6,A7, A8	A1, A2, A3, A6, A7, A8
	Figure 6.16	A1, A3, A8	A2, A6, A7	
	Figure 6.19	A2, A3, A6,A7	A1, A8	
Revised IPA (expplicit importance vs implicit importance)	Figure 6.14	A1, A2, A5, A12	A13, A9, A14, A4	A1, A2, A4, A5, A9, A12, A13, A14
	Figure 6.17	A1, A4, A12, A14	A2, A5, A9, A13	
	Figure 6.20	A5, A12	A1, A2, A4, A9, A12, A14	

In the researcher's personal view, traditional IPA results (explicit importance vs. explicit performance) are preferred to revised IPA by explicit importance versus explicit performance difference. This is because, while the importance is high, if both focal ports and other ports perform well or poorly, the difference will be small. The small performance difference would be ignored if both are poor, which may result in unnecessary neglect of urgently-needed improvement. However, the analysis results from this revised IPA are retained because they reflect the performance difference between focal ports and other ports. The results from revised IPA by employing 3-factor theory are also retained, as they include both explicit and implicit importance, which means they not only consider implicit importance but also consider importance derived from performance.

To figure out important factors rigorously, the interviews were also reviewed to supplement the analysis. As a consequence, key factors for combined sample are shipping services (both deep-sea and feeder services), cost (shipping prices, port charges and overall logistics cost) and government support. Key factors for the Humber are shipping services (deep-sea services), cost (shipping prices and port charges) and port services (risks, handling speed and safety). Key factors for Xiamen are shipping services (both deep-sea and feeder services), cost (shipping prices and overall logistics cost), infrastructure (port technical and landside transport infrastructure), logistics services and government support.

This section has identified the key factors. It is worth noting that the Humber and Xiamen have different key factors. The results imply that different port regions under external environment have different key factors driving port performance and choice. This has addressed Research Objective One. It has also analysed how the factor importance varies for different ports, which is Research Objective Three.

6.5.6 Differences among different respondent groups in importance and performance recognition

As shown in the company response profile, the Humber and Xiamen share similar percentages of response by company type over the overall responses. Hence, the combined data from the Humber and Xiamen were employed for the difference analysis between different company types over the recognition of factor importance and the performance rating for the same factor.

Respondents were divided into five groups according to their disciplines. As categorised in Chapter 4 and Section 6.2.2, Group 1 (Gp1) refers to consignors and consignees including manufacturers, retailers and distributors, which are port end users for their products import, export and transhipment. Group 2 (Gp2) refers to PSPs and other service providers that help the port users to book ships or help shipping services to find cargos or provide other port services. Group 3 (Gp3) is shipping lines that provide shipping services of transporting the cargo from the port of origin to the destination port. Group 4 (Gp4) is port managers that provide the port facilities and services. Group 5 (Gp5) is the group of other port stakeholders including government agencies, academics and consultants.

As shown in Section 6.2.2, the case numbers of the five groups were not equal. The biggest group (Gp2) had 62 observations while the smallest group (Gp5) had only 10 observations. The ratio of largest/smallest is 6.2 which is much bigger than 1.5. According to Stevens (1996), this violates the assumption of ANOVA. However, the Kruskal-Wallis H test can be applied to test the differences between groups of more than two when the assumptions of ANOVA are violated. Therefore, a Kruskal-Wallis H test was conducted to find out the differences between the different company groups and to explore the impact of company types on factor importance recognition and rating of port performance.

The Kruskal-Wallis H test results revealed significant differences across the different company groups (Gp1, n=51: consignors, Gp2, n=62: PSPs, Gp3, n=32: shipping lines, Gp4, n=49: port manager, Gp5, n=10: other port stakeholders) in the following four factors. No significant differences existed between the other factors.

1. A2-importance of shipping prices (Chi-square=16.687, df=4, Asymp Sig. =0.002). The group of PSPs recorded a higher median score (Md=5) than the other four groups, which all recorded median values of 4.

2. A9-importance of port technical infrastructure (Chi-square=14.727, df=4, Asymp Sig. =0.005). The group of consignors recorded a lower median score (Md=3) than the other four groups, which all recorded median values of 4.

3. B6-performance of cargo handling speed (Chi-square=14.360, df=4, Asymp Sig. =0.006). The group of shipping lines recorded a lower median score (Md=3) than the other three groups, which all recorded median values of 4.

4. B9-performance of port technical infrastructure (Chi-square=9.572, df=4, Asymp Sig. =0.048). The group of consignors recorded a lower median score (Md=3) than other port stakerholders (Md=3.50) that accordingly recorded a lower median score than the other three groups, which all recorded median values of 4.

Although the Kruskal-Wallis H tests revealed the significant differences across the different company groups, they did not reveal which of the groups were statistically different from one another. To further find out the differences, follow-up Mann-Whitney U tests between pairs of groups were conducted. A Bonferroni correction to the alpha values was applied when the pairs of groups were compared with one another, as suggested by Pallant (2007) and Field (2005) who explain that Bonferronni adjustment involves dividing the alpha level of 0.05 by the number of tests the researcher intends to use and using the revised alpha level as the criterion for determining significance.

To keep the alpha level at a manageable level, instead of doing every possible comparison, four key groups were selected for comparison. Mann-Whitney U tests were then conducted between pairs of six groups (Gp1-2, Gp1-3, Gp1-4, Gp2-3, Gp2-4 and Gp3-4). Therefore the current research means a stricter alpha level of 0.05/6=0.008.

Table 6. 28 Significant difference between pairs of company groups

Factors	Groups	1st Gp MD	1st Gp mean rank	1st Gp N	2nd Gp MD	2nd Gp mean rank	2nd Gp N	U value	Z value	P value	R value
A2-shipprices	Gp1-Gp2	4	50.62	51	5	62.25	62	1255.5	-2.108	0.035	-0.198
	Gp2-Gp3	5	53.09	62	4	36.67	32	645.5	-3.068	0.002	-0.316
	Gp2-Gp4	5	64.41	62	4	45.36	49	997.5	-3.397	0.001	-0.322
A9-techinfras	Gp1-Gp2	3	46.54	51	4	65.60	62	1047.5	-3.222	0.001	-0.303
	Gp1-Gp3	3	36.78	51	4	50.31	32	550.0	-2.608	0.009	-0.286
	Gp1-Gp4	3	44.85	51	4	56.38	49	961.5	-2.115	0.034	-0.211
B6-handlspeed	Gp1-Gp4	3	42.71	51	4	58.61	49	852.0	-2.977	0.003	-0.298
	Gp2-Gp4	5	49.43	62	4	64.32	49	1111.5	-2.603	0.009	-0.247
	Gp3-Gp4	3	30.98	32	4	47.54	49	463.5	-3.294	0.001	-0.366
B9-techinfras	Gp1-Gp4	3	42.35	51	4	58.98	49	834.0	-3.089	0.002	-0.309

The results in Table 6.29 show that there were statistically significant differences between different pairs of groups for the above mentioned different factors. This table reveals that different pairs of company groups had different views on their recognition of factor importance and factor performances.

For importance of shipping prices, PSPs considered it significantly more important than consignors, shipping lines and port managers. Regarding port infrastructure, consignors/consignees considered it significantly less important than PSPs, shipping lines and port managers. Port managers/operators evaluated its performance of handling speed and technical infrastructure much higher than cargo interests, PSPs and shipping lines. This implies that port service providers consider their performance much better than port service users. This finding is consistent with the literature by Murphy et al. (1992) who note that freight forwarders, consignors, ferry operators and port managers evaluate the port selection factors differently. However, it should be acknowledged that for most other factors, different port stakeholders did not evaluate their importance and performance significantly different.

6.5.7 Overall comparative analysis

Sections 6.1.1 to 6.5.6 have presented a detailed comparative analysis between factor importance, performance and other ports' performance both within each port's region and across regions respectively. This section will give a summary report on the overall comparison.

Figures 6.21 and 6.22 give an overview of the respondents' evaluation of the factor importance and performance from the Humber and Xiamen respectively.

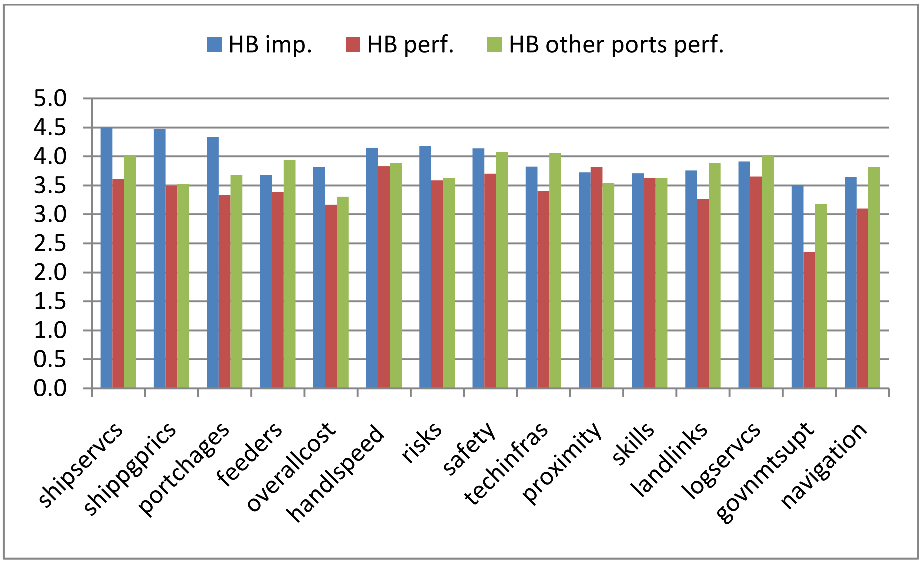


Figure 6. 20 The Humber comparison overview

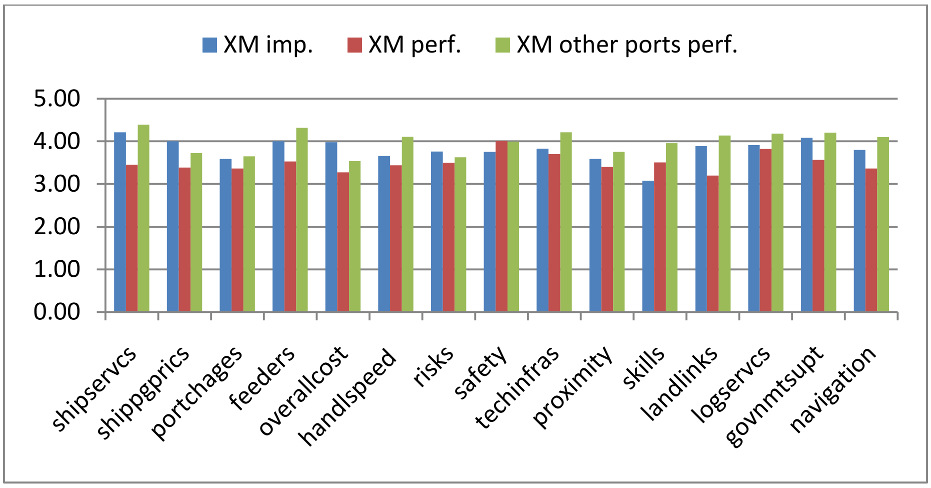


Figure 6. 21 Xiamen comparison overview

For both of the Humber and Xiamen, the importance was ranked almost the highest among the three sections. Compared with the performance satisfaction, the other ports actually performed better than focal ports. Both of the Humber/Xiamen and other ports' performances did not meet the customers' expectation as the mean performances were lower than the mean importance.

Significant/insignificant difference comparison

Table 6.7 presents a comparison summary from the highest score to the lowest score within groups in mean descending order of mean to explore the extent of the differences or similarities between the Humber and Xiamen or within regions. Table 6.30 presents a statistical summary of the difference between factor importance, factor performance and between different regions.

Table 6. 29 Significant/insignificant difference comparison summary by factor

	A (HB vs. XM)	B (HB vs. XM)	C (HB vs. XM)	(C-B) (HB vs. XM)	HB (C vs. B)	XM (C vs. B)	HB (A vs. B)	XM (A vs. B)
Sig. Diff	A3	B14	C14	(C-B)10	Pair14	Pair12	Pair14	Pair1
	A11	B10	C1	(C-B)6	Pair12	Pair1	Pair2	Pair5
	A14	B6	C11	(C-B)1	Pair9	Pair4	Pair3	Pair12
	A6	B8	C4	(C-B)11	Pair15	Pair15	Pair1	Pair2
	A2	B9	C12	(C-B)8	Pair4	Pair6	Pair5	Pair14
	A7			(C-B)12	Pair8	Pair14	Pair7	Pair4
	A8			(C-B)2	Pair13	Pair9	Pair12	Pair15
	A4				Pair3	Pair11	Pair8	Pair7
	A1				Pair1	Pair10	Pair15	Pair3
					Pair10	Pair13	Pair9	Pair10
						Pair2	Pair6	Pair6
						Pair3		
						Pair5		
Insig. Diff	A5	B1	C15	(C-B)4	Pair5	Pair7	Pair4	Pair9
	A15	B12	C5	(C-B)5	Pair6	Pair8	Pair13	Pair13
	A10	B7	C6	(C-B)7	Pair2		Pair11	Pair8
	A12	B15	C2	(C-B)15	Pair7		Pair10	Pair11
	A13	B11	C10	(C-B)3	Pair11			
	A9	B2	C13	(C-B)13				
		B3	C9	(C-B)9				
		B4	C8	(C-B)14				
		B13	C3					
		B5	C7					

Section 6.6.1 shows factor importance comparisons. Section 6.6.2 on port performance and 6.6.3 on performance difference imply that both the Humber and Xiamen need performance improvement on overall cost, port charges and landside links. In addition, the Humber needs performance improvement in government support and navigation, while Xiamen needs improvement on shipping prices and hinterland expansion. Different company groups were found to have different perceptions of importance and performance in some factors.

6.6 Comments from respondents

Apart from the closed questions, the respondents were asked to answer some open questions. Table 6.30 presents the respondents' profile for each open question.

Table 6. 30 Respondents' profile over open questions

Questions	Other factor to inf. port perf.		Other ports' performance		overview of comments		total responses
Region	No. of responses	% of response	No. of responses	% of response	No. of responses	% of response	
The Humber	26	28.26%	19	20.65%	21	22.83%	92
Xiamen	79	48.77%	21	12.96%	12	7.40%	162

6.6.1 Factors influencing port performance

The respondents were asked to give any other factors they thought would influence their port performance. Twenty-six out of the 92 Humber respondents (response rate=28.26%) answered this question. Eleven Humber respondents noted that road/rail connections to the ports are critical, as heavy road congestion would influence port performance. Three respondents commented that waterway links to the ports are important to reduce carbon footprint, reduce cost and alleviate the land traffic burden. Three respondents highlighted that 24hours/7day service of the terminals is critical. Two respondents thought speed of reaction and vessel turnaround time were important factors to influence port performance. Two respondents considered port infrastructure such as size of the lock and length of the quay to be essential to port performance, as they would restrict the vessel call at the port. Two respondents thought the port managers are important and should be proactive in working with customers/tenants to attract new business to the region and make investment to the ports to satisfy the clients. Two respondents answered that government support is important to lead the country out of the recession and support trade so that port performance could be improved.

Xiamen’s respondents made 97 comments on the factors to influence port performance. Twenty-eight out of the 97 comments (29%) were on the size of hinterland, the local economy and the hinterland economy. The second biggest group of comments were on government support and whether the government would have a strategic scheme on the regional port development. Sixteen responses emphasized the role of government. The third biggest group of comments were on services such as customs clearance and border cargo inspection. Respondents highlighted speed, documentation and value-added services, which influence efficiency. This was followed by coordination and partnership between the different port stakeholders such as consignors, shipping services and PSPs, between the proximate ports and between the ports and free trade zones. Professional skills and management levels were considered as an important factor as well, including the different levels of personnel who were involved in port performance such as the manager’s knowledge and operator’s skills.

Most of the factors given actually belong to the 15 factors listed in the questionnaire. Additional factors were given as:

- short sea operators
- trucking supply
- availability of warehouse space
- competition, innovation and spectacular investment
- postponed manufacturing facilities and local commitment
- efficient ports convenience to consignee and consignor's
- port ownership
- foreign lorry drivers using UK ports and roads
- bigger scale ships
- weather
- large scale enterprise and exporting enterprise
- local enterprises with export orientation
- sense of service
- fair competitive environment
- product quality and product seasoning
- the city positioning
- service efficiency
- developed level of rail/road/air
- standardization
- low/no entry barrier
- trade mode and trade partners
- the inter-provincial transport service and network
- cargo types

These factors are findings from this research, which are invaluable for future research.

6.6.2 The performance of the Humber and Xiamen ports

When the respondents were asked to evaluate their own ports' performance apart from the 15 factors, 19 out of the 92 Humber respondents (20.7%) and 21 out of the 162 respondents (13%) gave their answers to this open question.

Six Humber respondents commented that the performance on ports' road connections and access to motorways was poor, with severe congestion in some areas. Three respondents considered the railway links to the ports were restricted, insufficient and poor. The waterway and canal connection in this region was considered rather good but not put into use. Other responses were:

- Limited systems integration
- Insufficient Haulage and trucking
- Good canal connection
- Very good depth of channel navigation in Hull and Immingham
- Very poor land availability
- Low profile, reduced impact and not internationally recognised at all
- Inconsistency on business rates issue has wrecked confidence
- Limited destinations as primarily a fishing port
- Hull is well placed for trade from Europe into the Midlands and northern England.

In Xiamen, 19 respondents evaluated the customs and border cargo inspection. They thought Xiamen performed poorly with low efficiency in this regard. They realised Xiamen's geographical location advantage, which enabled the direct and transhipment to Taiwan. The concept of Haixi economy would bring benefit to Xiamen with the support of government policy. The respondents also understood that the freight would change as season changes. It was also noted that rail and air connections in Xiamen are not too favourable. The findings are consistent with the findings from interviews, as stated in Chapter 5.

As few respondents provided comments on other ports' performance, their comments will not be included in the analysis.

6.6.3 Overall comments

In the Humber, when the respondents were asked to make comments on the whole questionnaire, 7 out of the 21 respondents commented about the high cost and charges at the Humber ports. The port charges are comparatively much higher than other ports operated by its competitor of PD ports. The respondents made some other comments: Further detailed research is required such as berth availability, dock or riverside facilities. The cost of shipping services is governed by the outside world, which is a competitive market.

In Xiamen, the responses were quite different. Five out of the 12 respondents (41.7%) answered that local economy and hinterlands' economy are of high importance to consider for port performance as economy is the factor based on which decisions are made. Four out of the 12 respondents (33%) considered border management such as custom clearance efficiency, and cargo inspection at the border of the utmost importance. Consignors' requests should be considered, as the port is no longer an isolated entity but one point on the supply chain. Xiamen's geographical location and environment should be researched, as this is helpful and practical to the port development. The government factor is seen as important, and it needs more detailed investigation.

6.7 Chapter summary

This chapter has analysed the data from the questionnaires. Descriptive and distribution statistics were presented after data preparation. This was followed by factor analysis of importance factors, and then comparative analysis was conducted based on the questionnaire factors. The main findings from the questionnaire may be summarised as:

1. For the combined sample, five aggregate factors were extracted from the 15 questionnaire factors in descending order of importance: port services, logistics support, cost, shipping services and others. Services and logistics support rather than facilities and labour were considered important.
2. The self-stated factor importance shows that shipping services, shipping prices, port charges, safety, speed and risks are important factors for the Humber in hierarchical order. In Xiamen, the factor importance order is shipping services, government support, shipping prices, feeder services, overall logistics cost, logistics services, landside links and port infrastructure.
3. Traditional IPA findings reveal clearly on which factors urgent actions are needed; which ones need keeping up the good work; which ones have low priority for improvement and which ones may be excessive. Port charges was identified as the urgent factor in the Humber, while landside links to the hinterland, overall logistics costs, shipping services, shipping prices and feeder

services were identified as urgent factors in Xiamen. These urgent factors are the ones with high importance but low performance.

4. Compared with the performance difference, the salient factors are shipping services, port charges and safety in the Humber, and shipping services, feeders, government support and landside links to the hinterland in Xiamen.
5. Compared with the performance of other ports and factor importance, the performances of both Humber and Xiamen ports are deemed poorer than customer expectation and poorer than competitors.
6. Among the 15 factors performance, four out of the top 6 poorly performed factors were the same for both Humber and Xiamen: overall cost, landside links, port charges, navigation. Both port regions need to improve performance on cost and shipping services. Additionally, the Humber needs to improve the logistics support on landside transport infrastructure, government support and feeder services, and Xiamen needs to improve proximity and skills.
7. The findings from this study validate the claim in the literature that IPA matrixes are different depending on whether the importance is self-stated or implicitly derived. There is no significant difference among the statistical methods for deriving importance weights, but there are differences between the results from self-stated importance and implicitly derived importance.
8. Revised IPA results show that the Humber needs to improve shipping prices, port charges, speed and risks urgently while Xiamen needs to take urgent actions on landside links, overall cost, shipping prices and port technical infrastructure.
9. IPA results show that different regions under different economic environments and different cultures have different urgent factors, salient factors, basic factors, performance factors and excitement factors that affect port performance.
10. There are significant differences between the Humber and Xiamen's performance difference (focal ports vs. other ports) in proximity, speed of cargo handling, shipping services, skills, safety, landside links and shipping prices in descending order. Xiamen's gaps are significantly bigger than the Humber's gaps except safety of cargo handling.
11. The findings reveal that there exist some significant differences between the company groups in their perception of factor importance and performance, such as importance of shipping prices and port technical infrastructure, and performance of handling speed and port technical infrastructure.

12. Regarding performance comparison, both of the Humber and Xiamen ports need to improve shipping services, because its performance was not rated as very satisfactory, although it was recognised as the most important factor. Secondly, both regions need to improve the performance of cost, including all the cost factors, but the importance hierarchy is not the same. Thirdly, logistics support needs improving. The Humber needs to improve government support, as the scores of government support in the Humber importance, performance and other ports' performance were all rated as the lowest among the 15 factors. The Humber also needs to improve navigation, feeders and landside links. Xiamen needs to improve landside links, navigation and government support, too. Finally, the Humber needs to improve its port infrastructure while Xiamen needs to improve its speed of cargo handling and hinterland expansion.

The empirical research analysis results from Chapters 5 and 6 have identified what factors influence port performance, what different factors influence port performance in the different contexts, and how differently the different port regions perform in terms of those important factors. The findings will be discussed and elaborated further in relation to the supporting literature in Chapter 7.

7. DISCUSSION ON FACTORS INFLUENCING PORT PERFORMANCE

Chapters 5 and 6 analysed the data from interviews and questionnaires respectively. The empirical research has identified some of the issues in enhancing port performance in China and the UK. This chapter is based upon the data analysis and discusses the main findings from the previous two chapters in a more focused manner within the context of relevant literature, and interprets the findings in an attempt to probe the underlying principles, thereby contributing to theory and practice. This chapter aims to address the research objectives described in Chapters 1 and 4, namely, to:

1. *Identify the key factors that drive port performance and choice.*
2. *Investigate the differences in importance and performance among these factors.*
3. *Analyse how the factor importance and performance vary for different ports.*
4. *Analyse the role port hinterland plays in port performance and choice.*
5. *Illustrate the usefulness of the key findings from the analysis for port stakeholders.*

The key findings will be discussed in sub-sections 7.1 through to 7.5, based on the five research objectives.

7.1 Key factors determining port performance and choice

The key factors influencing port performance and choice are presented in Figure 7.1 based on the combined sample.

7.1.1 Key factors cross-validated by a questionnaire and interviews

This research investigated factors that determine port performance using several techniques including factor analysis, explicit importance, gap analysis, traditional IPA (importance-performance matrix by explicit importance vs. explicit performance), revised IPA (explicit importance vs. performance difference), and revised IPA by employing 3-factor theory (implicit importance vs. explicit importance) that concentrate on customer quality. Descriptive analysis, statistical validity and significant tests were conducted to identify the significant differences. These techniques use a construct for measuring factor importance, which is based on the literature, such as De Langen (2003), Wang and Oliver (2003), Lirn et al. (2004), Bichou and Gray (2004), Gordon et al. (2005), UNCTAD (2005), Notteboom and Rodridgue (2005), Bichou (2006), Robinson (2006), Tongzon (2007), Ducruet et al (2008), Weigmans et al. (2008), Wu (2008), Wu and Huang (2008), Arvis et al. (2010). No particular construct by a single

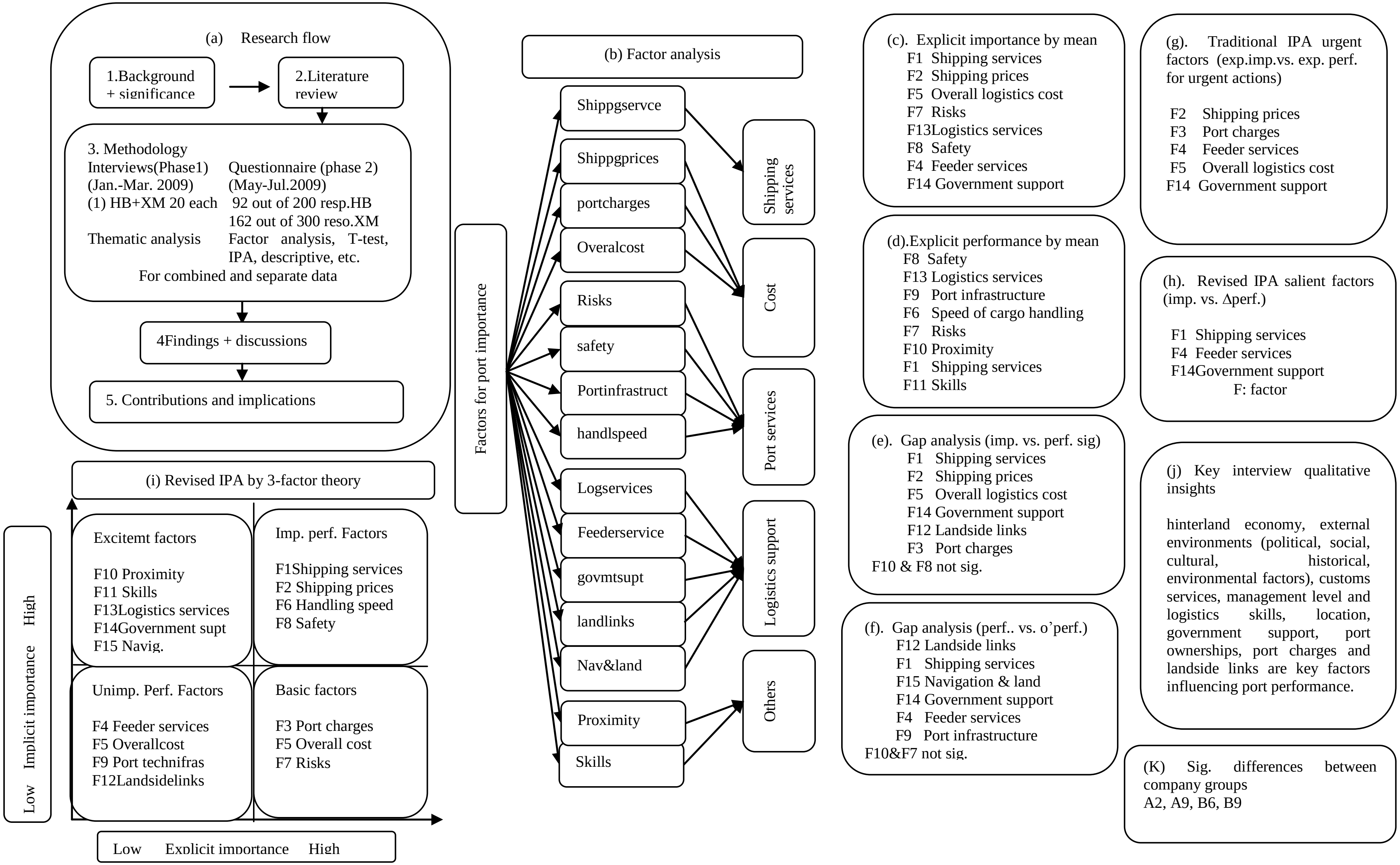


Figure 7. 1 Research flow and factors influencing port performance and choice by combined sample

author was followed but different constructs were considered and refined to meet the specific needs of this research. The constructs focus on indicators of port performance and components of port competitiveness on ports.

Figure 7.1a summarises the research flow. The questionnaire construct used in this research consisted of 15 factors that were categorised into five aggregate factors based on combined data: port services, logistics support, cost, shipping services and others, as shown in Figures 6.9 and 7.1b. Experts on ports and academics confirmed the reliability and validity of the aforementioned construct. Reference to the literature and Phase 1 interviews ensured that the factors were relevant to port performance and to the research objectives. Statistical tests were then used to investigate the reliability and validity of the questionnaire construct. This research investigated the factor importance from several perspectives, trying to identify the factors that influence or determine port performance.

The results from factor analysis show that four aggregate factors of shipping services, cost, port services, and logistics support are important in descending order, according to their aggregate means and percentage of variance. The explicit importance means from the combined sample reveal that shipping services, shipping prices, overall logistics cost, risks, logistics services, safety, feeder services and government support are important factors as their means are bigger than the grand means (Figure 7.1c). Traditional IPA identified that shipping prices, port charges, feeder services, overall logistics cost and government support are urgent factors with high importance and low performance (Figures 6.13 and 7.1g). According to the revised IPA, shipping services, feeder services and government support are salient factors compared with other ports' performance (Figures 6.16 and 7.1h).

Gap analysis aims to investigate the factors that need improving. Two gap analyses were conducted: gap between importance and performance and gap between performance of focal ports and that of other ports. The gap analysis between importance and performance identifies the areas to improve service quality (Johns 2001; O'Neill et al. 2001). The results of Section 6.5.5 show that the respondents had a perceptual problem with their focal ports, as there were large gaps between the performance and their expectation, which led to customer dissatisfaction. There were no significant differences in 2 factors (proximity and safety) but there were significant differences in the remaining 13 out of 15 factors. Apart from shipping services, government support and landside links, large gaps existed between satisfaction and expectation in shipping prices, port charges and overall cost (Figure 7.1e), and considerable performance gaps existed between focal ports and other ports in feeder services, port infrastructure and navigation (Figure 7.1f).

The three-factor theory of customer satisfaction suggests that the relationships between attribute performance (satisfaction) and importance are non-linear (Matzler et al. 2003). Three-factor theory categorises factors influencing port performance into basic factors, excitement factors and performance factors. The revised IPA employing 3-factor theory (Figure 7.1i) shows that port charges, risks and overall logistics cost are basic factors. Skills, proximity, government support, navigation, and logistics services are excitement factors. The remaining factors are performance factors.

Although different important factors were identified by different techniques, generally these urgent factors, salient factors and basic factors share some common features. It is found in general that shipping services (both deep-sea and feeder services), cost (shipping prices, port charges and overall logistics cost), logistics support (government support), port services (risks, logistics services) and infrastructure (landside links) are important factors influencing port performance. In the following paragraphs, these factors are discussed one by one.

Shipping services: The interview results reveal that both Humber and Xiamen interviewees considered the shipping services (both deep-sea and feeder services) critically important (Section 5.5). This finding was validated by questionnaire findings: firstly, the results of factor loading show that shipping services are very important factors. Secondly, questionnaire respondents considered shipping services as an important factor among the aggregate factors and questionnaire factors by mean (Section 6.6.1 and Figure 7.1c). Thirdly, results from gap analysis show that they are important factors that need improving (Section 6.6.5, Figures 7.1e and 7.1f). Fourthly, the traditional IPA matrix shows that shipping services fall in the quadrant of urgent actions (Section 6.5.5A and Figure 7.1g). Finally, revised IPA analysis by considering explicit importance and explicit performance difference (6.5.5B and Figure 7.1h) confirms that shipping services are salient factors.

More shipping lines with more frequency can attract more customers and more cargoes so that port cargo volume/throughput can be increased. Customers are particularly concerned about the cargo’s in-transit time, which has become increasingly important to reduce stock and save cost in the current global supply chain context.

This finding is consistent with the literature. Gordon et al. (2005) note that the variety of shipping routes and shipping options are very important for the enhancement of port performance. Similarly, the literature has addressed that ship direct calling (Brooks 1985), number of ships (Carbone and Gouvernal 2007), container transport routes of port connectivity in the world (Slack 1985; Brooks 1985; Gordon et al. 2005; Tongzon 2009; Arvis et al. 2010), and frequency of vessel calls at port (Gordon et al. 2005) are all components for port competitiveness. Moreover, Lam and Yap (2008) find that connectivity is one of the most important criteria for port choice. The authors have all addressed that seaside connections are important for port performance.

For carrier operations, apart from frequency and destinations of shipping services to the deep-sea ports with multiple destinations, the feeder services are important to the short sea shipment, as the importance mean (3.88) is above the grand mean. The importance was also reflected during the interviews and the findings confirm claims of Gordon et al. (2005) that feeder operations are important.

Carriers contribute to port development by sea transport, investing and operating in the ports, particularly after containerisation (Souza et al. 2003; Cullinane 2004; Notteboom 2006). As shipping lines are port's major customers (Gordon et al. 2005), only by enhancing the cooperation between ports and shipping lines can port performance be improved, port and shipping lines play their roles and show their advantages in the logistics development, and the logistics system develop smoothly. Thus availability of shipping services including feeder connections is important for port performance.

Cost: Cost is identified as an important factor that drives port performance. In this research, cost consists of shipping prices, port charges and overall logistics cost from shippers to customers. The interview interviewees explained that Xiamen has attracted customers by the very important way of reducing port charges and cargo handling fees, while the Humber has lost some customers due to high port charges. Most interviewees highlighted the importance of logistics costs. This finding was validated by the questionnaire factor analysis (Section 6.4) which shows that cost was the second most important A-factor. Factor mean scores (Table 6.7) show it was above average. Traditional IPA showed it was a factor for urgent action (Section 6.5.5A). Revised IPA showed it was a basic factor (Section 6.5.5C). They all validated the importance of cost.

The findings support the literature. Porter (1980) treats cost leadership as one of his three generic strategies, which are the most successful competitive strategies that firms pursue. Lirn et al. (2003) and Tongzon & Heng (2005) note that cargo handling charges are justified determinants of port competitiveness. Hongkong has been losing handling volume to Shenzhen due to its high port costs, exemplifying the importance of costs.

As labour costs account for about 60% of the total operating costs for container terminal operators (Baird 1999), the investment in port facilities such as labour saving equipment and IT system could save handling cost (Lirn et al. 2004). Some port operators, such as Hutchison Port Holdings (HPH), have invested in port terminals worldwide to attract more carriers and shippers to reduce cost. HPH has expanded its business into 25 countries and territories in Mainland China, Southeast Asia, the Middle East, Africa, Europe and America. Presently, Hutchison Whampoa owns 49 ports and 300 berths worldwide (Dreary 2008). China Merchants Group is another example of port operators that save cost by means of investing and operating in 53 berths in Hong Kong, Shenzhen, Xiamen, Ningbo, Qingdao and Tianjin. Lu and Yang (2006) note that cost is a critical factor for manufacturers making investment decisions in international logistics zones.

Reduction of port charges is an effective way to reduce the customer's cost and attract shippers and carriers. Typical examples are Pusan and Kwangyang (www.ce5e.cn). Kaohsiung is another example to keep its customers by reducing port charges. The conduct of practitioners implies that port charges are important for port competitiveness.

Logistics support: Being an important component of logistics support, government support was highlighted in importance by interviewees (Section 5.2). Factor analysis (Section 6.4), mean scores (Table 6.7), traditional IPA matrix, revised IPA matrix with performance difference (6.5.5A) and revised IPA basic factors entirely cross-validate the importance of government support. The results of gap analyses show that government support needs improving to narrow the gap between satisfaction and expectation (Figure 7.1e) and the performance gap between focal ports and other ports (Sections 6.5.5 and 6.5.3, Figure 7.1f).

The importance of government support was not only highlighted by Xiamen. In the Humber, although the questionnaire mean scores of factor importance were very low, the results of gap analyses show that Humber stakeholders were not happy with their government support compared with their expectations and compared with other ports' performance. This implies that the Humber stakeholders expected the government support to be improved.

The findings support claims in the literature that governments ensure good port performance to achieve the objectives that governments have set for the port (Brooks and Pallis 2008). Government support can encourage international trade to increase currency as country wealth. In China and many other countries worldwide, bonded areas or logistics parks enjoy a policy benefit on tax, as in the cases of Hongkong and Singapore (Section 3.3).

Government is supposed to guide the social allocation of human, material and financial resources so that the structure of regional economy and relevant sectors such as agriculture, industry, communication, logistics and services can be optimized and the resources can be utilized efficiently. Regarding the support to port performance, government's economic management functions are primarily to develop and implement the national macro-control policies, improve infrastructure and create a favourable environment for economic development. Meanwhile, government should help with fair competition and regulate social distribution. However, government is not supposed to interfere directly with the production and business activities of ports.

Keynes (1936) claims that government should intervene in the market economy as a “visible hand”. This indicates that government has coercive power over the market by limiting imports and encouraging exports. It once contributed significantly to the UK and France’s commercial and industrial development. However, Adam, the father of economics, held the counter view that government should not intervene in economic activities as an “invisible hand” but encourage free market competition (Gramp 2000).

Government inaction in relation to the ports has promoted port development to a certain degree. However, the pure market economy may result in serious problems, such as the global economic crisis during 1929-1933. In the 1970s, a school of moderate government intervention in the economy emerged. Its proponents claim that a market economy should develop freely with moderate government intervention. This approach enabled the US economy to develop very fast. In the World Development Report 1991 prepared by the World Bank, the interaction and relationship between government and market was discussed and a consensus was reached in favour of a ‘market-friendly’ approach that government should “intervene reluctantly, apply checks and balances, and intervene transparently and simply” (World Bank 1991).

The ways in which government controls and influences port development vary from country to country, depending largely on the level of government direct involvement in the port business. The relationship between government support and port performance as a market is a very controversial topic. It is generally believed that a market economy is a free mechanism without government intervention. This is not true, because government is generally a part of the market economy, where people have different relationships requiring certain rules to coordinate with each other, and the rules should be stipulated by the government (Huang 2008). Tongzon (2007) notes that government support is a very important factor for Singapore's efficient port performance. This is why the research would hold the view that government should intervene port performance to a certain degree.

Infrastructure: Logistics is infrastructure-related (Luo et al. 2001). Infrastructure includes both "hard" infrastructure and "soft" infrastructure. Both can be catalysts that drive port performance once properly provided, or can be barriers that hinder logistics performance if they are not available. Infrastructure in this research includes port natural conditions (such as navigation), transport infrastructure (such as landside links) and port technical infrastructure such as the loading and unloading facilities, and information system. However, the soft infrastructure such as legal and financial institutions were excluded due to time and data constraints.

The findings (Figure 7.1f) support the literature on the importance of loading and unloading facilities, quay/yard cranes and other equipment (Willingale 1981; Murphy et al. 1991; 1992; Starr 1994; McCalla 1994; Gordon et al. 2005; World Bank; Wu 2008). Song and Yeo (2004) emphasise ports' natural conditions and claim that port facilities are deemed capable of manipulation. Notteboom and Rodrigue (2005) explore that port regionalisation requires a broader regional load centre networks to serve large logistics poles; hence, a more powerful IT system and the knowledge capability to handle it are required. Since port performance involves many stakeholders, the IT system would serve them in a systematic way.

Xiamen Interviewee 9 commented that port infrastructure including port natural endowment, such as the number of container terminals, port loading and unloading capacity, size of the terminal yard and the depth of navigation channel, can be improved by proper investment. He claimed that,

> *"It is not a problem if it can be solved by money. The terminal facilities, the depth of navigation, and so on can be improved if the investment is available."*

The interviewees in both the Humber and Xiamen also considered transport infrastructure as important (Section 5.4). The finding was validated by the questionnaire results (Figures 7.1e and 7.1f), which support the review of Song and Yeo (2004) that port physical infrastructure is the second most important factor for port competitiveness, after volume.

The finding also supports Notteboom and Rodrigue (2005) and Arvis et al. (2010) in terms of landside connections and inland transport speed; supports Slack (1985), UNCTAD (1992) and McCalla (1994), Joly and Martell (2003) in terms of intermodalism/inter-linked transportation networks/hinterland networks and availability of transportation. Luo et al. (2001) use infrastructure as a potential factor in shaping the logistics differences between different countries. Pettit and Beresford (2008) identify that inland connectivity is a powerful determinant of port performance in the UK, and Lam and Yap (2008) confirm the crucial importance of connectivity.

Port services were identified as important by interviewees (Section 5.8). This was validated by questionnaire results (Sections 6.5.1, 6.5.5 and Figure 7.1). The findings support other studies on services, which include a wide range of contents, such as customs service (Bichou 2006; Arvis et al. 2010), port operations efficiency, namely, ship loading/unloading service, pick-up and delivery service (Talley 1996; Gordon et al. 2005; UNCTAD, 2005), labour efficiency (Talley 1996; Gordon et al. 2005; Wu 2008; Arvis et al. 2010), responsiveness to customers (AAPA 2005), flexibility (Gordon et al. 2005), warehousing management service (Wu 2008), port reliability for channel/berth/gate access (Talley 1996), complexity (Arvis et al. 2010), and risk management on port congestion/ cargo damage/cargo loss (Brooks 1984; 1985; Slack 1985; Murphy et al. 1988; 1989; 1991; 1992; Talley 1996).

Apart from customs services, Section 5.8 addressed the importance of logistics services on speed, risk and safety. This is consistent with the literature that although Shenzhen has a much lower cost (250USD/40TEU), many customers still choose Hongkong rather than Shenzhen because of Hongkong's high speed of cargo handling and its high efficiency. It also enhances the literature by Yeo et al. (2008) that service and port management have become an important criteria for port competitiveness.

7.1.2 Other key factors influencing port performance

Besides the factors discussed in Section 7.1.1 which are cross-validated findings from questionnaires and interviews, some other factors emerged from the in-depth interviews.

Location is identified as an important factor (Section 5.1). This finding supports the literature claiming that port location is strategically important for port sector and trade development (Lirn et al. 2003; Langen 2004; Song and Yeo 2004; Gordon et al. 2005). However, as location was identified as uncontrollable, it is rated not so important for port performance. This finding was validated by the later questionnaire analysis results. The mean (3.88) of proximity/locations is the second most unimportant among the 15 factors. This finding leads to the conclusion that although location/proximity is critical for port performance, it is not so important as other factors in terms of improvement due to its feature of being beyond control.

Logistics demand: During the interviews in Xiamen, one of the most highlighted factors was the logistics demand from the local and hinterlands economy. As the Xiamen interviewees were aware, Xiamen does not lack investment in the ports but lacks cargo sources. Twenty-nine percent of the questionnaire respondents highlighted that the hinterland economy directly relates to the logistics demand, which critically influences port performance. The Humber interviewees were proud of their logistics demand, being located within a 4-hour drive of one quarter of the UK, which provides sufficient cargoes.

This finding is consistent with Song and Yeo's (2004) observation that cargo volume, which is equivalent to logistics demand, is the third most important factor in port competitiveness. This is also consistent with Fleming and Hayuth (1994), who note that port performance is constrained by the regional economy, which means the local, regional economy and logistics demand influence port performance. Rotterdam's hinterland economy, and the developed countries around the Netherlands (the UK, France, Germany, Belgium and Denmark), contribute to Rotterdam's position as the door to Europe, which exemplifies that logistics demand influences port performance.

Political stability: Some interviewees raised the issue that Xiamen's logistics largely relies on the political relationship between mainland China and Taiwan because of its unique location in relation to Taiwan. Section 5.11 presented the finding that political stability influences port performance. This is why Xiamen has long been promoting a cross-strait economy. Trade cooperation and the concept of "peaceful reunification" (Taiwan and the mainland are supposed to reunify in a peaceful way) have played a very important role of Xiamen becoming a "window" and "base" for Taiwan. This finding supports Lirn et al. (2003) who note that political risk is a factor that influences port selection.

Xiamen is a port much more strongly influenced by political issues than any other port in China, which cannot be overlooked by port managers when considering its development strategy. Xiamen could not be developed as quickly as some other Chinese ports, due to the relationship with Taiwan. Xiamen does not benefit from a preferential policy from Central Government, which would not provide huge investment as it did in PRD and YRD. However, Xiamen has the potential power to become a regional transhipment port if the relationship between Taiwan and mainland China improves, which will benefit Xiamen with more container generation.

Rapid development has taken place in the past two years after the relationship between Xiamen and Taiwan improved, even in the economic recession. With the opportunity provided by the Haixi Economic Zone policy starting from 2009, Xiamen is facing the possibility that Taiwan-funded enterprises will soon move to mainland China on a large scale. The Humber ports are not facing a similar political issue, being situated in the EU context. This implies that political factors can be very critical for certain ports under a particular institutional context.

The finding from Xiamen shows that political stability is important for port performance and that ports and economy can be improved in a peaceful developing environment; otherwise they will stagnate. This is consistent with Lirn et al. (2003) who note the importance of political stability and strongly recommend that political stability should be included in a broader region research. This finding is also consistent with Lu and Yang (2006) who find that political stability is notably viewed as the most important investment criterion.

In terms of land, the space for port expansion is usually scarce because port location is traditionally near the commercial centre of a city (UNCTAD 2006). The Humber ports, like many others, are suffering from the lack of land for expansion. In this regard, ports should reserve enough land space for future development. It can cause the land price in the port area to become too expensive to maintain logistics activities.

Port ownership: The finding of this research shows that ownership influences port performance (Section 5.9). The Humber interviewees explained that the Humber ports do not perform well because they are solely owned by ABP, which has a monopoly. This finding supports claims in the literature that full port privatisation is not an effective way to increase port operations' efficiency as they solely target profit-seeking (Brooks and Cullinane 2007; Tongzon and Heng 2005). Tongzon and Heng (2005) suggest that partial port privatisation is a fairly effective way to enhance port performance (Tongzon and Heng 2005). This implies that port managers should introduce private finance, private operation and management instead of state funds and administration, however, the percentage of privatisation should be controlled. A private port's shareholders would take profit as a primary measure of efficiency, while public ports are practically accountable to their stakeholders. Some concerns were raised as sole owner, as a monopoly, would hinder the competition that is conducive to maintaining low prices. It may lead to sacrificing the consumers' interest to maximise the profit. Humber Interviewee 10 described,

> *"ABP is the pure port owner for over 80% of the ports on the Humber estuary. It has the power of monopoly in this area. There is a lack of competition."*

The unsatisfactory Humber infrastructure is partly due to the monopoly. As the interviewees explained, new projects in the Humber are very slow to be implemented due to lack of long-term contracts with customers. The Humber port owners wait for the customer contract before putting a project in place. The conflict is that ABP would not start a project without a long-term contract, while the customers would not promise to use the terminal with a contract unless they were sure about the success of their business. This situation is quite different from that of Xiamen, where infrastructure investment is quickly available to implement projects. In Xiamen it is understood that port technical infrastructure should be available before the customers come and infrastructure is recognised as one of the most important factors in attracting customers.

As reviewed in the literature, pure public ownership is not a good mode of port ownership for port development, and this research has found that sole private ownership is not a good mode, either. According to the government interviewees, it is difficult for the government to intervene in port management and development of purely private ports. This gives more convincing evidence that sole private ownership, as a monopoly, is the main reason for poor performance in terms of expensive charges and poor services. Owing to monopoly, ABP has a decision-making power, while the customers do not, as they may have no other ports to go to in this area due to location problems.

Borger et al. (2008) note that private ports do not necessarily charge higher port prices but may actually charge less than public ports. However, this research shows that if private ports are owned by a sole owner, it is conducive to port development. To avoid monopoly, port ownership needs to be diversified.

Social culture was identified as one factor influencing port performance from the Xiamen interviews (Section 5.13). It seems that Xiamen is facing conflicts between urban culture and commercial interest in developing its logistics. This finding supports Carter and Peng (1997), who note that in China, logistics is characterised by social and cultural customs. Port performance is international and cross-cultural in nature (Luo et al. 2001). Culture, as an aspect of the business environment, varies around the world. Culture differences influence how ports operate, and this role has not received the attention that it deserves (Long 2003). This research contributes to the literature with empirical data on cross-culture logistics showing that culture influences port performance.

Environmental concerns were identified as one factor influencing port performance (Section 5.10). Environmental concerns actually influence port performance to some extent. For example, approval of a new container terminal proposal for Hull was delayed partly due to environmental concerns. As ports are at the sea-land interface where environmental sensitivities are high, the issue is more complex and it takes more time to have a port project approved. This confirms previous assertions that ports face environmental pressure (UNCTAD 2006).

Serious environmental issues have arisen, coupled with the tremendous economic growth globally in the past few decades. Consequently, environmental concerns have become important to ports because of their cross-functional nature. Innovative and environmentally-friendly logistics ideas are often used. For instance, Wal-Mart's cross-docking and elimination of non-value-added activities are environmentally responsible; use of rail and barge is promoted rather than road haulage and air cargo, which has a profound impact on the environment.

This finding that environmental concern is an impediment to port project development contributes to the literature as it has not been addressed in the literature except by the UN report. However, although environmental concerns temporarily and negatively influence port performance, they are favourable to sustainable port performance.

History indirectly influences port performance (Section 5.12). Both the Humber and Xiamen were prosperous for a long period but declined later on. Xiamen declined due to political relationships with Taiwan while the Humber declined due to decline of the fishing industry. However, after declining, Xiamen is now developing very fast with

China's economic boom and the improved relationship between the mainland China and Taiwan. The Humber has not recovered yet due to a stagnant UK economy.

Historical influences apply not only to Xiamen and the Humber, but also to other port cities. This influence is obvious as ports developed based on their history. For example, Rotterdam's prosperity today is built on its history starting from the 13th century, when the port facilities and canals were built. The good communication system in the 18th century prepared for trade and industry development later on in oil, oil product, minerals, coal, food, and fertilisers, in Germany, UK, France and Italy.

Figures 7.1 suggests both external and internal factors influence port performance. The external factors not only influence port performance but also influence internal factors. For example, government support is an external factor and it is strongly related to political and legislative factors. It influences port infrastructure by investment and influences customs services by legislation, while port infrastructure and customs services are both internal factors and port performance indicators. This section has discussed findings on the external factors influencing port performance.

7.1.3 A proposed framework for IPA

As there are a number of factors influencing port performance and the factors are complicated, a comprehensive process shown in Figure 7.2 is proposed to follow to identify the key factors. That is, the factors should be investigated from different aspects instead of one by employing IPA, to avoid bias.

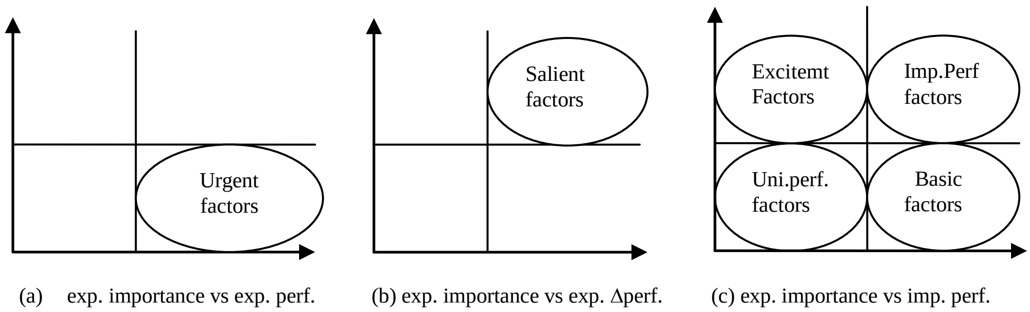


Figure 7. 2 Comprehensive process of getting key factors

Firstly, concentrate/urgent factors are gained by plotting an importance-performance matrix, using explicit importance and explicit performance weights (Figure 7.2a). Secondly, to consider competitors' or bench markers' performance, the IPA matrix is plotted by using explicit importance and explicit performance difference between focal ports and other ports (Figure 7.2b). Thirdly, as self-rated importance rating has some shortcomings (Section 3.6), implicit importance is incorporated to extract the basic factors and determinant attribute of port performance. Three-factor theory is employed to extract basic, performance and excitement factors to apply different strategies (Figure 7.2c).

7.1.4 Section summary

Section 7.1 has discussed port importance in relation to the supporting literature, interviews and questionnaire survey results. It has discussed the important factors that influence port performance.

In terms of questionnaire factors, this section has addressed determinants of port performance from five aspects: by factor analysis, by mean scores, by two gap analyses (importance vs. performance, and performance of focal ports vs. that of other ports), by traditional IPA analysis (explicit importance vs. explicit performance), by revised IPA employing gap analysis (explicit importance vs. performance difference), and by revised IPA by employing 3-factor theory (implicit importance vs. explicit performance).

The questionnaire and interviews cross-validate that shipping services, cost, government support, infrastructure and port services are important factors and most of them are key internal factors, which were discussed one by one. Other factors identified from the interviews and questionnaire responses to the open questions were location, logistics demand (economic), political, social, cultural, historical and environmental factors, most of which are external factors. The identification of these important external factors enriches the PESTEL theory by adding a component of historic influence.

This section has addressed Research Objective One to identify the key factors that drive port performance and choice. The next section will address Research Objective Two to investigate the differences in importance and performance among these factors.

7.2 Differences in importance and performance among the important factors

7.2.1 Importance difference among the important factors

As discussed in Section 7.1, the results of factor analysis reveal that shipping services, cost, port services and logistics support are important in descending order for aggregate factors. The grand mean is used to separate the important factors from unimportant factors. Figure 7.1c presents the important factors in descending order by explicit means: shipping services, shipping prices, overall logistics cost, risks, logistics services, safety, feeder services and government support.

For gaps between customer satisfaction and expectation, the importance order was identified as shipping services, shipping prices, overall logistics cost, government support, landside links and port charges, as presented in Figure 7.1e. Performance gaps between focal ports and other ports reveal that attention needs to be paid to (in order): landside links, shipping services, navigation, government support, feeder services and port infrastructure.

7.2.2 Performance difference among the factors

Previous studies suggest that ports are dissimilar in performance (Bichou 2007). The studies have used a variety of methods of performance measurement. For instance, Trujillo and Nombela (1999) and Carbone and Gouvernal (2007) used the economic and financial indicators; Gordon et al. (2005) and Bichou (2006) used efficiency measurement; Wu (2008) and Talley (1996) used infrastructure measurement; Robinson (2006) and Arvis et al. (2010) used cost measurement; De Langen (2003) used time measurement.

This research has investigated the factor performance measurement for the combined sample. The responses to all the questions about performance yielded mean scores above 3 in a five-point scale. It can be argued that the factor performances fell in the respondents' 'zone of tolerance", as long as certain conditions were met (Berry and Parasuraman 1991). To simplify the analysis and discussion, the grand mean is employed to mark the split of satisfying performance and dissatisfying performance. After the limit is reached, the customer will become dissatisfied (Ford et al. 1999).

Based on this criterion, the ports perform well in the following factors in descending order: safety, logistics services, port technical infrastructure, speed of cargo handling, risks, proximity, shipping services and skills (Figure 7.1d). Most of these are port services. Factors where performance ranges from very poor to poor are government support, overall logistics cost, landside links, port charges, navigation, shipping prices and feeder services. This means that performance on port services is quite satisfying, while cost and logistics support are not.

The poorly performed factors are reflected in the results of gap analysis. The results of gap analyses (Sections 6.5.3 and 6.5.5, Figures 7.1e and 7.1f) show that port stakeholders are not satisfied with their port performance compared with their expectation and performance of other ports. As sample populations do not appear to obtaining what they expect from their own ports in these factors, this may indicate an even larger scale problem in the countries involved (Ford et al. 1999).

Section 7.2 has investigated port importance and performance differences among the factors, which has addressed Research Objective Two. The next section will address Research Objective Three.

7.3 Variance in factor importance and performance for different ports

Section 7.1 discussed the key factors driving port performance and choice, Section 7.2 investigated the differences in importance and performance among these factors. This section will analyse how the factor importance and performance vary for different ports. Figure 7.3 presents an overview of this section.

7.3.1 Variance in factor importance for different ports

Important factors by mean

Sections 6.3, 6.5.1 and Figure 7.3a show the factor importance differences between the Humber and Xiamen. For factor importance differences, apart from shipping services and shipping prices, the Humber considered port charges, cargo handling, risks and safety important while Xiamen considered feeder services, overall costs, logistics services, landside links and government support important.

For the 15 factors, there are significant differences between the two regions in the following nine factors in descending order: port charges, skills, government support, speed of cargo handling, shipping prices, risk, safety, feeders and shipping services. The Humber scores were significantly higher than Xiamen's, except for government support and feeders. The importance of port charges differs most. This is because in the Humber, port charges have seriously influenced port performance as a big issue, while Xiamen port charges were considered reasonable or even lower than the average level in China.

Government support was perceived very differently by the two regions. The Humber considered it the least important while Xiamen considered it the second most important. This is because the Humber and Xiamen are in the context of two different institutions. The Humber is in a developed country, where there is a mature market economy. Ports are a free market in the UK and the government does not intervene in port management and development. However, Xiamen is in a developing country, where there is a transitional economy from a planned economy to a free market

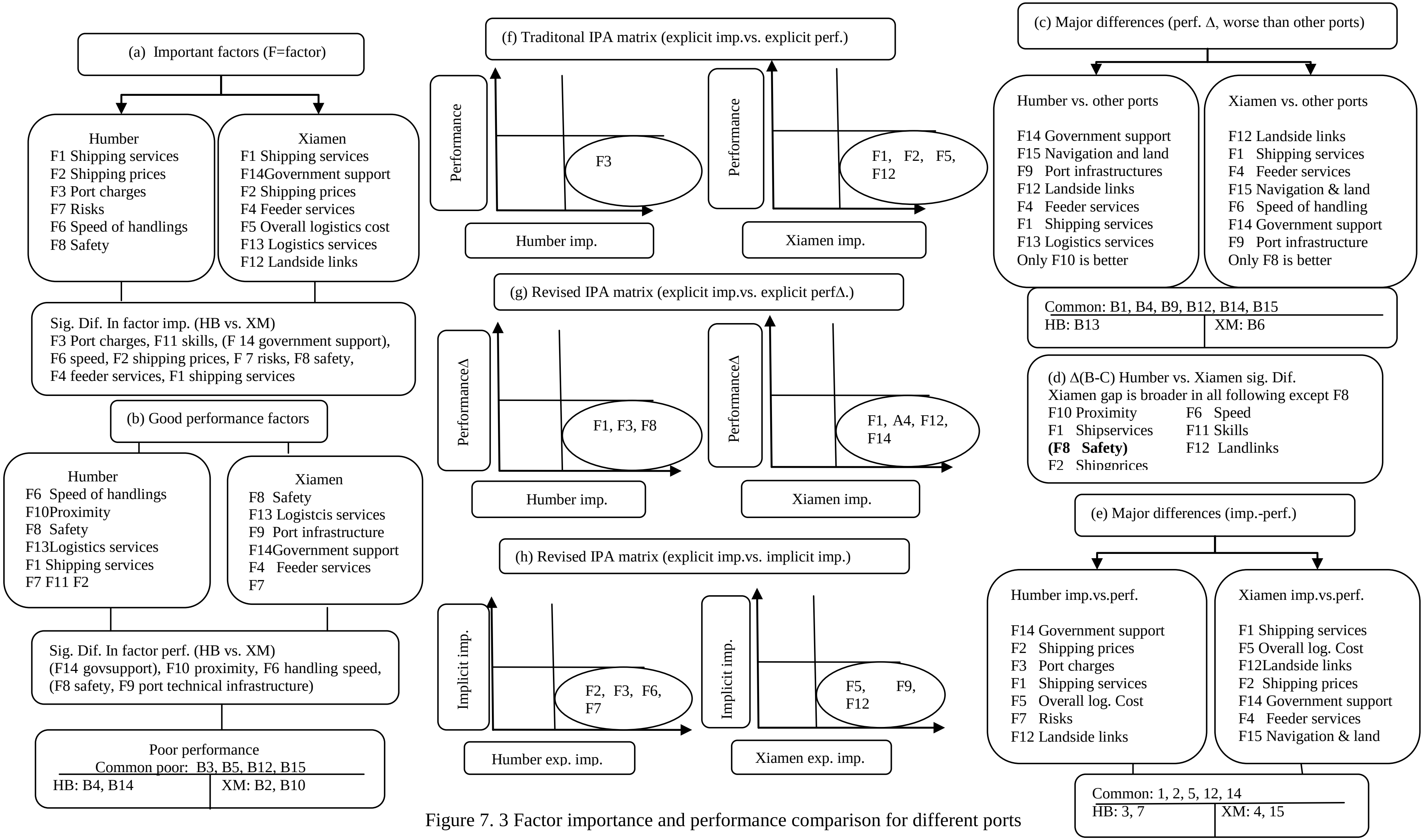


Figure 7. 3 Factor importance and performance comparison for different ports

economy. The Chinese government still controls and intervenes heavily in ports, especially the strategic issues. For example, the Chinese government intervened more deeply into the economy in 2009 to assist recovery from the economic recession by a series of preferential policies. Logistics is one of the top 10 industry sectors earmarked by the Chinese government for revitalisation. For example, in response to the financial crisis and to support the port industry to overcome the difficulties, in 2008, China's central government decided to invest 4,000 billion RMB mainly in infrastructure to stimulate the domestic demand. In 2009, 1.8 trillion RMB was allocated to stimulate infrastructure projects.

In contrast, the Humber interview and questionnaire respondents did not see much government support for logistics. Figures 7.3a, 7.3c, 7.3d and 7.3e reveal that The Humber and Xiamen have significantly different views on the importance of government support influencing port performance. The Xiamen interview interviewees highlighted the importance of government support and considered it as the most influential forces on port performance (Section 5.2). As one interviewee stated, the most important factor influencing performance development in China is government support. This finding was validated by the results of the questionnaire survey (Section 6.5.1).

Song and Yeo (2004) find that China's port facilities were insufficient because Chinese ports developed very late. However, with government intervention, great changes have happened to Chinese ports. Facilities have increased fast since the 1970s, when China's container transport started in Tianjin. According to the Chinese Ministry of Communications (MOC), by the end of 2008, China's total port cargo throughput had amounted to 7 billion tons and 128m TEUs, with 413 ports and 31,000 berths (194 times the number in 1949 when China was founded, 1416 of which can handle cargoes over 10,000MT). This was nearly 700 times more than what they were 60 years ago. The annual increase of the port handling capacity reached 500 million tons (average annual growth rate of 11.5%), which is equivalent to building a new Shanghai port (www.moc.gov.cn).

Chinese ports provide strong support to China's national economy and foreign trade. According to AAPA (2009), 7 out of the top 10 ports in cargo volumes and 6 out of the top 10 ports in container TEUs were from China, which implies that China's ports and port facilities are no longer backward and insufficient. The achievement is inseparable from the government support. The government intervention in the market economy is obvious and is still going on to some extent.

Xiamen's local government also shows its support to the Xiamen infrastructure. Xiamen is No. 7 among China's ports in terms of TEUs. The interview interviewees noted that the Chinese government contributes to Xiamen's satisfactory infrastructure. Xiamen's city transport and the port infrastructure are good (Section 5.3 and 6.5.2). The government has been making efforts to improve the poor landside links. For example, three railways are under construction, and the Fuxia express rail came into operation in January 2010. Xiamen government support is also reflected by FDI attraction (Wang and Chen 2008).

Comparing the Humber and Xiamen reactions to the poor physical infrastructure, Xiamen responded much faster to the market requirements, pushed by the government. In Xiamen, the government, port managers and the private investors will put money in place once a project is approved. Xiamen interviewees expressed positive attitudes towards the government investment and strategy (Section 5.2).

The finding that the Humber did not take the government role seriously while Xiamen highly appreciated it supports the literature with empirical evidence that government authorities in UK and China have played very different roles (Wang and Slack 2004). The authors note that the UK government authorities' power has gradually been reduced to nurture a more liberal business environment, while in China, central and local governments still strongly intervene in port development and terminal operations.

Availability of shipping services was considered significantly different between the Humber and Xiamen, because the Humber shipping services were not considered satisfying. The interviewees hoped this could be improved so that customers could have more frequent services for their cargoes. As for Xiamen, it has already attracted about 100 shipping lines and the frequency is good. As for feeder services, as Xiamen has overinvested in port infrastructure, it has sufficient port capacity for future development. However, due to constraints of limited local economy and hinterlands, feeder services are important to bring in more cargoes from inland areas and increase the transhipment volume in Xiamen. In contrast, in the Humber area, as its hinterlands are not broad, the feeder services are not so important. Instead, the Humber ports function as a feeder to some big European ports.

Important factors from gap analysis

Performance gap analysis between focal ports and other ports (Section 6.5.3) shows that both regions have big gaps in government support, landside links, feeders, navigation, port infrastructure, feeder services and shipping services. Additionally, big gaps exist in logistics services for the Humber and speed of cargo handling for Xiamen. Figure 7.3c presents the gap difference in descending order. The big gaps indicate that both regions do not satisfy customers compared with other ports.

Importance-performance gap analysis (Section 6.5.5 and Figure 7.3e) shows that both regions have big gaps in government support, shipping prices, shipping services, overall logistics cost and landside links. Additionally, big gaps exist in port charges and risks in the Humber and feeder services and navigation in Xiamen. The gaps indicated that given the importance of these factors, their mean performance scores were potentially problematic. This would lead to customer dissatisfaction. The respondents had a perceptual problem with their ports and special attention needs paying to those factors with big gaps as their performance rankings were much lower than their expectations. The only areas where respondents appeared to obtain what they expected were proximity in the Humber and safety & skills in Xiamen.

The two types of analyses were conducted to investigate gaps. They explain to some extent why the Humber and Xiamen ports cannot attract many customers and why customers would rather go to other ports instead of the Humber and Xiamen.

IPA: urgent, salient and basic factors

Section 6.5.5A and Figure 7.3f show the traditional IPA results from analysing explicit importance and explicit performance. Port charges is the Humber's urgent factor, while landside links, overall logistics cost, shipping prices and shipping services are urgent factors for Xiamen. Revised IPA results from analysing explicit importance against explicit performance difference (Section 6.5.5B and Figure 7.3g) show that the Humber's salient factors are shipping services, port charges and port safety, while Xiamen's salient factors are shipping services, feeder services, landside links and government support.

Sections 6.5.5C and Figure 7.3h show that shipping prices, port charges, speed, risks are basic factors for the Humber, while landside links, overall logistics cost, shipping prices and port technical infrastructure are basic factors for Xiamen. They should be maintained at the basic level of performance, because they are unimportant if their performances are delivered above a certain threshold level; but they become critical if their performance falls short. These factors can suddenly turn into determinant attributes with high importance and low performance. On the contrary, the Humber's excitement factors are skills, navigation, logistics services and proximity, while Xiamen's excitement factors are skills, port charges, safety and navigation. They are order-winning criteria. They enhance satisfaction if performance is high. If the performance is low, overall satisfaction is not negatively impacted. The remaining factors are performance factors. Their importance changes depending on their performance level. Satisfaction with these factors increases linearly as performance of these factors is improved.

Section summary

The research findings of importance by mean, gap analysis, traditional IPA and revised IPAs have shown that different regions under different economic, social, political, cultural and environmental contexts have different urgent, salient and basic factors that affect port performance. Although different methods and techniques generate different important factors, all the factors are within the range of important factors above with means above grand means. Most of the important factors are found to be internal factors, although they are influenced by external factors.

7.3.2 Variance in factor performance for different ports

This research finds that it is difficult to compare port performance by throughput between the Humber and Xiamen, because freight is made up of different commodities. The finding confirms the claim of Slack (2007). The Humber deals with many inevitably weighty bulk cargoes while Xiamen handles both bulk materials and general cargoes, and Xiamen handles many more containers than the Humber. However, although throughput is difficult to compare, the factor performances are comparable by subjective measures.

Section 6.5.2, Figure 7.3b and Table 7.1 present the performance difference between the Humber and Xiamen. Both port regions have good performance in safety, risks and logistics services. In addition, the Humber ports have good performance in speed, proximity and shipping services; while Xiamen ports are good in port technical infrastructure, government support and feeder services.

Both the Humber and Xiamen have poor performance in port charges, overall logistics cost, landside links and navigation. Apart from these, the Humber ports have poor performance in feeder services and government support, while Xiamen ports have poor performance in proximity and shipping prices (Section 6.5.2).

Table 7. 1 Performance issues of the Humber and Xiamen

	The Humber	Xiamen
Shipping services	Poorer than other ports	Poorer than other ports
Shipping prices		Poor, Sections 5.6 and 6.5.2
Port charges	Expensive port charges, Sections 5.6 and 6.5.2	Poor, Sections 5.6 and 6.5.2
Feeder services	Not sufficient, Sections 5.5 and 6.5.2	
Overall logistics cost		Poor, Sections 5.6 and 6.5.2
Speed of cargo handling		Poorer than other ports
Port infrastructure	Poor port facilities, Sections 5. 3.1 and 6.5.2	
Proximity		Poor, Sections 5.1 and 6.5.2
Skills	Poor but not very important, Sections 5. 8 and 6.5.2	
Landside links	Poor, Sections 5. 4 and 6.5.2	Poor, Sections 5.4 and 6.5.2
Government support	Poor, Sections 5. 2 and 6.5.2	Poorer than other ports
Navigation	Lack deep water, insufficient land for future development, Sections 5.3 and 6.5.2	
Others	Poor port image, Sections 5.14, environment constraints (Section 5.10)	Poor custom service (Section 5.8) Poor logistics demand (Section 5.7) Overinvestment to cause high cost

The Humber and Xiamen have significant performance differences in the following factors in descending order: government support, proximity, speed of cargo handling, safety and port infrastructure. Xiamen performed much better than the Humber in government support, safety, port infrastructure and carriers, whereas the Humber performed much better than Xiamen in proximity and handling speed.

Government support differs most. The government support performance of the Humber is the poorest and that of Xiamen is number 4 out of the 15 factors. This finding validates interview results in Section 5.2. Government support of the Humber port importance, performance and performance difference compared with other ports were all identified as the poorest among the 15 factors. Poor government support was further identified as one reason for poor infrastructure and a slow planning process for the Humber.

Proximity is the factor with the second most difference, as the Humber's hinterland is not huge and it does not have competitors nearby while Xiamen's local economy is poor, and there is much overlapping of hinterlands with other ports such as Ningbo, Fuzhou, Zhangzhou, Quanzhou, Linde, or even Shanghai, Shenzhen and Guangzhou.

For port infrastructure, as the interview results and questionnaire analysis show, the Humber's port infrastructure is poor in terms of port natural conditions and port facilities/equipment, such as channel navigation, water depth, old gantry and cranes. However, Xiamen has deep water, modern facilities and good port connectivity. The interviews indicate that Xiamen has overinvested in port infrastructure, and in the questionnaire analysis, its performance ranking was No. 3 out of the 15 factors. This finding is not consistent with literature asserting that Xiamen should invest heavily in port infrastructure (Wu et al. 2008).

Regarding port services such as speed of cargo handling, the Humber has professional management, as the ports in UK developed much earlier than those in China. Xiamen started developing ports in the late 1970s, when the Humber was already very efficient in cargo handling. With regard to port safety, as Xiamen takes safety as a high criterion for port image, safety is well controlled with high standards. The overall services in Xiamen are good, except customs services, based on the general comments from interviews and questionnaire survey results. The performance of Xiamen logistics services was ranked number 2 out of the 15 factors.

Port charges of the Humber are much higher than those of Xiamen. This is because the Humber ports are solely owned by ABP, which results in monopoly. Lambertides and Louca (2008), who examine the relationships between ownership structure and operating performance for European maritime firms, find that operating performance is related to the ownership. Specifically, performance is positively related to foreign held shares, investment held shares and portfolio held shares. In the Humber, monopoly is the main reason for high port charges and big problems with infrastructure investment (Section 5.9). This finding confirms and supports the S-C-P theory that structure impacts performance (Scherer 1980; Bain 1956).

Xiamen port ownership is more diversified, which results in better investment from various entities. However, it was noted that port operation needs integrated management when ownership is diversified. Currently, Xiamen ports are prominently characterised by "oligopoly" competition with un-integrated services. For sustainable port development, the diversified port operators are often not competing rationally. In order to solve the problem, a scheme is needed to balance the different operators’ interests. The investors are advised to separate from the operations management team.

A state-owned holding company may act as the core power to form a "port group" which integrates the port operations management. The different investors would share the equity but not be directly involved in the management, so that specialization and economies of scales can be achieved, market competition can be reconstructed, non-rational competition can be eliminated and the port charges can go back to a reasonable rate to improve the overall profitability of the port and enhance its overall strength.

For the Humber, as addressed in Section 5.6, many local manufacturers, retailers and distributors would choose the southern English ports rather than the Humber ports for import and export, even though the Humber ports are closer to them. Marks & Spencer has chosen Bradford as the home of its new distribution centre, where the M61 and M62 are easily accessed. Next, Tesco, IKEA, Excel, Faberge and B&Q have placed their distribution centres in Doncaster, home to a number of major distribution centres, due to its proximity to major urban centres and motorway/rail infrastructure. The Humber ports do not manage to attract the big companies. Smith & Nephew do not use the Humber ports but Felixstowe; Reckitt & Benckiser use Doncaster as a distribution centre and would choose rail and other modes rather than sea shipment from Hull. Arco, as the biggest retailer in the labour and personal protection sector in the UK, does not use the Humber but Felixstowe. The interviewees explained that it is more convenient, quicker and cheaper for them to import and export from the South.

The major retailers did not choose the Humber estuary as their distribution centre. This may be due to the Humber ports' high charges (Sections 5.2.6 and 6.5.2), poor port infrastructure and hinterland connected infrastructure (poor landside links), no deep-sea water, insufficient feeder services, poor facilities, poor skills, insufficient land, weak government support, and better services at lower cost provided by other ports (e.g. Tesco opened a new Teesport Distribution Centre in Middlesbrough). Moreover, the Humber does not benefit from a strong local economy, as the Humber estuary itself does not support sufficient logistics demand, not being a manufacturing base and not being close to the customers. As the big supermarkets are particularly market-driven, and neither the population nor heavy industry is dense in the Humber, they would not choose the Humber as the location for their distribution centres.

But why did some customers still choose the Humber and Xiamen instead of other ports, even though their port performance was poorer than that of other ports? Firstly, it is because the Humber/Xiamen have comparatively better performance in some areas, which were analysed in Section 6.5.2 as the top 5 performance factors. Secondly, the customers would make the decision on port choice based on many factors. Location is an important element for them to consider. The Humber's proximity is the only factor with better performance than other ports. Thirdly, it depends on whether the customers have alternative choices. If they do not find better alternative ports after considering the relevant factors, they choose the Humber and Xiamen.

For Xiamen, the high overall logistics costs and port charges might be due to overinvestment in port facilities. Highly efficient terminals used to be the best workable strategy to defeat competitors. However, it is no longer the best strategy, as proved by European ports. Notteboom and Winkelmans (2001) noted that inimitable and durable core competences with cost leadership or differentiation (by offering specific port services in the market niches) remain the strategy to achieve competitiveness. This is also in line with Porter's Strategy of Core Competitiveness (Porter 1980).

The questionnaire analysis results show significant differences between the performance difference of the Humber and Xiamen in proximity, speed of cargo handling, shipping services, skills, safety, landside links and shipping prices in descending order. Xiamen gaps are much wider than those of the Humber in all the factors except safety (Figure 7.3d). This implies that Xiamen has bigger potential problems and face a more competitive environment.

7.3.3 Differences between factor importance and performance

Sections 6.5.5 and 7.3.1 presented the significant differences between factor importance and performance. For the Humber, the finding shows statistically significant differences in 11 factors in descending order: government support, shipping prices, port charges, shipping services, overall cost, risks, landside links, safety, navigation, infrastructure and handling speed. For Xiamen, the finding shows significant differences in 13 factors in descending order: shipping services, overall cost, landside links, shipping prices, government support, feeder services, navigation, risks, port charges, proximity, speed of handling. The top five factors are regarded as the most problematic. The identification of specific problematic areas can be improved to help the port managers develop a more positive view of their ports. The findings of importance-performance gap analysis validate the above findings with supporting mean differences.

Section 7.3 has analysed and discussed the factor importance and performance difference for different ports. The next section will discuss Research Objective Four.

7.4 The role of a port hinterland in port performance and choice

The results from interviews (Section 5.7) show that hinterlands play an important role in port performance. This finding is validated by responses to the open questions in the questionnaire (Section 6.5.1). It supports Slack's (2007) claim that hinterlands have a clear impact on the performance of port development, as seaport performance is strongly entwined with the development of hinterlands which have cargo access to the ports. It also supports Garcia-Alonso and Sanchez-Soriano (2009) that hinterlands contribute to port selection and supports Pettit and Beresford (2008) that hinterlands contribute to port prosperity.

The scope of port hinterlands is dynamic. The broader the hinterlands are, the larger the cargo volume available. Port hinterlands change in relation to infrastructure and competitors nearby. More options of landside links connecting ports and other inland places would make cargo transport more convenient. The better quality the landside infrastructure is, the more convenient the transport connectivity is. If there is any port nearby, it would share the hinterlands and compete for cargo volume. Notteboom and Rodrigue (2005) note that port regionalization can enlarge port hinterlands so that more cargo sources are available to improve port performance. Portugal’s fall and Rotterdam’s rise (Section 3.4) exemplify that ports would flourish or decline depending on whether the hinterlands are large or small, and whether their economy is strong or weak.

Containerization requires larger hinterlands that provide more cargoes and it has enhanced the port-hinterland relationships. The scope of the hinterland varies due to containerization and development of port regionalisation, such as the appearance of Oresund region in Scandinavia and ASEAN (O’Laughlin et al. 1993). The hinterlands of Xiamen are enlarging with the development of Xiamen ports and better landside links (Section 5.7). In turn, the expanding hinterlands benefit port performance with larger volume and better throughput.

Because the location of Xiamen is between two big port regions - YRD and PRD, its hinterland is squeezed by the ports in the two regions. The customers would prefer ports in YRD and PRD, as they can provide better services at lower costs due to economies of scale. Moreover, Xiamen’s local economy is weak; its hinterland is constrained by poor landside infrastructure; the close provinces’ economy is weak. These indicate that Xiamen’s hinterland is weak. Consequently, the logistics demand of the port is weak. This would influence Xiamen’s port performance.

Due to the constraints of limited hinterlands, Xiamen is not expected to target becoming an international transhipment port, because it is close to three big and mature container port clusters: PRD, YRD and Kaohsiung. Table 7.2 presents the throughput of the main container ports close to Xiamen in 2009.

Table 7. 2 Throughput of main container ports close to Xiamen in 2009

Port Name	Throughput (million TEU)	World rank
Shanghai	25.00	3
Ningbo	10.50	9
Shenzhen	18.25	5
Guangzhou	11.19	7
Xiamen	4.68	19

Source: adapted from AAPA

This implies that developing Xiamen into a transhipment port is improper. Developing an international transhipment port may face unexpected risks such as natural port conditions, the movement of world economic trade centre, and the local political influence. These uncertain factors may cause the ports to fall idle. This finding provides port managers with evidence that irrational investment may not be good for Xiamen's port performance.

In the case of the Humber hinterlands, the interviewees and questionnaire respondents were happy with its proximity (sections 5.2.1 and 6.5.2), which implies that Humber respondents are happy with the cargo supply from their hinterlands, although the Humber's local manufacturing and local economy is weak. The Humber has a big volume of cargoes coming from the potential hinterlands in West Yorkshire and Scotland. This will further improve the Humber port performance.

7.5 Usefulness of key findings for port stakeholders

The findings of this research have a number of implications for port managers in the Humber and Xiamen. Matzler et al. (2003) propose strategies by employing three-factor theory. Their strategies are followed for different types of factors and strategies for the Humber and Xiamen are provided in Table 7.3.

In general, the following implications emerge for the management of port customer satisfaction: fulfil all basic factors, be competitive regarding performance factors and stand out for excitement factors (Maltzler et al. 2003). For the Humber, the basic factors are speed of cargo handling, risks, shipping prices and port charges. They should be maintained at the basic level of performance. On the contrary, navigation, logistics services, proximity and skills are order-winning criteria. They need to stand-out. Satisfaction with the remaining factors increases linearly as their performance is improved. For Xiamen, landside links and overall cost should be maintained at the basic level of performance. Navigation, port safety, port charges and skills should be treated as order-winning criteria. Satisfaction with the remaining factors increases linearly as their performance is improved.

Table 7. 3 Strategies of the Humber and Xiamen subject to revised IPA results by 3-factor theory

Port	Factor group	Factors	Our performance	Other ports' performance	Implication
The Humber	Excitement factor (high implicit importance Vs low explicit importance)	navigation	poor	poor	neglected opportunities
		logistics services	good	good	head-to-head competition
		proximity	good	poor	competitive advantage
		skills	good	poor	competitive advantage
	Performance Factor (high explicit imp. Vs high imp. Imp; low exp. Imp.vs low imp. Imp)	shipping services	good	good	head-to-head competition
		landside links	poor	good	competitive disadvantage
		overall cost	poor	poor	neglected opportunities
		feeders	poor	good	competitive disadvantage
		technical infrastructure	poor	good	competitive disadvantage
		government support	poor	poor	neglected opportunities
	Basic factor (high exp. Imp. Vs. Low imp. Imp.)	speed	good	good	No advantage
		risks	good	poor	No competition
		shipping prices	good	poor	No competition
		port charges	poor	good	No market entry possible
Xiamen	Excitement factor	navigation	good	good	head-to-head competition
		safety	good	good	head-to-head competition
		port charges	poor	poor	neglected opportunities
		skills	good	poor	competitive advantage
	Performance factor	government support	good	poor	competitive advantage
		logistics services	good	good	head-to-head competition
		shipping prices	poor	good	competitive disadvantage
		feeders	good	good	head-to-head competition
		technical infrastructure	good	good	head-to-head competition
		shipping services	poor	poor	neglected opportunities
		speed	poor	good	competitive disadvantage
		proximity	poor	poor	neglected opportunities
		risks	good	poor	competitive advantage
	Basic factor	landside links	poor	good	No market entry possible
		overall cost	poor	poor	false competition

As discussed earlier in Section 7.1.3, traditional IPA and revised IPA by gap analysis should also be considered together with revised IPA by three-factor theory to set priorities for improvement and resource allocation, and to consider competitor's performance as well. In this research, other ports' performance is assumed as competitor's performance.

Table 7. 4 The Humber and Xiamen implications for port managers

Port	Finding of issues	Implications
Humber	Monopoly	Build more ports; diversify port ownership
	Poor government support	Improve planning process; government investment in infrastructure
	Expensive port charges	Diversify port ownership, diversify investment; make the port charges transparent; benchmarking; improving port facilities to reduce labour cost; government intervene
	Poor port infrastructure	Improve infrastructure; diversify investment
	Poor landside links	Promote intermodalism
	Others	Build logistics distribution centres, attract more cargoes, improve image of the Humber; improving shipping services
Xiamen	Poor landside infrastructure	Improve transport infrastructure to connect Xiamen and hinterlands; improve intermodalism; information system improvement
	Poor logistics demand	Enlarge hinterlands by landside links and dry ports; improve local and hinterland economy;
	Poor customs services	Improve the customs services
	Political issue to Taiwan	Make use of the location advantage of Xiamen to Taiwan
	Lacking strategic scheme	Develop a strategic logistics scheme
	Poor shipping services	Cooperate with shipping lines; improve domestic feeder services
	Others	Promote regional transhipment hub; seek constant government support;

To put the strategy in Table 7.3 into practice, as well as considering the integrated process of Figure 7.2, the Humber and Xiamen port managers are supposed to perform the activities as shown in Table 7.4.

Diversify the Humber port ownership

For the Humber, to cope with the issue of monopoly, one way might be to build more ports in the Humber estuary by different port owners, so that there will be competition among different ports. This is because competition can improve port services and reduce port charges at the rational level. The other way might be to diversify the current port ownership so that more parties can be involved in the port management. The Humber can learn from Xiamen with regard to port ownership diversification. As sole ownership negatively influences the port infrastructure (Section 5.3), the Humber needs to allow diversified investment in port infrastructure to expand the container terminals, purchase advanced quayside equipment, and assign more quayside cranes to a vessel so that both landside transport infrastructures and port facilities can be improved for better port performance. Ownership diversification could attract more social capital, improve the port efficiency and services, and reduce port operation risks (Notteboom et al. 2000; Cullinane et al. 2002).

Improve the Humber government support and port infrastructure

Interview analysis shows that the relationship between government support and port development is loose in the developed countries (Section 5.2). The Humber is facing difficulties in a slow planning process and poor port infrastructure. The government should intervene and help it out with investment and proper guidance to solve the financial problem.

In response to the extension of the European Union, increasing trade with the North Sea and Baltic countries and greater competitiveness within the UK's port industry, the Humber ports' facilities need continual development to accommodate projected increases in trade and changes in trading patterns. Adequate port facilities in the Humber are fundamental to the continual prosperity of the local and regional economy. However, due to lack of investment, the port facilities are not satisfactory.

Government investment in port facilities and transport infrastructure could improve port efficiency to benefit the region. China's central government and local government exemplify government support for infrastructure investment. Chinese port investment currently comes from several sources: central and local government finance, loans from foreign government, securities finance, financial institutions and domestic-foreign joint investment. The Humber could obtain the finance for the port infrastructure investment using similar approaches. Besides these, it can also get finance by project financing to raise international capital.

As Xiamen performs very well in government support to port performance, the Humber may learn from Xiamen about how the government supports the improvement of port performance. China's and Korea's experiences in government support (Section 3.3.1) to port facilities and landside links imply that governments in other countries can learn from them for diversified investment, either from domestic or foreign private investment or public investment, to improve port infrastructure.

Reduce the Humber port charges

The Humber could learn from Xiamen to reduce expensive port charges. Port performance cost could also be reduced by improving port facilities. This is what China has been doing in the past 20 years and what Vietnam is doing now. Port efficiency and competitiveness will result in less labour cost to reduce port charges as well. The charges could be reduced based on the benchmark of other ports. Additionally, government intervention is important to stipulate the guide price, standardize the market order, and prevent vicious competition in logistics cost between ports. For instance, China's ports have standard port charges (known as THC), which are set by the Ministry of Communication for all Chinese ports. Port charges are also visible to the public via websites and at the port service building (Section 5.6).

Promote intermodal links for both of the Humber and Xiamen ports

As Hayuth (1987) noted, intermodalism offers a choice of routes, ports of call and modes of transport by an intermodal operator, freight forwarders or large shippers. Port users cannot efficiently move cargo without adequate inter-modal links, which would result in congestion, risks and higher cost (Tongzon 2009).

There are no intermodal links to the Humber ports. Intermodalism may be promoted as it can enable modern ports to compete for far-reaching cargoes with far-distant counterparts in terms of hub, transhipment and transport network of sea-road, sea-river or sea-rail, or mixed with sea, river, road and rail at any intersection (Section 2.4.5). The Humber needs to improve its landside links as they are found to be poor (Section 5.4). On the Northern Bank, the road should be improved on A63 Castle Street and Hedon Road. The rail network needs building to link Hull port, not only for coal, but also for other cargoes and containers. On the Southern Bank, the A160 and A180 should be improved to increase the capability of transport from Grimsby and Immingham to other destinations. The rail facilities should also be improved linking Immingham, which takes 25% of the whole country's rail freight.

It is necessary to enlarge Xiamen's hinterlands by intermodal links. Although investment is not a problem, the scheme of the logistics hub needs thoughtful planning with regard to access to the busy ports.

This research has found that neither the Humber nor Xiamen has real intermodal transportation (Section 5.4) to improve transport efficiency. The port managers should promote an efficient intermodal system with active participation of shippers, carriers and 3PLs. The transport infrastructure, port technical infrastructure and information system should gradually become an integrated logistics service system to promote intermodalism and develop port performance, as Islam et al. (2005) noted that consignors and consignees should all have access to door-to-door services.

Build logistics distribution centres in the Humber

Setting up distribution centres at ports instead of inland is one approach in port-centric logistics, which is more efficient as international freights or domestic sea transport freight would come through ports first (Falkner 2006). For instance, ASDA Wal-Mart opened a 350,000 sq ft import centre at Teesport in 2006 and has saved more than two million road miles by adopting the port-centric concept. Tesco opened its 1.2 million square foot import centre at Teesport in August 2009, creating 800 jobs. These are examples of the location selection for supermarket distribution centres. The Humber needs to attract distributors/retailers by employing the concept of port-centric logistics, for creating employment and bringing local economy improvement.

Improve other factors for the Humber

Apart from the above aspects, it can be seen that the Humber needs to improve other factors. Firstly, the Humber has potential hinterlands cargo resources to support port development. As addressed in interview analysis in Chapter 5, about 60% of the cargos handled through the UK southern ports are actually from and to the Northern region. To relieve the pressure of congestion in the southern ports such as Felixstowe and Southampton, the Humber ports can take over a great volume of cargoes that are closer to the Humber to increase port performance by throughput. Secondly, as analysed from interview and questionnaire data and discussed earlier, the Humber shipping services and feeder services need improving. Thirdly, the port image needs enhancing, as port reputation is a component of port competitiveness (Brooks 1985).

Strengthen Xiamen's landside links and other infrastructures

Xiamen's logistics demand is hindered by the poor infrastructure (interview analysis Section 5.4 and questionnaire analysis 6.5.2). There is a need to lay a solid foundation of infrastructure for the development of port performance, including integration of port resources, information system and transport infrastructure. Xiamen does not lack berths or other facilities. On the contrary, the ports are actually underutilised due to the lack of cargo resources (Section 5.7). This supports Wu and Huang (2008) who proposed developing port-adjacent industries, integrating social and harbour logistics resources, and investing on ICT system and transport infrastructure. Xiamen is the second most overinvested port in China. This finding is not consistent with literature asserting that Xiamen should invest heavily in port infrastructure (Wu et al. 2008). This finding will benefit practitioners to integrate its port facilities to reduce port cost.

Increase logistics demand

Both Xiamen's local economy and hinterland economy are weak, according to interview analysis, and there is poor corresponding physical infrastructure, as explained earlier. This research finding shows that the hinterland should be enlarged by promoting intermodalism, dry ports and improving transport infrastructure to link hinterlands.

The concept of a "dry port" might enlarge the hinterlands. The infrastructure investment could be pushed to Jiangxi, Hunan and Fujian Province, where the "dry port" would be a very effective way to get more cargo sources (Harding and Juhel 1997) and in line with China's plan of overall economic development with the rise of development in central and western China.

Ports need to cooperate with shippers to control and secure the cargos from hinterlands. Cooperation with shippers would expand the distribution system and make good use of hinterland logistics parks, so that logistics demand can be increased.

Improve the customs services

Song and Yeo (2004) identify that service level plays the fourth most important role in port competitiveness. Xiamen is very poor in customs services (Section 5.8), which needs to be improved for better international trade and port performance. The government can promote paperless customs clearance and make Xiamen a fully functional e-port. The efficiency of customs clearance requires significant and urgent improvement by means of the extension of service hours, simplifying the documentation, and simplifying the inspection process so that shippers can save time in customs declaration and clearance (Arvis et al. 2010).

Enhance Xiamen shipping services

Compared with other ports, Xiamen has a performance gap in shipping services (section 6.5.2). In order to attract more cargoes, the port needs to attract more shipping lines to come with better shipping frequency and more destinations. It needs to cooperate with shipping lines to control the seaside hinterlands by means of renting the terminals to shipping lines or building special docks in cooperation with shipping lines. Xiamen could also expand the feeder transportation from Fuzhou, Shantou, Wenzhou to broaden the hinterlands of supply channels. For feeder services, domestic container transport has the advantage of saving time (5-7days less than by truck), cost (100 RMB/t), less damage and loss (www.cosco.com).

Make use of the location advantage of Xiamen to Taiwan

As Xiamen has a unique location advantage in relation to Taiwan, it should play a strategic role in developing a cooperative relationship with Taiwan. Such cooperation would include partnership with Taiwan and making Taiwan part of its hinterlands. From a logistics and economic point of view, firstly, Xiamen should try to attract cargoes along the coastal line and the Yangtze River, tranship cargoes to Taiwan via Xiamen, and distribute the cargo from Taiwan to other ports in mainland China through the above routes. Secondly, Xiamen should establish a distribution centre for cargoes from/to Taiwan; and open up liner ships as shuttle services between Xiamen and Taiwan. The sea-rail intermodal business that has obvious advantages of both convenience and economy could be explored and expanded. The cargoes from China central and western provinces could go to Taiwan by a rail-sea intermodal system, and vice versa. Thus, it is necessary to have a proprietary distribution centre for Taiwan.

Promote Xiamen regional transhipment hub

With the decline of Taiwan’s economy, the position of Kaohsiung is declining. Meanwhile mainland China’s economy has been growing, which offers a good opportunity for Xiamen to overtake Kaohsiung to become a regional transhipment hub. Xiamen should be positioned as a regional port, subject to strategic analysis of the coastal ports along China’s south-eastern coast. In this region, due to its location between YRD and PRD, the hinterlands are squeezed by the two deltas, which has resulted in weak logistics demand. Hence, it is not feasible to build an international transhipment port. This was also validated by the interview analysis (Section 5.2). However, it would be appropriate to build it up as a regional transhipment port, which is a very competitive business. Transhipment could be cheaper than direct call services if the transhipment port was carefully chosen (Lirn 2002).

The reasons for Xiamen to become a regional transhipment port are: 1.Comparing other ports nearby, Fuzhou is the most competitive port, but Xiamen has better facilities than Fuzhou. 2. Xiamen has more experience in port operations and services. 3. Xiamen has a better location in relation to Taiwan than Fuzhou. 4. Xiamen can promote a strategy of port alliance to achieve a win-win situation. It could include Zhangzhou and Quanzhou as its feeder ports, develop good co-operation with them, avoid fierce competition, duplicate port construction, and form an integrated force to improve competitiveness.

Seek constant government support

As the Chinese institutional system is still in the process of transformation from a planning economy to a market economy, the government still plays a very important role in resource allocation. In China, government intervention in port performance is popularly considered a good thing. In Xiamen, government has encouraged the integration of port resources, port restructure and co-operation between port enterprises. However, Xiamen has not developed so fast as other cities in the economic zone, and needs to seek constant government support for port development. Practically, the Xiamen government should learn from the Singapore government on tax incentives; facilitating international trade through an efficient customs administration, security, good sanitation and business environment; and providing foreign logistics companies with easy access to funds (Tongzon 2007).

In response to the financial crisis, China has launched the "Top Ten Industry Promotion Plan". The logistics and information sector is ranked among the targets for promotion. From the perspective of national strategy to develop logistics and information industry, the State highlights the establishment of a modern logistics system, reduced costs, and improved efficiency, which offers the logistics industry significant opportunities to achieve leapfrog development. The ten industries are concentrated in the manufacturing sector, which needs logistics support and has brought a great opportunity for ports to improve. Xiamen should take this opportunity to revitalize port performance and increase input of government policy support. Xiamen should make good use of the policy of Haixi Economic Zone to attract cargo from Taiwan, attract more companies to relocate here and attract more transhipment cargoes.

To these ends, Xiamen should set up logistics parks and bonded logistics parks, which are often closely related to Free Trade Zones (FTZs), areas where companies may ship products to postpone or reduce customs duties or taxes (Grant et al. 2006). Introducing FTZs for the international logistics industry is therefore an effective way to attract international business. This will add value to the import and export business and provide customers with the multi-functional services of inspection, customs clearance, cargo receiving, distribution and processing to create an open, interoperable-based logistics service platform. Four logistics parks and 13 logistics centres in Xiamen are either in use, under construction, or on the agenda. The programme is developing very fast in order for Xiamen to keep pace with other developed cities. Their practical use rather than mere conceptualisation requires attention.

Develop a strategic logistics scheme

Xiamen lacks a strategic logistics scheme. For example, the port areas are not separated from the residential areas, which causes congestion and risks (section 5.2); and the port facilities are overinvested and not integrated.

7.6 Difference between findings and the literature

Most of the findings enrich the literature with empirical evidence. However, some findings are not consistent with the literature and they add knowledge to the literature. 1. Song and Yeo (2004) find that traditional factors such as location and port facilities rather than service quality are important. However, this research finds that shipping services, shipping prices and cost are very important for port performance. This indicates that service quality-related factors rather than traditional factors are important. The inconsistency implies that as time goes on, service quality becomes increasingly more important than traditional factors. 2. Tongzon and Heng (2005) note that 0.67-1 privatization is very effective for port performance. Borger et al. (2008) find that private ports do not necessarily charge higher port prices but actually charge less than public ports. However, this research has found that 100% pure privatization with sole ownership is not conducive to effective port charges. As the Humber's port charges are high, and some customers would not choose the Humber ports. 3. Location has been recognised as very important for port performance by many researchers such as Lirn et al. (2003), de Langen (2004), Gordon et al. (2005). This research has found that location is comparatively unimportant for port performance improvement, as it is beyond a port's control. 4. Cargo volume is an important port competitive factor but Song and

Yeo (2004) consider it beyond a port's control. This research shows that cargo volume can be manipulated by means of improving the local and hinterland economy and expanding the hinterlands by improving quality of transport infrastructure, an intermodal or "dry port". Cargo volume can also be increased by promoting manufacturers to produce more types of products, increasing the production volume and improving feeder services, based on interview analysis. 5. Xiamen is the No. 2 overinvested port in China. This finding is not consistent with literature asserting that Xiamen should invest heavily in port infrastructure (Wu et al. 2008). Song and Yeo (2004) identify that China's port infrastructure is insufficient. This research has found that this is no longer true as port infrastructure has been improved greatly in recent years. This finding has updated the literature as China has been improving its infrastructure. It is important for port managers to avoid further overinvestment and result in high logistics cost. 6. The literature did not include such factors as location, politics, culture and history into empirical research, while this research collected empirical data to enrich the literature.

Chapter 7 has provided a discussion of the findings of this research and covered the main findings and research objectives. Chapter 8 contains conclusions and recommendations.

8. CONCLUSION AND RECOMMENDATIONS

This thesis has investigated the development of port performance and logistics in two European and Asian ports through mixed methods, and examined various factors determining port performance. This chapter concludes the research in four sections. The first section summarises key findings of this research. The second section restates the five research objectives and summarizes how they were met. The third section highlights the research contribution. The fourth section discusses the limitations of this research and provides recommendations for future research.

8.1 Key findings

Increasing international trade draws attention to the importance of port performance, and port efficiency is a relevant determinant of a country's competitiveness (Sanchez et al. 2003). As ports perform differently, identifying key factors influencing port performance is important to improve performance.

As reviewed in Chapters 2 and 3, few researchers have engaged a variety of key port stakeholders as interviewees and provide comprehensive views on port performance to avoid response bias. Some research has been conducted on business performance, port performance, criteria for port competition and choice, but only a few empirical comparative studies have been carried out on the key factors influencing port performance, and there is a lack of literature that includes both internal and external factors in a single study. They do not prioritise the different factors, either. Few empirical researchers have compared the factors influencing port performance in Asia and Europe, either. Moreover, IPA has not been applied to port research yet to improve port service quality. This research is a comparative study to identify the determinants of port performance and investigate the differences in importance and performance among the factors. It has also analysed how the factor importance and performance vary for different ports and analysed the role a port hinterland could play in port performance and choice. Finally, it has illustrated usefulness of key findings for port stakeholders.

Apart from some external factors gleaned from interviews, the investigated construct of questionnaire factors influencing port performance and choice consisted of 15 factors based on the literature, which were categorised into five aggregate factors: shipping services, cost, port services, logistics support and others. The reliability and validity of this construct was verified by the literature and Phase 1 interviews. The research strategy was implemented using mixed methods to collect both qualitative and quantitative data in two port regions (China and the UK) and in two phases. Phase 1 included semi-structured in-depth interviews. Phase 2 included questionnaire-based surveys which were distributed to port experts of 500 organisations with a response rate of 50.8%.

Interviews were conducted to obtain insightful understanding of various factors. Thematic analyses were employed for interview analysis. The process of data reduction, data display and conclusion drawn and verification was followed iteratively. Factor importance and performance of the focal ports and performance of other ports were measured by questionnaire respondents. A variety of techniques were employed for the data analysis by employing SPSS. Factor analysis was used to reduce the fifteen questionnaire factors to five aggregate factors. Their importance was distinguished by factor loadings. Means were used to assess the factor importance and performance in descending order. Gap analyses were used to identify the difference between customer satisfaction and expectation, and to identify the difference between performance of focal ports and that of other ports. Traditional IPAs were used to identify factors for urgent action by port managers; revised IPAs using explicit importance against performance difference derived salient factors; revised IPAs by explicit importance against implicit importance were used to identify basic factors that should be treated cautiously. A variety of statistical validation and significance tests were conducted to analyse the data. The different techniques generated different research findings from the combined sample and from the separate samples.

8.1.1 Key findings from the combined sample

This section presents key findings from the combined sample. Firstly, port services, cost, logistics support, shipping services and others were identified as aggregate factors by factor analysis. The first four factors explained a higher percentage of total variance. According to the means of the aggregate factors, shipping services, cost, port services and logistics support are important in descending order of importance.

Secondly, explicit means of factor importance show that shipping services, shipping prices, overall logistics cost, risks, logistics services, safety, feeder services, government support and port charges are important factors in descending order of importance. This finding implies that priority needs to be considered according to the importance ranking when other conditions are the same.

Thirdly, gap analyses reveal that big gaps between expectation and satisfaction exist in shipping services, shipping prices, overall logistics cost, government support, landside links, port charges; and big performance gaps exist between focal ports and other ports in landside links, shipping services, navigation, government support, feeder services and port technical infrastructure. The big gaps indicate that improvement needs to be made to narrow the gaps with other ports and to satisfy port customers.

Fourthly, traditional IPA results identify that shipping prices, port charges, feeder services, overall logistics cost and government support are factors with high importance and low performance. Immediate actions need taking on these factors. The revised IPA results employing gap analysis find that shipping services, feeder services and government support are salient factors compared with other ports. As these factors fall in the quadrant of urgent actions, immediate improvement needs making.

Fifthly, the revised IPA employing 3-factor theory identifies that port charges, risks and overall logistics cost are basic factors. They should be maintained at the basic level of performance, otherwise they become critical if their performance falls short and suddenly turn into determinant attributes. Skills, proximity, government support, navigation, and logistics services are excitement factors. They enhance satisfaction, so they should stand out. The remaining factors are performance factors. Their satisfaction increases linearly as their performance is improved.

Sixthly, from interview analyses, some external factors have been identified as important that influence port performance, such as economic, social, political, cultural and environmental factors. These external factors are usually qualitative factors and they influence internal factors and port performance as well, for example, government support would influence quality of infrastructure; economic wealth is closely related to logistics demand which directly influences shipping services.

Lastly, port performance is generally acceptable, as the factor mean scores are above 3 on a 5-point Likert scale. Specifically, ports perform well in descending order in the following factors: safety, logistics services, port technical infrastructure, speed of cargo handling, risks, proximity, shipping services and skills. Most of them are port services. The poor performance factors are government support, overall logistics cost, landside links, port charges, navigation, shipping prices and feeder services. This finding indicates that performances on port services are quite satisfying, while performances on cost and logistics support are not.

It should be acknowledged that different methods of data analysis resulted in identification of different factors influencing or determining port performance. However, the urgent factors, salient factors and basic factors are all reasonable and explainable, as they were investigated from different perspectives.

8.1.2 Key findings from the analysis of separate data of the Humber and Xiamen

This section presents key findings from separate samples. This research establishes that different ports have different factors influencing their port performance, and ports perform differently because of different external (institutional, social cultural, economic, legislative and environmental) environments and internal (natural conditions, management and services) factors.

Factor importance was investigated first. The results from factor analysis show that the Humber considers that aggregate factors of cost and port services are more important than logistics support while Xiamen considers that logistics support is the second most important factor, next to shipping services. The Humber consider the importance of shipping services, shipping prices, port charges, risks, speed of cargo handling and safety in descending order, while Xiamen consider the importance of shipping services, government support, shipping prices, feeder services, overall logistics cost, logistics services and landside links in descending order.

For factor importance comparison between the Humber and Xiamen, the t-test results show significant differences between nine out of the fifteen factors. Port charges, skills, government support, handling speed and shipping prices are the top five significantly different factors in descending order. The Humber analysis shows that all the identified factors are more important when compared to Xiamen except government support.

Regarding port performance, the Humber performances of speed of cargo handling, proximity, safety, logistics services and shipping services are in descending order, while Xiamen performances of safety, logistics services, port infrastructure, government support and feeder services are in descending order. There are significant differences between the two port regions in terms of government support, proximity, handling speed, safety and port infrastructure in descending order. The performance of Xiamen in government support, safety and port infrastructure is better than that of the Humber, while the performance of the Humber in proximity and handling speed is much better than that of Xiamen.

Figure 7.3e shows that there are significant differences between the Humber importance and performance in government support, shipping prices, port charges, shipping services, overall logistics cost, risks and landside links in descending order. Figure 7.3e also shows that there are significant differences between Xiamen importance and performance in shipping services, overall logistics cost, landside links, shipping prices, government support, feeder services and navigation & land in descending order.

The importance-performance gap analysis reveals considerable gaps between factor performance and expectation. The gaps indicate perceptual problems with the respondents' focal ports. Shipping services (both deep-sea and feeder services) and costs are factors with which both the Humber and Xiamen users are dissatisfied. The performance gap analysis shows that respondents are also dissatisfied with the performance of their focal ports compared with other ports in government support, landside links, feeders, navigation, port infrastructure and shipping services. Additionally, Xiamen has an extra gap: speed of cargo handling. The results show that neither of these sample ports seems to have achieved what the customers expect, and neither of them has better performance than other ports. This may indicate an even larger scale problem in both countries involved.

Comparing the performance gap differences, it is found that the gaps of Xiamen are much wider than the gaps of the Humber in proximity, speed of cargo handling, shipping services, skills, landside links and shipping prices, while the gap for the Humber is much wider than the gap for Xiamen in safety.

Port charges are the Humber's most urgent factor, while shipping services, shipping prices, overall logistics cost and landside links are Xiamen's most urgent factors, with high importance and low performance, which need immediate action for performance improvement. Shipping services, port charges and safety are the Humber's salient factors and shipping services, feeder services, landside links and government support are Xiamen's salient factors, compared with the performance of other ports. They need improvement as they have high importance but poorer performance than other ports.

According to the revised IPA results, the Humber's basic factors are identified as shipping prices, port charges, speed and risks, while Xiamen's basic factors are identified as overall logistics cost and landside links. These basic factors must meet the minimum requirements of customers; otherwise, they will cause customer dissatisfaction.

The descending order of the Humber's explicit importance is shipping services, shipping prices, port charges, risks and speed of cargo handling, while that of the Humber's implicit importance is skills, safety, logistics services, navigation, and proximity. The findings confirm the view of Matzler et al. (2003), who identify considerable differences between the results of explicit importance and implicit importance. The results from Xiamen lead to the same conclusion.

Besides the questionnaire factors, other factors causing differences in port performance are identified through the interviews, as explained in Section 8.1.1. The factor differences in such factors as political stability, logistics demand in local region and hinterlands, social culture, port ownership, environment concerns and history have given rise to performance differences. These factors were not included in the questionnaire to obtain quantified data, because of the subjective nature of the data.

Wu and Huang (2008) identified that factors influencing Xiamen port performances are local industrial development supporting total value of imports and exports, total investment in fixed assets supporting construction of berth and port transport channel and social consumption. They limited the factors to port facilities, transport infrastructure and local economy. The current research has confirmed their findings and enriched the literature with more comprehensive factors.

Government support is the biggest difference, as the two countries have different institutional systems. China is undergoing transition from planning economy to market economy and there is considerable government intervention in port development, while the UK is a pure market economy in which the government does not control or manage ports. The difference in government support (F14) results in a different quality of infrastructure including port facilities, information systems (F9) and transport infrastructure (F12) due to investment differences. The Chinese government is much more involved in port infrastructure investment and landside infrastructure investment. Investment diversification has enabled Xiamen to improve infrastructure more rapidly.

Political influence is very strong for Xiamen's port performance while it is not an issue for the Humber. The stability of the relationship between mainland China and Taiwan plays a significant role in Xiamen's port performance.

The reasons why the two regions perform so differently are because they vary in terms of the following factors: geographical location with different natural conditions such as navigation and hinterland areas, history and social culture embedded with the port development, political stability and port ownership, and institutional systems that provide different levels of support to port performance by the government (see interview analysis results in Chapter 5). In addition, the management level and logistics skills (F11) have influence on port internal operations efficiency (F6-F9).

The Humber has high port charges because of complete privatisation, which implies that port ownership influences port performance. Port privatisation does not necessarily lead to lower costs, and this research shows that complete privatisation in the Humber has resulted in higher port charges. This finding is not consistent with the claim of Tongzon and Heng (2005) who state that port privatisation is an effective way to enhance port performance. On the other hand, the case of Xiamen indicates that ownership diversification and partial privatisation at certain level may be more efficient for port charges.

Briefly, in terms of factors influencing port performance, both internal factors and external factors play an important role. The external factors may have impact on internal factors and influence port performance directly or indirectly, while internal factors directly influence or reflect port performance.

8.2 Achievement of five research objectives

This section summarizes the five research objectives and how they were met.

8.2.1 Key factors that drive port performance and choice

Factors driving port performance and choice were initially identified by the literature review, then confirmed by phase 1 semi-structured interviews, and finally validated by phase 2 questionnaire surveys. Data were collected from two port regions from five groups of key port stakeholders. Questionnaire respondents scored their local factor importance and performance and other ports' performance. Factor analysis, mean comparison, gap analysis, t-tests, IPAs were employed for combined data. The factors were categorized and prioritised by questionnaire analysis so that key factors were extracted.

Factors from interviews are more qualitative and external oriented, while factors derived from questionnaire surveys are more quantitative and internal oriented. The key external factors were identified as location, government support, logistics demand, political, social, cultural, historical and environmental factors. The key internal factors were identified as shipping services, cost, infrastructure (both transport infrastructure and port technical infrastructure), port services (speed, risks and safety). The external factors influence internal factors that influence port performance (Section 7.1).

8.2.2 Differences in importance and performance among the factors

Based on the literature, a questionnaire survey was designed. Respondents evaluated the factor importance and performance. Differences in importance and performance among the factors were measured, compared and prioritised based on mean, and results were presented in descending order. Then this objective was achieved by insightful discussion, supported by the research findings and the literature (Section 7.2).

8.2.3 How the factor importance and performance vary for different ports

The same questionnaire was employed but separate data from the Humber and Xiamen were used. Data were analysed by t-tests, gap analysis, IPAs, Kruskal-Wallis H tests, plus descriptive analysis such as mean comparison, standard deviation, skewness and kurtosis. This was to achieve the objective of identifying how the factor importance and performance vary for different ports (Section 7.3).

8.2.4 The role of a port hinterland in port performance and choice

Interview questions on the role of port hinterland in port performance and choice were developed from the literature review, then the questions were raised to the interviewees. Rich data from the interviewees were gained. The data were analysed by a process of data reduction, data displays, conclusion drawing and verification. This was followed by discussions of findings with the support of the literature. This research found that a port hinterland plays an important role in port performance in terms of cargo volume. The finding was validated by responses to questionnaire open questions.

8.2.5 Usefulness of the key findings for port stakeholders

Based on the findings from in-depth semi-structured interviews and structured questionnaire survey results, following the discussions over the above four research objectives, usefulness of the key findings were derived for the Humber and Xiamen port stakeholders.

It has been suggested that the Humber port managers should diversify port ownership to reduce cost, encourage diversified investment for infrastructure improvement; obtain financial assistance from government and private business to improve the infrastructures (port physical infrastructure, information system and landside infrastructure inclusive); improve government support to reduce port charges; get more seaside links to increase the shipping frequency and destinations, promote intermodal links, build logistics distribution centres, attract more cargoes from the enlarging hinterland; and enhance the Humber image. The Humber local authorities could proactively lobby the Highway Agencies and central government for infrastructure improvement.

Xiamen port managers need to improve custom services, seek continuous government support, improve the hinterland's connected infrastructure, increase logistics demand, improve the relationship with Taiwan, enhance the seaside links, reduce cost by intermodalism and setting up "dry ports" in inland China, build logistics parks and make use of the bonded logistics park. Compared with the Humber, Xiamen can learn from the Humber's efficient customs service, improve logistics demand and speed-up cargo handling.

8.3 Research contribution

The findings allow practitioners, consultants and policymakers to examine the determinants of port performance in different port regions and improve port performance accordingly.

8.3.1 Contributions to academic knowledge

Maritime transport is one of the world's most important international industries (Mangan et al. 2008), but the research on cross-culture logistics has lagged behind considerably (Luo et al. 2001). This might be due to the difficulty of language barriers and access difficulties of conducting cross-cultural logistics research. This research has attempted to fill this gap and contributed to the literature as follows:

Firstly, this research has filled the gap of cross-culture comparison of port performance and influencing factors by empirical research between two ports in Europe and Asia. This unique research allows ports in different regions to learn from each other. Moreover, it contributes to the literature and allows academics and practitioners to see cross-cultural difference in terms of how ports perform differently and how people choose ports in the very different contexts. The factors influencing port performance and choice were insightfully investigated, identified, analysed and compared through rich combined data and separate data. As studying one port region limits the research scope, and it is also very restrictive, this research has included more than one port region for comparison and analysis for generic applicability in the methodology and findings.

Secondly, this research has contributed to the literature with a comprehensive review of up to date port performance indicators and factors that influence port performance. This contribution was firstly reflected in Chapter 3, and then the literature was enhanced with valid findings from the empirical research. Various studies have addressed the factors that influence business performance, but there is scant empirical research on the subject of which key factors determine port performance. This research has empirically identified the aggregate factors that drive port performance: port services, cost, shipping services and logistics support. It has also contributed to knowledge that logistics demand, location and port ownership are important for port development with empirical evidence, as these variables have often been discussed theoretically but not empirically.

Thirdly, the results that the Humber and Xiamen have different important factors influencing port performance confirm the claim of Ford et al. (1999) that trying to develop a single model of important factors to apply in a cross-cultural context might be a mistake. It has enriched the literature. This finding implies that the strategy should change accordingly when the environment changes.

Fourthly, this is an empirical research to apply stakeholder theory to the port sector by involving all key port stakeholders as interviewees in the target sampling frame in a single study, to limit interviewee bias. There was scant literature on factors influencing port performance from the perspectives of various port stakeholders, although port managers have always had an interest in factors that drive port performance. Specifically, this research collected data from carriers, PSPs, cargo interests, port managers and other port stakeholders, who form the port participants and customers (Murphy and Daley 1994; Bichou and Gray 2004). This has filled a research gap by including all key port stakeholders as interviewees in a single research.

The findings from respondent group analysis show that differences exist in importance of shipping prices and port infrastructure, and in performance of speed of cargo handling and port infrastructure. The analysis results reveal no significant differences between the different groups among the remaining 26 out of 30 factors of importance and performance. This finding is debatable against the claim of Murphy et al. (1992) that different groups of stakeholders would have different views on port performance. The researcher would argue that different stakeholders evaluate some factors differently but they score many factors with no significant difference. The finding implies that further investigations are needed to test group differences.

Fifthly, IPA has been widely applied for prioritising service improvements in different research areas, such as manufacturing, operations and engineering services, freight/highway transportation, financial services, education and hospitals. This research has extended the body of knowledge by showing that IPA can be applied to port sector for port performance research. A comprehensive process to identify key factors influencing port performance was presented in Figure 7.2 by IPA, which means that traditional IPA (explicit importance against explicit importance) is employed to identify factors for urgent actions; revised IPA by employing gap analysis (explicit importance against explicit performance difference) is employed to identify salient factors and revised IPA by employing 3-factor theory (explicit importance against implicit importance) is used to identify basic factors.

Basic factors, performance factors and excitement factors were identified from both combined sample and separate samples employing IPA. This is an application and testing of 3-factor theory in the port sector. This research has filled the gap by applying IPA as an effective tool for strategic decision making in port management to identify the key factors influencing port performance. The empirical research provides evidence that IPA is an extremely valuable tool to help in setting priorities for service improvement, in a highly competitive service market of ports. Knowledge is improved by applying 3-factor theory to the port sector and the 15 selected factors are categorised into three groups.

The resulting models and importance-performance grids can be strategically relevant for any port competitor. This is a promising tool for port managers, since it can examine past, current, and potential customers' perceptions and it allows for possible corrective actions to improve perceptual problems. This could help a port's service providers to improve its image. IPA also allows the ports to identify potential problems through a periodic use of this methodology before they actually become critical.

Revised IPA was effectively employed in the port sector. It is not only a contribution to knowledge, but also a contribution to methods of data analysis.

Sixthly, port ownership was identified as an important factor influencing port performance. This finding is a theory test of structure-conduct-performance (SCP), that is, port structure influences port performance. It also confirms the claim of Wiegmans et al. (2008) that portfolio influences port choice.

Seventhly, little research has been conducted on factors influencing Xiamen port performance except Wu and Huang (2008) and few previous studies were found on factors influencing the Humber port performance. This research has identified a much wider range of influencing factors other than infrastructure and local economy improvement for Xiamen, and it has identified influencing factors for the Humber, which has implications for port managers of both ports, who need to take those factors seriously, develop corresponding strategies and take relevant actions to improve port performance.

Eighthly, actions of competitors are acknowledged as an important factor for strategy design in management science. However, little empirical research has been undertaken to measure this factor in port selection (Guy and Urli 2006). This research has conducted empirical work to measure the factor performance of any other port the respondent is familiar with, which is assumed to reflect the competitors' performance. It means that this research has filled a gap in the literature within this context.

Ninthly, this research has not only identified factors influencing port performance, but also classified, measured, prioritised and compared the factors. Factor prioritisation and comparison allow port stakeholders to take different strategies to cope with factors with different importance and factors with different performance.

Tenthly, the findings from this research could possibly be generalized and made applicable to other ports, eventually for identifying port development policies and strategies, as the Humber ports are representative of private ports, feeder ports and developed western ports, while Xiamen represents regional ports with diversified ownerships in an eastern developing country.

Lastly, this research has enhanced the literature by empirical evidence that such qualitative factors as political, government support, culture and history are important factors influencing port performance.

The findings that are consistent with the literature have provided support for the literature. Those findings that are not consistent with the literature (such as whether location is important for port performance improvement, whether pure privatization is conducive to port charges, whether infrastructure can be controlled or not and whether cargo volume can be increased, see Section 7.6) enrich the literature by looking at these factors from different perspectives.

8.3.2 Contributions to port management

One purpose of this research was to aid port managers in the practical task of formulating their operations strategy for port performance and development. This research yields practical insights for managers to improve port performance. This practical relevance is valuable because of port regionalization, as a consequence of increasing competition between port regions. This research contributes to port managers' understanding of how to improve port performance with specific recommendations for each port region (Section 7.6).

Although government authorities cannot do much about history and social culture, they can influence and lobby the government for supporting port performance. Government can even influence the institutional system to a certain degree. The most influential actions for them to take are planning and helping to carry out regional port development schemes, providing financial support for infrastructure improvement and coordinating with the various port stakeholders to improve port performance.

The port authorities can provide logistics support on landside links, feeder services and land support. They can improve the management level to help with port performance in terms of reducing port charges, improving port service quality on cargo handling, warehousing and freight forwarding, risk, safety and skills. They can do more for port facilities improvement, ICT system employment and lobbying for connections with the port landside hinterlands. The practitioners can increase cargo volume by improving landside infrastructure to connect hinterland, by promoting dry port and by enhancing local manufacturing.

Identifying and quantifying factors influencing port performance allow port managers to prioritise and compare the importance of various factors, so that they can treat the factors differently based on the different importance level. The more important factors can be taken more seriously than less important factors to avoid waste of resources.

PSPs can improve port performance in terms of speed of cargo handling, risks, safety, port technical infrastructures and logistics services.

8.3.3 Contributions to research methodology

Previous studies ended up providing vague understanding of port performance and its determinants as they employed a single dominant method. This research aimed to offer honest and realistic insights into the process of research. Specifically, it added a research based on mixed methods. Qualitative (inductive) interviews and quantitative (deductive) questionnaires were employed in this research to collect the primary data, enhancing the research validity. In the empirical research, data were collected through a comprehensive and large-scale questionnaire survey and extensive interviews with broad port stakeholders in two different port regions of Asia and Europe.

The mixed methods (interviews first, followed by questionnaires) were employed to examine the factors that influence port performance and to explore the similarities and differences of port performance in the developed and developing countries. The use of mixed methods in data collection contributes to enriching the research methods in logistics and supply chain management, an area where positivism dominates. It exemplified that methodological pluralism is possible and practical, and the interpretative approach can offer rich insight into complex problems.

This research has contributed insights into how to obtain a higher response rate by e-mails and communications. The respondents should first be experts who have knowledge of the questions the researcher is interested in. Then, communication skills are important to convince the potential respondents to accept interviews and complete the questionnaire. Thirdly, e-mail was found to be an effective and efficient technique to obtain a quicker and more efficient response than by traditional post. This research was conducted internationally to obtain invaluable data solely by the researcher herself, which reduced bias and enhanced the data validity.

8.4 Limitations of this research and recommendations for future research

This research has produced a number of relevant and interesting insights into the factors that determine port performance in two ports of Asia and Europe through a rigorous research process as described in Chapter 4. However, some limitations exist in this research, and it is important to recognise these limitations in relation to data as well as to the methodology used. In response to the limitations, recommendations for future research will be made. The limitations and recommendations are listed as follows:

It should be noted first of all that due to time, finance and access constraints, the population for this research was limited only to the Humber estuary in UK ports and Xiamen Chinese ports.

To generalise findings, future studies may extend the research areas to broader and more randomised samples of more ports, covering more ports worldwide, as the strength of theory can be improved by utilising multiple examples (Yin 2009).

The response rate was different for different regions and different groups of companies. It is therefore difficult to derive any significant conclusions about the non-response bias in terms of response rate by company category.

As this research adopted a cross-sectional design and cross-sectional data, the findings only provide an analysis of a current situation, as opposed to a longitudinal approach to explore if there are any causal relationships between factor importance and port performance and if the relationships change over time.

The data used in this research were created from a survey and based on the perceptions of respondents, as opposed to absolute measures. Future studies could be designed to develop constructs that are based on absolute values and thus avoid subjectiveness in response. However, developing the constructs would be complicated, and respondents may not know the answers to the questions, or may not be willing to disclose the information requested.

Difficulty was faced in obtaining financial data. In Xiamen, due to cultural influences, some interviewees did not feel free to talk during the interviews, as the Chinese have a culture of not speaking out if they are not sure whether they should do so. Future research should carefully consider cultural and linguistic differences, particularly when the research areas are in both developed and developing countries, although in this study the research process was carefully managed by back translation by professionals and bi-linguists to avoid potential ambiguity.

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APPENDIX: QUESTIONNAIRE

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THE UNIVERSITY OF HULL
Logistics Institute

Developing Logistics Excellence in the Humber's Hinterland

This survey is being undertaken to build knowledge and gain insights into the logistics capabilities of the Humber's ports and its hinterland. The research is directed by Professor Chandra Lalwani, Academic Director, and Professor John Mangan, Visiting Professor, and conducted by Ms Mengying Feng, PhD Scholar. The confidentiality of individual contributions is assured. The questionnaire is for academic research purposes only. **Please be assured you will not receive any targeted mailings arising from your completion of this questionnaire.** A summary of our analysis, which we hope to have completed by September 2009, will be sent to all respondents (you can fill in your contact details in Section D below).

Completion of this questionnaire should take just **five minutes** of your time – we would value your input very much.

Section A – Identifying factors of importance

How important do you regard the following factors which concern the performance of the Humber's ports and the logistics infrastructure in the hinterland – please just **tick** √ one score for each factor (1 = not at all important to 5 = very important).

		1	2	3	4	5
1	Availability of shipping services (destinations, frequencies, etc)					
2	Price of shipping services					
3	Port/ terminal handling, warehousing and other charges					
4	Feeder connections to the deepsea ports and the major shipping lines					
5	Port / shipping service is on the cheapest overall route to the destination					
6	Speed of port cargo handling					
7	Congestion, delays and other risks					
8	Port/ terminal security and safety					
9	Technical infrastructure of the port (handling equipment, ICT, etc)					
10	Proximity of the port to your customers and / or sources of supply					
11	Availability of skilled employees in the region					
12	Quality of landside transport links (inter-modal links)					
13	Availability and quality of logistics services (warehousing, freight forwarding, cargo handling, etc)					
14	Government supports for logistics activities and new developments in the region					
15	Depth of navigation channel					

Are there other factors which you believe are important in terms of the performance of the Humber's ports and the logistics infrastructure in the hinterland?

Section B – Scoring the performance of the Humber's ports and the logistics infrastructure in the hinterland

Taking the same list of factors from Section A, now please score the performance of each of these factors in the case of the Humber and its hinterland (1 = the Humber performs *really badly* with regard to this factor, to 5 = the Humber performs *really well* with regard to this factor).

		1	2	3	4	5
1	Availability of shipping services (destinations, frequencies, etc)					
2	Price of shipping services					
3	Port/ terminal handling, warehousing and other charges					
4	Feeder connections to the deepsea ports and the major shipping lines					
5	Port / shipping service is on the cheapest overall route to the destination					
6	Speed of port cargo handling					
7	Congestion, delays and other risks					
8	Port/ terminal security and safety					
9	Technical infrastructure of the port (handling equipment, ICT, etc)					
10	Proximity of the port to your customers and / or sources of supply					
11	Availability of skilled employees in the region					
12	Quality of landside transport links (inter-modal links)					
13	Availability and quality of logistics services (warehousing, freight forwarding, cargo handling, etc)					
14	Government supports for logistics activities and new developments in the region					
15	Depth of navigation channel					

If you have identified any other factors please again identify these and score them:

Section C – Scoring the performance of any other port and its hinterland logistics infrastructure

Now please identify one other port area (other than the Humber) which you are most familiar with. Again taking the same list of factors now please score the performance of each of these factors in the case of that port and its hinterland (1 = the port performs *really badly* with regard to this factor, to 5 = the port performs *really well* with regard to this factor).

Please identify the port:

		1	2	3	4	5
1	Availability of shipping services (destinations, frequencies, etc)					
2	Price of shipping services					
3	Port/ terminal handling, warehousing and other charges					
4	Feeder connections to the deepsea ports and the major shipping lines					
5	Port / shipping service is on the cheapest overall route to the destination					
6	Speed of port cargo handling					
7	Congestion, delays and other risks					
8	Port/ terminal security and safety					
9	Technical infrastructure of the port (handling equipment, ICT, etc)					
10	Proximity of the port to your customers and / or sources of supply					
11	Availability of skilled employees in the region					
12	Quality of landside transport links (inter-modal links)					
13	Availability and quality of logistics services (warehousing, freight forwarding, cargo handling, etc)					
14	Government supports for logistics activities and new developments in the region					
15	Depth of navigation channel					

If you have identified any other factors please again identify them and score them with regard to this other port:

Please add any comments you wish to make concerning any of the issues considered in this questionnaire:

Section D - Respondent Profile (or append a business card)

Respondent Name: __________

Job Title: Manager __________

Company Name: __________

Telephone: __________

Email: __________

If you have any queries about this survey please contact:

Mengying Feng
elinorfmy116@hotmail.com
☎ *0782 8517 613* **Thank you for your assistance.**