Establishing a generic systems model of port clusters and their associated port logistics process

A Thesis Submitted in Accordance with the Conditions
Governing Candidates for the Degree of

Doctor of Philosophy

In the University of Wales, Cardiff

by

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Ph.D. 2006

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DECLATION AND STATEMENT

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This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any other degree.

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This thesis is the result of my own investigation, except where otherwise stated.
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ABSTRACT

Ports are playing an ever pivotal role in the development and operation of industrial supply chains. Port management has historically been reactive to legislative and customer pressures. Such a reactive approach has resulted in ad hoc infrastructure development including physical facilities and information technology. Ports may thus be viewed as large scale complex systems where there is a need to define a more holistic perspective of their design and operations.

Recent developments in the construct of port clusters and maritime clusters have led to increased complexity. The advantage in these developments is that greater integration between the port and associated services and users in the supply chain in port should be realised. However, there is a need to apply appropriate industrial engineering tools and techniques in order to visualise such clusters as whole systems without the need for excessively complex models. Such visualisations will help in developing our understanding of the interrelationships between the various parts and aid in the development of structured design methods.

The thesis presents a structured analysis and design technique (SADT) in order to visualise a port cluster as a system of systems wherein hierarchy lies. This research identifies a port cluster and within that a port logistics process. SADT has been chosen as there are readily available software tools to aid in the visualisation and it provides a robust structured method by which to model hierarchical systems. This study applies SADT to the port cluster system that has distributed around the Port of Busan in Korea but has not been organised systematically.

This dissertation shows that SADT does provide an opportunity to define and analyse the cluster in terms of the port logistics process, port activities and actors. In conjunction with the calculation of the industrial productivity of the cluster, it will be able to distinguish who could be the leading industry or leading company in the cluster. Finally, the results of the industrial productivity analysis also will be express using SADT diagram, so that it could provide the clear picture which industry/business should be the leader in each port logistics process.

Acknowledgement

I owe to many people and institutions for their support and assistance to the completion of this dissertation. I cannot thank all of them individually, but I do want to thank them collectively for their invaluable support. There are a few people to whom I must express my gratitude for their crucial roles. First of all, I would like to express my deep gratitude and sincere appreciation to my excellent supervisors, Prof. Naim M. M., Dr. Lalwany, C. S., and Dr. Marlow P. B, for their incessant encouragement, helpful criticism, valuable suggestions, and patient guidance of this thesis. Without all of their help this research would not have been possible.

I also would like to thank all the family in the Logistics Systems Dynamics Group including Prof. D. R. Towill, Dr. S. M. Disney, A. T. Potter, Ms. D. Scott; and Department of Maritime Studies and International Transport, Cardiff University for their help and assistance. My thanks also go to all kind librarians and administrators.

My deep appreciation goes to Prof. J. I. Lee, Dr. T. K. Jeong, Prof. G, G, Jin, Dr. Y. S. Ha, Prof. S. H Lee, Dr. J. S. Oh of Korea Maritime University (KMU); Prof. Y. S. Kwon, Dr. G. C. Lee, Dr. K. S. Lee, and Dr. J. J. Kim, Dr. H. R. Choi, and Dr. N. K. Park of Center for Intelligent & Integrated Port Management Systems (CIIPMS), for their continuous encouragement and support. Especially I would like to thank Professor Prof. C. Y. Lee, Dr. S. H. Moon, and Dr. D. K. Ryoo of the Korea Maritime University and Dr. C. H. Park of Incheon Metropolitan City Government for their encouragement to start my second Ph.D in abroad.

I also wish to thank Mr. Andrew Jeong, Mr. Abraham Lee (K.O.Tech) for their support during my stay in Cardiff, and all port related companies who participated in the interview survey and field survey in Port of Busan, especially for Mr. K. I. Jeong (Bawill Hyeopwoon Shipping Agency). Without their co-operation, this dissertation would not have been possible. In particular, I would like to acknowledge the generous support and time given by many senior executives and managers who participated in personal interviews in the midnight for this study.

I will not forget the helps from Mr. Y. J. Woo, Mr. M. D. Song of the Ministry of Maritime Affairs & Fisheries (MOMAF) to settle down my family in strange Cardiff at the beginning; and kind English teaching and supports by Mr. Steve Owens, Hyunju, and Yeongju, too.

My heartfelt gratitude goes to my parents, parents-in-law, sister Kyongwon, brother Hongkwan, and sisters-in-law who have been very patient and supportive, in particular, my parents who have supported and encouraged me to study second Ph.D. in abroad. Finally, with all my heart, I wish to express a special thanks to my beloved wife Hyunjung, my daughter Yukyoung and my son Younghoon for their spiritual help and sacrifice throughout this research. The completion of this dissertation and the doctoral programme was a truly a joint effort on both our parts. My wife's support, understanding, love and encouragement were invaluable to the completion of this dissertation.

CONTENTS

Chapter 3. PHILOSOPHICAL BACKGROUND AND METHODOLOGY

Chapter 4. CONCEPTUAL MODEL OF PORT CLUSTER SYSTEMS

Chapter 5. PORT OF BUSAN

Chapter 6. A SYSTEMETIC APPROACH TO THE PORT CLUSTER

List of Tables

List of Figures

List of SADT Diagrams

Glossary

AGS – Annual Gross Sales
C/C – container crane
CFS – Container Freight Service
CY – Container Yard
EVA - Economic Value Added
F/L – Fork Lift
IBTP – Incidental Business for Transport in Port
ISIC – International Standard Industrial Classification
KNSO – Korea National Statistics Office
KOLA- Korea Logistics Association
KSIC – the Korean Standard Industrial Classification
MOMAF – Ministry of Maritime Affairs & Fisheries in Korea
NASIC – North American Standard Industrial Classification
PLRC – Port Logistics Related Company
PLRCs – Port Logistics Related Companies
PSC – Port State Control
S/C – Straddle Carrier
SADT – Structured Analysis and Design Technique
SIC - Standard Industrial Classification
SSM – Soft Systems Methodology
STB – Shipping Transport Business
SWB – Storage and Warehousing Business
T/T – Transtainer
TBP – Transport Business in Port
VTS – Vessels Traffic Station
Y/T – Yard Tractor

CHAPTER 1

INTRODUCTION

1.1 Aim and Objectives

The ultimate aim of this study is to contribute to the theoretical and empirical knowledge not only of the port logistics relevant companies, but also of either the port authority or the port city government which needs to promote the port relevant industry strategically, and the main focus is on container ports, but reference to other port types is made where appropriate..

To achieve the above aim this study has five objectives which are as follows:

The first objective is to contribute to the theoretical knowledge on the close boundary of the port cluster system from the similar assemblages surrounding it. A small amount of research on the port clusters has been conducted recently, but it is still not clear what the actual port cluster system boundary is.

Some of the previous research relevant to port clusters is based on empirical research using an inductive approach. This method has the obvious and fundamental limitation to understanding the data on the actual condition of the relevant companies or the port cluster, because there are very few ports or port cities in the world that have exclusive statistics of activities in which port related companies are involved. Arising from this the second objective is to introduce a total survey conducted by the author, on port logistics relevant companies working in the Port of Busan; Korea (containing 1,699 companies and 36,894 employees)

The third objective is to apply the systems theory to the port logistics process and to suggest a new conceptual model of the port logistics system from the port logistics process perspective. This conceptual model is important for the visualisation of the relationship between the company and companies working in the port cluster. This conceptual model will be validated through fieldwork and a detailed case study.

The fourth objective is to apply appropriate industrial engineering tools and techniques in order to visualise the port clusters. Recent developments in the construction of port clusters have led to an increase in complexity. The advantage of these developments is that there is greater integration between the port and associated companies, but there is a need to apply appropriate industrial engineering tools and techniques in order to visualise such clusters as whole systems without the need for excessively complex models. Such visualisations will help in developing our understanding of the interrelationships between the various parts, and aid in the development of structured design methods.

The last objective of this study is to estimate how much Value Added was created within a port cluster and to create an order of the associated companies in the port cluster from the industrial productivity perspective. Even though some ports have their own statistics on their port industry from the various companies, employees and amount of sales, it is not easy to recognise how much Value Added is created within a port cluster. The amount of gross sales is not enough to compare the industrial production in its entirety. Moreover, without holding continuous discussions on industrial production, any decisions made could easily be rendered useless. The industrial productivity order could be used to evaluate which companies will be the leading companies in the port cluster.

All these efforts will support the making decision for industrial policy for either the municipal government or the port authority.

1.2 Background

Since the introduction of multimodal transport, port competition has become very complex in nature. It often seems that there is no longer a direct transactional relationship between a customer and a port, as port expenses are matters that are under the control of the ship owner.

Shippers are not interested in a specific port or their handling capability as the multimodal transporters relieve them of this concern by providing a door-to-door service. The port looks as though it is set to become just a transit point between the departure point and the destination. Although the total distribution cost affects ship owners' choice of ports, their decisions are based upon providing a door-to-door service rather than port-to-port. Since they are saving the costs of inland transportation by using containers, they seek economies of scale in these by concentrating the traffic to a limited number of ports (Ross, 1998) which have superior access to major inland transportation corridors. The conclusion is that containerisation, port concentration and intermodality have reached a high operational and technical stage and have brought a significant change in marketing structure and hinterland relations (Hayuth 1982).

In these circumstances, a port is no longer recognized as a simple place for cargo exchange but a functional element in dynamic logistics chains through which commodities, people, and information flow (Hayuth, 1993; Lee, 1998; Notteboom, 2000; Haezendonck, 2001; Van De Voorde et al, 2002).

Consequently these serial revolutions have changed port investors' minds about the ports as from public goods into private goods, and consequently most ports competitively have increased investment onto port infrastructure and facilities. During the last two decades the ownership of one of the most important trade entry points in many countries, the seaport, has changed from being solely in the hands of national or local governments into either wholly or partially private hands. It is this change, which is called privatisation, which has attracted much interest from both academics and those working within the industry (Valentine and Gray, 2002).

The high level of investment in ports within the same economic regions to develop a logistic hub-port has led to further competition. With the increase of inter-port competition, a port is needed not only to provide the value added from the port user's point of view but also to generate value added for the port service providers themselves to gain competitive advantages.

Ports are playing an ever pivotal role in the development and operation of industrial supply chains, but port management has historically been reactive to legislative and customer pressures. Such a reactive approach has resulted in ad hoc infrastructure developments including physical facilities and information technology.

Since the publication of the UNCTAD's report on the port performance indicators in 1976 (See **Table 1-1**), there has been much research on port productivity and efficiency. (See. Jansson and Shneerson, 1982; Prokopenko, 1987; Talley, 1988; Tongzon, 1995a, 1993, 2001; Roll and Hayuth, 1993; Chow *et al,* 1994; Heaver, 1995; Sachish, 1996; Coto *et al.*,2000; Murillo and Vega. 2000; Estache *et al*, 2002; Cullinane *et al*, 2002)

Table 1-1 Summary of port performance indicators suggested by UNCTAD

Financial Indicators	Tonnage worked Berth occupancy revenue per ton of cargo Cargo handling revenue per ton of cargo Labour expenditure Capital equipment expenditure per ton of cargo Contribution per ton of cargo Total contribution
Operational Indicators	Arrival late Waiting time Service time Turn-around time Tonnage per ship Fraction of time berthed ships worked Number of gangs employed per ship per shift Tons per ship-hour in port Tons per ship-hour at berth Tons per gangs hours Fraction of time gangs idle

Source: UNCTAD (1976) from Marlow and Paixão (2002)

However, it may be noticed that **Table 1-1** shows that most of the relevant research has discussed the productivity and effectiveness of the port itself from the port logistics perspective. It seems that their focal point is still not far from the perception which regards a port as 'a simple place for cargo exchange', since the performance indicators used are limited to ship side activities.

Table 1-2 summarise the typical research on port competitiveness undertaken since 1979.

Much of this research also discussed the competitiveness of ports from the shipping company perspective. It seems that their focal point still does extend to the land from the sea, and has never looked at the industry or companies working in the port.

Table 1-2 Summary of typical research on port competitiveness.

Researcher	Year	Respondent	Factors
French	1979	Shipping Companies	Facility, Tariff, Congestion, Service, Lankage, etc.
Allen	1982	Shipping Companies	Voyage Distance
Willingale	1982	Shipping Companies	Voyage Distance, Market Size, Tariff, Terminal Capacity, Port Ownership, etc.
Slack	1985	Shipping Companies and Freight Forwarder	Frequency of calling, Inland Trans Tariff, Port Congestions Port Capacity, etc.
Murphy	1987	Port Authority and US Shipping Company	Equipments, Frequency of Damage, Schedule Keeping, Shipping Information Providing, etc.
Peters	1990	Port Authority, Shipping Company	Service, Capacity and Condition of Facilities, Strategy, Human Resources, etc.
Murphy	1992	Port Authority, US Shipping Company and Freight Forwarder	Non-unit Cargo Handling Capacity, Frequency of Damage, Management of Port Facility, etc.
Lee	1992	Shipping Company	Container Cargo Volume, Shipping Power, Facilities, Infrastructure, Productivity, Price Competitiveness, Service Quality, etc.

Source: Author

Recently, there is a noticeable trend by ports to establish port clusters either via their port authorities or via municipal governments. Such a trend is aimed at increasing port competitiveness by enhancing relationships between the port and associated companies in the port area (Han, 2003 and De Langen, 2004).

Despite this trend, little research has actually been undertaken to analyse port clusters and their impact on ports' operational performance and that of the companies within the cluster. Some exceptions include the research on the application of cluster theory in the port industry (Haezendonck, 2001) and performance measurement of three existing port clusters (De Langen, 2004).

1.3 Research Questions

The previous five research objectives lead to the following five specific research questions and the direct goal of this study is to answer these five research questions:

RQ1. What are the defining boundaries of a port cluster system?

RQ2. What is the degree of assemblage to distinguish between a port cluster, a port, a maritime cluster and a port range?

RQ3. How do port users and port cluster companies engage in the port logistics process?

RQ4. Are systems methods and techniques, such as soft systems methodology and structural analysis & design technique appropriate for modelling the port logistics process and the port cluster system?

RQ5. To what extent do companies create industrial productivity from their work in the port cluster?

To answer those research questions properly, it might be useful to define the gap first between this study and the former researches.

Concerning to RQ1 "What are the defining boundaries of a port cluster system?" what is the gap between the existing researches (De Langen, 2004 and Haezendonck, 2001) and this research from the defining boundaries of a port cluster system point of view? De Langen (2004) mentions the port cluster system boundary that it should be geographically concentrated, but does not designate specifically. He also says the elements of port clusters are concentrated and mutually related business units, associations and public (-private) organizations centred on a distinctive economic specialization (p.10). On the other hand, Haezendonck (2001) uses a concrete expression of 'within the same port region' which is more specific rather than De Langen (2004). However, in terms of the elements, she presents a flexible boundary, such as 'interdependent firms engaged in port related activities.'

Therefore, in terms of the physical boundary this study accepts Haezendonck (2001)'s definition and in terms of range of the elements this study follows De Langen (2004)'s. On this procedure, this study has tried to clearly define the boundary of port clusters concept applying a 'special classification code for logistics industry in the Korean Standard Industrial Classification (National Standard)' to Busan Metropolitan City region. The specific boundary of the port clusters will be introduced in Chapter 6 and Chapter 7 together with total surveyed data.

Relevant to RQ2, what is the degree of assemblage to distinguish between a port cluster, a port, a maritime cluster and a port range? New assemblage concepts relevant to the port industry are frequently introduced in these days; such as a port cluster, a port, a maritime cluster and a port range. According to the research object, the port assemblage could be a subject of the competitions or a subject of port productivity study (Frankel, 1987; Goss, 1990a; Button, 1993a; Hayuth, 1993; Lee, 1998; Notteboom, 2000; Van De Voorde et al, 2002; Notteboom et al., 2001; Robinson, R., 2002; Haezendonck, 2001; De Langen, 2004).

However, there has been no research about the relationship among a port cluster, a port, a maritime cluster and a port range, since nobody compares all of these concepts at the same time.

This study compares examples of a port cluster located in Rotterdam (called Deltalinq), Port of Rotterdam, three maritime clusters activated in Europe region and Hamburg-Le Havre port range (HLH range). To define distinctly the relationships between the similar port relevant assemblages, the relationships between them will be expressed with a Venn diagram of Set theory and it also will be tested by 16 experts and scholars. These procedures will be presented in chapter 4 with the Venn diagrams considering the competitions between them.

Relevant to RQ3, how do port users and port cluster companies engage in the port logistics process? There were few researches on port users and port cluster companies since the studies on the port cluster were started recently. De Langen (2004) applied North American Industry Classification System (NAICS-2002) to array the firms of the clusters. Haezendonck (2001) classified the port sectors' activities into transhipment, warehousing, value added logistics, manufacturing, activities by shipping agents & forwarders etc., and distribution activities within cluster. However, those classifications were not conformed to the port logistics process nor were engaged in the port logistics process.

Concerning to RQ4, Are systems methods and techniques, such as soft systems methodology and structural analysis & design technique appropriate for modelling the port logistics process and the port cluster system? Usually, human behaviour is unpredictable, organisational and management problems are seldom clear to cut and to well-define. They are normally complex, with many indeterminable variables - 'soft' systems. The port logistics process and the port cluster system are not exceptions.

Therefore, systems approach method is influential and powerful. Especially Soft System Methodology (SSM) is introduced to formulate and to structure thinking about problems in complex port cluster. Its core is the construction of conceptual models (based on the understanding of human activity systems outlined above) and the comparison of those models with the real world. However until this time no research was found that has applied systems approach into port cluster.

This study also applies appropriate industrial engineering tools and techniques, called Structured Analysis Design Technique (SADT), in order to visualise port clusters as whole systems without the need for excessively complex models. Up to the present, it is very difficult to find a research carried out on visualisation of the relationships between port sectors within a port, much less within a port cluster.

To what extent do companies create industrial productivity from their work in the port cluster (RQ5)? From Prokopenko (1987) constitutes the most appropriate method to measure productivity as it involves two important variables, capital (including equipment) and labour; measurement of the port industry has been focused on productivity indicators even though Bowersox and Closs (1996) suggest that logistics performance can be made against other classes of performance measures, namely, cost, customer service, asset management and quality.

Sachish (1996) in a study carried out on productivity functions in Israeli ports identified five ways to calculate these optimum throughputs when a port is seen as a business unit, and from these he chose the 'engineering approach' to measure productivity measured in terms of twenty-foot equivalent units (TEUs) or volume of cargo in tons moved assuming that ports are throughput maximisers and where a port's performance level depends greatly on its efficiency in handling cargo.

Tongzon (1995), in a study carried out on container terminal performance, suggested that attention should be paid to this information when developing a port reform aimed at improving port performance as this provides a clear distinction between port efficiency and effectiveness. Consequently, port performance indicators have been classified into two broad categories, the financial and the operational ones.

On the other hand, Talley (1988), Sachish (1996), and Tongzon (1995a) suggested the necessity of developing and using a single performance indicator that reflects the key aspects of a port operation since it would constitute a comprehensive basis for port efficiency assessment. However, those studies on port productivities shown above are limited to calculate specific intra-port (terminal) productivity or to compare specific inter-port (terminal) productivity; e.g. productivity of terminal operation and those are different from calculation of total productivity of port relevant industry.

Consequently, we can not apply those research results to analyse the relationship between the port and the regional economy neither. A few economists have tried to analyse the relationship between industrial productivity of port industry and regional industry with Input-Output Analysis, however there were obvious limitation coming from sampling analysis.

This study solves these problems through a total survey on the port cluster established autogenously around Busan port. The tangible added value calculated from the total survey contributes to analyse not only the productivities comparison within a port, but also the relationship between the port cluster and the regional economy.

1.4 Thesis Layout

This thesis is composed of three parts as illustrated in **Figure 1-1**. The first part presents the theoretical framework of the study and encapsulates chapters one to three. The first chapter contains some introductory elements (Aim, Objectives, Background and Research Questions, Thesis Layout) as has already been outlined.

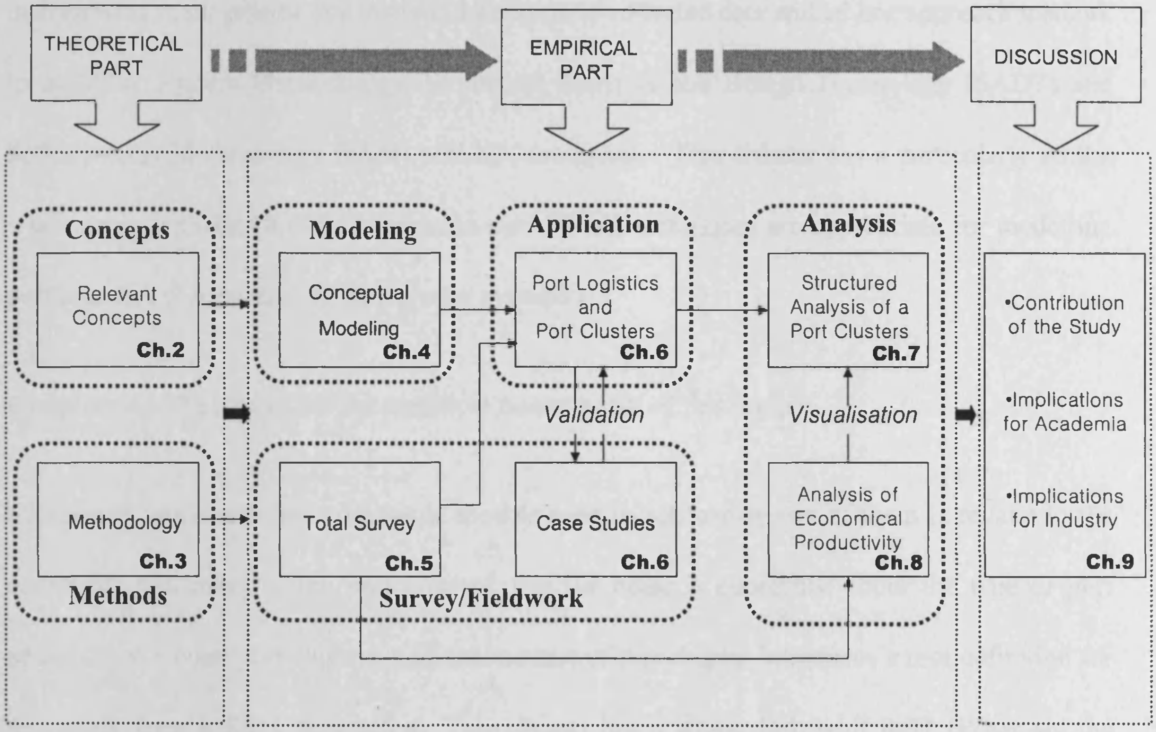


Figure 1-1 Layout of this thesis
Source: Author

Chapters 2 and **3** come under the theoretical research part of this thesis. **Chapter 2** presents the literature review on the concepts of port clusters and similar assemblages related to the port clusters such as Port, Port Ranges and Maritime Clusters, together with illustrated rich pictures to give a clear overview. Moreover, the literature review on other important concepts to understand this thesis will also be presented in this chapter, such as systems, port logistics, industrial productivity and value added.

Chapter 3 deals with the methodologies used in this thesis. Philosophical backgrounds such as positivism, naturalism, realism and epistemological statistics will be discussed in this chapter. The fieldwork methodologies will also be introduced in this chapter, such as survey, case study, interviewing management and statistical analysis of collected data and ad hoc approach method. In addition, System Methodology, Structured Analysis and Design Technology (SADT) and Soft Systems Methodology (SSM) will be introduced. This chapter has a particularly strong relationship with **RQ 4** (Which systems method and techniques are appropriate for modelling port logistics process and the port cluster system?).

Chapters 4 to **7** come under the empirical research part of this thesis.

Chapter 4 introduces two conceptual models used to set theory; one of them is related to the conceptual boundary of the port clusters, and the other is concerned about the type of port competition around port clusters. The second half of this chapter introduces a root definition for this study from a SSM perspective. This chapter has a strong link with **RQ1** (What are the defining boundaries of port cluster system?), **RQ2** (What is the degree of assemblage to distinguish between a port cluster, a port, a maritime cluster and a port range?) and **RQ 4** (Which systems method and techniques are appropriate for modelling port logistics process and the port cluster system?)

Chapter 5 develops two more conceptual models. The first is related to a port logistics system when considering the port logistics process. The other shows us that port logistics related companies are linked to the port logistics process. This chapter is associated with **RQ3** (How do port users and port cluster companies engage in the port logistics process?).

Chapter 6 shows the results of total survey for port logistics companies in Busan, Korea. The results will be displayed not only as statistical tables but also as geographical figures. In addition fieldwork (group interviews and case studies) will be conducted for the validation of the second conceptual model developed in **Chapter 5**. Industrial classification for the total survey and a more specific industrial classification used will also be discussed in this chapter as well. This chapter is also associated with **RQ3** (How do port users and port cluster companies engage in the port logistics process?) and is partly related to **RQ5** (To what extent do companies create industrial product from their working in the port cluster?).

Chapter 7 presents several SADT diagrams as an appropriate industrial engineering technique to visualise intra-port clusters. Such visualisations will help in developing our understanding of the interrelationships between associated companies in the port cluster. This chapter bears a relationship with **RQ3** (How do port users and port cluster companies engage in the port logistics process?), and **RQ4** (Which systems method and techniques are appropriate for modelling port logistics process and the port cluster system?)

Chapter 8 estimates how much Value Added was created within a port cluster by the associated companies. This is because the amount of gross sales obtained in **Chapter 6** is not enough to compare the industrial production fully. Consequently, the industrial productivity order made from the estimation process could be used for supporting the leading companies' election in the port cluster. This chapter is related to **RQ5** (To what extent do companies create industrial productivity from their working in the port cluster?).

Finally, **Chapter 9** summarises the contribution of this study and discusses the implications for academia and industry. Limitations and possible future research are also mentioned in this chapter.

The research questions are presented in **Table 1-3** with the respective chapters where they are concerned.

Table 1-3 Research Questions

Reference	Research Question	Chapter
RQ1.	What are the defining boundaries of a port cluster system?	4
RQ2.	What is the degree of assemblage to distinguish between a port cluster, a port, a maritime cluster and a port range?	4
RQ3.	How do port users and port cluster companies engage in the port logistics process?	5, 6, 7
RQ4.	Are systems methods and techniques, such as soft systems methodology and structural analysis & design technique appropriate for modelling the port logistics process and the port cluster system?	3, 4, 7
RQ5.	To what extent do companies create industrial productivity from their work in the port cluster?	6, 8

Source: Author

CHAPTER 2

PORT CLUSTERS AND RELATED ASSEMBLAGES

2.1 Chapter Overview

This chapter presents a review on the concepts of port clusters and similar assemblages related to the port clusters, such as Port, Port Ranges and Maritime Clusters, together with rich pictures to illustrate these. Moreover this chapter will also examine other important concepts such as port logistics and systems. The position of the chapter on this thesis is presented in **Figure 2-1**.

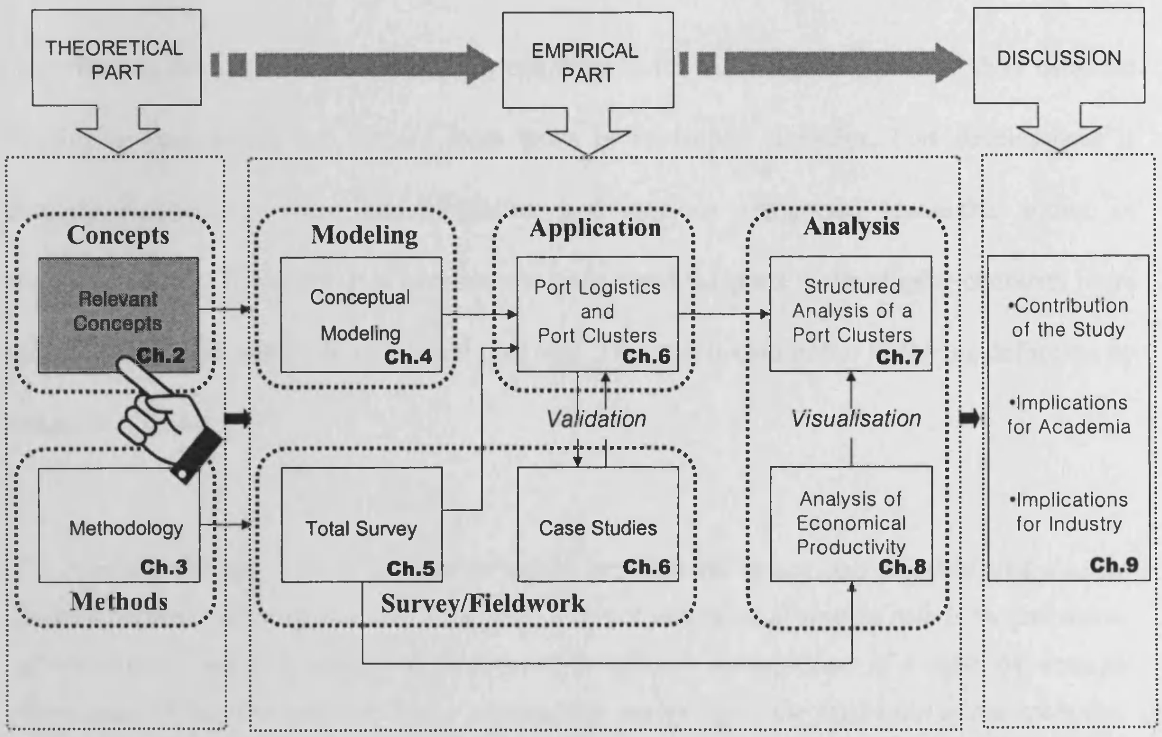


Figure 2-1 The position of 'Port Clusters and Related Assemblages' in the thesis
Source: Author

2.2 Seaports

The Port Working Group in the Commission of the European Communities (1975) recognised a port as the reception of ships, their loading and unloading, the storage of goods, the receipt and delivery of these goods by inland transport and the activities of businesses linked to sea transport.

Frankel (1987) stated that a port is "a connection point or joining area between ocean traffic and land traffic," while Goss (1990a) defined a port as "a gateway through which goods and passengers are transferred between ships and the shore". Button (1993a) viewed a 'seaport' as a self-contained, organized place where goods and passengers are exchanged between ships and the shore. However, from time to time, there is growing recognition that a port should be considered as a component or set of components of a broader technological system (Hayuth, 1993 in Haezendonck, 2001).

Nevertheless, the ports of the developing countries in the Asia region have a slightly different developing background and history from those in developed countries. Port development is strongly connected to their industrialisation, and they are recognised as another source of economic benefit. Therefore, it is necessary to understand the ports in developing countries more broadly rather than merely in traditional concepts. This is reflected in the following definition by Nakanishi (1968):

"A common linkage area or a junction which provides the space and physical distribution facility between shipping and land transport. A direct way of analysing its role is the provision of operational facilities, equipment and space for effective management of a rapid increase in the volume of cargoes and/or act as a passageway according to the expansion of the economy. Another way of thinking about it is to see it as an economy independent of the national economy; it is an institution, or rather, the engine which can improve the production or the consumption of the hinterland. In other words it can contribute to the welfare and prosperity of the population around the port."

Yet, even this definition fails to successfully give a more comprehensive explanation as to what exactly is carried out by a modern port. A more comprehensive explanation was given by Lee (1998) who defined a port as "A common connect area linking shipping and inland transport. It is also an economical base for development of the hinterland from logistics, production, living, information generating and international trade perspectives." Lee (1998) also categorised ports into seven different types: commercial port, fishery port, industrial port, ferry port, refuge port, marina and naval harbour, depending on its usage.

Definitions of ports have continued to develop as transformations in the transport industry occur. According to an IAPH (1996), a seaport should offer a complex as its key function, such as *distripark*, rather than solely a trans-shipment centre. Notteboom (2000, in Van De Voorde et al, 2002) incorporated logistics into a new port definition:

"A seaport is a logistics and industrial centre of outspokenly maritime nature that plays an active role in the global transport system and that is characterised by a spatial and functional clustering of activities that are directly and indirectly involved in 'seamless' transportation and information processes in production chains".

Notteboom et al. (2001) also indicates that the gateway position of major seaports offers opportunities for the development of value added logistics.

Robinson, R. (2002) recognised that a port is no longer simply a place for cargo exchange but also an important functional element in dynamic logistics chains.

Ports are playing an ever more pivotal role in the development and operation of industrial supply chains. Nevertheless, port management has historically been reactive to legislative and customer pressures.

Such a reactive approach has resulted in the creation of ad hoc port related companies including government agencies. Thus, ports may be viewed as large-scale complex systems where there is a need to define a more holistic perspective of their design and operations. Even so, 'ports' continue to be considered as a group of competing units.

Figure 2-2 illustrates the kinds of ports and various functions of ports and is helpful to understand what ports are working for. Rich pictures are usually dran to illustrate the wider scope and complexity of a system. The main reason for SSM researchers to draw rich pictures instead of making notes and writing prose is that human centres system a rich display of relationships, and pictures are a better means for recording relationships and connections than linear prose (Checkland P. and Scholes J. (1999) p.45)

The functions of ports could be presumed by followed seven categorisation of the ports; namely *commercial ports* where ocean carried cargo is transferred into inland transports from/to the destination, *ferry ports* using for passengers' departure and arrival, *marina/cruise-ship terminals* using for pleasure in the sea, *industrial ports* where is exclusively utilised for manufacturers supplying materials and transporting products, *fishery ports* carrying out the fisheries from fishery boats, *refuge ports* providing shelters for emergency evacuated or damaged vessels, and *naval harbours* for military purpose. For the most case, ports stands for the commercial ports connecting the destinations and ocean shipping.

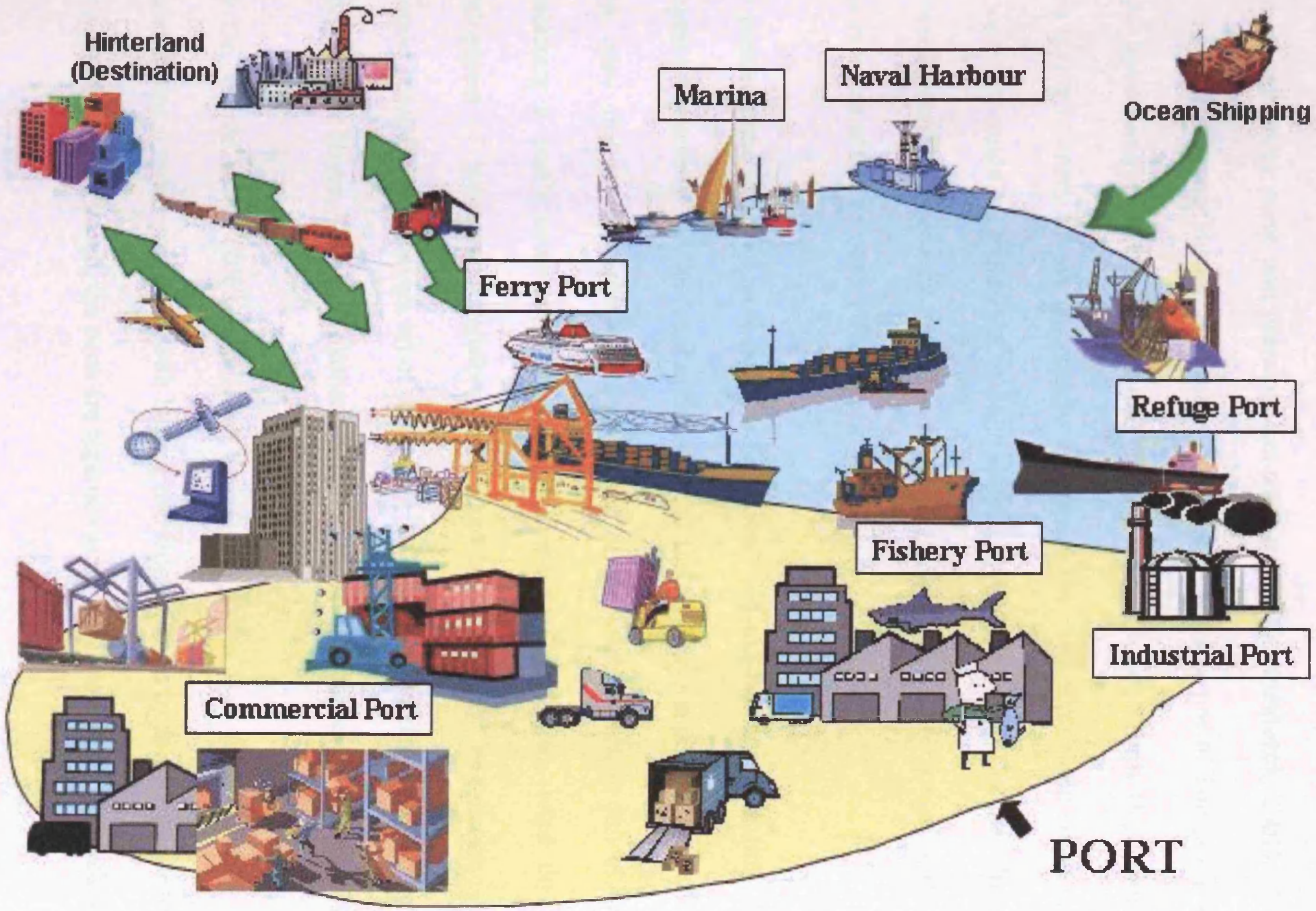


Figure 2-2 A rich picture of port concept
Source: Author

2.3 Port Range

The port range is a geographic area encompassing a hinterland that is served by a number of different competing ports, port operators and port services (Haezendonck, 2001). Figure 2-3 is a rich picture illustrating the port range, concept a group of ports. The ports within a port range have same hinterland behind them and they compete with the others to attract ships trying to carry the cargo from/to the hinterland. The hinterland could be a region in a country or could be expanded to huge region such as Western Europe. In former case, domestic ports in a country compete with the others, but in later case, ports in different countries vie with each other for the cargo.

The precise periphery of a port range is ill-defined and may change over time depending on competitive pressures and the focus of the study, as the relevant competitors within the same 'port range' may change over time. Hence, the port range is an important unit of analysis when considering a port's competitive strategy. Haezendonck(2001) also stated that, due to the development of inter-modal transfer systems and more efficient long-distance transport and transport networks, the relevant set of rivals may change. Typical examples of port ranges include Hamburg – Le Havre, Tokyo – Yokohama, Osaka – Kobe and Marseilles – Barcelona.

Van De Voorde et al. (2002) also cites that a port range is a geographically defined area encompassing a number of ports with largely overlapping hinterlands and thus serving much the same customers. As a result, the ports are regarded as potential competitors of each other.

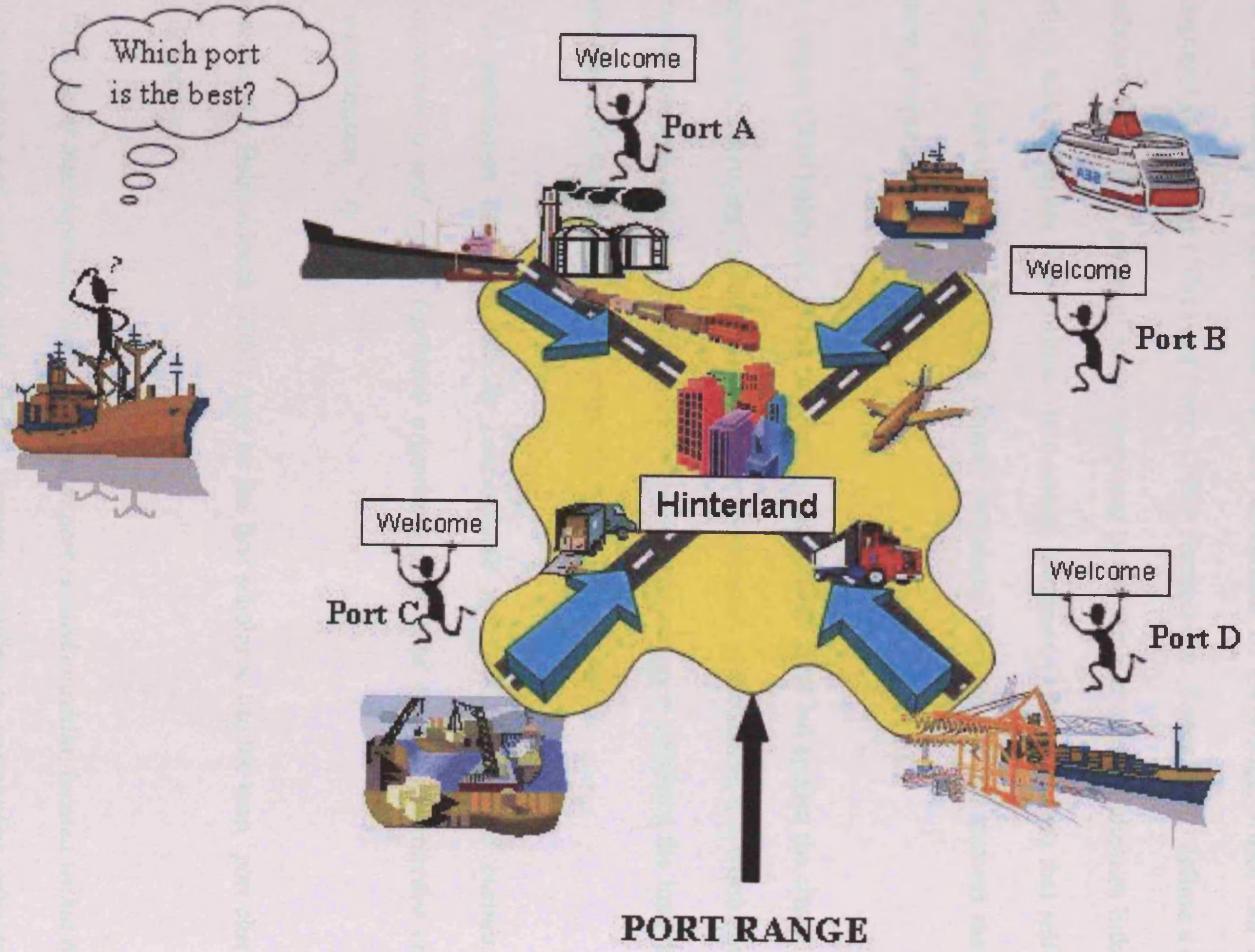


Figure 2-3 A rich picture of port range concept
Source: Author

2.4 Port Clusters

Hoen (2001) pointed out that the two most important approaches for explaining clusters are the new economics of geography and the new economics of knowledge, which can roughly be recognised as Krugman (1991) and Porter (1990) respectively. Porter (1990) defines a cluster as a spatially concentrated group of firms competing in the same or related industries linked through vertical and horizontal relationships. In contrast, Krugman (1991) indicates that self-enhancing economic activities occur in a few densely populated regions and this process may result in greater prosperity and growth.

De Langen (2004) does not define the port cluster concept itself but applies the cluster concept to seaports for enhancing the understanding (seaport) clusters performance. It is worth noting that he includes research/education institutes in the cluster population to reinforce the innovation factor associated with expertise and knowledge. He states that a cluster is;

> *"A population of geographically concentrated and mutually related business units, associations and public (-private) organizations centred around a distinctive economic specialization." (p.10)*

Consequently, Haezendonck (2001) may be the first scholar to use the term 'port cluster', which she defined as:

> *"The set of interdependent firms engaged in port related activities, located within the same port region and possibly with similar strategies leading to competitive advantage and characterized by a joint competitive position vis-à-vis the environment external to the cluster" (p.136)*

Port clusters can be regarded as a concentrated group of economic activities performed by various actors linked through the same or related activities. In other words, port clusters are inter-organisational networks among actors belonging to different sectors (Debackere and Vanmeulen, 1997 in Haezendonck, 2001) but situated at the crucial interface between the land and the sea legs of industrial and commercial activities (Winkelmans, 1991 in Haezendonck, 2001). The history of research on port clusters is not long; thus it is difficult to find any studies on the subject before Haezendonck's. Therefore, the definitions are neither concrete nor sufficient. Until recently port clusters have been used to explain port competition. Nonetheless, there is no doubt that the concept of port clusters will contribute to the development of greater economic activity for those companies associated within it. (Han, 2003 and De Langen, 2004)

The membership structure of a regional association of dissimilar and complementary firms give a good first idea of the kinds of economic activities carried out in the cluster. **Figure 2-4** shows a typical 'association structure' of a cluster. In this diagram, firms in a cluster are members of a regional industry association (or a regional department of a national industry association) and these associations are members of the cluster association (De Langen, 2004). **Figure 2-5** shows an example of a 'port cluster association' – Deltalinqs based in Rotterdam.

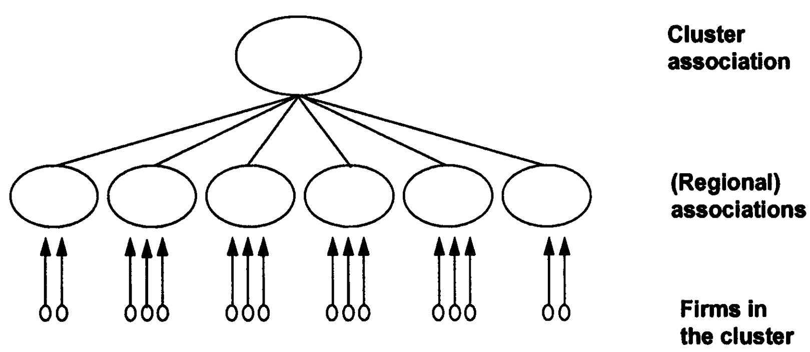


Figure 2-4 Cluster association concept
Source: De Langen (2004) p.13.

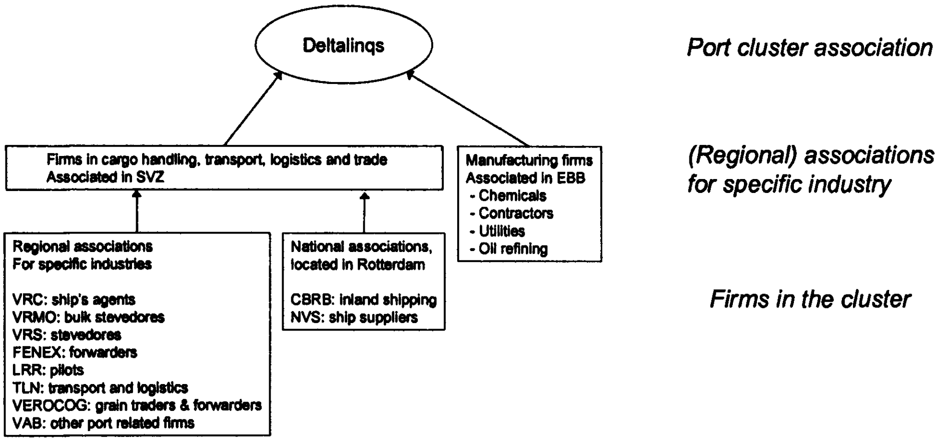


Figure 2-5 An example of a 'port cluster association' - Deltalinqs based in Rotterdam Port
Source: http://www.deltalinqs.nl/

Han (2003) in the research for his proposition for the development of a port cluster, suggested four different steps in establishing a cluster as shown in **Figure 2-6**.

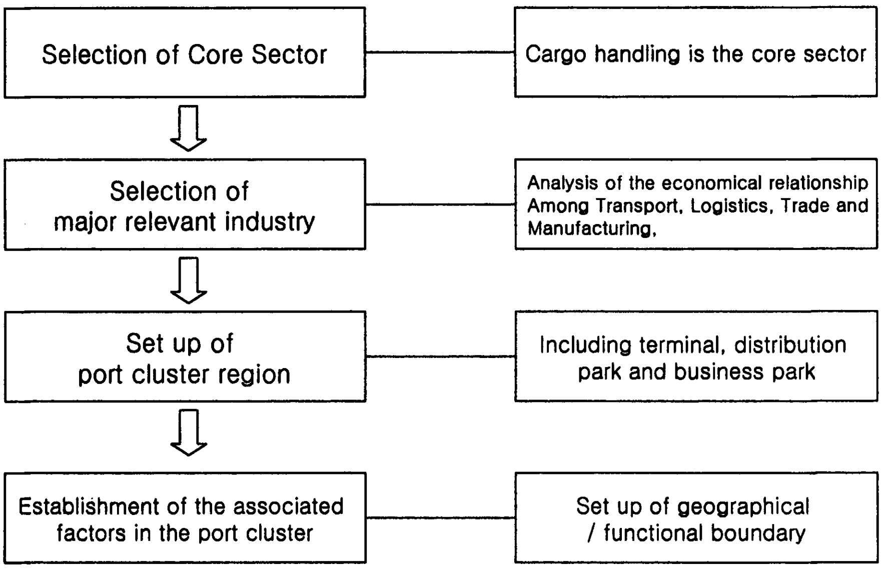


Figure 2-6 Port cluster construction Flow
Source: Han (2003) "A study on the establishment of port cluster in Korea," Korean Port Economics Review, Vol. 19. No.1.

Lorenzoni and Badenfuller (1995, p.147) defined Leader firms as "strategic centres with superior co-ordination skills and the ability to steer change." De Langen defined these thus:

> *"Leader firms are firms that have – due to their size, market position, knowledge and entrepreneurial skills – the ability and incentive to make investments with positive externalities for other firms in the cluster."* (p.59)

A distinction can be made between network externalities (Economides, 1996) and cluster externalities. Cluster externalities spread to all firms in the cluster whereas network externalities spread only to firms included in a relatively closed inter-firm network. Clusters consist of a large number of complementary and competing firms, with both actual and potential inter-firm relationships. Thus, cluster externalities are more general than network externalities (De Langen, 2004). Therefore, Leader firms need to have a strong market position so there are incentives to create positive external effects for other firms in the network/cluster. Finally, De Langen (2004) explains the most important effects of leader firm behaviour as the following:

Firstly, leader firms invest to improve coordination of innovation networks.

Secondly, leader firms coordinate internationalisation of firms in the cluster

Thirdly, leader firms co-invest to improve the infrastructure for training, education and knowledge exchange

Lastly, leader firms invest to improve the organisational infrastructure in the cluster.

Figure 2-7 is a rich picture on port cluster concept, it illustrates that a port cluster is a kind of business party or gathering for various port relevant companies considering how to increase the value added from the port. The port relevant companies in the port cluster include shipping finance, cargo trucking, cargo warehouse, container yard, cargo handling, shipping, ship repairing, port information service, bunkering, ship chandler, ship supplier, etc.

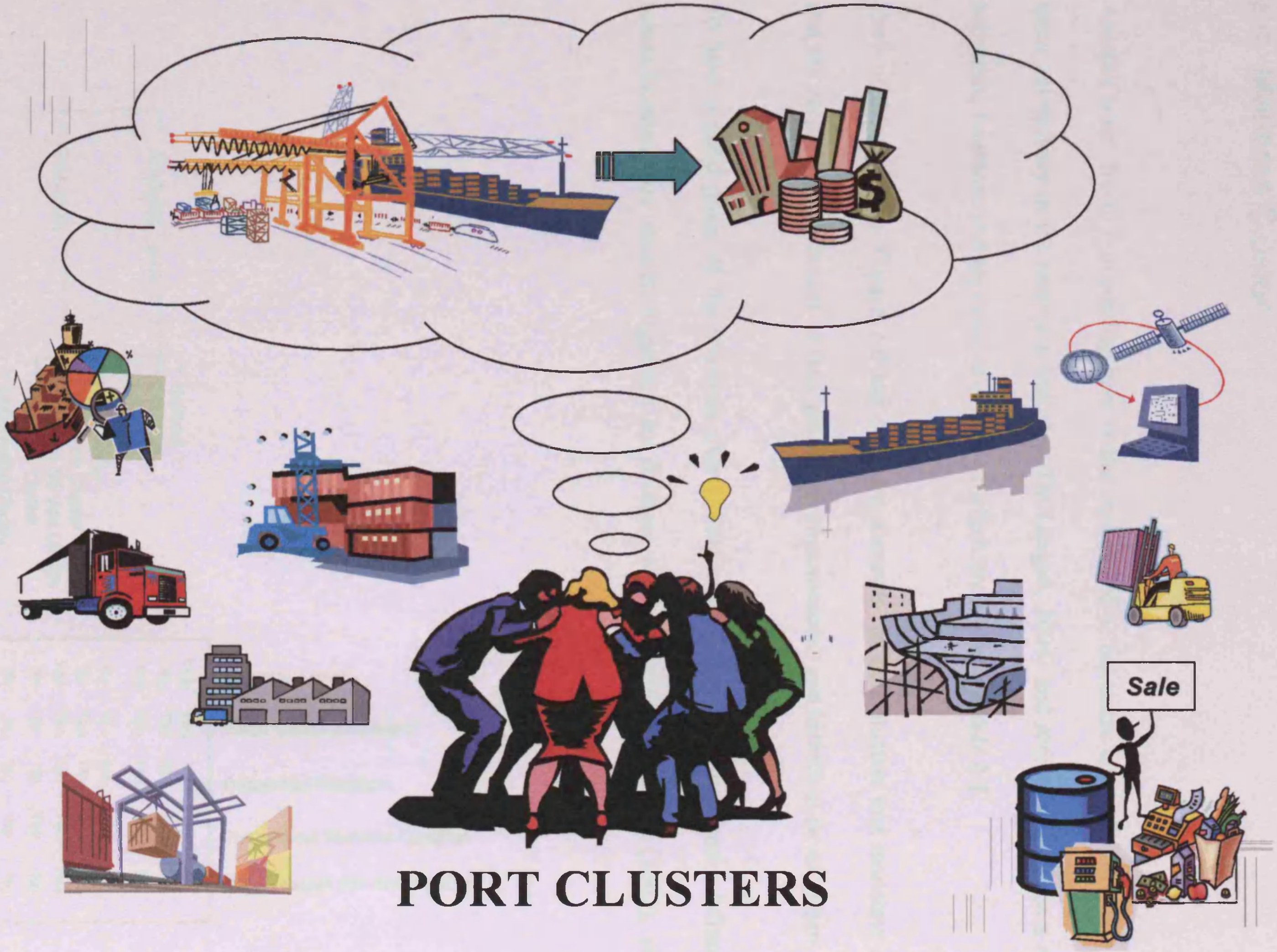


Figure 2-7 A rich picture of Port Clusters Concept
Source: Author

2.5 Maritime Cluster

Another point worth considering here is the concept of a 'maritime cluster'. This term is used quite extensively in the maritime industry (De Langen, 2004) and seems to embrace a range of activities, functions and services, examples of which are given in **Table 2-1**.

Each of the examples **Figure 2-8** has different concepts for port clusters and maritime clusters; and are very much dependent on their particular circumstances and historical development.

To have a good grasp of the maritime cluster, this study firstly combined both of frameworks (classifications) on cluster suggested by Roelant & Hertog (1998) and Lee (2002), secondly,

Cluster		Maritime London	Dutch Maritime Network	Deltalinqs Rotterdam	Connecticut Maritime Coalition	Port of Busan (No Association)
Analysis Level	National	Yes	Yes	No	No	No
	Industrial	No	No	Yes	Yes	Yes
	Business	No	No	No	No	No
Function	R&D Cluster	No	No	No	No	No
	Production Cluster	No	Yes	No	Yes	No
	Sales and Service Cluster	Yes	Yes	Yes	Yes	Yes
	Innovative Cluster	No	No	No	Yes	No
Knowledge Activity	Self-creating Cluster	No	No	No	No	No
	Knowledge Intensifying Cluster	Yes	No	No	No	No
	Absorptive Cluster	No	No	No	No	No
	Self-sufficient Cluster	Yes	Yes	Yes	Yes	Yes
Formation Process	Spontaneous Cluster	Yes	Yes	Yes	Yes	Yes
	Intended Cluster	Yes	Yes	Yes	Yes	No
Behaviour	Competitive Cluster	Yes	Yes	Yes	Yes	Yes
	Cooperative Cluster	Yes	Yes	Yes	Yes	Yes

Figure 2-8 Characteristics of maritime clusters and port clusters

Source: Author based on Lee, G.S. (2002) and Roelandt & Hertog (1998)

Table 2-1 Contents of typical Maritime Clusters

UK Maritime Cluster (Maritime London)	**Norwegian Maritime Cluster (Maritime Forum of Norway)**	**Dutch Maritime Cluster (Dutch Maritime Network)**
Accountancy Arbitrators Associations (Admiralty Solicitors Group, Association of Average Adjusters, Chamber of Shipping, Greek Shipping Co-operation Committee, Intermediation, International Underwriting Association, Japanese Ship owners' Association, London Maritime Arbitrators Association, Salvage Association) Banking Chartering Education Insurance Law Management consultants Other (Aldgate Ward Club, C-Mar Services, National Maritime Museum, Corporation of Trinity House, Aldgate Ward Club) Ports (ABP, Port of London) Publishing Ship broking Ship classification (Lloyd's Register, RINA UK Ltd) Ship registry (Isle of Man Marine Administration) Ship owners/operators Surveyors Trade unions (NUMAST)	**Aquaculture Technology and Service** Consultancy & other services (Environmental Assessment, Financing, Fish Farm Management & Training, Product Development, Testing & Documentation, Research & Development, Vaccination and Disease Treatment) Products & equipment **Fishing Gear, Yard and Service** Consultancy & other services (Certification, Consultancy, Financing, Naval architecture & marine engineering, Research & development, Training) Gear & Equipment Information & Communications Technology **Ship Gear, Yard and Service** (Alarm, monitoring & control systems, Cargo equipment, Communications systems, Computer Systems, Consultancy, Databases, Financing & Insurance, Industry Organizations, Machinery, main components, Maintenance equipment & supplies, Navigation & positioning equipment & systems, Shipbrokers, Shipbuilding /Yards, Ships equipment, Software, Training, Transport & Logistics)	Dredging Events (Exhibitions & Shows, Trade & Promotion Fares, Matches) Fishing Industry Government Inland Shipping Internet & ICT Maritime Equipment & Suppliers Maritime Services (*Bunkering Stations, Damage and Consultation, Diving Companies, Education & Courses, Employment Agencies, Finance, Government Services, ICT, Inspection and Control, Insurances, Legal Services, etc.,*) Marketplaces & Portals Media Museums Offshore Port Services Royal Navy Shipbuilding Industry Shipping Industry Trade Associations Water sport Industry Water Sport Tourism Working in the maritime sector Yacht Building

Source: http://www.ctmaritime.com, http://www.deltalinqs.nl/, http://www.dutchmaritimeguide.com, http://www.imo.org, http://www.maritimelondon.com, http://www.nmm.ac.uk, http://www.nortrade.com surveyed several cases on maritime clusters and port clusters through the internet, thirdly, applied the several cases to combined framework, finally expressed the application result as a tree structure on **Figure 2-8**. For example, in case of port cluster in Rotterdam (Deltalinqs Rotterdam) that is one of existing activated port cluster is categorised as an industrial level, a sales and service cluster, a knowledge self-sufficient cluster, a spontaneous cluster, a competitive and a cooperative cluster. As shown in **Figure 2-8**, Maritime London and Dutch Maritime Network is categorised as a maritime cluster. Deltalinqs Rotterdam, Connecticut Maritime Coalition is one of port clusters. In case of Port of Busan, there is a spontaneous port cluster but official association to organise them is not established yet.

From the perspective of a systems analysis, Roelandt & Hertog (1998) classify clusters into three different areas:

1. National level – a relationship between industries within a total economy,

2. Industrial level – a relationship between industries producing similar end-goods but at different levels or an internal relationship between industries,

3. Business level – a relationship between part suppliers around one or a few core companies.

Alternatively, Lee (2002) classifies clusters according to their functions, knowledge activity, formation process and behaviour. We can combine the two different frameworks of clusters into one (as shown in **Figure 2-8**) and apply them to existing real-world situations; namely, Maritime London, Dutch Maritime Network, Detalinqs Rotterdam, Connecticut Maritime Coalition and the Port of Busan. In the case of the Busan Port, the establishment of a port cluster association is being discussed.

Figure 2-9 is a rich picture on maritime cluster concept, it illustrates that a maritime cluster is a kind of assembly or conference for various maritime industries considering how to develop the maritime industry and how to define their obligation.

Usually, maritime clusters include wider range of industries rather than port clusters, namely fisheries, relevant manufacturing, salvage, marine pollution response, marine sports, maritime exhibition and museum and off-shore oil drilling, etc.

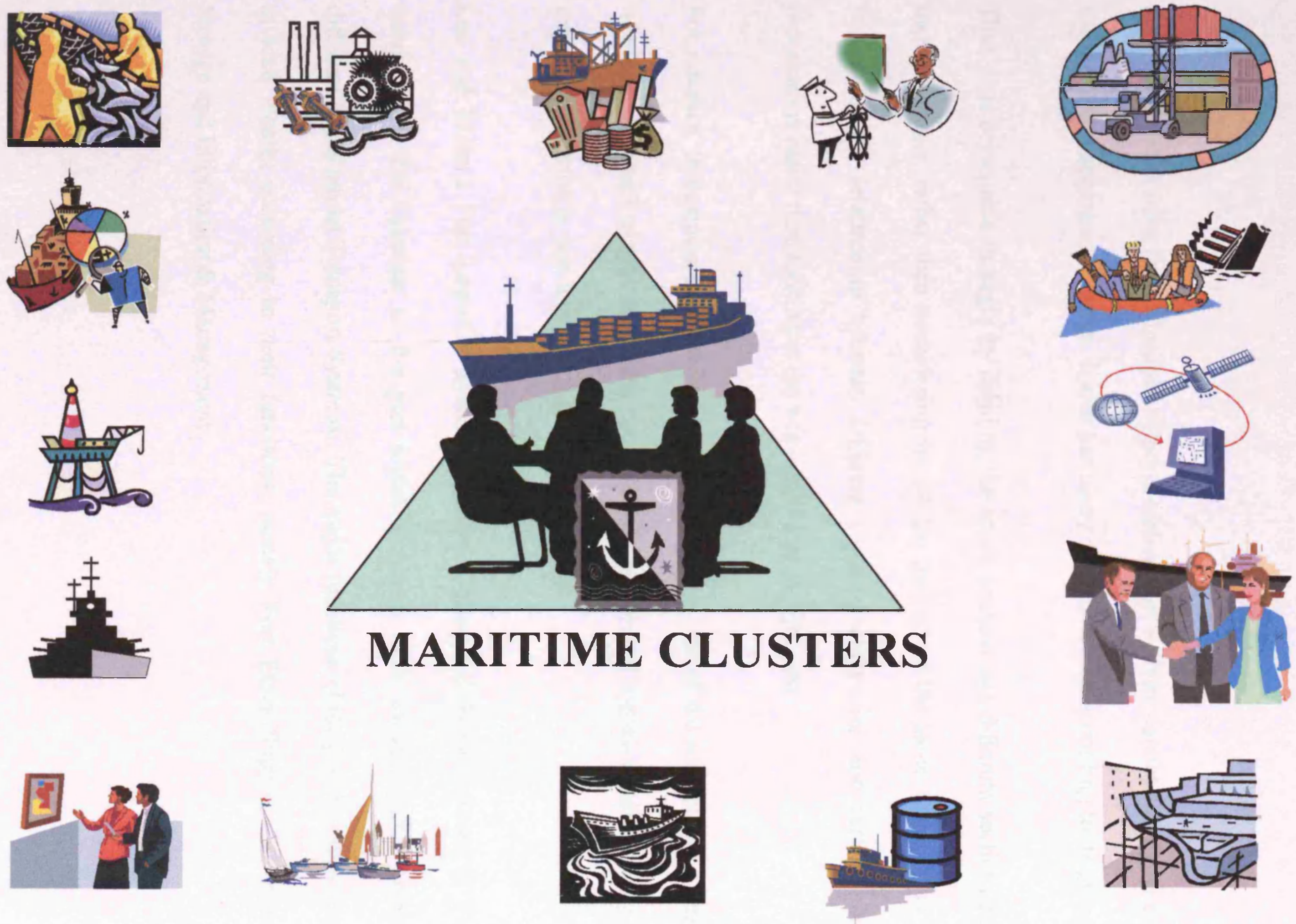


Figure 2-9 A rich picture of Maritime Clusters concept
Source: Author

2.6 Port Logistics System

As we have seen from the definitions of ports earlier, port activity cannot simply be explained as loading and discharging of cargo. It also has many other functions according to its process.

Thus, it is reasonable to begin by dividing the entire process into different sections according to their functions, rather than considering whole the process at the same time. This is because examining the relationship between different types of companies and certain port logistics processes is easier than looking at the whole port logistics process.

For instance, in business logistics process, stevedoring is one of the subsidiary processes for the whole of business logistics, but this is not so in the case for port logistics. Additionally, the second important function in port logistics is the storage process.

Lee and Moon's Port Logistics System (process) Conceptual Model shown in **Figure 2-10** distinguishes the character of the port logistics system as a linkage system connecting two different Multi-modal Transport Systems. The major functions of the port logistics system is also divided clearly according to their functions; namely Port Entry Support, Stevedore, Transit, Storage and Information & Management.

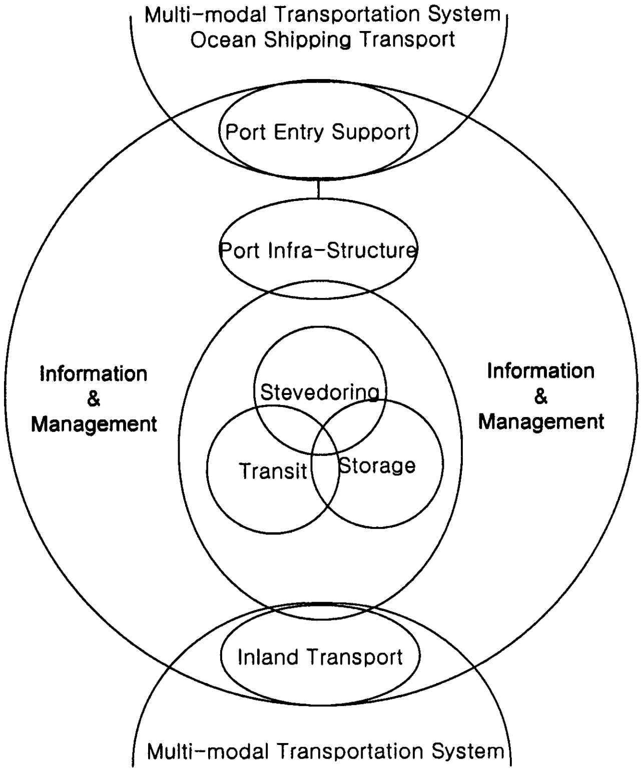


Figure 2-10 Lee and Moon's Port Logistics System Conceptual Model
Source: Moon and Lee (1983)

However, this conceptual model contains the following five weaknesses first, the port logistics flows are not clear; second, the function of voyage support could not be found in this model, even though the voyage support function is one of the most important roles of a port;. third, the levels of the sub-systems are not equal - for example between Port Infra-structure and the other sub-systems; fourth the border of the system boundary is not clear, and lastly, the relationship between each sub-system is not clearly established.

Meanwhile, Park (1997) subdivided the port logistics system into Port Entry System, Stevedore System, Transit System, Storage System and Linkage System, and two sub-systems around them, namely Port Information System and Urban system as **Figure 2-11**.

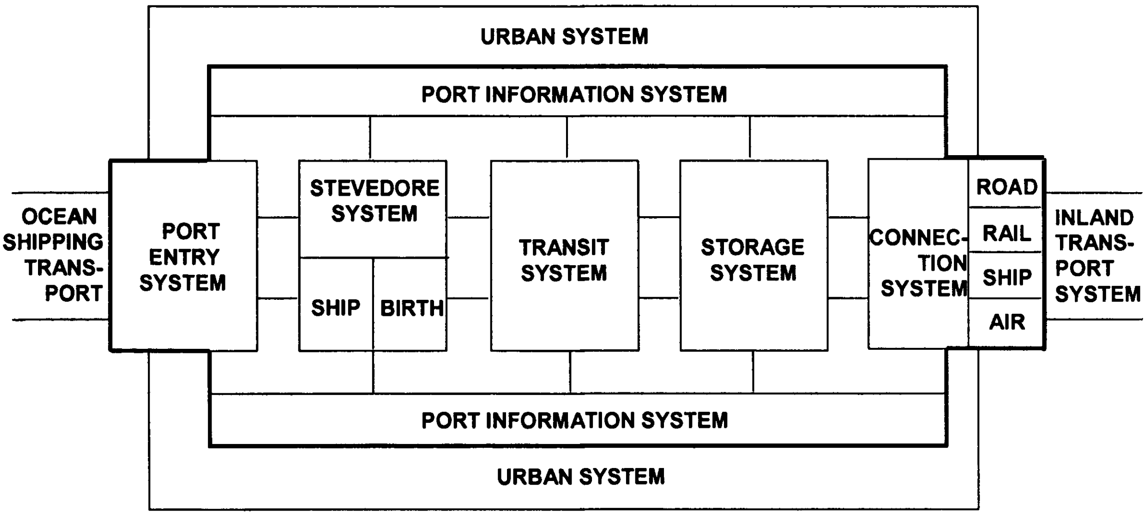


Figure 2-11 Park's Port Logistics System (process) Conceptual Model
Source: Park, C. H. (1997)

The most unique feature of Park (1997)'s conceptual model is that the Urban System of the port city around the port is included as an external system as well as Ocean Shipping Transport System and Inland Transport System. Moreover, compared to the conceptual model by Lee and Moon (1988), reinforcement of the linkage between each sub-system is more notable. **Figure 2-12** is a visual conception of port logistics considering above researches and illustrates a typical port logistics process in a port from ocean shipping to inland destination according to import cargo flows.

The vessel finished voyage <*Ocean Going*> has to clear the C.I.Q (customs, immigration, quarantine) process at the anchorage of the port, and only C.I.Q. cleared vessel can come alongside the berth by help of pilot and tug-boat <*Port Entrance*>. As soon as the vessel is alongside the berth discharging of the cargo is started by stevedoring facilities and port labours <*Stevedore*>, something is transfer directly to railway station or trucking cargo terminal and something is moved to warehouse <*Transit*>. The cargo that is transferred into railway station is loaded on the train and transferred into truck terminal is loaded on the truck staring to the destination <*Inland Transport Connection*>. The cargo that is transferred into warehouse is kept until shipper's order is come <*Storage*>. Export cargo flows are reverse of import cargo flows, but most in cases, the entered vessel receives some ship supply or bunkering service before starting another voyage <*Voyage Support*>.

Each process is gradually coming connected smoothly with information system or telecommunication system <*port information system*>. These whole processes are not compulsory some process is omitted case by case. The matter of detail will be handled in sector **6.5**.

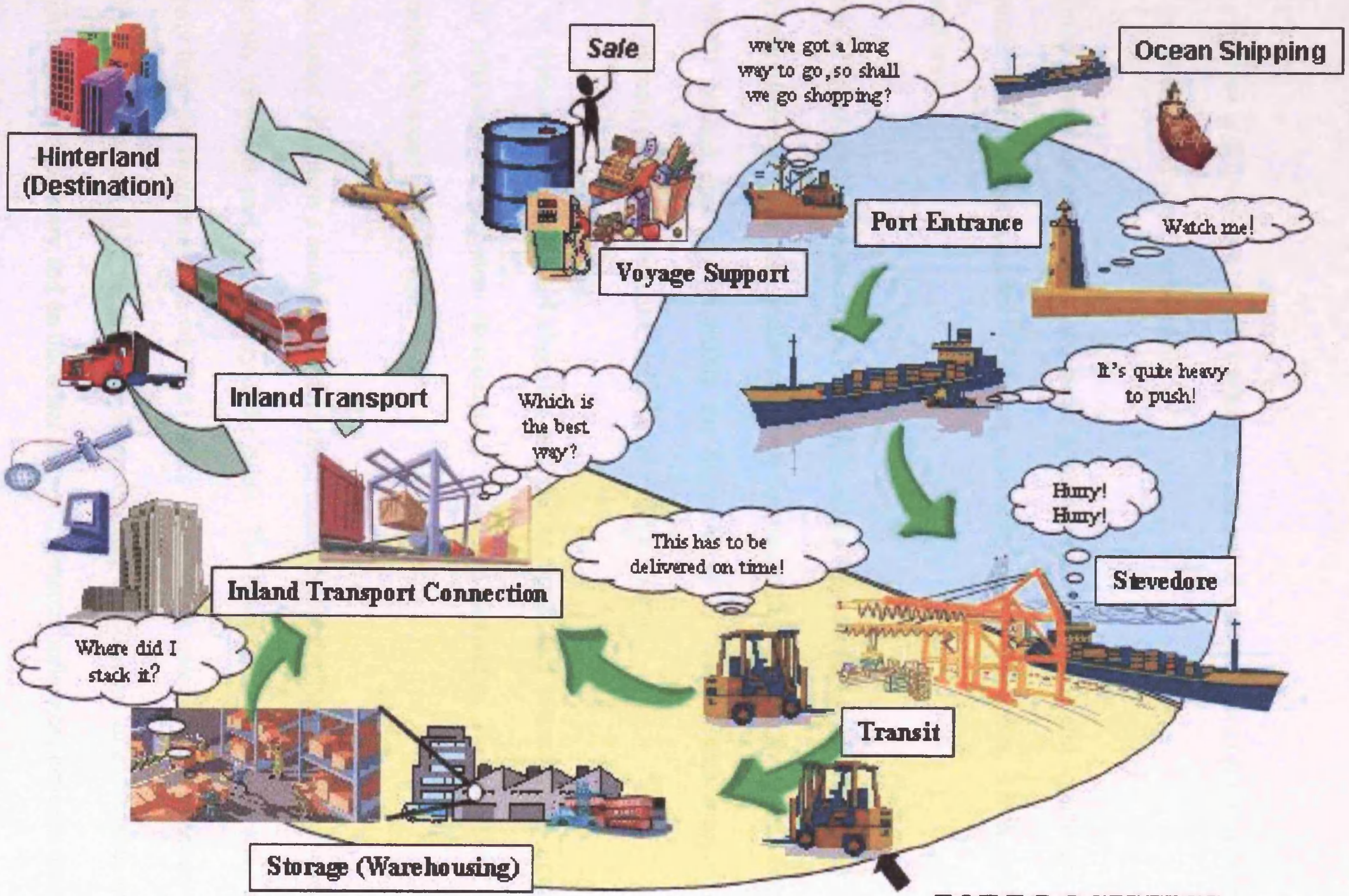


Figure 2-12 A rich picture of the Port Logistics Concept
Source: Author

2.7 System

Usually a **System** is defined as a complex whole; an integrated entity of heterogeneous elements that acts in a coordinated way (Burke 2000).

The common conception of "system" within the disciplines of engineering and computer science is a physical, artificial (human-made), dynamic combination of technologies, which acts in a coordinated way.

A structure of systems within systems can be thought of as a Systems Hierarchy. Matthews (2000) said a ***Systems Hierarchy*** is a self-similar structure; the pattern that recurs is the system concept. Burke (2000) defined each system within the hierarchy is as "whole" with respect to its component element and to a system at a higher level in the hierarchy.

The art of Systems Thinking is in choosing appropriate upper and lower bounds upon the potentially infinite levels of system abstraction in the system hierarchy. The upper and lower bounds define the scope of the system.

The upper bound constructs a ***boundary*** around those elements that the systems thinker considers to be usefully viewed as part of the entity under study. The boundary thus delineates the entity under study from the ***environment*** in which it resides. It should be noted that the boundary is an artificially created concept. The validity of systems thinking and analysis often depends on the appropriate choice of boundary and an understanding of the mutual influences between the entity under study and the environment.

The lower bound, which attracts little attention in the literature, defines the level of abstraction below which systemic issues are not relevant to the current study. The systems thinker selects a level of abstraction below which little value can be gained in studying its systemic nature. Thus it is assumed that entities at this level are "atomic" and indivisible.

The basic building blocks of a system are commonly known as ***components*** and can be thought of as the operating parts of a system. They consist of inputs, processes, and outputs. Each component of a system has associated ***attributes***, which are the properties or discernible manifestations of the component. Linkages between components in a system are known as ***relationships.***

The key issue in this conception of systems is that of emergence. An ***emergent property*** of a system is a property that is meaningful when attributed to the whole system, not to its individual elements (Checkland, 1981). Thus it can be viewed as an attribute of the whole system that does not reside in any of the component elements.

One of the methodologies of this study, systems analysis is the process of analyzing a system with the potential goal of improving or modifying it. In other words, systems analysis involves the study and design of a system in order to modify it, hopefully for the better. It differs from a trial-and-error approach. (FitzGerald & FitzGerald, 1987, p.9-10) since we have to solve the problem at the same time.

2.8 Summary

As competition among ports has increased, new concepts have also been generated such as port range, maritime clusters and port clusters based. Until now, they were merely used to explain port competition. Nonetheless, the concept of port clusters will contribute to the development for those companies associated within it.

Despite this trend, little research has actually been undertaken to analyse port clusters and their impact on ports' operations performance and that of the companies within the cluster. A couple of exceptions have been the research on the application of cluster theory in the port industry (Haezendonck, 2001) and performance measuring of existing three port clusters (De Langen, 2004). The former author may be the first scholar to use the term 'port cluster', therefore, the history of port cluster research is not longer than 5 years,.

While Haezendonck and De Langen have distinct related definitions of port clusters, the conceptual boundary of the port cluster is not clear. The unclear conceptual boundaries of port clusters make it difficult to progress analysis and to design effective systems. There is also a lack of clarity between ports and other related terms such as port ranges and maritime clusters.

The situation within a port cluster is similar to that above; there is no research about the relationship among the constituents of a port cluster. Therefore, this study aims to define port clusters in terms of their distinct characteristics and system boundaries and to visualise the relations among the associated constituents in a port cluster. In addition, there has been no research about the standard approach to select the Leading industries/companies who will lead the cooperation of the relevant industries/companies in the port cluster.

CHAPTER 3

PHILOSOPHICAL BACKGROUND AND METHODOLOGY

3.1 Chapter Overview

This chapter is the second and the last chapter in the theoretical part of this thesis as presented in **Figure 3-1**. The different types of research technique and methodologies used for the analysis of the issues that this research deals with are illustrated and discussed in detail. Among them, emphasised parts are Soft System Methodology (SSM), survey research and Structured Analysis and Design Technique (SADT) which have been mainly applied in this study.

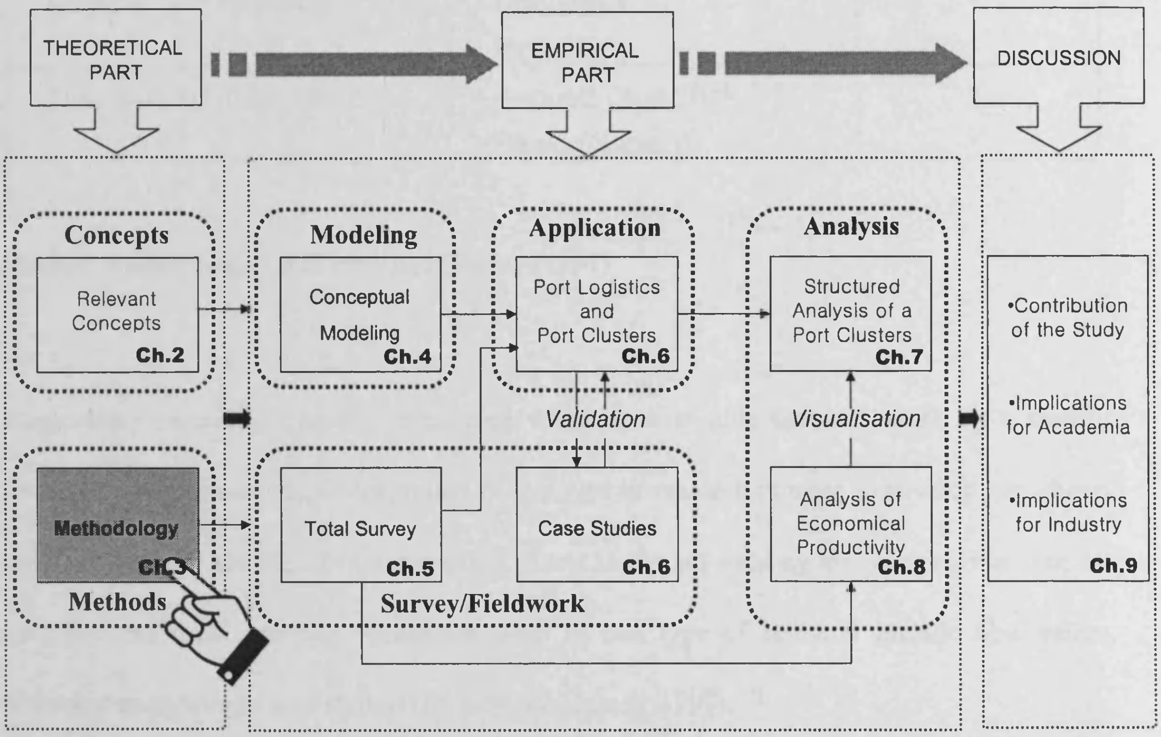


Figure 3-1 The position of 'Philosophical Background and Methodology' in the thesis
Source: Author

3.2 Type of Research

Hussey and Hussey (1997) categorised the research type as **Table 3-1**, and a project has to follow all four types to be completed as they do not exempt each other. Thus every study should start with a purpose, which will determine the process and the logic, which is turn will define its outcome or benefits.

Table 3-1 Type of research

Basis of classification	Type of Research	This Study
Purpose of the research	Exploratory	✓
	Descriptive	✓
	Analytical	✓
	Predictive	
Process of the research	Qualitative	✓
	Quantitative	✓
Logic of the research	Deductive	✓
	Inductive	✓
Outcome of the research	Applied (Specific)	✓
	Basic (Generic)	✓

Source: Author based on Hussey and Hussey (1997)

Exploratory research is usually conducted when there is little previous work on a specific problem. The philosophical background of this type of research is more to develop new theory and understand a specific phenomenon than to test an already existing hypothesis (Ghauri et. al., 1995). The most common techniques used in this type of research include observation, historical analysis and case studies (Hussey and Hussey, 1997).

Descriptive research attempts to explain the existence of certain phenomena with the use of a number of hypotheses (Dubin, 1978). The approach usually followed is via the questioning of a group of people that are related to the specific problem and, through their opinion, analyse the existing phenomenon and come up with strong findings that approve the initially stated hypothesis or not.

Both analytical and predictive forms of research are a continuation of descriptive research. The difference between them is that the former intends to explain a particular situation, whereas the latter attempts to understand the cause of the phenomenon and forecast the possibility of that situation occurring in other cases (Hussey and Hussey. 1997). Both belong to the so-called casual research as their aim is to define the causes and effects of specific factors or variables to a situation and to themselves as well (Popper, 1955).

Logistics research has been based traditionally in the positivistic area, therefore encouraging the use of quantitative methods (Notteboom and Winkelmans, 2001). Nowadays the major trend in logistics research is a focus on people and the corporate culture (Lambert et al. 1998). Involvement of people automatically means that a positivistic perspective would not be sufficient for completely solving the research questions in the port logistics industry. Consequently, qualitative methods like interviews, participant observation or diaries should be contemplated, to provide triangulation.

Traditionally triangulation was used in order to validate research results. Nowadays research data or method triangulation has been a tool to further enrich research by relating to different views (Hammersley and Atkinson 1995, Gummesson 2000, Silverman 1993).

Wass and Wells (1994) highlighted the difference between quantitative and qualitative data. The positivistic perspective is associated with quantitative and systematic data and the gathered information is directly observable and measurable. In the case of Port Logistics the combination of qualitative interviews and participant observation ensures an in-depth analysis of the research questions. Additional quantitative methods could be used (e.g. surveys) in order to generate impersonal, exact and precise data (Wass and Wells 1994).

3.3 Philosophical Background

Hart (1998) describes positivism as "the idea that logic could be used as the basis of a method for investigating the nature of the world," and Silverman (1985) defines positivism as the type of knowledge which gathers "facts about the world." In a positivistic understanding, these facts are counted among objective data, which is superior to subjective data (meanings and beliefs). According to the definitions above, positivism may be a suitable philosophical approach for this thesis. Usually the business performance is measured by its efficiency in terms of costs and time, because companies aim to make their organisation effective and efficient.

Typical positivistic methodologies are *cross-sectional studies*, *experimental studies*, *longitudinal studies*, and *surveys* (Hussey and Hussey, 1997).

The goal of cross-sectional studies is to gather information on variables in different contexts synchronously (Hussey and Hussey, 1997)). By contrast experimental studies allow the researcher to identify relationships. The aim is to manipulate an independent variable and thus detect its influence on the dependent variable. Generally these experiments are conducted in either a laboratory or a natural setting in a systematic way (Wass and Wells 1994). Longitudinal studies are not typically positivist methodologies, but often associated with it (Hussey and Hussey 1997, p. 62-63). As opposed to cross-sectional studies, which take a snapshot of an ongoing situation, longitudinal studies take place over time.

In a survey, a sample is taken from a population and dissected. A representative sample is usually analysed statistically. In this way it is often possible to make generalisations from the findings. Within applied management research, and logistics in particular, much of the existing research has applied positivistic methodologies (e.g. Towill et al., 1992; Disney et, al., 2000).

Meanwhile, Lambert et al. (1998) said "the problems and challenges that organisations face do not lie primarily with strategic decision making, but in systems, structure, mission, people, corporate culture, and reward structure." This not only applies to the organisation itself, but also to logistical operations within a company. Therefore, a unilateral view in research might lead to invalid results. It can be understood that a repeatable outcome might not be assured with only a positivistic approach of research. Hart (1998) who explains that social order, patterns of social relationships also states this and modes of thinking are difficult to combine with the absolute logic of positivism. The approach is also followed in this theory. Therefore, as a complement to the positivistic paradigm, phenomenological approaches have been used in recent years, as MacBeth and Ferguson (1994).

In contrast to positivism, phenomenology includes human experiences, such as perceptions and attitudes. "It takes philosophy to begin from an exact, attentive inspection of one's mental, particularly intellectual, processes in which all assumptions about causes, consequences and wider significance of the mental process under inspection are eliminated" (Bullock and Trombley 1999).

As mentioned above, logistics is not only dealing with rational processes, but also with people and the corporate culture. Involvement of people automatically means that "a positivistic perspective" is not sufficient to completely solve the research questions. "Phenomenology" introduced perception into academic research.

According to "pragmatic epistemology," as a third philosophical perspective, knowledge consists of models that attempt to represent the environment in such a way as to simplify problem-solving as much as possible. It is assumed that no model can ever hope to capture all relevant information, and even if such a complete model did exist, it would be too complicated to use in any practical way. Therefore we must accept the parallel existence of different models, even though they may seem contradictory. The model which is to be chosen depends on the problems that are to be solved. The basic criterion is that the model should produce correct (or approximate) predictions (which may be tested) or problem-solutions, and be as simple as possible (DeRose, 2002).

3.4 Methodology

3.4.1 SSM (Soft Systems Methodology) and Systems Theory

This study considers the 'port cluster system' as a target of study and uses the Soft Systems Methodology (SSM) and SADT as research methodologies.

For many people the name of Peter Checkland is almost synonymously linked with SSM through his book: 'Systems Thinking, Systems Practice' (1981). He is seen as the main founder of the methodology, and this theory has had a large impact within the systems movement as an alternative towards the orthodox paradigm of hard systems thinking. Checkland (1981) said that a designed abstract system should always be adapted and supplemented by concrete action. In real-life situations, the most effective systems thinker will be working simultaneously, at different levels of detail, on several stages.

Soft Systems Methodology (SSM) is based upon systems theory, which provides an antidote to conventional, 'reductionist' scientific enquiry - with its tendency to 'reduce' phenomena into smaller and smaller components in order to study and understand them. Systems theory attempts to study the whole picture; the relation of component parts to each other, and to the wider picture. In effect it is 'holistic.' Biology and environmental science use its principles widely, as do other disciplines including systems analysis. SSM is *not*, contrary to popular supposition, an information systems design methodology - it is rather a general problem solving tool. Brian Wilson, a colleague of Checkland's at Lancaster, has adapted the methodology for business information analysis, and various attempts (Avison's 'Multiview,' for instance) have been made to incorporate it into systems design work (Rose, 2005).

"The aim of soft systems methodology" asserts Checkland' is to take seriously the subjectivity which is the crucial characteristic of human affairs and to treat this subjectivity.....in a way characterised by intellectual rigour.' SSM is variously characterised by Checkland as a 'system of enquiry,' 'enquiry process,' 'learning system,' 'reflection in action,' 'an organised version of doing purposeful thinking,' or 'structured way of thinking' (Checkland and Scholes 1990). Its purpose is to 'articulate a debate about change' and address complex management problems:

"SSM is not usually concerned with well-defined (often technical) problems in organisations - such as how to maximise the output from a manufacturing facility – but with the ill-structured problem situations with which managers of all kinds and at all levels have to face" (Checkland and Holwell 1998)

Systems thinking have come to be characterised as either 'hard' or 'soft.' There are fundamental differences between a man-made 'designed physical' system, such as a nuclear reactor, and an organisational system - a 'human activity' system.

Where mechanical components are involved, their behaviour can usually be predicted with reasonable accuracy, and so are 'hard' systems. Where human beings are involved this is not necessarily the case because behaviour is unpredictable, while organisational and management problems are seldom clear cut and well-defined. They are normally complex, with many indeterminable variables and can be regarded as 'soft' systems.

At first glance, information systems would seem to be 'hard' - designed physical - systems, but experience shows that they seldom add value unless they are closely married to their organisational context, and the people who use them. There are therefore many softer issues which are important in information system planning, design, and implementation.

'Soft' has another, more specialist meaning - depending on the type of person, and his/her training and experience, Systems may be understood as tangible things which are really present in the world. However, systems ideas may be understood as a series of intellectual constructs that we use to help us deal with the enormous complexity of the real world. This is an interesting, but un-resolvable argument; SSM tends strongly to the latter position.

SSM helps formulate and structure thinking about problems in complex, human situations. Its core is the construction of conceptual models, based on the understanding of human activity systems outlined above, and the comparison of those models with the real world.

This process can greatly clarify those multi-faceted problems with many conflicting potential solutions, or no obvious way forward. Conceptual models are not representations of the real world, like a data-flow diagram. They are constructs which embody *potential* real world systems but, more importantly, follow rigorously the systems principles already discussed, and their own well-defined internal logic.

SSM is not, therefore, about analysing systems found in the world, but about applying systems principles to structure *thinking* about things that happen in the world - a difficult, but crucial distinction to grasp. It is most usefully carried out by people involved in the problem situation, with expert help available to guide and facilitate.

Figure 3-2 outlines Checkland's seven stage overview, which has come to be known as 'mode 1' SSM: The diagram maps out the SSM investigative procedure, making a clear distinction between things which happen in or express the real world and systems thinking, which is conceptual. The problem situation is often expressed in the form of a *rich picture* (2). *Root definitions* are then derived (3) - textual statements (somewhat like mission statements) which describe potential relevant systems to be considered. These may be *primary tasks* (which model basic, long term functions such as the operation of a production department) or *issue based* (which deal with transient, or more abstract concerns, such as the re-organisation of an office, or a system to implement total quality management). *Conceptual models* are activity models of these potential systems (4).

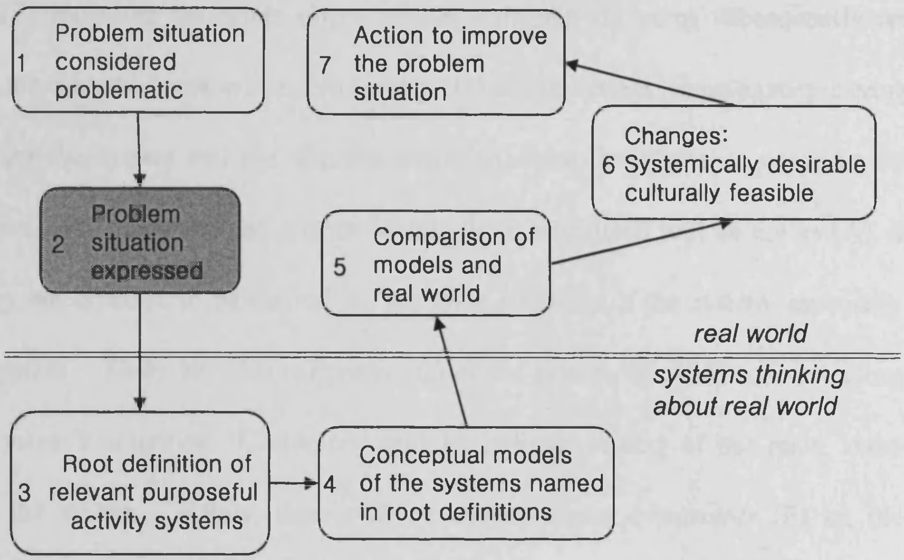


Figure 3-2 Checkland's seven stage overview of the SSM (known as 'mode 1' SSM)
Source: Checkland (1984)

A root definition and a conceptual model are two expressions, one descriptive, the other diagrammatic, of the same potential system, and should always justify and explain each other. There are various, (normally straightforward) ways of comparing these models with what is actually happening in the world (5). This comparison should lead to suggestions for improvements (which will be desirable according to the systems way of thinking of the world, but should also be feasible in the culture of the organisation considered) (6) and action on those suggestions (7).

This explanation implies that SSM practitioners follow a step-by-step logical progression in their investigations. This is hardly ever the case - stages are often re-visited, taken out of order and sometimes omitted as the situation dictates. Application of this methodology will be detailed in the next Chapter.

Five elements are as follows. The core of a root definition of a system will be a *transformation* process (T) including the direct object of the main activity verbs subsequently required to describe the system. There will be *ownership* (O) of the system, some agency having a prime concern for the system and the ultimate power to cause the system to cease to exist. The owners can discourse *about* the system. Within the system itself will be *actors* (A), the agents who carry out or cause to be carried out the main activities of the system, especially its main transformation. There are also *customers* (C) of the system, beneficiaries or victims affected by the system's activities. 'Customers' will be indirect objects of the main verbs used to describe the system. Fifthly, there will be *environmental constraints* (E) on the system, features of the system's environments and/or wider systems which it has to take as 'given'.

To these five elements we add a sixth item which by its nature is seldom explicit in a root definition but which cannot ever be excluded: a Weltanschauung (W). This is an outlook, framework or image which makes than one possible worldview, of course; that has been argued to be the nature of separate root definition whether it is supplied by the analyst or expressed by people in the problem situation.

These six elements covered in a well-formed root definition may by remembered by the mnemonic CATWOE (Checkland, 1981) Another definition of a System is as a complex whole; an integrated entity of heterogeneous elements that act in a coordinated way (Burke 2000).

Soft Systems Methodology (SSM) deals with some elements of hard systems aspects. SSM (Checkland & Scholes, 1990) supports the activities and processes through using a conceptual model to represent the activities of the root definition. The resources can also be presented in the root definition and the activities modelled can be related to them in the conceptual models.

SSM validates the quality through defining measures for activities in a conceptual model of the proposed system. Activities monitor these measures and take control action to improve matters in the proposed system. In addition the business issues are considered as a combination of the different perceptions in the conceptual models that help to identify business system options and define acceptance criteria for the delivered system.

On the positive side, SSM deals with all the elements of the soft approach. SSM may therefore be used to improve our understanding of ill-structured problems. However, the weakness of SSM is that SSM does not support the other elements of the hard approach such as data, events and design interfaces (Al-Humaidan, & Rossiter, 2001).

3.4.2 SADT (Structured Analysis and Design Technique)

One of the methodologies of this study - systems analysis is the process of analyzing a system with the potential goal of improving or modifying it. In other words, systems analysis involves the study and design of something (a system) in order to modify it, hopefully for better. It differs from a trial-and-error approach. (FitzGerald & FitzGerald, 1987, p.9-10)

The objective of using this methodology is for a complete understanding of the components and their present activities in the port cluster system. Many people understand specific procedures within the system, but few understand the entire system as a clear picture. It is the analyst's task to learn and to visualise the entire system and the interactions between the components before considering how to improve it. Therefore, this section focuses on a particular systems analysis technique, the Structured Analysis Design Technique, and gives a brief history of its implementation. The advantages that this technique, and the systems analysis, in general can offer in the effectiveness of port cluster system are also illustrated.

Usually, PERT/CPM charts are used to manage organisations and work distribution. In case of functional chart technique, Flow Charts, HIPO, I-P-O Chart could be used for sequential processing and physical attributions of a system (FitzGerald and FitzGerald (1987), pp.211-214)

However, this study particularly focuses on "activities in port cluster system" and the complexity of this required the use of a better visualisation technique.

A "system" can be defined as a set of interacting components with relationships among them. The world can be viewed as a complex interconnected set of natural and constructed systems (Checkland, 1984).

Marca and McGowan (1987) divide the range of these systems from complex (e.g., the planetary bodies in a solar system) to medium complexity (e.g., the space shuttle) to extremely complex (e.g., molecular interactions in living organisms). The methodology called "SADT" – an abbreviation for Structured Analysis and Design Technique – was developed specifically to help people describe and understand constructed systems that fall into the spectrum of "medium" complexity.

"Structured Analysis" and the concept of decomposition were originally proposed by Douglas T. Ross more than 40 years ago (Ross, 1977a, 1997b). Another significant development also took place in 1972, while Ross was involved in designing a "factory of the future." At this time Ross had joined the software house SofTech (established in 1969). Through this involvement and work in this company SADT was 'invented' and became SofTech's adopted methodology. A year later, in 1973, Ross was to find himself applying this methodology in the training of analysts in 'the Architecture Method' used in the Air Force Computer Aided Manufacturing (AFCAM) project. The project dealt with "large-system" problems such as real-time telephonic communications design, computer-aided manufacturing (CAM), command and control software, and military readiness. Since then, it has been successfully applied to describe a large number of complicated constructed systems in a wide variety of domains.

The following year the name "Structured Analysis" was adopted for the methodology, which now comprised the box and decomposition in one graphic 'language for blue printing system', thus SADT was formulated (Skordis, 1990).

SADT is now, one of the best known and most widely used system engineering methods. The reason for this success is that SADT is a complete methodology for developing system descriptions, centred on the concepts of system modelling (Marca and McGowan, 1987).

Of particular interest in the development of SADT was its adoption by the US Air Force under the IDEF0 trade name. The methodology had previously been used on the initial project AFCAM, and used again in the ICAM project, i.e., the Integrated Computer Aided Manufacturing. ICAM was directed towards increasing manufacturing productivity through the systematic application of computer technology. The approach was to develop structured methods in order to apply the computer technology to manufacturing and to utilise these methods in order to gain a better understanding of how best to improve productivity.

To fulfil the needs for better analysis of the system's parameters the ICAM Program developed the IDEF method referred to as the 'architecture of manufacturing', which showed how industry works and around which sub-systems could be planned, developed and implemented.

IDEF was designed to meet very specific requirements, i.e., be able to describe manufacturing operations; be complete, concise and consistent in its development and communication; and include rules and procedures that could be reviewed.

IDEF therefore should be transformed to a systematic methodology that could determine between 'organisation' and 'function.' The methodology was strongly influenced by general systems theory, software engineering, and even cybernetics. The major subset of the IDEF method which utilised and standardised SADT was IDEF0, a functional model which is a structured representation of the functions of a system or environment, and of the information and objects which inter-relate those functions.

Modern real applications of SADT are not only geared merely towards product manufacturing and increased productivity but also the 'analysis of Flexible Manufacturing Systems' and the aspects of safety of an automated system (Daniels, 1990 from Skordis, 1990).

Applications in this area have been made to the robotised work-cell at the 'Nancy University Process Control and numerical control laboratory,' where they have been using SADT technique in the design of a flexible manufacturing workshop, in order to model the life cycle of a Flexible Manufacturing Shop (FMS). The main conclusion drawn by the authors from this research was that a hierarchical step is the only way to improve the safety of complex assemblies. As highlighted in **Chapter 2** - port cluster systems are complex systems and so hierarchical analysis will be the best way to analyse the system.

The SADT graphic language organizes the natural language in a particular and unique way, and it is because of this that SADT can describe systems formerly beyond our ability to explain well. From SADT perspective, a model focuses on system activities. Historically, those SADT models that focus on system activities are called "activity models," and those that focus on system things are called "data models." Activity models present system activities in a successively detailed manner, and they define the relationship among those activities through the things of the system. The complete SADT methodology also includes the construction of multiple models to properly describe a complex system.

As we can see at **Figure 3-3**, the "box and arrow" graphics of SADT diagram show the function as a box and the interfaces to or from the function as arrows entering or leaving the box, while **Figure 3-4** shows us that box and arrow graphics can include examples of both activities and data in the diagram.

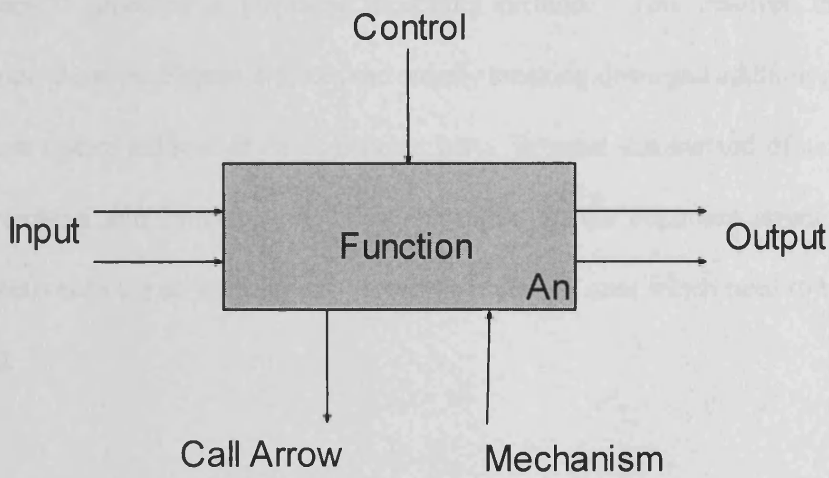


Figure 3-3 Function Box and Interface Arrows
Source: http://www.idef.com

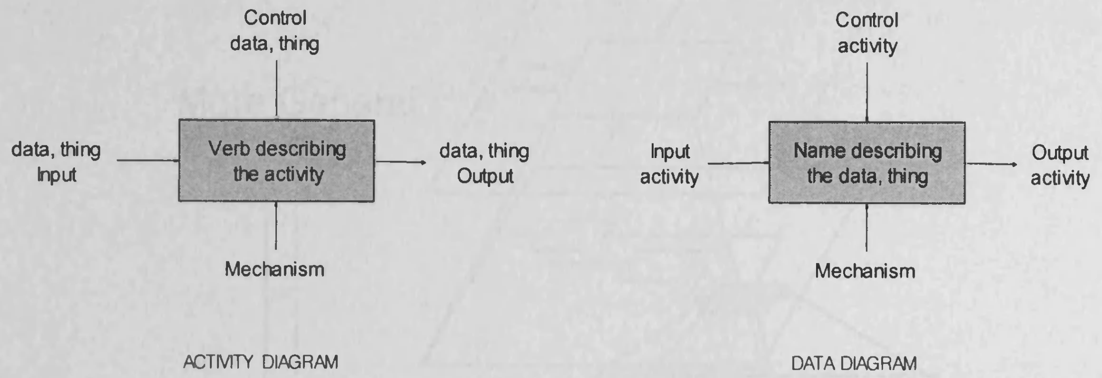


Figure 3-4 SADT Activity Diagram
Source: Skordis (1990)

The graphical language of the SADT methodology can be considered to be the most important feature, since it produces a graphical modelling method. This involves the structured decomposition shown in **Figure 3-5**, i.e., the orderly breaking down and addition of extra detail to a complex system reduced to its constituent parts. Because this method of analysis is top-down, hierarchical and structured, it focuses attention on the important issues bringing the correct objectives to the foreground as opposed to irrelevant ones which need to be kept in the background.

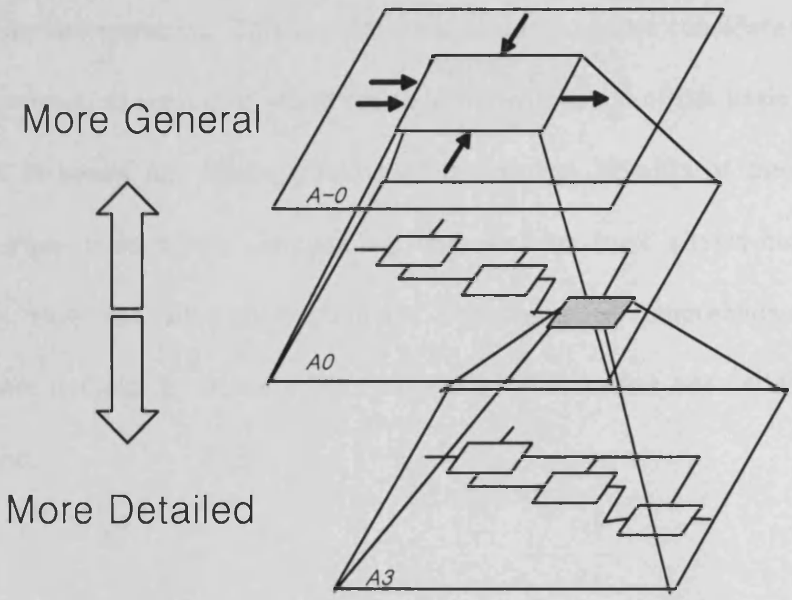


Figure 3-5 Hierarchy and Structured decomposition of SADT Methodology
Source: modified from http://www.idef.com by author

The effect of that in modelling a port cluster system becomes obvious since, all the parameters involved in any activity (it will be expressed as a company in Chapter 7) within the model can be accounted for. Simultaneously, the relationship between activities can be identified.

One problem with SADT is the tendency of SADT models to be interpreted as representing a sequence of activities. While SADT is not intended to be used for modeling activity sequences, it is easy to do so. The activities may be placed in a left to right sequence within decomposition and connected with the flows. It is natural to order the activities left to right because, if one activity outputs a concept that is used as input by another activity, drawing the activity boxes and concept connections is clearer. Thus, without intent, activity sequencing can be imbedded in the SADT model. In cases where activity sequences are not included in the model, readers of the model may be tempted to add such an interpretation. This anomalous situation could be considered a weakness of SADT. However, to correct it would result in the corruption of the basic principles on which SADT is based and hence would lose the proven benefits of the method. The abstraction away from timing, sequencing, and decision logic allows concision in an SADT model. However, such abstraction also contributes to comprehension difficulties among readers outside the domain. This particular problem has been addressed by the IDEF3 method.

3.4.3 Survey Research

Survey research is used when the researcher investigates the opinions of a number of persons on a specific issue which involves themselves or the general social unit of which they are part (Rossi, et. al., 1983). This methodology enables us to picture a present or future situation on the issue under study and come up with useful findings which could assist in the decision process of future action (Hussey and Hussey, 1997).

Within the main objectives of this study the author aims to comprehend and document the prevailing understanding of the port cluster and associated port logistics relevant companies (PLRCs) in it. Therefore, survey research will be used to achieve this.

3.4.4 Interviewing

Interviews are seen as both a positivistic and phenomenological method for data collection (Hussey and Hussey 1997). The difference lies in the way of conducting the interview. In using a phenomenological approach, unstructured questions are commonly used whereas, with a positivistic approach, questions are generally prepared beforehand in detail (Fetterman 1998). In this thesis, a phenomenological approach of interviewing is being taken (unstructured or semi-structured interviewing).

In logistics and supply chain management, a field characterised by quantitative methods for data collection, qualitative methods like interviewing are nowadays equally important (MacBeth and Ferguson 1994). This is because of the involvement of people in decision making. "The problems and challenges that organisations face do not lie primarily with strategic decision making, but in systems, structure, mission, people, corporate culture, and reward structure" (Lambert et al. 1998, p.434).

An interview resembles a normal conversation; questions and answers follow each other (verbal interaction). Although an interview can be structured or semi-structured, changes in interviewees, places and time result in different interviews. (Atkinson et al. 2001, Fettermann 1998, Seidmann 1991).

Rubin and Rubin (1995, p.1) state that "Qualitative interviewing is a way of finding out what others feel and think about their worlds. Through qualitative interviews you can understand experiences and reconstruct events in which you did not participate". This comment is backed up by Miles and Huberman (1994) who state that qualitative data "often have been advocated as the best strategy for discovery, exploring a new area...to supplement, validate, explain, illuminate, or reinterpret quantitative data gathered from the same setting" (p.10). Thus, Silverman (1993) pointed out that qualitative methods are not only a tool for gathering data, but also an instrument for understanding quantitative data.

In an interactive interview, interviewees have to have a deep insight into the company's structures and thus better information is gathered. In addition, an interview is an opportunity to broach several aspects if something is unclear or requires further requests.

If we consider a group interview to logistics industry, logistics correlations can be good interview target, for example when interviewees from different departments/sections are participating and discussing the structure of a port cluster. To conclude, using qualitative interviews as a method for data collection is a useful tool in port cluster research, and it is important in understanding interviewees' motives and concerns.

The data collected must be analysed and it is worth bearing in mind that the collection and analysis of qualitative data belongs to a much broader framework of data management and analysis methods. This comprises data collection, storage and retrieval, followed by data reduction, display and conclusion (Huberman and Miles, 1994).

Computer software is now available to automate some of the above process but the principles are still followed and issues such as coding and interpreting data need to be thought about by the researcher. It must be borne in mind that data collection and analysis take place simultaneously, as proposed by Huberman and Miles (1994) who conclude that the three sub processes of data analysis, data reduction and display conclusion occur before, during and after data collection.

3.4.5 Ad hoc Approach Method

The recent severe competition among ports has led to a surplus of port service suppliers and this situation in turn is leading to the relocation of suppliers by the port service consumers, such as shippers, ship owners, freight forwarders and so on.

Historically, the economic effects of a port have been the main focus of research, the employment effect as a proxy for this variable.

However, the containerisation of cargo and the growth in ship sizes have led to changes in the stevedoring pattern in a port. At the same time, the accelerative automation of port facilities, including stevedoring facilities, means bigger marginal productivity by capital investment rather than by labour investment.

Traditional benefit calculation methods emphasising employment therefore cannot reflect current situations as the employment effect is decreasing.

The Ad hoc Approach Method is a simple but accurate method, which requires a survey on the primary inputs of the industry, and also estimates the sum of Value Added directly from these

A total survey on the industry is the essential precondition in using the method, and takes lots of manpower and time, and hence cannot be attempted easily. However, as will be stated in **Chapter 6**, this study could apply this method since a total survey on the industry was conducted in advance and the data was collected from the port logistics relevant companies in Busan, Korea.

At the time of the total survey, basic data could be obtained; namely the number of companies, number of employees and gross sales. However, the data required to calculate the Value Added such as ordinary income, employment costs, net interest expense, rent, taxes and dues and depreciation could not be collected cause through a survey alone. Consequently, the estimation of the Value Added has not been possible.

Fortunately in 2002, a report was released on the Value Added of all Korean ports by the Korean government (MOMAF). The report was based exactly on the same period as the total survey in Busan. From this report, we could obtain the national average Value Added Rate of each port relevant industry.

The Acquired data on the national average Value Added Rates were instantly applied to the total survey data on the port relevant industries in Busan once again and closer estimation on the Value Added of the port relevant industry in Busan was then available.

Despite its various limitations[1], the Ad hoc Approach Method has unbeatable merits that distinguish it from other quantitative estimation models – namely, demand approach, input-output approach, CGE: computable general equilibrium approach and so on, as it directly surveys the primary inputs of the industry.

3.4.6 Case Study

Case study is known as a triangulated research strategy. Snow and Anderson (cited in Feagin, Orum, & Sjoberg, 1991) assert that triangulation can occur with data, investigators, theories, and even methodologies. Stake (1995) stated that the protocols that are used to ensure accuracy and alternative explanations are called triangulation. The need for triangulation arises from the ethical need to confirm the validity of the processes. In case studies, this could be done by using

[1] Ad hoc Approach Method cannot be used to get the optimum cost-effective investment level for certain industries, it cannot be used to evaluate the scale substitution technology, and it does not consider transaction costs.

multiple sources of data (Yin, 1984). The problem in case studies is to establish meaning rather than location.

The earliest use of case study was in France. However the methodology in the United States was most closely associated with The University of Chicago Department of Sociology. From the early 1900's until 1935, The Chicago School was preeminent in the field and the source of a great deal of the literature (Tellis, 1997). Zonabend (1992) stated that case study is done by giving special attention to completeness in observation, reconstruction, and analysis of the cases under study. Case study is done in a way that incorporates the views of the "actors" in the case under study.

Hamel (Hamel et al., 1993) asserted that the drawbacks of case study were not being attacked, rather the immaturity of sociology as a discipline was being displayed. As the use of quantitative methods advanced, the decline of the case study hastened. However, in the 1960s, researchers were becoming concerned about the limitations of quantitative methods. Hence there was a renewed interest in case study. Strauss and Glaser (1967) developed the concept of "grounded theory." This along with some well regarded studies accelerated the renewed use of the methodology.

Hamel (Hamel et al., 1993) and Yin (1984, 1989a, 1989b, 1993, 1994) forcefully argued that the relative size of the sample whether 2, 10, or 100 cases are used, does not transform a multiple case into a macroscopic study. The goal of the study should establish the parameters, and then should be applied to all research. In this way, even a single case could be considered acceptable, provided it met the established objective. Therefore, a frequent criticism of case study methodology is that its dependence on a single case renders it incapable of providing a generalizing conclusion. Yin (1993) stated that considered case methodology "microscopic" because it "lacked a sufficient number" of cases.

The literature provides some insight into the acceptance of an experimental prototype to perceive the singularity of the object of study. This ensures the transformation from the local to the global for explanation. Hamel (Hamel et al., 1993) characterized such singularity as a concentration of the global in the local. Yin (1989a) stated that general applicability results from the set of methodological qualities of the case, and the rigor with which the case is constructed. He detailed the procedures that would satisfy the required methodological rigor. Case study can be seen to satisfy the three tenets of the qualitative method: describing, understanding, and explaining.

The literature contains numerous examples of applications of the case study methodology. The earliest and most natural examples are to be found in the fields of Law and Medicine, where "cases" make up the large body of the student work. However, there are some areas that have used case study techniques extensively, particularly in government and in evaluative situations. The government studies were carried out to determine whether particular programs were efficient or if the goals of a particular program were being met. The evaluative applications were carried out to assess the effectiveness of educational initiatives. In both types of investigations, merely quantitative techniques tended to obscure some of the important information that the researchers needed to uncover.

The body of literature in case study research is "primitive and limited" (Yin, 1994), in comparison to that of experimental or quasi-experimental research. The requirements and inflexibility of the latter forms of research make case studies the only viable alternative in some instances. It is a fact that case studies do not need to have a minimum number of cases, or to randomly "select" cases. The researcher is called upon to work with the situation that presents itself in each case (Tellis, 1997).

Case studies can be single or multiple-case designs, where a multiple design must follow a replication rather than sampling logic. When no other cases are available for replication, the researcher is limited to single-case designs. Yin (1994) pointed out that generalization of results, from either single or multiple designs, is made to theory and not to take a census of the populations. Multiple cases strengthen the results by replicating the pattern-matching, thus increasing confidence in the robustness of the theory. Applications of case study methodology have been carried out in High-Risk Youth Programs (Yin, 1993) by several researchers.

The unit of analysis is a critical factor in the case study. It is typically a system of action rather than an individual or group of individuals. Case studies tend to be selective, focusing on one or two issues that are fundamental to understanding the system being examined.

Case study evaluations can cover both process and outcomes, because they can include both quantitative and qualitative data. Yin (1993) listed several examples along with the appropriate research design in each case. There were suggestions for a general approach to designing case studies, and also recommendations for exploratory, explanatory, and descriptive case studies. Each of those three approaches can be single or multiple-case studies, where multiple-case studies are replicatory, and not sampled cases. There were also specific examples in education, and management information systems. Education has embraced the case method for instructional use. Some of the applications are reviewed in this paper.

Among them, explanatory cases are suitable for doing causal studies. In very complex and multivariate cases, the analysis can make use of pattern-matching techniques. Yin and Moore (1988) conducted a study to examine the reason why some research findings get into practical use. They used a funded research project as the unit of analysis, where the topic was constant but the project varied. The utilization outcomes were explained by three rival theories: a knowledge-driven theory, a problem-solving theory, and a social-interaction theory. This thesis also will apply this method in **Chapter 6**.

In exploratory case studies, fieldwork, and data collection may be undertaken prior to definition of the research questions and hypotheses. This type of study has been considered as a prelude to some social research. However, the framework of the study must be created ahead of time. Pilot projects are very useful in determining the final protocols that will be used. Survey questions may be dropped or added based on the outcome of the pilot study. Selecting cases is a difficult process, but the literature provides guidance in this area (Yin, 1989a). Stake (1995) recommended that the selection offers the opportunity to maximize what can be learned, knowing that time is limited. Hence the cases that are selected should be easy and willing subjects. A good instrumental case does not have to defend its typicality.

3.5 Summary

This chapter dealt with the methodologies used in this thesis. Not only philosophical background such as positivism, naturalism, realism and epistemological statistics were discussed, but also the field work methodologies were introduced, such as Survey Research, Interviewing, and Ad hoc Approach Method.

Particularly relevant to RQ 4 (Which systems method and techniques are appropriate for modelling port logistics process and the port cluster system?), are industrial engineering tools and techniques to visualise the relationships within a port cluster. SADT has been selected to visualise these relationships. Furthermore, SADT diagrams have a hierarchy making it an effective method to express the port cluster. Such visualisations would help in developing our understanding of the interrelationships between the various parts and aid in the development of structured design methods. SADT is an effective technique to visualise a port cluster as a system of systems containing a hierarchy.

In addition, in order to systematically conduct this study, the Soft System Methodology (SSM) is also explored. This approach helps to formulate and structure thinking about problems in complex, human situations. Its core is the construction of conceptual models, based on the understanding of human activity systems and the comparison of those models with the real world.

CHAPTER 4

CONCEPTUAL MODEL OF PORT CLUSTER SYSTEMS

4.1 Chapter Overview

This chapter is the first chapter in the empirical part of this thesis as presented in **Figure 4-1**. This chapter introduces the two conceptual models used to set the theory; one is related to the conceptual boundary of the port clusters, and the other is concerned about the nature of port competition around port clusters. The second half of this chapter introduces root definition of port clusters from the soft systems methodology perspective.

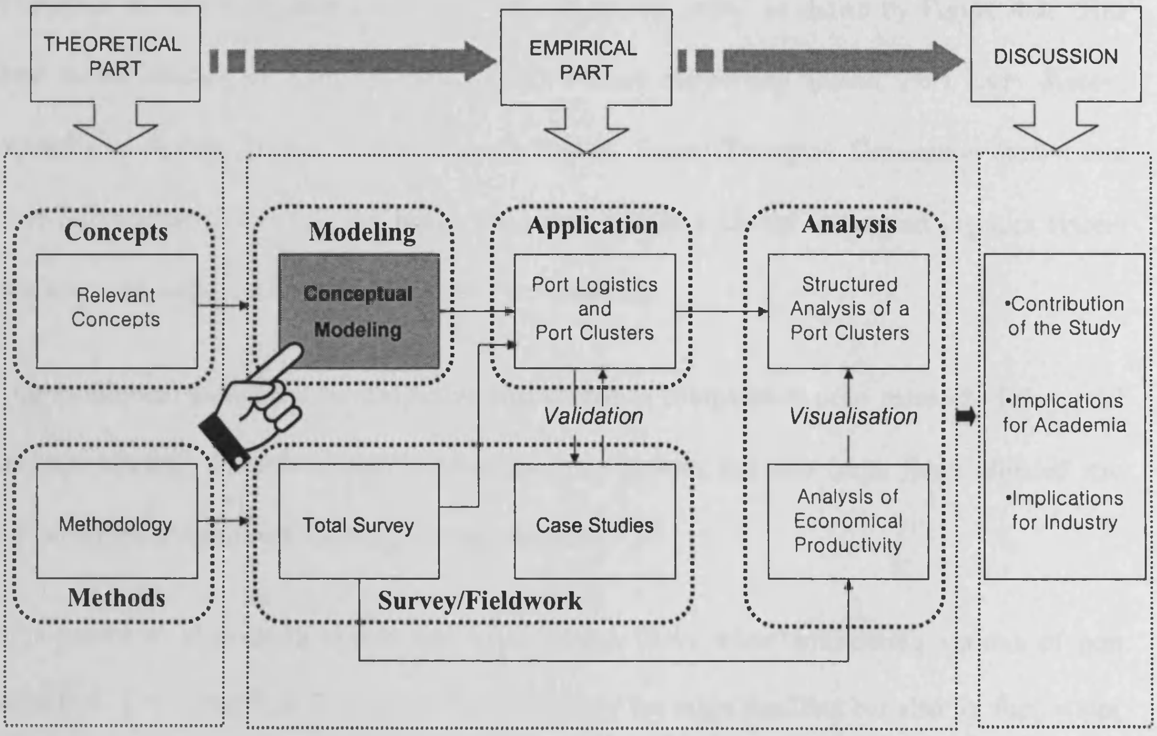


Figure 4-1 The position of 'Conceptual Model of Port Clusters System' in the thesis
Source: Author

4.2. Conceptual Model of Port Logistics System

The conceptual models of port logistics systems defined by Moon & Lee (1983) and Park (1997) have been illustrated in **Figure 2-10** and **Figure 2-11** respectively.

However, these conceptual models contain a number of weaknesses. Firstly, voyage support could not be found on either model. Also, it is inappropriate that the ship and the berth should both considered part of the stevedore system as they are different functions altogether. Further, the models only include cargo shared at the port, excluding transhipment from sea to land transport. Finally, neither model takes the cargo flows into account, but only the relationship between each sub-system.

Therefore this study suggests a new port logistics system model as shown by **Figure 4-2**. This new model consists of 7 sub-systems, namely *Voyage Supporting System, Port Entry System, Stevedoring System, Transit System, Storage System, Inland Transport Connection System and Port Information System.* In this study, the Urban System included in the port logistics system was removed since it is beyond the scope of this research.

This conceptual model has six distinctive characteristics compared to prior research: This model includes not only the relationship between each sub-system, but also cargo flows, divided into inbound (import) and outbound (export) movements.

It is useful to distinguish import and export cargo flows when considering various of port activities. For example, a ship calls at a port not only for cargo handling but also for fuel, water, spare parts or provisions; some cargo is transhipped to the other vessels without being carried into the inland; and in case of transit(T/S) cargo, this may be stored in a warehouse before loading to a ship. These various port activities will be described in a later Case Study (See. **chapter 6**).

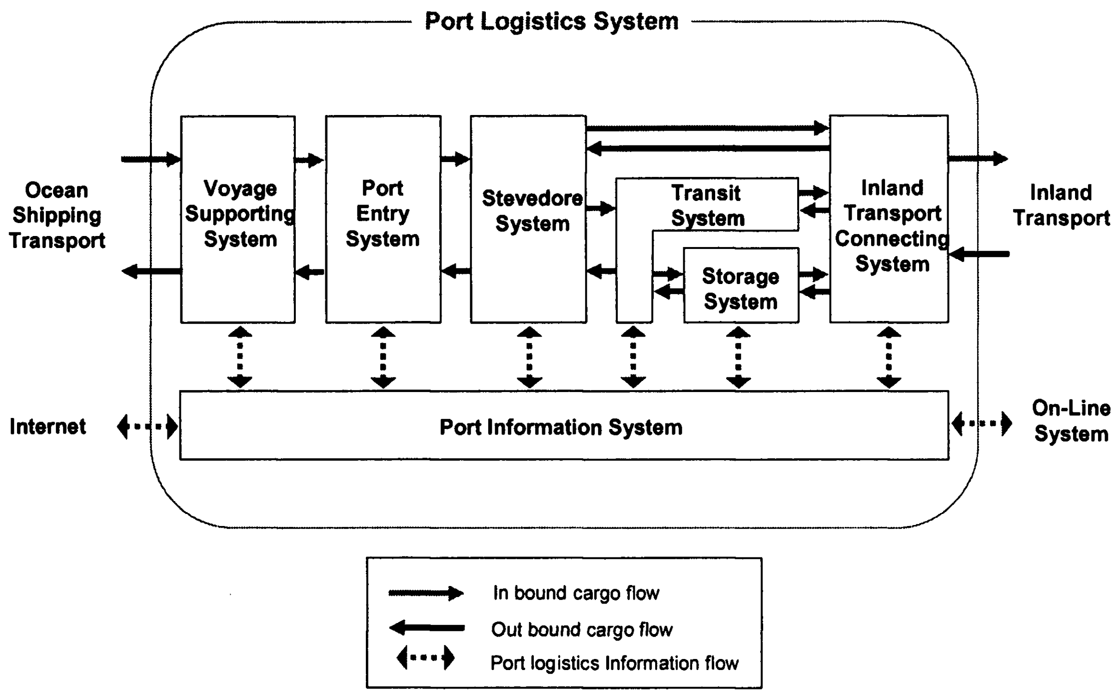


Figure 4-2 Port Logistics System Conceptual Model
Source: Author

Even though it was included in the prior research, this model excludes Port Infrastructure since it is different level from the other sub-systems. The other sub-systems are processes of port activities but port infrastructure is a kind of facility itself. This model includes Liquid Bulk Cargo flow transported immediately after discharging connected directly to the Inland Transport Connecting System, as well as Direct Carried-Out Cargo flow. The cargo flow connected to Inland Transportation after storage is also considered.

The role of the Transit System in **Figure 4-2** is particularly emphasised in this model due to considerations of the special circumstances around Busan port. The importance of the Transit System of the Busan Port is somewhat higher than other ports since the capacity of on-dock storage facilities (e.g. Container Yard) is insufficient and users depend on the storage facilities located outside of the port area (See also **Figure 2-11.** and **Figure 6-15.**)

The Port Information System was also considered in the system connecting and communicating to the other sub-systems each other. There are loading and discharging procedures both before and after the Storage System and Inland Transport Connection System, however they are omitted in this conceptual model.

4.3 Conceptual Model of Port Clusters and Related Assemblages

4.3.1 Background

Recently there has been a noticeable trend by ports to establish port clusters either via their port authorities or municipal governments. Such a trend is aimed at increasing port competitiveness by enhancing relationships between the port and associated companies in the port area.

Despite this, little research has actually been undertaken to analyse port clusters and their impact on the operational performance of both ports and companies within the cluster. A couple of exceptions have been the research applying cluster theory to the port industry (Haezendonck, 2001) and performance measurement of three existing port clusters (De Langen, 2004).

While Haezendonck and De Langen have related definitions of port clusters, the conceptual boundary of the port cluster is not clear. This makes it difficult to analyse them and design effective systems. There is also a lack of clarity between ports and other related terms such as port ranges and maritime clusters. This thesis aim to define port clusters in terms of set theory, and in particular, looks at their distinct characteristics and system boundaries.

From this, the characteristics of port clusters are defined and real-world examples of their applications are identified. A conceptual model of port clusters based on set theory is developed and applied using the North Western Europe region as an example.

4.3.2 Conceptual Model of Port Cluster and Relevant Assemblages

For a clearer understanding about the relationship between port cluster related concepts, a conceptual model using set theory is developed. A Venn diagram, shown in **Figure 4-3**, is developed based on the existing example of maritime clusters and port clusters as given in **Table 2-1** and **Figure 2-8**.

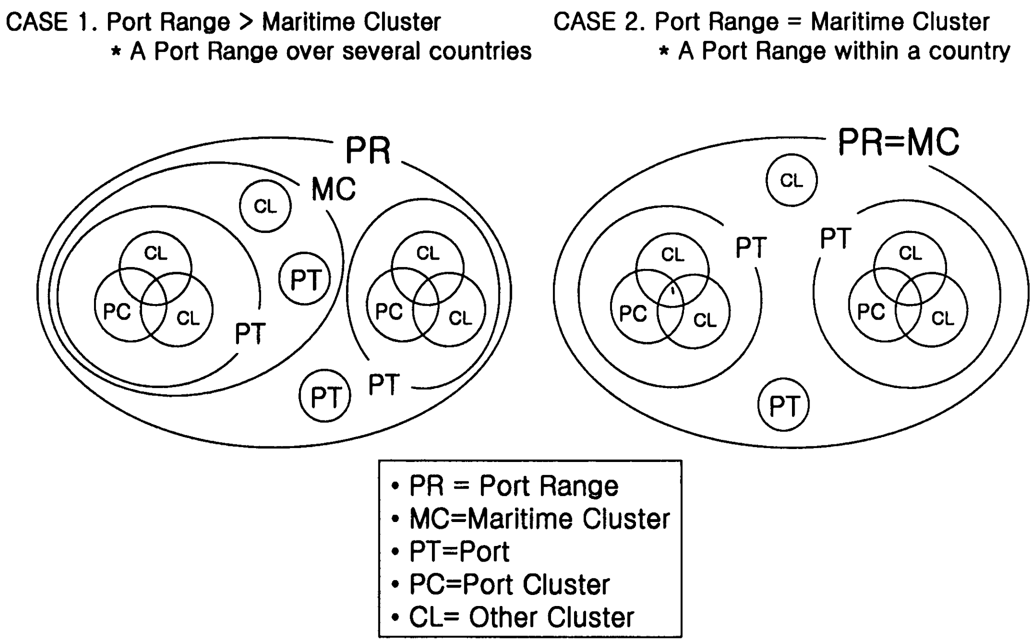


Figure 4-3 Conceptual model of Port Clusters and Related Assemblages
Source: Roh (2004)

In Case 1 the port range covers several countries while in Case 2 the port range is limited to a single country. In both cases a 'port cluster' can be shown as a subset of both the 'maritime cluster' and the 'port'. From a set theory perspective (Lipschutz, 1979) we can define the following relationships;

$$\mathbf{PR \supseteq MC \supset PT \supset PC} \quad [1]$$

for Case 1

$$\mathbf{PR \supset MC} \quad [2]$$

for Case 2

$$\mathbf{PR = MC} \quad [3]$$

where

PR = Port Range

MC = Maritime Cluster

PT = Port

PC = Port Cluster

CL = Other Clusters, such as dredging and shipbuilding

and

PC = {Direct service providers for Port Activity, Logistics and Transportation Industries relevant to the port, Public Institutes, Research and Education Institutes,......}

PT = {Port clusters, Port infrastructure, Dock labour, Cultural sites, Health and safety services...}

MC = {Ports, Shipping clusters, shipbuilding cluster, marine equipment supplies cluster, offshore cluster, inland shipping cluster, dredging cluster, port cluster, maritime services cluster, fishing cluster, navy sector, yacht building industry cluster, ship classification, tourism and recreation,......}

It is possible to apply the conceptual model to the North Western Europe region. In the 'Hamburg – Le Havre' Port Range there are many ports including the ports of Hamburg (Germany), Bremen (Germany), Amsterdam (Netherlands), Rotterdam (Netherlands), Antwerp (Belgium), Dunkerque (France) and Le Havre (France), as illustrated in **Figure 4-4**..

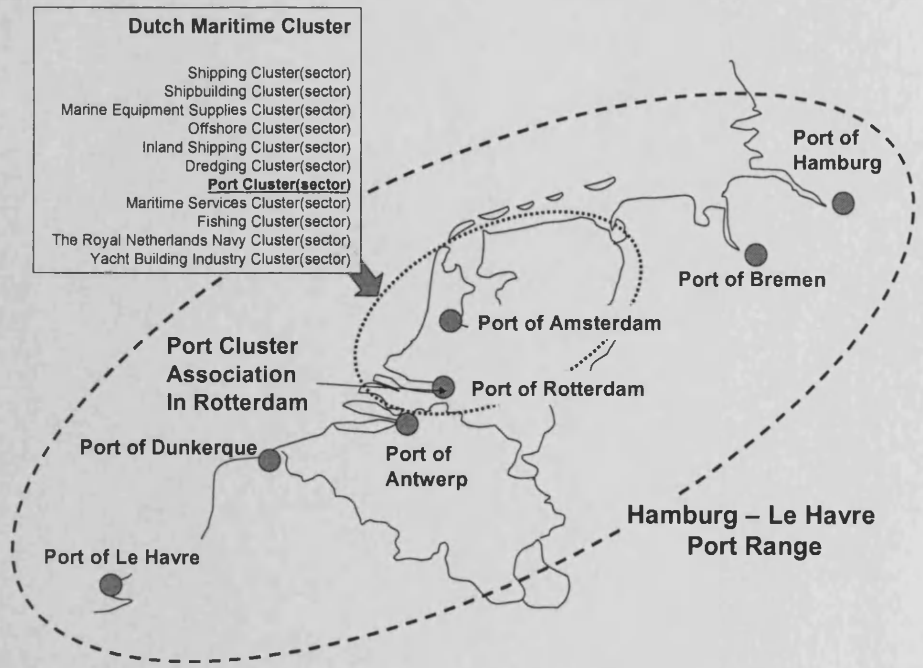


Figure 4-4 Application of the conceptual model to North Western Europe Region
Source: Roh (2004)

At the next level the Dutch Maritime Cluster covers several Dutch ports including the ports of Amsterdam and Rotterdam. Inside the Port of Rotterdam, there is the Rotterdam Port Cluster Association. The Port Range and its associated sub-sets are shown in **Figure 4-4**. Therefore, this example is equivalent to Case A in **Figure 4-3**.

As mentioned in the introduction, this thesis aims to establish a model that highlights the level at which competition happens. The concept of port clusters started with the aim of developing more appropriate strategies to win orders between competing ports. It is proposed that competition may arise at different levels of which port clusters are just one. Without understanding at which level competition arises then the wrong strategies may be `developed.

Figure 4-5 shows us a conceptual model of levels of competition between port ranges and related assemblage; maritime clusters, port clusters and port. **Figure 4-5** is based on the model of **Figure 4-3** and builds on Haezendonck's (2001, p.15) competition framework. Haezendonck proposes four levels of competition: *inter-port competition on a Port Authority Level, inter-port competition on a Commodity Level, inter-port competition on an Operator Level and Intra-port Cluster competition.* By contrast, **Figure 4-5** suggests six different levels of port competition

The first level is the 'intra-port competition', that is competition on a company level within a single port. An example is competition between two stevedoring companies.

The second is the 'inter-port cluster competition'. For example, two port clusters such as the Antwerp Port Cluster and the Rotterdam Port Cluster compete in order to gain an increased market share of traffic, cargo handling and value adding services.

Thirdly 'inter-port competition within a country' relates to the situation where two or more ports within a country compete, usually either the boundaries of a maritime cluster. An example would be Amsterdam and Rotterdam. Competition is not limited to purely commercial organisations but may also include port authorities and municipal governments.

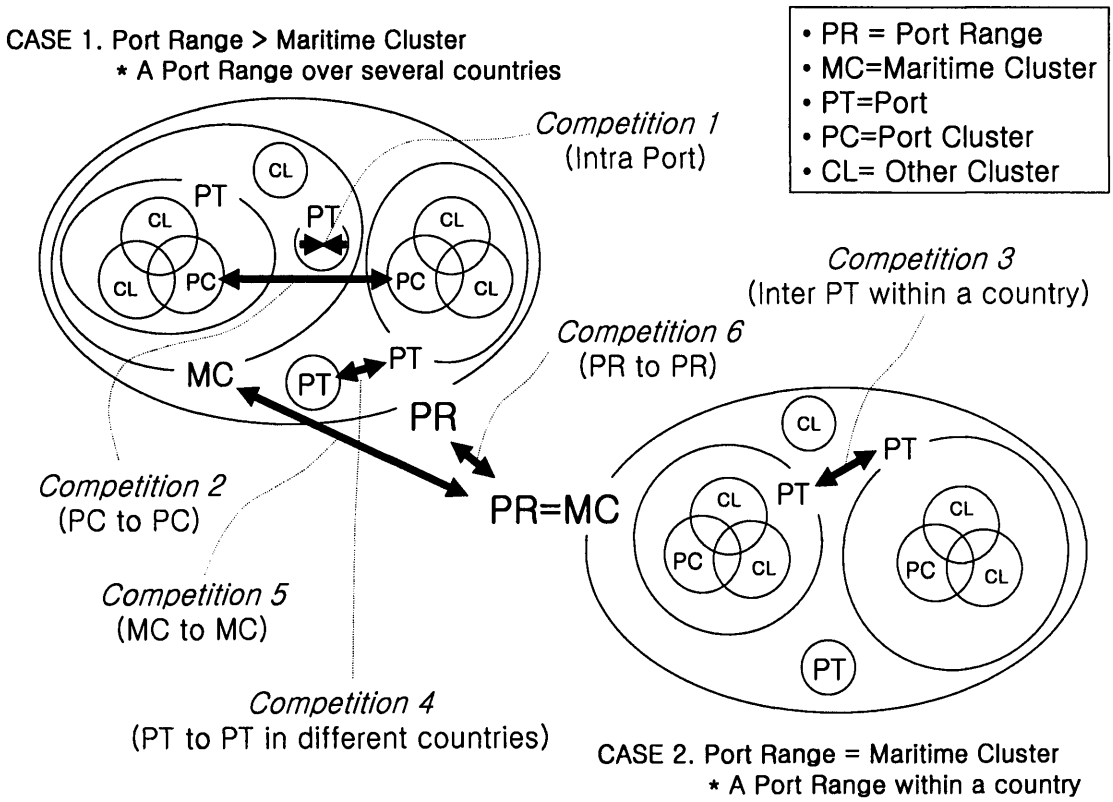


Figure 4-5 A model of competition between port clusters and related assemblage
Source: Authors

The fourth level is the 'inter-port competition between two different countries'. Here, ports in two different countries compete, regardless of whether maritime or port clusters have been established. For example, Rotterdam in the Netherlands and Hamburg in Germany compete for market share, Competition is not limited to purely commercial organisations but may also include port authorities, municipal government and central government.

The fifth level is the 'inter-maritime cluster competition between two different countries'. This may involve full scale competition between two different countries with intervention by central governments. For example, two different maritime clusters such as Dutch Maritime Cluster in the Netherlands and the London Maritime Cluster in the United Kingdom compete to gain leadership in the maritime field although in two different ways. The Dutch Maritime Cluster portrays itself as the gateway for the Europe. The London Maritime Cluster aims to be the leading centre for maritime finance, law and insurance in the world.

The final level is the 'inter-port range competition'. For example, the Hamburg – Le Havre Port Range and the Mediterranean Port Range compete in order to gain an increased market share of cargo handling and traffic of the same hinterland.

4.3.3 Validating the Conceptual Model

The verification and validation process on the proposed conceptual model for port clusters was difficult because the concept of a port cluster itself is relatively new and undefined consequently. There are few scholars or experts are familiar with the port relevant industry.

The process adapted involved serial interviews after a presentation about the model to 16 experts and scholars with various nationalities at an established international conference on ports and their related activities[1]. While 11 people (68.7%) among experts or scholars agreed to this conceptual model and 4 people (25.0%) disagreed. One answered no opinion. The expert who had no opinion explained that defining the port clusters' boundary is not so meaningful under a rapidly changing world and dynamical port environment.

The four who disagreed to this conceptual model, asserted that the processing plants and the

[1] 2004 IAME(International Association of Maritime Economics) Annual Conference in Izmir/Turkey (28 June to 2 July 2004)

multi-national companies (MNC) spring up at the FTZ similarities (Free Trade Zone)[2] in the ports also have to be included in the port clusters conceptual boundary. In other words, this concept of the port cluster should wider than just port and shipping related activities. Consequently, an expanded conceptual model for port clusters was developed (see **Figure 4-6**).

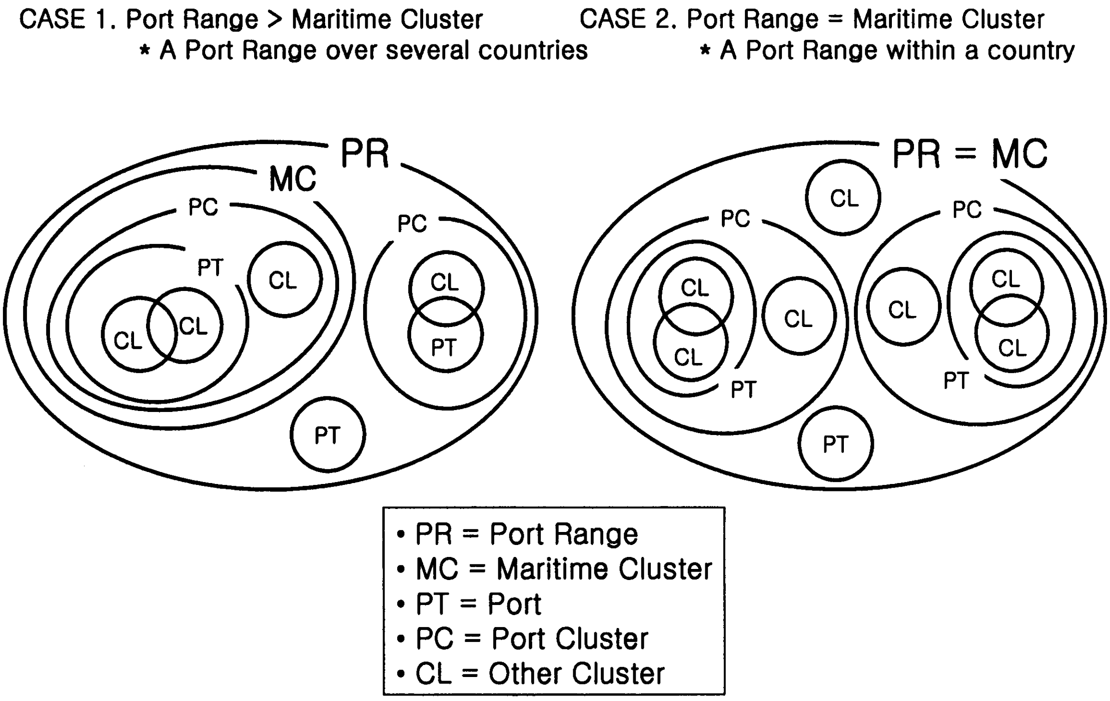


Figure 4-6 Expanded conceptual model of the port clusters and related concepts
Source: Authors

$$\mathbf{PR} \supseteq \mathbf{MC} \supset \mathbf{PC} \supset \mathbf{PT} \qquad [1]$$

for Case 1

$$\mathbf{PR} \supset \mathbf{MC} \qquad [2]$$

[2] As relevant to the FTZ concept, even though they have slight difference, Free Port, Free Zone, Bonded Area, Integrated Bonded Area, Special Economic Zone and Special Economic District, etc. are still active in the ports of the world.

for Case 2

$$\mathbf{PR = MC} \quad [3]$$

where

PR = Port Range

MC = Maritime Cluster

PC = Port Cluster

PT = Port

CL = Other Clusters, such as dredging and shipbuilding

and

PT = {Port infrastructure, Dock labour, Cultural sites, Health and safety services…}

PC = {Ports, Direct service providers for Port Activity, Logistics and Transportation Industries relevant to the port, Public Institutes, Research and Education Institutes, processing plants or the multi-national companies (MNC) in FTZ similarities in the port ......}

MC = {Ports, Shipping clusters, shipbuilding cluster, marine equipment supplies cluster, offshore cluster, inland shipping cluster, dredging cluster, port cluster, maritime services cluster, fishing cluster, navy sector, yacht building industry cluster, ship classification, tourism and recreation,……}

Nevertheless, these opinions reflect future developments for port clusters rather than current practice. One reason is that FTZs have different regulations across different ports. Second, it is still difficult to find the apparent difference between manufacturers working in and out of the FTZ similarities. It is because many of the manufacturers are working in the FTZ only for the benefit of tax without concerning the port.

In Case 1 the port range covers several countries while in Case 2 the port range is limited to a single country. In both cases a 'port' that is specific to a port cluster can be shown as a subset of the 'maritime cluster' as well as the 'port cluster' (compare with **Figure 4-3**). We can also define the following relationships:

4.4 Soft System Methodology for Port Cluster Systems

4.4.1 Rich Pictures

The analysts' first task is to 'express' the problem situation - to form a *rich picture* (See. **Figure 4-7**). A rich picture is a 'thorough, but non-judgmental understanding' (which is acquired through normal investigative techniques), and has become associated in SSM with a by using pictures rather than words, a deeper understanding of the problem can be gained (Rose, 2005).

Pictures also display relationships - the way business functions work together, for instance - better than text.

Rich pictures are normally hand drawn, and may include elements of *structure* (the departments of a university, for instance), or *process* (studying, examining), *issues, concerns,* or *developments* (implementing a quality service).

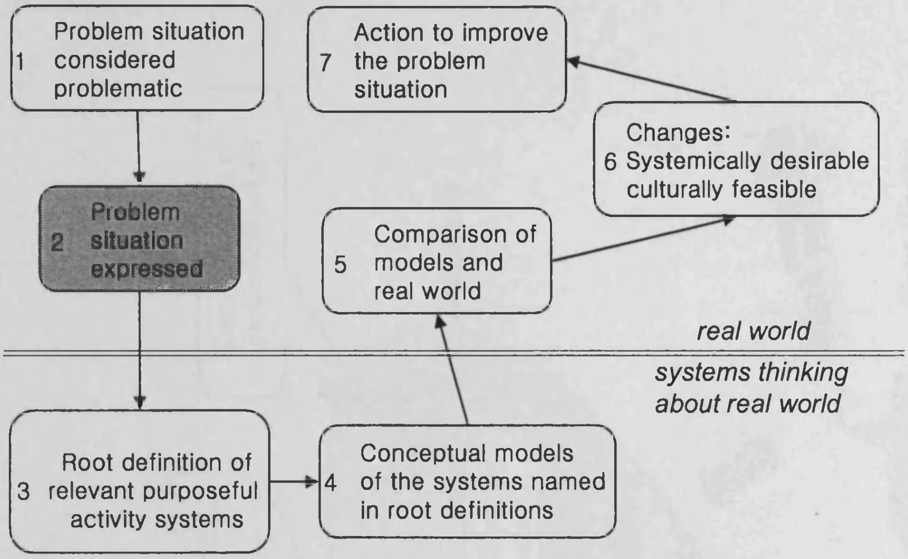


Figure 4-7 'Rich Picture' among Checkland's seven stage of SSM
Source: Checkland (1984)

They depict what is considered important in the problem situation. There are no rules; some graphical talent obviously helps, but is not a pre-requisite since the purpose is investigative, rather than artistic. Matchstick men and women are common, sometimes with bubbles coming out of their mouths to indicate important issues, crossed represent conflict while eyeballs indicate something being overlooked, inspected or supervised.

Figure 4-8 illustrates the rich picture of this research using SSM.

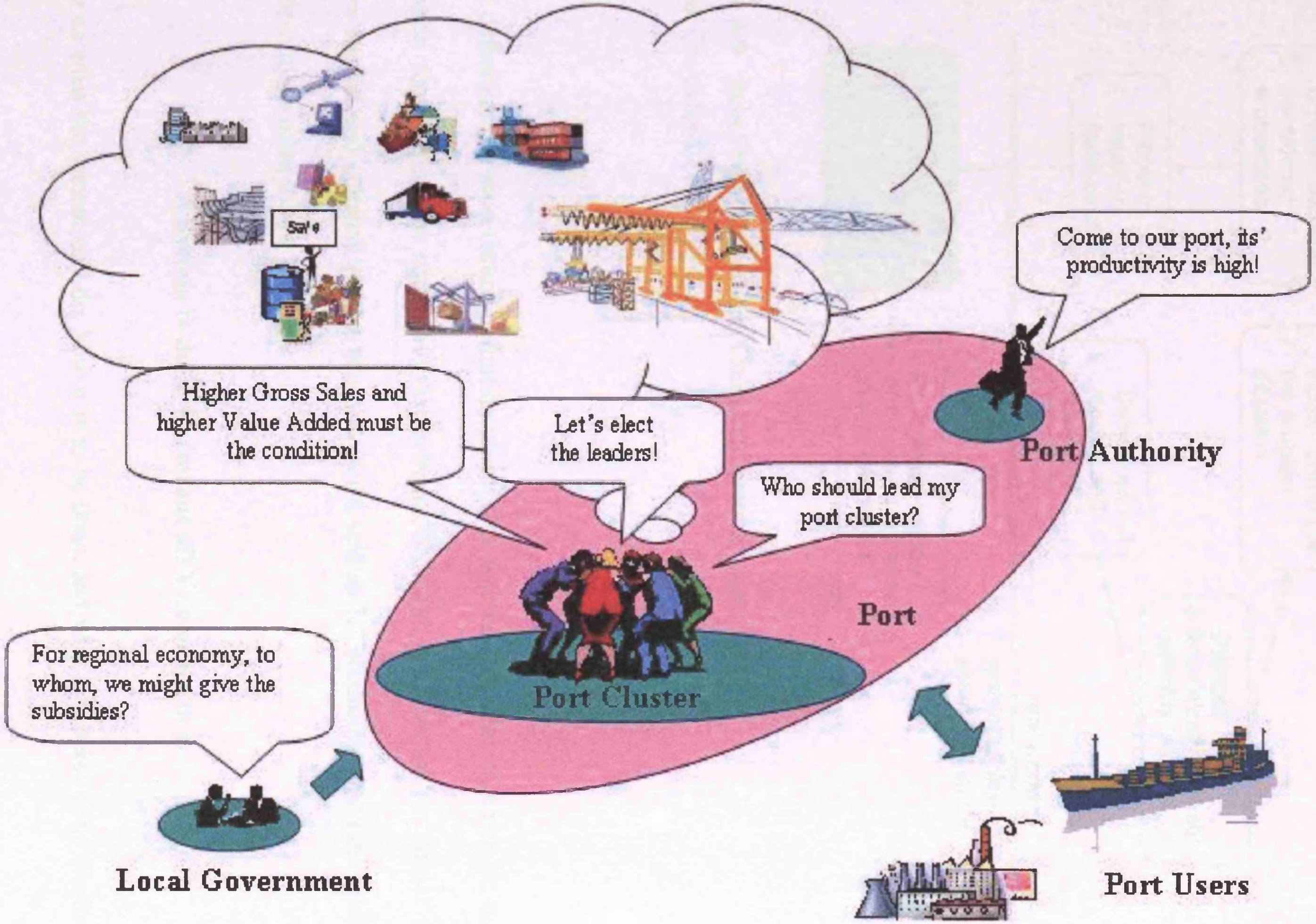


Figure 4-8 Rich picture of this dissertation (as 'mode 1' SSM)
Source: Author.

4.4.2 Root Definitions (CATWOE)

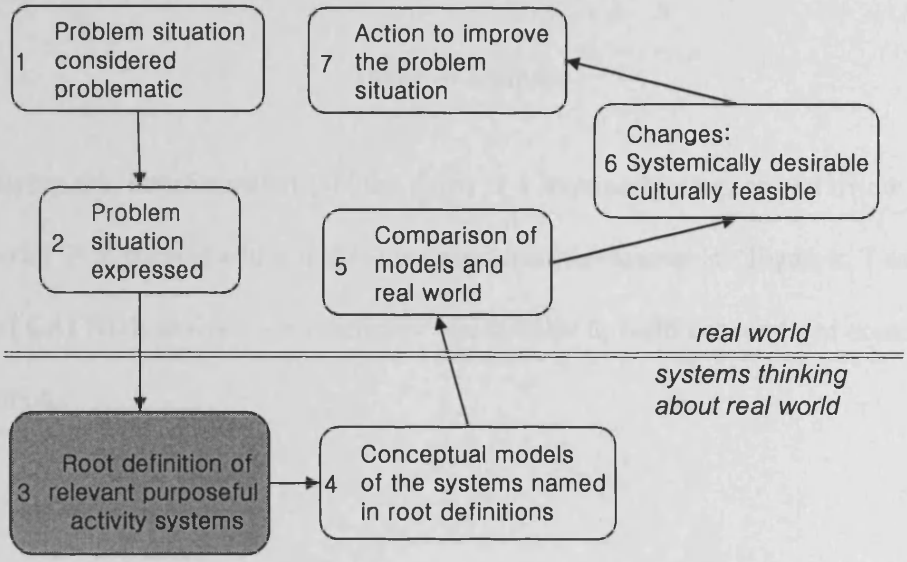


Figure 4-9 'Root Definition' among Checkland's seven stage of SSM
Source: Checkland (1984)

A root definition is a short textual definition of the aims and means of the system to be modelled. Remember that it is not the real world that is being modelled, but potential or 'virtual' systems that are logical and coherent (which the real world seldom is) according to systems principles. Root definitions often follow the form:

A System to do X, by (means of) Y, in order to Z

It tells us what the system will do, how it is to be done, and why it is being done (its long term aims).

> **A Port Cluster chooses the leader industries/companies(X) by means of evaluation of the industrial productivity i.e. Gross Sales, Added Values (Y) in order to lead the constituents of the Port Cluster (Z)**

Each conceptual system has at its heart a transformation process in which something, an input, is changed, or transformed, into some new form of itself, an output. This is normally notated as:

Input → Output

Accompanying this transformation ('T' for short) is a weltanschauung, or worldview. This is a very powerful SSM concept which makes the transformation reasonable. Together, T and W form the core of CATWOE analysis – a mnemonic which helps to build coherent and comprehensive root definitions.

Here are the components:

Customers	the victims or beneficiaries of T
Actors	those who do T
Transformation process	input → output
Weltanschauung	the worldview that makes the T meaningful in context
Owners	those with the power to stop T
Environmental constraints	elements outside the system which are taken as given, but nevertheless affect its behavior

Although some of these terms are commonly used, they have particular meanings in SSM which do not necessarily correspond exactly with their everyday meanings. Each element of CATWOE will be identifiable from a good root definition, if only by implication. For this study the CATWOE comprises

Customers	constituents of the Port Cluster System
Actors	constituents of the Port Cluster System

Transformation process	constituents of the Port Cluster System → chosen leader industries/companies as the leader
Weltanschauung	the belief that high industrial productivity is a good criterion to choose the leader industries/companies
Owners	constituents of the Port Cluster System
Environmental constraints	interest of local government & port authority, and standard of industrial productivity

4.4.3 Conceptual Models

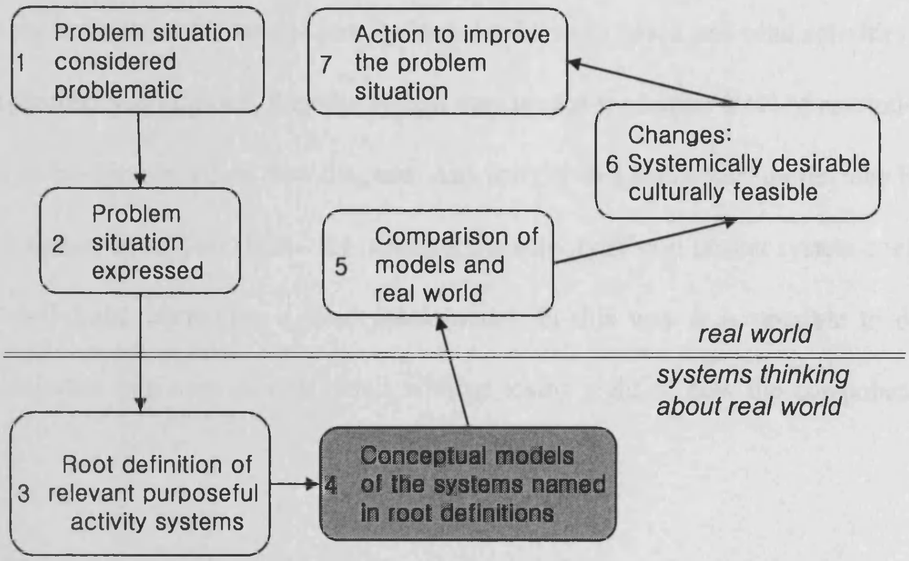


Figure 4-10 'Conceptual Model' among Checkland's seven stage of SSM
Source: Checkland (1984)

Conceptual models demonstrate potential activities and their logical dependencies (See **Figure 4-10**). The activities, which must be expressed in a verb noun phrase ('do something,' 'open new factory' etc.) are placed in rough, hand drawn bubbles. The bubbles may be joined by arrows, indicating dependence, where either one activity cannot be performed unless the other is completed or that it will be done poorly if the other is done poorly.

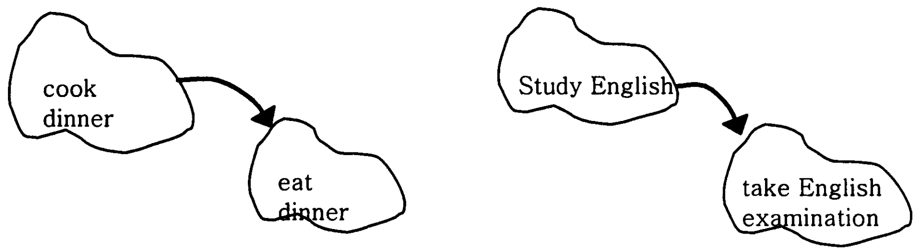


Figure 4-11 How to express the conceptual model
Source: Rose (2005)

A reasonably understandable model usually includes between seven and nine activities.. If more detail or complexity is required, then the system may model at a higher level of resolution. This is equivalent to levelling in a data flow diagram. Any activity in a conceptual model may be taken to represent a system in its own right – for instance, the activity of port cluster system could have its own root definition, leading to a conceptual model. In this way it is possible to decompose complex activities into considerable detail without losing sight of how the component parts fit together.

Figure 4-12 is a conceptual model built from the root definition of a port cluster system outlined above.

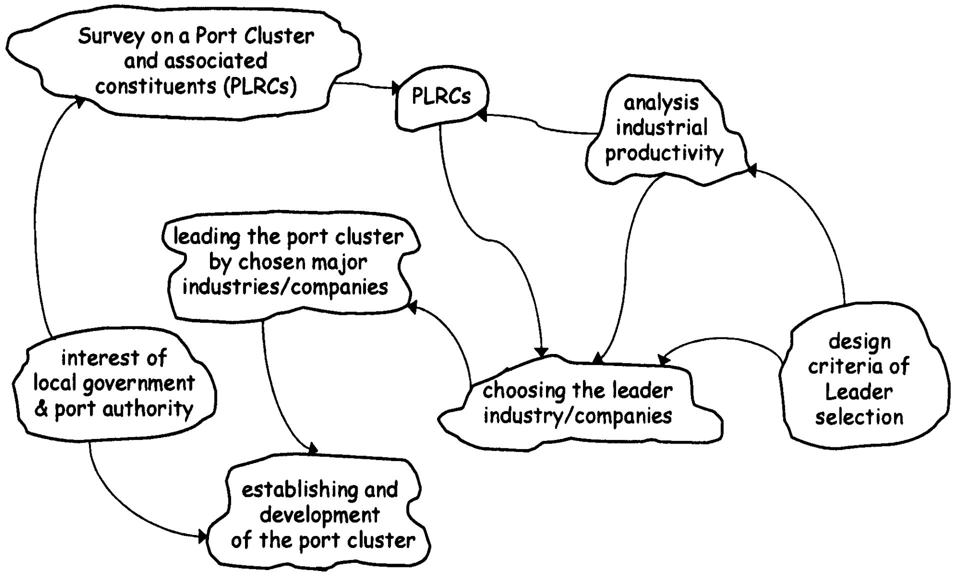


Figure 4-12 Conceptual Model on port cluster system by SSM
Source: Author

According to the formal systems model, every human activity system, must be able to have its performance evaluated and regulated itself when the desired performance is not achieved. It is normal to make these monitoring and control mechanisms explicit in a conceptual model, and in particular establish performance measures. SSM describes these in terms of efficacy, efficiency, and effectiveness which, like the terms in CATWOE, have well defined meanings:

E^1 – **efficacy** – does the system work – is the transformation achieved?

E^2 – **efficiency** – a comparison of the value (not necessarily monetary) of the output of the system and the resources needed to achieve that output – in other words, is the system worthwhile?

E^3 – **effectiveness** – does the system achieve its longer term goals? – (closely allied, therefore, with the Z of root definition)

It is an essential discipline to say how, for any given system, the three **E**'s will be measured.

The measures of performance for a port cluster system are:

Figure 4-13 and **Figure 4-13** is the complete conceptual model that has been developed:

> A Port Cluster chooses the leader industries/companies **(X)** by means of evaluation of the industrial productivity i.e. Gross Sales, Added Values **(Y)** in order to lead the constituents of the Port Cluster **(Z)**

Customers	constituents of the Port Cluster System	E^1	Are the leading industries/companies necessarv to choose?
Actors	constituents of the Port Cluster System		
Transformation process	constituents of the Port Cluster System → chosen leader industries/companies as the leader	E^2	How much industrial productivity, of what standard, is necessary to be the leading industries/companies?
Weltanschauung	the belief that high industrial productivity is a good criterion to choose the leader industries/companies		
Owners	constituents of the Port Cluster System	E^3	Do the constituents of the Port Cluster find the industrial productivity a useful way of choosing the leading industries/companies?
Environmental constraints	interest of local government & port authority, and standard of industrial productivity		

Figure 4-13 Root definition of this thesis - including monitor and control process

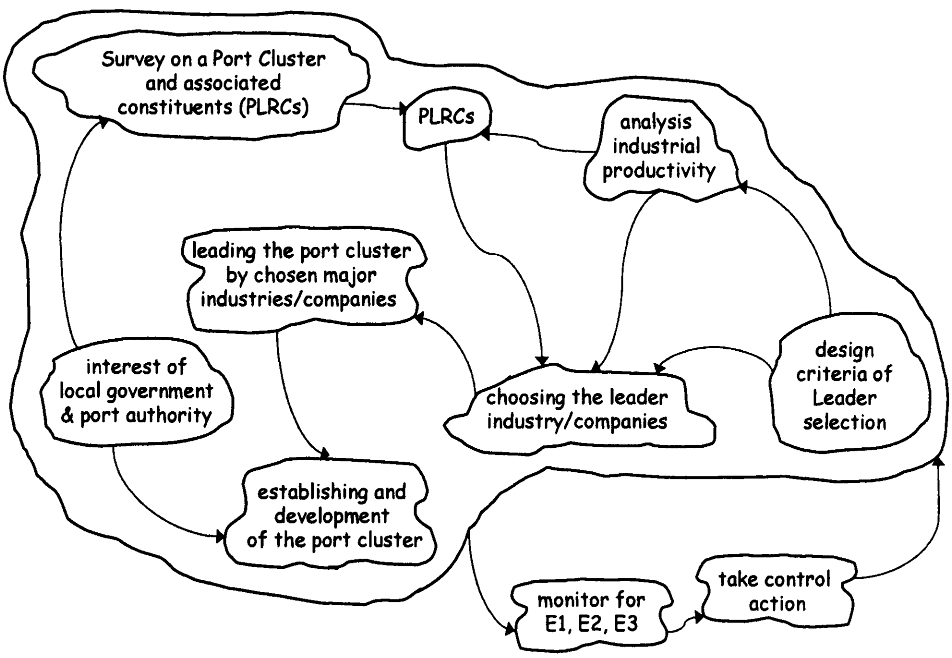


Figure 4-14 Conceptual model of port cluster system by SSM - including monitor and control process

Source: Author

4.5 Summary

This chapter introduced two conceptual models used to set the theory. One is related to the conceptual boundary of the port clusters and answer RQ1 and RQ2. The other is concerned about the type of competitions between ports in a cluster. The second half of this chapter introduces root definition of a port cluster from the soft system methodology perspective.

Based on secondary data, the set theory has been utilised to visualise the interrelationship between various assemblages such as ports, port clusters, maritime clusters and port ranges. This helps to clarify the various terms. The potential application of the model to the North Western Europe region is outlined. More importantly, the model is extended to identify six levels of competition from which appropriate company and port strategies, and government policies may be developed.

The proposed conceptual model was validated by 16 experts and scholars who attended a well-established international conference on ports through serial interviews. 68.7% of experts or scholars agreed to this conceptual model while the others asserted that the processing plants or multi-national companies (MNC) that establish themselves in the FTZ (Free Trade Zone) have to be included within the port cluster's conceptual boundary.

This thesis presented that an expanded conceptual model regarding an advisable direction for the port clusters development and it helps to understand the port clusters concept is expanding towards including the port concept in it, no more than confined within a port concept.

The second part is concerned about application of Soft System Methodology (SSM) into port cluster system for RQ 4. At **Chapter 3**, it was mentioned why this study chooses SSM as a proper methodology, but SSM helps formulate and structure thinking about problems in complex human situations. Its core is the construction of conceptual models, based on the understanding of human activity systems outlined above, and the comparison of those models with the real world.

This study conducted according to the seven stages of SSM which has come to be known as 'mode 1' SSM suggested by Checkland (1990), and it comes under the second stage to the fourth stage among the seven stages. This below are the Root Definition including CATWOE that has been built up in this chapter and it shows the perspective and the goal of this study concisely.

CHAPTER 5

PORT OF BUSAN

5.1 Chapter Overview

This chapter shows the results of a total survey conducted in 2000 by the author, among port logistics companies in Busan, Korea, 1,699 companies and 36,894 workers. The results of the survey will be displayed not only as a statistical table but also as a geographical figure.

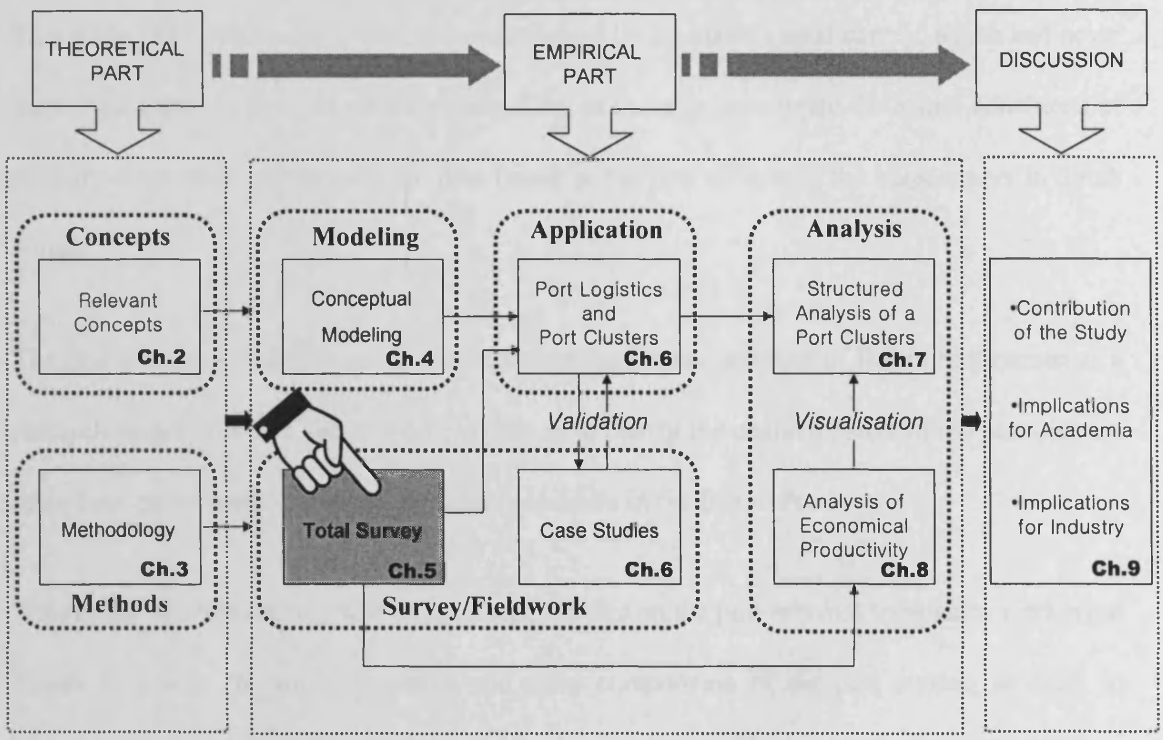


Figure 5-1 The position of 'Port of Busan' in the thesis

Source: Author

As well as this, additional fieldwork (serial group interviews and case studies) was conducted for the validation of the second conceptual model developed in Chapter 6. Industrial classification for the total survey and a more specific industrial classification used will also be discussed in this chapter as well.

Prior pieces of research relevant to the port clusters are not many. Some of them tried to conduct an empirical research on the whole port clusters using an inductive approach; even so this method has the obvious and fundamental limit to understanding by the data on the actual condition of the relevant companies or the port cluster. This is because there are very few ports or port cities in the world that have exclusive statistics of activities in which port relevant companies are involved.

This study has significance in that it was conducted by means of a total survey, which had never been tried before in the port clusters study field, in order to investigate the actual conditions of relevant companies and to generate data based in the port of Busan, the biggest port in South Korea.

The first purpose of this chapter is to understand the present position of Busan Port chosen as a research target area and the second purpose is to clarify the characteristics of the port clusters units through an investigation of the actual condition in the Busan Port.

The results of a total survey will be presented that are on the port relevant companies working at Busan Port who are the main actors and main components of the port cluster, in order to understand how many companies there are and what they work for. This chapter will be focused on what kind of port relevant companies there are and how they are involved in either direct or indirect port logistics process. In other words, the prior chapters are relevant to providing the answer for the question "Who (what) are they?" However, this chapter is concerned with answering the following question: "What do they do?"

5.2 OUTLINE OF BUSAN PORT

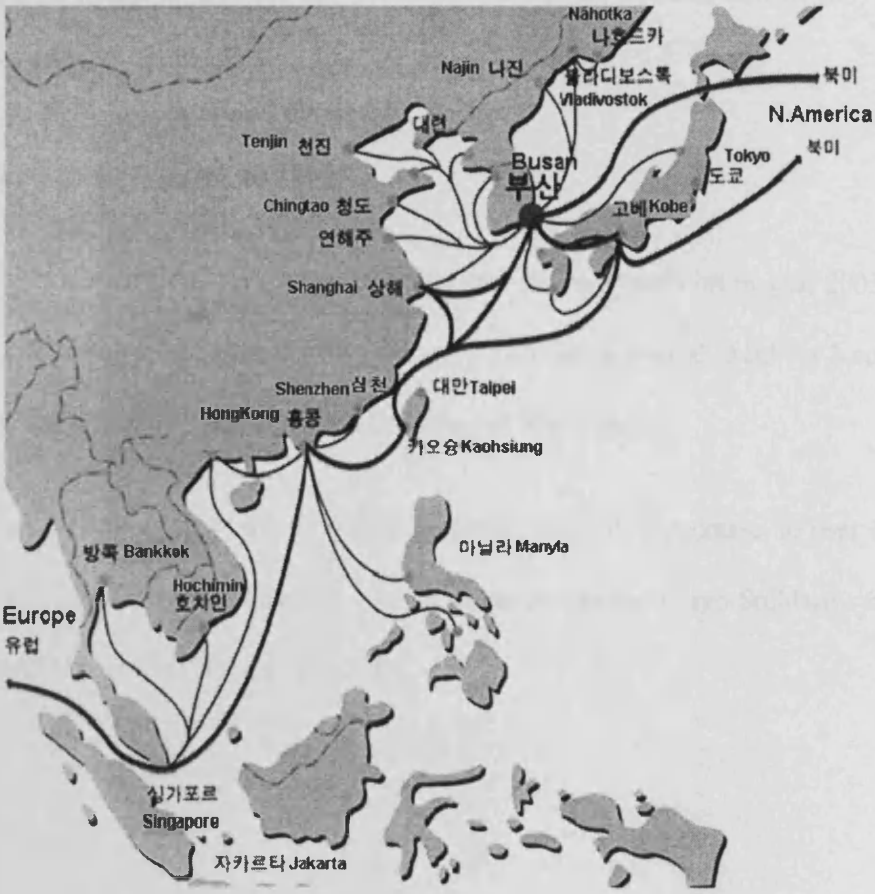


Figure 5-2 Major Voyage Routes to Busan Port and other Asian Ports

Source: Author

Busan Port is located at the southeastern end of the Korean Peninsula (35° 04′ 42" north latitude and 129° 01′ 01" east longitude, See **Figure 5-2**). Surrounded by mountains and islands, Busan Port offers still water surface within the port and little difference between rise and fall of the tide. Located adjacent to one of the three international arterial routes as well, Busan Port is equipped with the natural advantage in terms of requirements as a port.

As the foremost port in Korea, Busan Port processes 40% of total marine export cargoes and 81% of container cargoes in Korea as well as 42% of marine products domestically produced (PBA, http://www.pba.or.kr).

5.2.1 Cargo Volume of Busan Port

From the container cargo volume perspective, the rank of the Busan Port in year 2003 dropped down to the 5^{th} in the world from the 3^{rd} position, which was previously kept for 3 consecutive years. It was overtaken by Port of Shanghai and Port of Shenzhen.

The container cargo volume of the year 2003, however, was still in increase, to over 10 million TEU in spite of two times of collective transport rejection by the Cargo Solidarity and severe typhoon 'MAEMI' as it is shown in **Table 5-1**.

Table 5-1 Container Cargo Volume of the major port in the world.

(Unit: TEU, %)

Rank 2003	Rank 2002	Port	2003	2002	Rate of Increase (%)	Country
1	(1)	Hong Kong	20,449,000	19,144,000	6.8	China
2	(2)	Singapore	18,410,500	16,941,000	8.7	Singapore
3	(4)	Shanghai	11,280,000	8,620,000	30.9	China
4	(6)	Shenzhen	10,610,832	7,614,000	39.4	China
5	(3)	Busan	10,407,809	9,453,356	10.1	S. Korea
6	(5)	Kaohsiung	8,843,365	8,493,052	4.1	Taiwan
7	(8)	Los Angeles	7,178,940	6,105,863	17.6	U.S.A
8	(7)	Rotterdam	7,107,000	6,506,000	9.2	Netherlands
9	(9)	Hamburg	6,138,000	5,374,000	14.2	Germany
10	(10)	Antwerp	5,445,437	4,777,387	3.0	Belgium
11	(13)	Dubai	5,151,955	4,194,264	22.8	UAE
12	(11)	Port Klang	4,841,235	4,530,000	6.9	Malaysia
13	(12)	Long Beach	4,658,124	4,526,365	2.9	U.S.A
14	(15)	Chingtao	4,225,000	3,410,000	23.9	China
15	(14)	NY/NJ	4,145,000	3,749,014	10.6	U.S.A
16	(20)	Tanjung Pelepas	3,487,320	2,660,000	31.1	Malaysia
17	(19)	Tokyo	3,280,000	2,712,348	20.9	Japan
18	(16)	Bremen/Bremerhaven	3,190,707	2,998,598	6.4	Germany
19	(21)	Lam Chabang	3,180,130	2,656,651	19.7	Thailand
20	(17)	Gioia Tauro	3,148,662	2,954,571	6.5	Italy

Souice: CONTAINERISATION INTERNATIONAL 2004. MAR. from PBA

5.2.2 Port Operation

Table 5-2 shows operation condition of the exclusive container terminals in Busan Port.

In case of 2003, you may find 2,070,809 TEU of gap between total container volume of the Busan Port (10,407,809 TEU) and of the exclusive container terminals (7,707,000 TEU). It comes from the container volume handled by general cargo terminal.

It is not only the cargo volume but also the number of berthing ship that is constantly increasing, in line with the growing berthing time. From the increase of PBO (Rate of berth occupation by a ship) in **Table 5-2,** it becomes clearer that coefficient of utilisation has been over 50% since 2002.

In contrast, we can a find that ABT (Average of Berthing Time by a ship) and AVCH (Average Cargo Handling Volume by a ship) have been decreasing. It means that efficiency and productivity of the terminals and the ships have been improving not rapidly but steadily. It is not difficult to suppose that those effects must come from the development of technology of the facilities and the ship.

Table 5-2 Operation Condition of the Exclusive Container Terminals in Busan Port

		1999	2000	2001	2002	2003
Cargo Volume (thousand TEU)	Total	4,245	5,073	5,395	6,813	7,707
	Jasungdae	885	1,323	1,272	1,535	1,584
	Shinsundae	1,177	1,282	1,320	1,528	1,786
	Uam	349	312	448	502	533
	Gamman	1,398	1,769	1,922	2,261	2,546
	New Gamman	-	-	-	481	746
	Gamcheon Hanjin	436	387	433	506	512
Ships of Berthing (Ships)	Total	3,640	4,368	4,809	5,448	6,155
	Jasungdae	935	1,156	1,283	1,282	1,362
	Shinsundae	899	869	980	975	1,142
	Uam	593	556	545	695	618
	Gamman	849	1,427	1,629	1,643	1,718
	New Gamman	-	-	-	505	885
	Gamcheon Hanjin	364	360	372	348	430
Berthing Time (hrs)	Total	63,670	74,934	70,002	93,718	102,931
	Jasungdae	15,895	18,888	17,679	24,813	23,400
	Shinsundae	14,964	17,931	16,078	18,219	21,158
	Uam	9,888	9,433	9,418	11,745	12,040
	Gamman	15,205	21,997	19,474	24,493	25,167
	New Gamman	-	-	-	7,140	12,673
	Gamcheon Hanjin	7,718	6,685	7,353	7,308	8,493
RBO* (%)	Average	46.4	52.0	49.6	54.0	60.7
	Jasungdae	45.4	53.9	50.5	56.8	66.8
	Shinsundae	42.7	51.2	45.9	52.1	60.4
	Uam	56.4	53.8	53.8	67.2	68.7
	Gamman	43.4	62.8	55.6	70.1	71.8
	New Gamman	-	-	-	35.9	48.2
	Gamcheon Hanjin	44.1	38.2	42	41.8	48.5
ABT** (hrs)	Average	18	18	16	17	17
	Jasungdae	17	16	14	19	17
	Shinsundae	17	21	16	18	19
	Uam	17	17	17	17	19
	Gamman	18	15	12	15	15
	New Gamman	-	-	-	14	14
	Gamcheon Hanjin	21	19	20	21	20
AVCH *** (TEU)	Average	1138	1099	1101	1212	1184
	Jasungdae	947	1,144	992	1,197	1,163
	Shinsundae	1,309	1,475	1,347	1,567	1,564
	Uam	589	562	821	723	862
	Gamman	1,647	1,240	1,180	1,376	1,482
	New Gamman	-	-	-	953	843
	Gamcheon Hanjin	1,198	1,074	1,164	1,454	1,191

* **PBO** (Rate of Berth Occupation by a ship, %) = (Total Berthing Time / Number of Berth x 24hrs x Days) x 100
** **ABT** (Average of Berthing Time by a ship)
*** **AVCH** (Average Cargo Handling Volume by a ship)
Source: PBA

5.2.3 Port Facilities

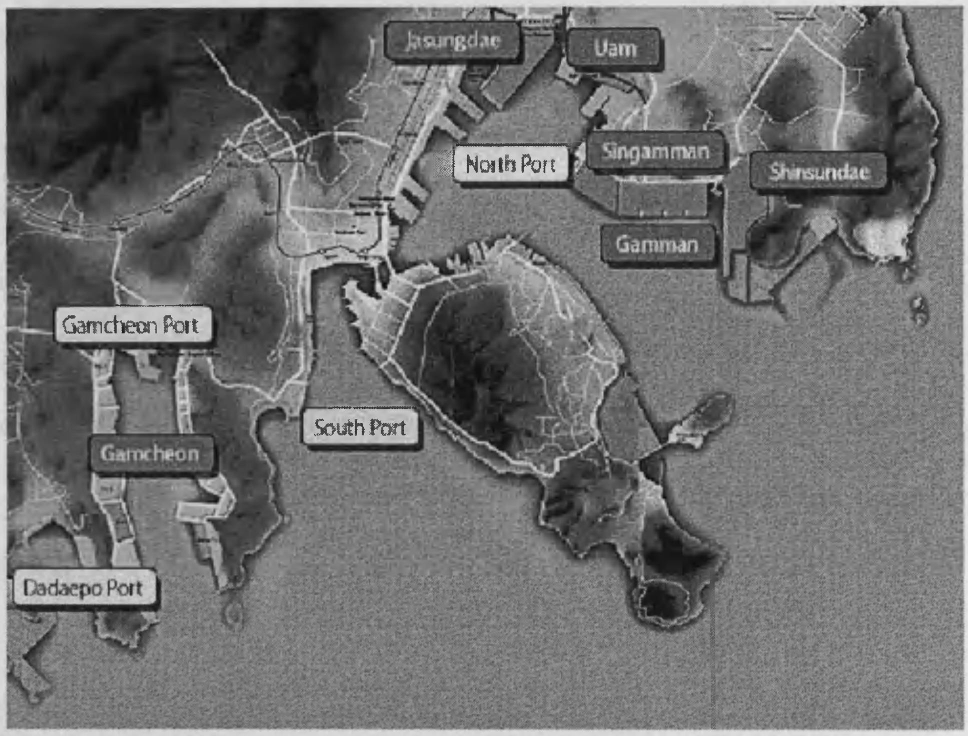


Figure 5-3 Port Facilities in Busan Port

Source: PBA(http://www.pba.or.kr)

Port of Busan, called as Busanpo in 1876, has been undergoing continuous harbor development since the commencement of the first wharf construction in 1906. Through such continuous effort, Busan Port has been developed as a modernized harbour, equipped with 4 ports including the North Port, East Port, Gamcheon Port and Dadaepo Port as well as 6 container terminals and an international passenger terminal (See **Figure 5-3**).

Currently, Busan Port is equipped with the capacity to annually process 91 million tons of cargo together with 26.8km of quay wall facility enabling simultaneous facilitation of 169 vessels. On the other hand, in accordance with the increasing container volume, the development for Busan New Port is being promoted for completion in 2011 to enable simultaneous berth of 30 vessels as well as processing of 8.04 million TEU containers per annum (PBA 2005, www.pba.or.kr).

It is located in the west of the Port of Busan, aimed at solving problems arising from lack of the facilities. The planned period of the project is from 1995 to 2011 (16 years) and the estimated total project cost is 9,154.2 billion won (approx. GBP4.58 billion). KW 4,173.9 billion (GBP 2 billion) has been invested from the government and KW 4,980.3 billion (about GBP2.58 billion) has been sourced by investors from private sectors (See **Figure 5-4**). The goals of the project are to build port facilities (including container wharf of 30 vessels positions) and the surrounding site of 3.24 million pyeong (2,647 acres) (See **Table 5-3**).

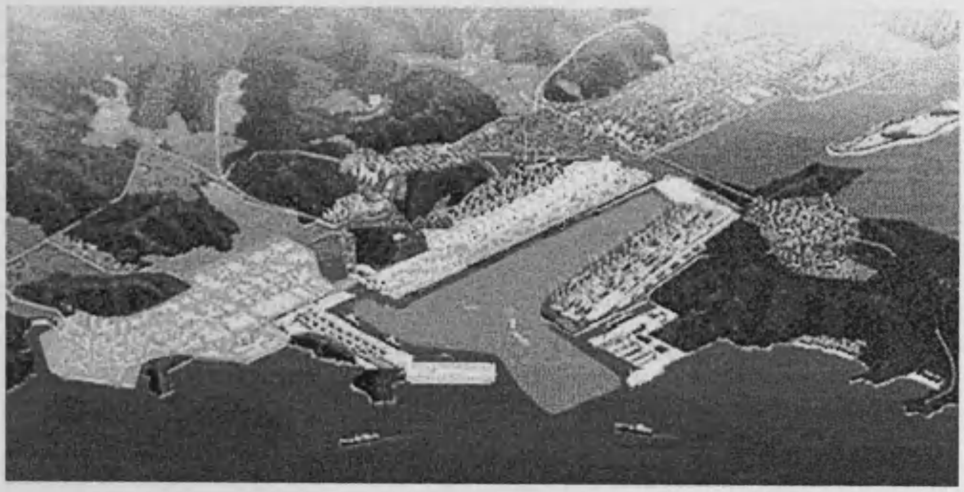


Figure 5-4 Bird eye view of Busan New Port

Source: PBA (http://www.pba.or.kr)

Table 5-3 Outline of Busan New Port Project

Classification		Overall (1995~2011)	Stage 1 (1995 ~2008)	Stage 2 (2009 ~2011)
Total	Project Cost (100 million won)	91,542	55,519	36,023
	Project Scale (No. of Vessel Positions)	30	14	16
	Results (10,000 TEU)	804	352	452
Government	Project Cost (100 million won)	41,739	28,012	13,727
	Project Scale	1.49km of breakwater	1.49km	-
		20.8km of ground revetment	20.8km	-
		62million m2 of dredging	40 million m2	22 million m2
		Connecting 0.3km of pier	0.3 km	-
		0.4km of multi-purpose wharf (1 vessel position)	0.4 km(1 vessel position)	
	(No. of Vessel Positions)	1 fishery compensation, etc.	1	1
Private Sector	Project Cost (100 million won)	49,803	27,507	22,296
	Project Scale (No. of Vessel Positions)	9.55 km (29)	4.3km of quay wall (13)	5.25km (16)

Source: PBA (http://www.pba.or.kr)

5.3 A TOTAL SURVEY OF THE PORT RELEVANT INDUSTRIES

Prior researches relevant to the port clusters are not many. Even those few that were carried out were confined within the deductive approach that is associated with construction of port clusters and measurement of such performance, which is based on the strategic theory of clusters.

The reason for this is that, except in the case of Rotterdam in the Netherlands, there is no known port cluster association so far. In most of the ports in the world, service companies which support the port logistics activities have comparatively small capital and are of small sizes. Consequently, it is quite difficult to grasp the actual condition of every individual company whose work is related to port logistics.

There are very few ports in the world that have exclusive statistics of activities in which port relevant companies are involved. Therefore, all the existing researches on port logistics industry could only depend on sampling surveys. This method has the obvious and fundamental limit to understanding the actual condition of the relevant companies or the port cluster.

Therefore, this study was conducted by the means of a total survey, in order to investigate the actual conditions of relevant companies based in the port of Busan, the biggest port in South Korea.

The purpose of this study is to clarify the characteristics of the port clusters units through the investigation of the actual condition.

Before entering to the analysis of the total survey responses, we define the scope of this research first, and we consider the inter-industry analysis (input-output analysis) that is preferred widely among the scholars and the policy leaders. We then analyse the total survey response from the PLRCs (port logistics relevant companies) in Busan by descriptive way and GIS (geographical Information System) technique.

5.3.1 Considering of Inter-Industry Analysis

Except for shipping, container terminal, stevedoring and warehousing companies requiring huge equipments and wide facilities, the rest of service companies supporting port logistics activities are of comparatively small capital and size. Consequently it is quite difficult to grasp the actual condition of whole individual PLRCs in a port. Even so, it is impossible to imagine port logistics without these smaller service companies who support various areas of the field. Therefore, we must not stop making the efforts to analyse these companies.

One of the typical methods that has been widely suggested, to analyse an industry is the inter-industry analysis (input-output analysis).

Starting from the research on the direct economic impacts of the Port of Hamton Road in Virginia State thorough a direct survey (Youchum & Agawal, 1988), Warf & Cox (1989) studied the economic impacts by ocean trade thoroughout the Port of New York and New Jersey using inter-industry analysis. Villaverde & Coto-Millán (1997) studied the economic impacts of the Port of Santander in Cantabria region in Spain. Meanwhile, Maritime Administration (MARAD: http://www.marad.dot.gov) in U.S. has made a Port Economic Impact Kit using the Inter-industry analysis model since 1960s.

Inter-industry analysis model has several merits: firstly, it has the advantage of the structure analysis on the economy since it contains circulations among the industries; secondly, it can be used to forecast the economy in advance; thirdly, it has strength in measuring the economical impact (Kang, 2000).

Every country has their own industrial statistics using standard industrial classification, whether it is the international standard industrial classification (ISIC) or the national one (SIC, NASIC, KSIC, etc.).

However, it was not appropriate to apply the inter-industry analysis to PLRCs for these two reasons: firstly, the industrial classification index did not consider specific industries such as

PLRC when it was originally devised; secondly, it is basically impossible to segregate those only relevant to port relevant industry from the huge classification index.

For example, even if it were the 5-digit level classification, it would still be impossible to segregate the freight forwarders who are related to the port and shipping from others (such as the land transportation or the air transportation).

Therefore, when conducting research on PLRC, the actual condition of the relevant companies has always been a great source of anguish to the researchers.

Even though Korea National Statistics Office (KNSO) and Busan Metropolitan City government conduct 'The Census of Basic Characteristics of Establishments' on the Busan civil area every year, the Korean Standard Industrial Classification (KSIC) has no specific classification code for PLRC . As a result, these statistics are scattered here and there or mixed-up with others, thus it is very difficult to compare or understand all of these at the same time.

To avoid this problem and to reflect the changes in the contemporary technology, Korea Logistics Association (KOLA) generated a 'special classification code' for the logistics industry and included this into 'The 8th Revision of KSIC' on 7 January 2000 (see **Table 5-4**).

However, this still presented limitations in understanding the precise and actual condition of PLRC, since it was not only confined within the port logistics, but for the general logistics industry.

Consequently, in most countries, port logistics relevant statistics are still produced depending upon indirect information that is grasped by the relevant associations or unions, except in a few countries who impose separate registration or give separate permissions.

Table 5-4 The 8th Revision of KSIC on 7th Jan. 2000

Level	Existing	New	Change		
			Total	Newly established	Unified
One digit level	17	20	3	3	-
Two digits level	60	63	3	5	2
Three digits level	160	194	34	36	2
Four digits level	334	442	108	121	13
Five digits level	1,195	1,121	△74	172	246
Special classification	-	10	Information & Communication Technology industry		
			Tourism industry		
			Environmental industry		
			Cultural industry		
			Logistics industry		
			Sports industry		
			Vehicle exclusive parts industry		
			Internet industry		
			Life engineering industry		
			Energy industry		

Source: Korea National Statistics Office (KNSO): http://nso.go.kr

In case of the Busan port also, until 1997, a licence had to be obtained from Busan Regional Maritime Affairs and Fisheries Office (MOMAF Busan), in order to start a port relevant business in Busan area. However, from 1998, this licence system was changed to a report system, since the government had come to the realisation that many companies had omitted the registration duties under the old system. There is no other way except a spontaneous report to grasp the actual condition of the relevant companies in the area. The situation is exactly same in other ports in the world.

Recently, discussions on the port clusters have emerged, but almost all the researchers who studied the relevant companies remain dependent on the existing indirect data produced by the port authority or by the relevant associations.

Despite knowing that it perhaps is the most important part of the research since the basic analysis unit and the smallest factors that consist of the system depend on it, researchers still depend on sampling surveys. Data gathered by sampling surveys, however, are very often out-of-date due to the dynamic nature of the field of PLRC.

Fortunately, an opportunity to conduct a total survey on behalf of the Busan local government in 2000 came to the author. A total survey on the entire port relevant companies was conducted around the port of Busan. As a result, the actual condition of the relevant companies in Busan was grasped, and a trial of an inductive approach on the port cluster could be carried out, starting from the actual condition of the relevant companies to the whole of the port cluster.

5.3.2 Scope of the Survey

The main purpose of this total survey is to investigate the precise and actual condition of the port relevant companies working for a particular port.

The survey targets of this study are the entire PLRCs in Busan metropolitan city who were operating the port logistics business, or who support the port logistics activities related to Port of Busan and the base point of time is 31 December 1999.

As a matter of fact, there were problems about the boundary of the port cluster system, since no 'relevant region' concept presented from many other cluster related researches could meet the exact conditions.

Although Krugman(1991) said natural and geographical units are incomplete by reason of interdependence on the border, we could not avoid using the administrative boundary of Busan.

There are two reasons for using the physical boundary; first, we only consider those PLRCs directly related to the port, and the administrative boundary of Busan is relatively large (762.9 km^2) as very few companies excluded from the boundary that has a relationship with Port of Busan. Secondly, most of the other statistics to compare with this survey results used the same approach to determine the boundary of research.

The following six cases were excluded from the target of the survey:

- ✓ Companies related to national defence
- ✓ Companies related to household affairs
- ✓ Companies related to fisheries – such as the catching of fish, farming on the sea, the manufacturing or repairing of fishing gear, the sales of marine products, etc.)
- ✓ Salesmen who have no settled office and operate in a irregular manner
- ✓ Companies who are establishing, or have remained idle over the past three months, at the base point of time.
- ✓ Companies related to insurance or finance

The total survey was conducted by trained five field survey teams and each team consisted of a team leader and four field surveyors. The team leaders were responsible for making daily survey reports and first attempts at verification of the gathered data. There was also a dedicated researcher to verify and to arrange daily reported data from the field survey teams.

The total survey was conducted between May 15 and July 20 in 2000 for sixty days including Saturdays but excepting national holidays. Each field survey team was responsible for covering their assigned areas and visited every office in the allotted areas sequentially. To decide whether a company could be included in the survey target population or not, if the part of their annual Gross Sales relevant to the port activity exceeds 50% of Gross Sales, then a company would be included.

Fortunately, an opportunity was come to conduct a total survey on behalf of the Busan local government in 2000. A total survey on the entire port relevant companies was conducted around the port of Busan

5.3.3 A Pilot Survey and Principle of the Survey

Five surveyors, who would subsequently be team leaders for the total survey, established the survey target lists from March to April 1999. The pilot survey was conducted from May to December by these five team leaders. The cost for the pilot survey, surveyor wages was approximately £6000 (12 million won) funded by a government relief project for unemployed people.

After rectifying problems identified from the pilot survey, such as adjusting of the questions and objectives of the questionnaire, the full survey was conducted from 15 May to 20 July 2000 by twenty well-trained surveyors lead by five team leaders. Verification of the survey responses was carried out from August to December 2000.

The cost for the total survey including wages was about £42500 (85 million won) funded by Busan Metropolitan City government.

It was a requirement that every surveyor visits every target company and held an interview directly with departmental managers. There were situations where a surveyor had to visit one company up to seven times to conduct a direct interview with the appropriate person and collect the completed questionnaire.

However, on rare occasions where surveyors could not collect questionnaires from the survey site or when they could not continue the interview for various reasons, the company was asked to fax the completed questionnaire to the person appointed as the respondent in charge of the survey site.

5.3.4 Classification of the Survey Target

Nevertheless, applying the existing classification in the logistics industry to the port logistics relevant industry had limits, as they were too broad to distinguish the features of the port logistics relevant industry from other logistics industries.

Table 5-5 shows us the extraction procedure of the Port Relevant Companies from the Logistics Companies in the 8th Revision of KSIC.

Table 5-5 Extraction of Port Relevant Companies from the Logistics Companies in the 8th Revision of KSIC

Group			KSIC	Industry	P.C.
1 Transport					
1-1	Land Transport; Tranport via Pipelines				
	1-1-1		60100	Interurban Rail Transportation	X
	1-1-2	1-1-2-1	60311	General Freight Trucking	O
		1-1-2-2	60312	Freight Trucking By Small Truck and Self-Management	O
	1-1-3		60400	Transport Via Pipelines	X
1-2	Sea and Coastal Water Transport				
	1-2-1		61112	Oceangoing Foreign Freight Transport	O
	1-2-2		61122	Coastal Water Freight Transport	O
1-3	Air Transport				
	1-3-1		62100	Scheduled Air Transport	X
	1-3-2		62200	Non-Scheduled Air Transport	X
1-4	Couriers and Messengers				
2 Operation of Cargo Transport Facilities					
2-1	Warehousing				
	2-1-1		63201	General Warehousing	O
	2-1-2		63202	Refrigerated Warehousing	O
	2-1-3		63203	Farm products warehousing	O
	2-1-4		63204	Dangerous Goods Warehousing	O
	2-1-5		63209	Other Warehousing	O
2-2	Other Services Allied to Transport Agency				
	2-2-1		63911	Supporting, Railway Transport Activities	X
	2-2-2		63913	Operation of Freight Terminal Facilities	X
	2-2-3		63921	Operation of Harbour and Marine Terminal Facilities	O
	2-2-4		63931	Airport Operation	X
3 Supporting and Auxiliary Transport Activities					
3-1	Cargo Handling				
	3-1-1		63101	Air Freight and Land Freight Handling	O
	3-1-2		63102	Water Freight Handling	O
3-2	Operation of Highhwaysand Related Facilities				
			63914	Operation of Highways and Related Facilities	X
3-3	Other Supporting Transport Services n.e.c.				
	3-3-1		63991	Freight Transport Arrangement	O
	3-3-2		63992	Packing and Crating	O
	3-3-3		63999	All Other Supporting Transport Services n.e.c.	★
3-4	Other software Consultancy and supply				
			72209	Other Software Consultancy and supply	O
4 Renting of Transport Equipment					
4-1			71121	Renting of Containers	O
4-2			71129	Other Renting of Transport Equipment n.e.c.	O
4-3			71290	Renting of Other Machinery and Equipment	O
5 Manufacture of Cargo Transport Equipment					
5-1	Manufacture of Motor Vehicles, Trailers and Semitrailers				
	5-1-1		34203	Manufacture of Containers for Carriage	X
	5-1-2	5-1-2-1	34122	Manufacture of Motor Vehicles for the Transport of Goods	X
		5-1-2-2	34201	Manufacture of Motor Vehicle Bodies and Motor Vehicles Assembled c	X
		5-1-2-3	34202	Manufacture of Trailers and Semitrailers	X
	5-1-4	5-1-4-1	20231	Manufacture of Wooden Pallets and Other Load Boards	X
		5-1-4-2	25232	Manufacture of Packaging Plastics and Shipping Containers	X
		5-1-4-3	28999	Manufacture of All Other Fabricated Metal Products n.e.c.	X
5-2			35111	Building of Steel Ships	O
5-3			35310	Manufacture of Aircraft, Spacecraft and its Assistant Equipment	X

O : chosen X : not chosen ★ : subdivision is necessary
Source : Author

For a more efficient and specific data analysis, we authors subdivided the classification of 'all other supporting transport service' extracted from the 8th revision of KSIC, into 12 sub-classification of 7 digits level so as to understand the characteristics of the port relevant companies in greater depth (See **Table 5-6**).

Table 5-6 Subdivision of 'all other supporting transport services'

Group			KSIC	Industry
1 Transport				
	1-1	Land Transport; Tranport via Pipelines		
		1-1-2 1-1-2-1	60311	General Freight Trucking
		1-1-2-2	60312	Freight Trucking By Small Truck and Self-Management
	1-2	Sea and Coastal Water Transport		
		1-2-1	61112	Oceangoing Foreign Freight Transport
		1-2-2	61122	Coastal Water Freight Transport
2 Operation of Cargo Transport Facilities				
	2-1	Warehousing		
		2-1-1	63201	General Warehousing
		2-1-2	63202	Refrigerated Warehousing
		2-1-3	63203	Farm products warehousing
		2-1-4	63204	Dangerous Goods Warehousing
		2-1-5	63209	Other Warehousing
	2-2	Other Services Allied to Transport Agency		
		2-2-3	63921	Operation of Harbour and Marine Terminal Facilities
3 Supporting and Auxiliary Transport Activities				
	3-1	Cargo Handling		
		3-1-1	63101	Air Freight and Land Freight Handling
		3-1-2	63102	Water Freight Handling
	3-3	Other Supporting Transport Services n.e.c.		
		3-3-1	63991	Freight Transport Arrangement
		3-3-2	63992	Packing and Crating
		3-3-3	63999	All Other Supporting Transport Services n.e.c.
			a	*Ship Broker*
			b	*Manning Services*
			c	*Shipping Agent*
			d	*Tallying Services*
			e	*Port Services*
			f	*Ship Approaching Services*
			g	*Supply Services*
			h	*Bunkering Service*
			i	*Port Telecommunication*
			j	*Shipping Management*
			k	*Customs Clearance Service*
			z	*The Others*
	3-4		72209	Other Software Consultancy and supply
4 Renting of Transport Equipment				
	4-1		71121	Renting of Containers
	4-2		71129	Other Renting of Transport Equipment n.e.c.
	4-3		71290	Renting of Other Machinery and Equipment
5 Manufacture of Cargo Transport Equipı				
	5-2		35111	Building of Steel Ships

Source: Author

Table 5-7 The Results of the Total Survey

Group	KSIC	Industry	Number of companies	Number of employee	Gross sale (mill KW)	Gross sale (thousand GBP)
Total			1,669	36,894	19,518,585	9,759.29
1 Transport			376	7,119	8,632,683	4,316.34
1-1 Land Transport: Tranport via Pipelines			273	3,627	638,219	319.00
1-1-2 1-1-2-1	60311	General Freight Trucking	*269*	*3,608*	*634,680*	*317.34*
1-1-2-2	60312	Freight Trucking By Small Truck and Self-Management	*4*	*19*	*3,539*	*1.77*
1-2 Sea and Coastal Water Transport			103	*3,492*	*7,994,464*	*3,997.23*
1-2-1	61112	Oceangoing Foreign Freight Transport	*57*	*2,590*	*7,846,342*	*3,923.17*
1-2-2	61122	Coastal Water Freight Transport	*46*	*902*	*148,122*	*74.06*
2 Operation of Cargo Transport Facilities			121	2,818	2,281,349	1,140.67
2-1 Warehousing			117	2,438	2,263,305	1,132.00
2-1-1	63201	General Warehousing	*68*	*1,394*	*161,700*	*80.85*
2-1-2	63202	Refrigerated Warehousing	*31*	*657*	*150,637*	*75.32*
2-1-3	63203	Farm products warehousing	*3*	*73*	*6,924*	*3.46*
2-1-4	63204	Dangerous Goods Warehousing	*11*	*275*	*1,914,044*	*957.02*
2-1-5	63209	Other Warehousing	4	*39*	*30,000*	*15.00*
2-2 Other Services Allied to Transport Agency			4	*380*	*18,044*	*9.02*
2-2-3	63921	Operation of Harbour and Marine Terminal Facilities	*4*	*380*	*18,044*	*9.02*
3 Supporting and Auxiliary Transport Activities			1,042	19,684	6,759,893	3,379.95
3-1 Cargo Handling			159	5,593	755,877	378.00
3-1-1	63101	Air Freight and Land Freight Handling	*25*	*129*	*6,956*	*3.48*
3-1-2	63102	Water Freight Handling	*134*	*5,464*	*748,921*	*374.46*
3-3 Other Supporting Transport Services n.e.c.			872	*13,613*	5,967,648	2,984.00
3-3-1	63991	Freight Transport Arrangement	*465*	*4,404*	*1,465,300*	*732.65*
3-3-2	63992	Packing and Crating	*4*	*67*	*160,933*	*80.47*
3-3-3	63999	All Other Supporting Transport Services n.e.c.	*403*	*9,142*	*4,341,415*	*2,170.71*
	a	*Ship Broker*	9	*39*	*451,098*	*225.55*
	b	*Manning Services*	*43*	*1,944*	*54,239*	*27.12*
	c	*Shipping Agent*	*31*	*404*	*1,707,469*	*853.73*
	d	*Tallying Services*	*18*	*1,534*	*17,332*	*8.67*
	e	*Port Services*	*13*	*670*	*24,209*	*12.10*
	f	*Ship Approaching Services*	*6*	*141*	*10,792*	*5.40*
	g	*Supply Services*	*117*	*1,711*	*1,551,825*	*775.91*
	h	*Bunkering Service*	*21*	*223*	*361,016*	*180.51*
	i	*Port Telecommunication*	*8*	*251*	*29,891*	*14.95*
	j	*Shipping Management*	*25*	*629*	*40,850*	*20.43*
	k	*Customs Clearance Service*	*85*	*969*	*48,353*	*24.18*
	z	*The Others*	*27*	*627*	*44,341*	*22.17*
3-4	72209	Other Software Consultancy and supply	11	478	36,368	18.00
4 Renting of Transport Equipment			26	485	45,126	22.56
4-1	71121	Renting of Containers	*16*	*347*	*28,283*	*14.14*
4-2	71129	Other Renting of Transport Equipment n.e.c.	*8*	*122*	*16,103*	*8.05*
4-3	71290	Renting of Other Machinery and Equipment	*2*	*16*	*740*	*0.37*
5 Manufacture of Cargo Transport			134	6,788	1,799,534	899.77
5-2	35111	Building of Steel Ships	*134*	*6,788*	*1,799,534*	*899.77*

Source : Author based on Roh (2000)

5.3.5 Descriptive Analysis on the Response

Table 5-7 shows the actual condition of the relevant companies in Busan using the special classification code in KSIC in summary.

In the year 2000, the number of the total surveyed PLRC in Busan, except the companies who do not meet the condition of the survey target, was 1,699, the number of the employees working in the companies were 36,894, and the gross sales was 9.759 million GBP(19 hundred billion Korean Won).

a. Analysis by the type of industry

Among the surveyed port relevant industry, cargo transportation industry possessed the highest portion of 34.6% (4,316 million GBP, 8,632 billion Korean Won).

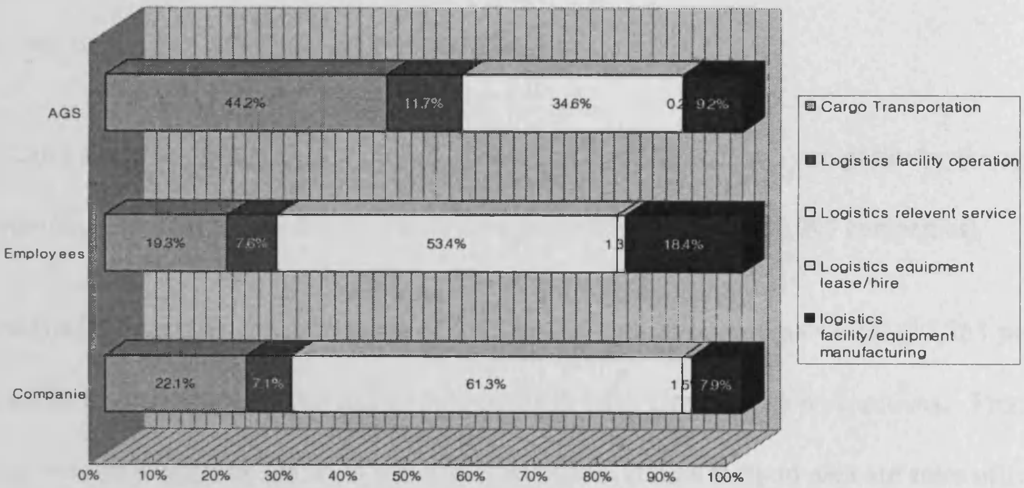


Figure 5-5 The Ratio of the Port relevant Companies by the type of industry

Source: Author, based on Roh (2000).

On the other hand, the cargo transportation service industry occupied the highest portion that is 61.3% (1,042 companies) from the number of company point of view and 53.4% (19,684 people) from the number of employee point of view (See **Figure 5-5** and **Table 5-8**).

Table 5-8 The Port relevant Companies by the type of industry

Type of Industry	Companies	Employees	Gross Sales	
			(thousand GBP)	(mm KW)
Cargo Transportation	376	7,119	4,316,342	8,632,683
Logistics Facility Operation	121	2,818	1,140,675	2,281,349
Logistics Relevant Service	1,042	19,684	3,379,947	6,759,893
Logistics Equipment Lease/Hire	26	485	22,563	45,126
Logistics Facility/Equipment Manufacturing	134	6,788	899,767	1,799,534

Source: Author, based on Roh (2000).

b. Analysis by the type of corporation

As can be seen in **Figure 5-6**, when we divided the companies into 3 categories by the type of corporation, independent company was the biggest portion at 64.4% (1,095 companies).

Nevertheless, factory/branch/business office was the biggest portion as 48.2% (17,768 people) from the employee and 64.0% (6,247 million GBP) from Gross Sales perspectives. From this result we can assume that most of the large size offices around the port area are sales offices or local offices and their head offices are not based on the local area.

In other words, most of the profits achieved from the port are taken out to other place instead remaining in the area. The economic scale, affecting the local economy, is supposed to be around 35 million GBP (70 billion Korean Won), including independent companies and the companies which have head office in local area (See **Table 5-9**).

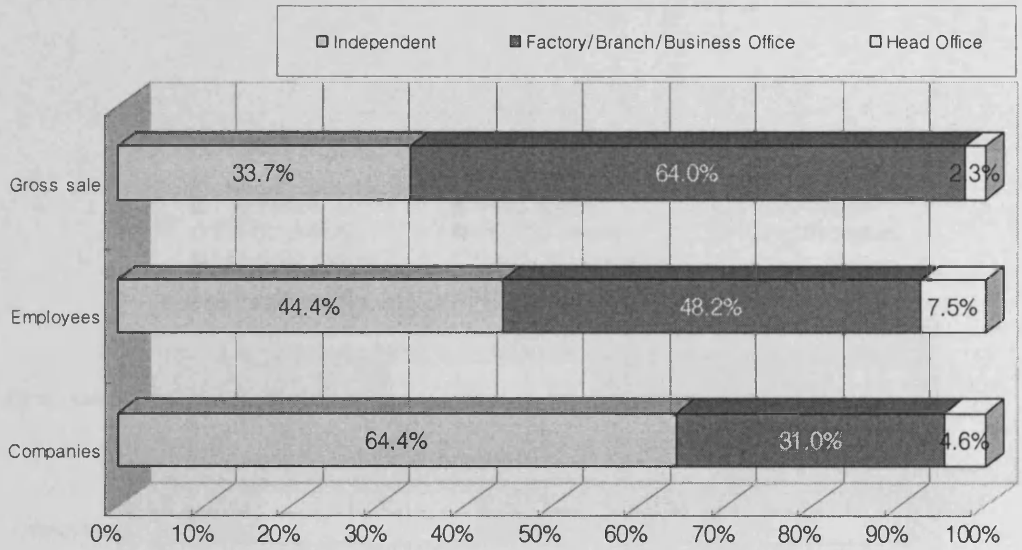


Figure 5-6 The Ratio of the Port relevant Companies by Corporate Type
Source: Author, based on Roh (2000).

Table 5-9 The Port relevant Companies by Corporate Type

corporate type	Companies	Employees	Gross sale (thousand GBP)	Gross sale (mm KW)
Independent	1,094	16,377	3,291,651	6,583,302
Factory/Branch/Business Office	526	17,768	6,247,017	12,494,034
Head Office	79	2,749	220,625	441,249

Source: Author, based on Roh (2000).

c. Analysis by the scale of the employees

We sub-divided the industry into 8 steps by the number of the employee, and the major was 1 to 5 people range. It means, from the number of the company point of view, 46.7% (790 companies) of companies were classified as 'small' (See in **Figure 5-7** and **Table 5-10**).

It was clarified that the small size company of which 1 to 5 people range occupied 24% from the GROSS SALES perspective. This ratio is as large as the ratio of big size companies of which 150 to 300 people range.

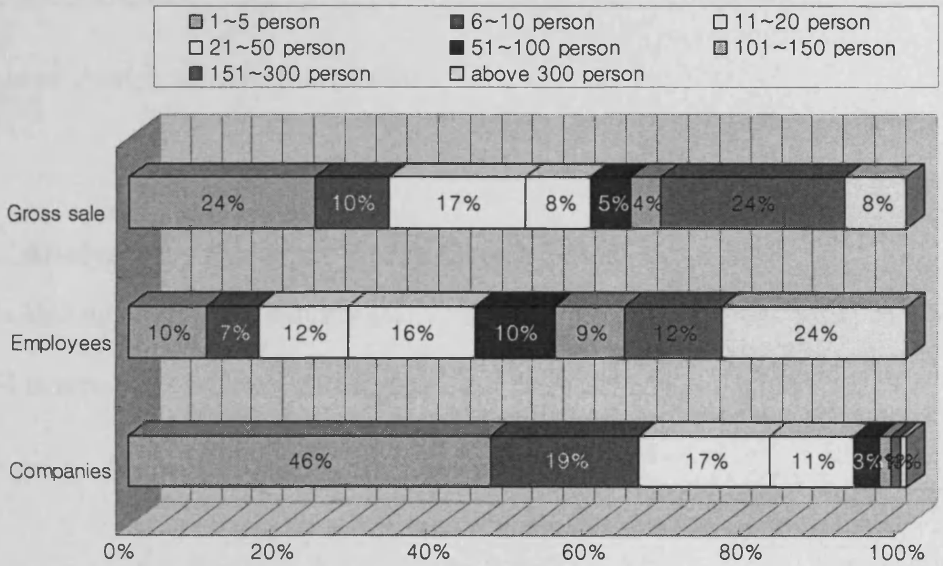


Figure 5-7 The Ratio of the Port relevant Companies by the scale of the employees
Source: Author, based on Roh (2000).

In case of productivity per capita (Gross Sales/number of employee) for small size companies of 1 to 5 people and the big size companies of 151 to 300 people, (637 thousand GBP and 506 thousand GBP) were comparatively high, the figures for the small size company of 6 to 10 people and 11 to 20 people (370 thousand GBP and 399 thousand GBP) were comparatively medium, and the figures for big size company of 151 to 300 people and above 300 people (135 thousand GBP and 89 thousand GBP) were comparatively low (See **Table 5-10**).

Table 5-10 The Port relevant Companies by the scale of the employees

Scale of Employees	Companies	Employees	Gross sale (thousand GBP)	Gross sale (mm KW)	Productivity per Capita (thousand GBP)
1~5 person	790	3,676	2,342,365	4,684,729	637
6~10 person	323	2,510	927,509	1,855,018	370
11~20 person	285	4,275	1,707,524	3,415,047	399
21~50 person	184	6,007	810,821	1,621,642	135
51~100 person	55	3,741	505,881	1,011,762	135
101~150 person	26	3,316	375,696	751,391	113
151~300 person	22	4,564	2,307,721	4,615,442	506
above 300 person	14	8,805	781,777	1,563,554	89

Source: Author, based on Roh (2000).

d. Analysis by the scale of the Gross Sales

We also sub-divided the industry into 10 steps by the scale of Gross Sales, and the major was 750 thousand to 1 million GBP range and they were 525 companies (30.9%).

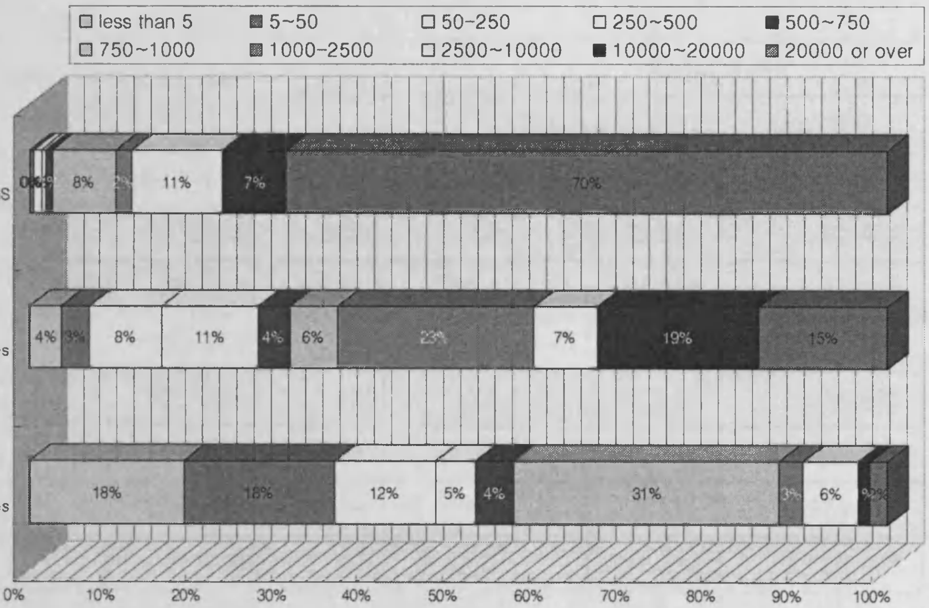


Figure 5-8 Ratio of the Port relevant Companies by the scale of Gross Sales
Source: Author, based on Roh (2000).

The number of employee who works in this Gross Sales range was 7,976 people and it was 21.6% of the total number. Even so, only 35 big companies (2.1% from the number of company point of view) who sold over 20 million GBP in a year still occupied 70% of total Gross Sales, hence we could understand that most of the sales by PLRC in Busan port area were handled by small number of big companies.

This response has not no concern with that the factory/branch/business office was 64.0% of portion (6,247 million GBP) from the GROSS SALES perspectives. Moreover it is not difficult to assume that most of the profits achieved from the port area would be taken out to other area (See **Figure 5-8** and **Table 5-11**).

Table 5-11 The Port relevant Companies by the scale of Gross Sales

Range of Gross Sales (thousand GBP)	companies	employees	Gross Sales	
			(thousand GBP)	(mm KW)
less than 5	306	128	7,716	15,431
5-50	300	117	45,701	91,402
50-250	199	294	78,309	156,618
250-500	78	393	50,927	101,853
500-750	75	130	68,344	136,687
750-1000	525	196	734,127	1,468,254
1000-2500	48	798	179,574	359,148
2500-10000	109	258	1,034,439	2,068,878
10000-20000	24	658	729,693	1,459,385
20000 or over	35	523	6,830,465	13,660,929

Source: Author, based on Roh (2000).

5.4 GEOGRAPHICAL ANALYSIS OF THE SURVEY

5.4.1 Outline of local business environment

This chapter discusses the geographical character of the port logistics relevant company, which is essential since the geographical character is one of the most important factors when studying a cluster. Therefore, analysis on the geographical distribution of PLRC in the port area (it is the boundary of Busan city in this study) is very meaningful for this study, as its purpose is to clarify the characteristic of the port cluster ultimately from the number of companies, employees, GROSS SALES point of view.

The area of Busan is 762.9 ㎢, the population is 3.75 million and it is the second largest city in Korea. It is also the first large-scale port to open in Korea. As can be seen in **Figure 5-9**, Busan consists of 16 districts.

In year 2000, GRPD (gross regional domestic product) in Busan was GBP 15.1525 billion (30,305 billion Won).

Figure 5-9 16 districts in Busan Metropolitan City
Source: Author

Table 5-12 shows us among them Kijang-gun, Kangseo-gu, Keumjung-gu are high ranked in the order of the area, and Jin-gu, Haewoondae-gu, Saha-gu, Nam-gu have comparatively large f populations.

Jung-gu, Yeonje-gu, Suyeong-gu and Dongre-gu are high ranked in the order of the population density perspective (B/A in **Table 5-12**).

Meanwhile Jung-gu, Dong-gu, Dongre-gu and Yeonje-gu are high ranked in the order of the company density (C/A in **Table 5-12**).

The density of employees of each district (D/C in **Table 5-12**) is not very different from another, but in case of Kangseo-gu and Kijang-gun was slightly higher. We understand that labour intensive agricultural and manufacturing industries were relatively developed in those areas since land price is cheaper than in the other regions.

Table 5-12 Outline of local business in Busan (2002)

(Units: ㎢, people, companies, people, people/㎢, companies/㎢, people/ company)

District	area(A)	population(B)	companies (C)	employees (D)	B/A	C/A	D/C
Total	762.9	3,747,369	268,784	1,145,605	4,911.8	352.3	4.26
Kijang-gun	217.8	76,959	5,315	28,002	353.3	24.4	5.27
Kangseo-gu	179.0	58,887	5,176	40,531	329.0	28.9	7.83
Keumjung-gu	65.2	280,692	19,751	93,783	4,307.1	303.1	4.75
Haewoondae-gu	51.4	403,598	19,501	77,401	7,846.0	379.1	3.97
Saha-gu	40.9	380,550	21,539	106,304	9,311.2	527.0	4.94
Buk-gu	38.3	321,473	13,739	44,840	8,393.6	358.7	3.26
Sasang-gu	35.8	296,208	28,758	129,722	8,264.7	802.4	4.51
Jin-gu	29.7	421,759	36,576	145,232	14,210.2	1,232.3	3.97
Nam-gu	25.6	306,150	16,364	63,356	11,945.0	638.5	3.87
Dongre-gu	16.7	291,020	22,241	78,170	17,426.3	1,331.8	3.51
Yeongdo-gu	14.0	175,559	10,098	40,695	12,557.9	722.3	4.03
Seo-gu	13.7	149,014	10,425	42,302	10,900.8	762.6	4.06
Yeonje-gu	12.1	228,801	15,874	70,536	18,940.5	1,314.1	4.44
Suyeong-gu	10.2	178,618	12,882	43,705	17,580.5	1,267.9	3.39
Dong-gu	9.8	121,821	14,737	73,419	12,468.9	1,508.4	4.98
Jung-gu	2.8	56,260	15,808	67,607	20,092.9	5,645.7	4.28

Source : Busan Metropolitan City; www.metro.busan.kr .

5.4.2 Distribution of PLRC by the Number of Companies

Figure 5-10 shows us the distribution of PLRC by the number of the companies. Jung-gu has a relatively high figure (60.2%) compared to others, Yongdo-gu(10.7%), Dong-gu(8.1%), Nam-gu(6.3%) and Saha-gu (6.1%) follow the next.

This response is not far from that those districts are around the main port (North port) and Saha-gu has Gamcheon port and Tadeapo port in it.

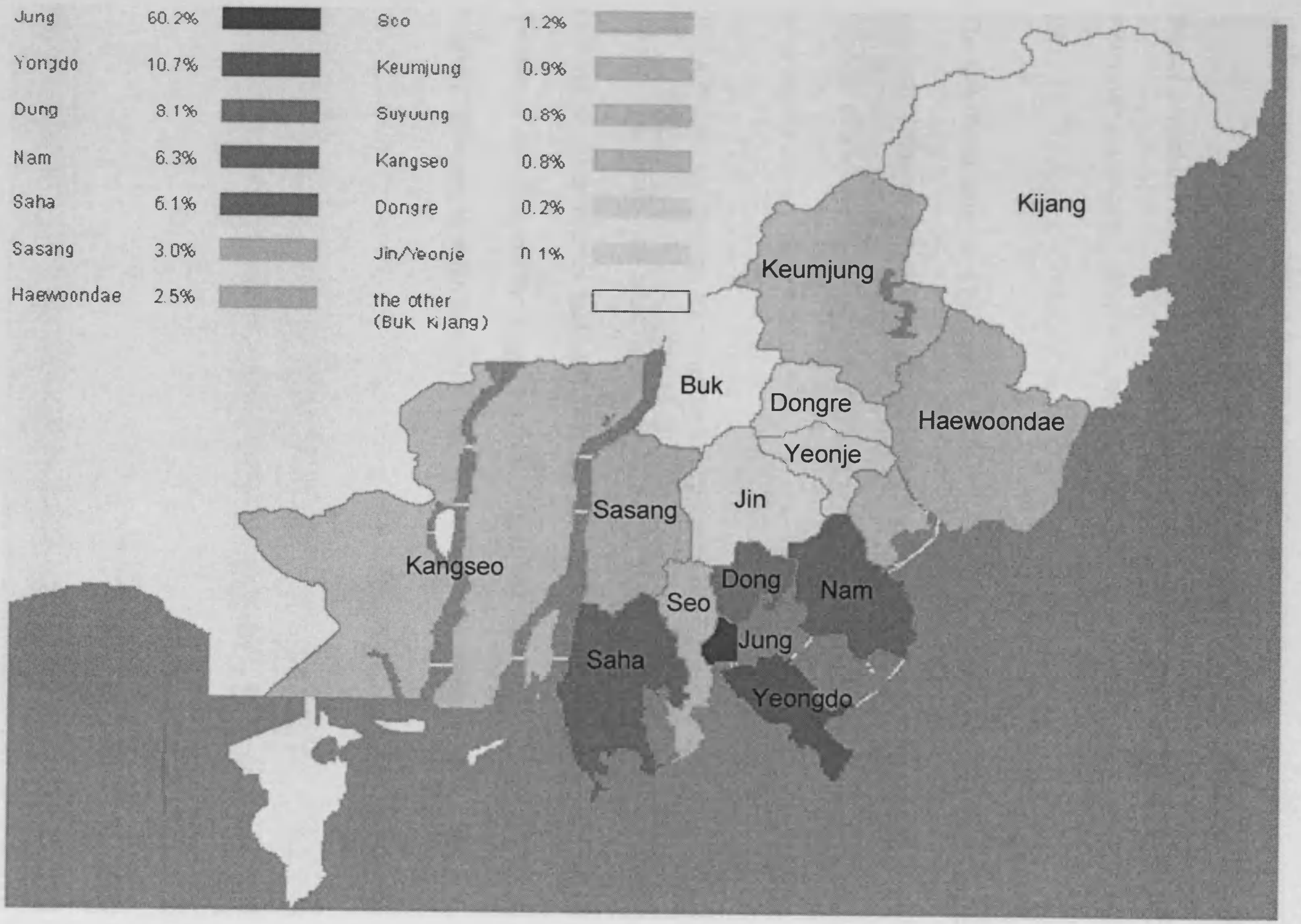


Figure 5-10 The distributions of PLRC by the number of company
Source: Author, based on Roh (2000)

5.4.3 Distribution of PLRC by the Number of Employees

Figure 5-11 shows us the distribution on the relative portion of PLRC from the the number of employees perspective. Relatively, Jung-gu is still higher (41.4%) to the others and Yongdo-gu(17.2%), Dong-gu (14.2%) and Nam-gu(12.2%) follow the next.

The significant thing in **Figure 5-11** is that the gap between Jung-gu and the chasers is relatively decreased compared to the distribution of PLRC by the number of companies. This response tells us that the size of PLRCs located in Jung-gu is relatively smaller than those in the other regions and not labour intensive.

This is because the business offices are usually concentrated in Jung-gu and the labour intensive industries are located the other region namely Yongdo-gu, Dong-gu, Nam-gu, Saha-gu. For example, the ship repairers that are typically labour intensive industries are concentrated in Yongdo-gu and the container cargo terminals and the logistics facilities operators are most located in Dong-gu, Nam-gu, Saha-gu.

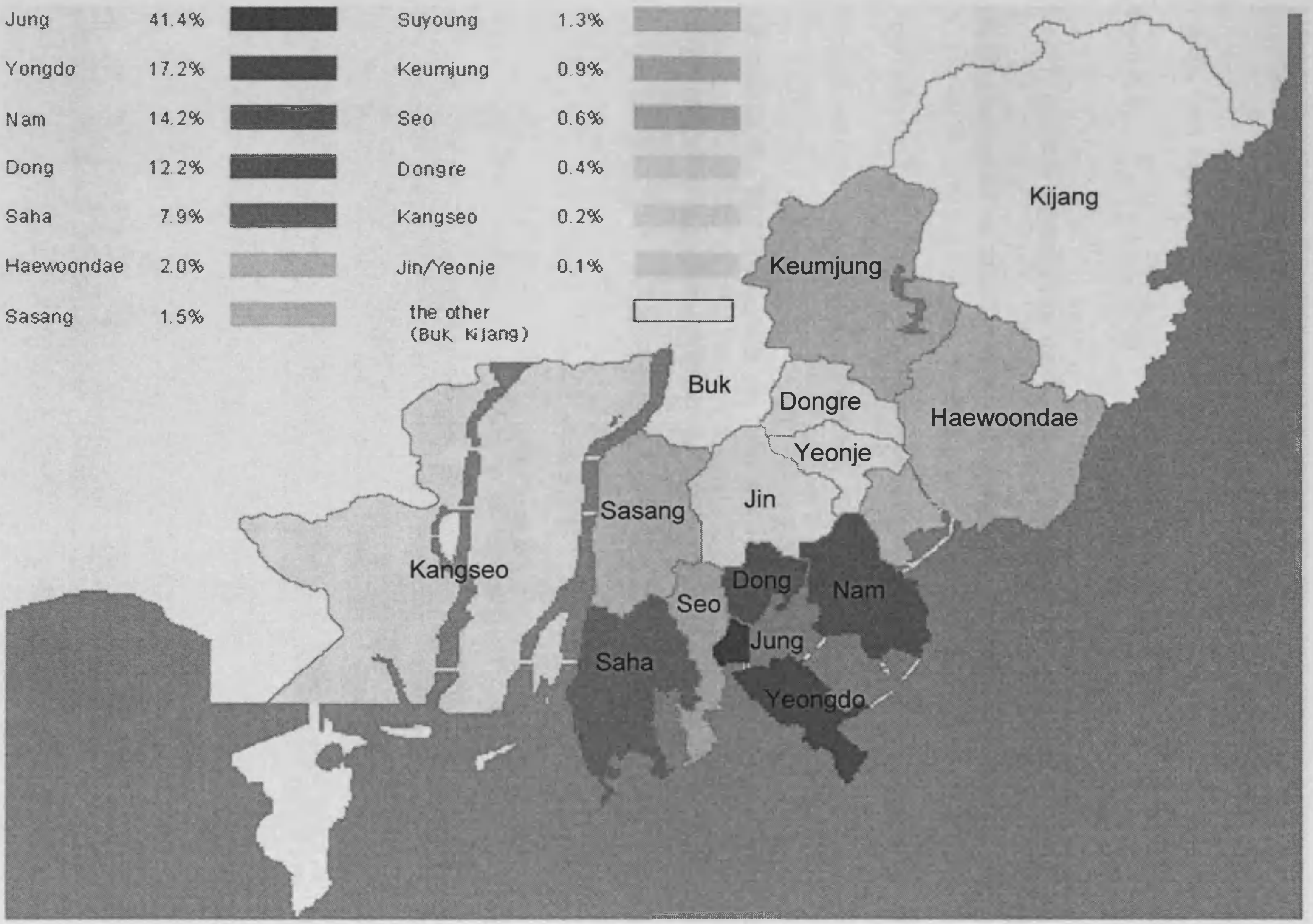


Figure 5–11 The distribution of PLRCs by the number of employee
Source: Author, based on Roh (2000)

5.4.4 Distribution of PLRC by the Gross Sales

Finally, from **Figure 5-12,** we can see the distribution of PLRC by Gross Sales, surveyed in sector **5. 3.**

Jung-gu still cuts a conspicuous figure. That is caused by the concentration of the big size of shipping companies and small but many port relevant service companies in that area.

Relatively, the logistics facility operators such as container terminal or warehouse in Nam-gu, Dong-gu and Saha-gu do not look so profitable.

Additionally, the PLRCs located in the outer area from the port, namely Keumjung-gu and Dongre-gu, also seem depressed from the Annual Gross Sales point of view.

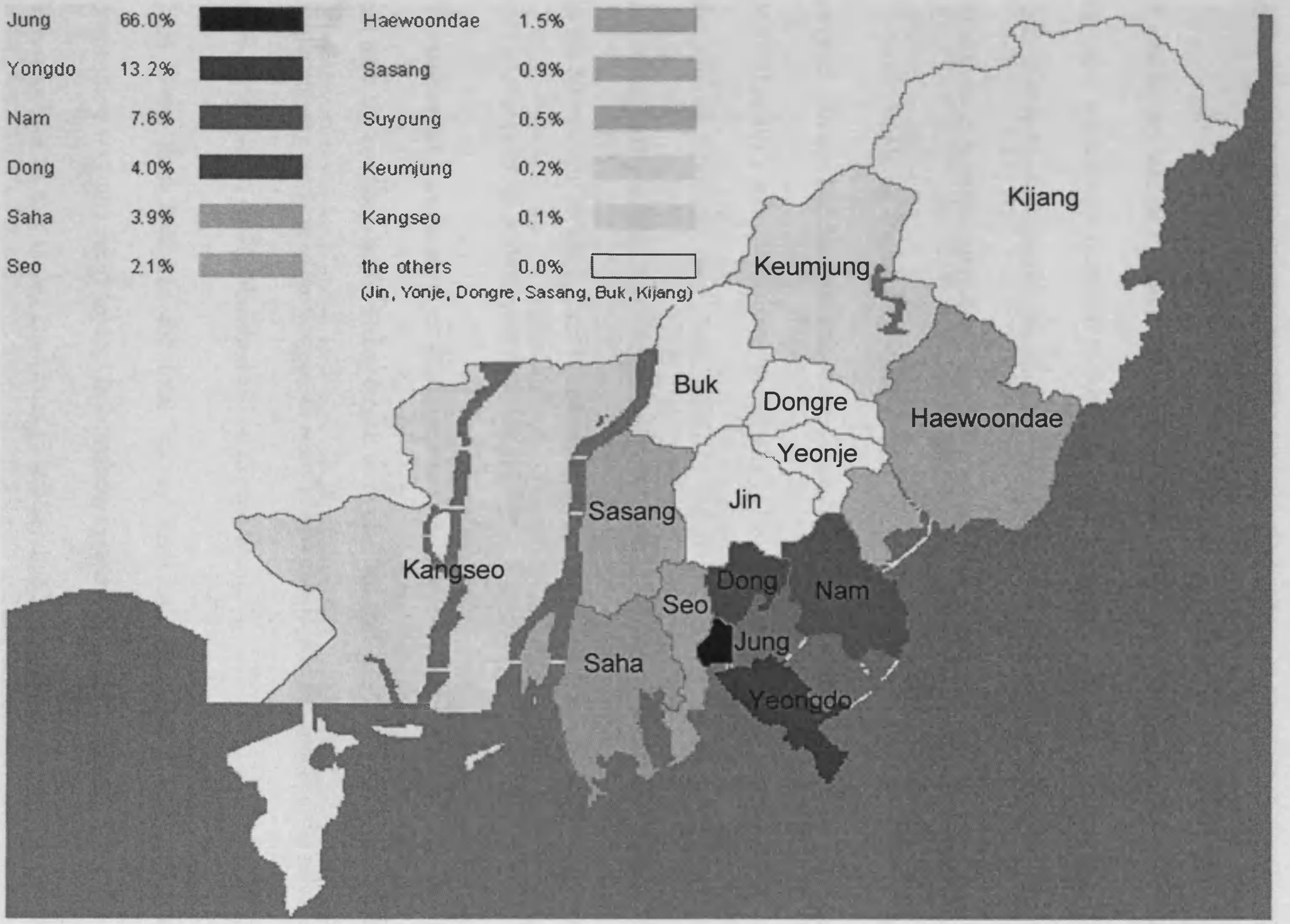


Figure 5-12 The distribution of PLRCs by the Gross Sales
Source: Author, based on Roh (2000)

5.5 SUMMARY

A total survey was the only alternative plan for grasping the actual condition of every individual company whose work is related to port logistics. Therefore this study has been conducted a total survey by the special classification code in KSIC, in order to investigate the actual conditions of relevant companies based in the port of Busan, the biggest port in South Korea.

However, applying the existing classification on the logistics industry to the port logistics relevant industry had the limit that was too broad to distinguish the feature of the port logistics relevant industry from other logistics industry. For more efficient and specific data analysis, the authors subdivided the classification of 'other unclassified transport relevant service' recommended by experts, that was included in the special classification for the logistics industry in the 8th revision of KSIC, into 12 sub-classification of 7 digits level so as to understand the characteristics of the port relevant companies.

The number of the total surveyed PLRC in Busan (in year 2000), except the companies who do not meet the condition of the survey target, were clarified that 1,699 companies, the number of the employees working in the companies were 36,894 people, and the annual gross sales (AGS) were 9.759 million GBP(19 hundred billion Korean Won).

This thesis then analysed the total survey response from the PLRC in Busan by descriptive way and geographical Information system (GIS) technique.

The responses of this survey contribute to structuralise and analyse the port cluster system. Hence they will contribute to the increase in industrial competitiveness and performance by horizontal integration of the sub-systems, together with the macroscopic approach on the various assemblages around the port clusters.

CHAPTER 6

A SYSTEMATIC APPROACH TO THE PORT CLUSTER

6.1 Chapter Overview

This chapter introduces conceptual models on the relevant industries. They were extracted and grouped/clustered according to the sub-systems divided from prior section **4.2**.. It also contains that what kinds of the relevant industries are related to each port logistics process using serial fieldworks.

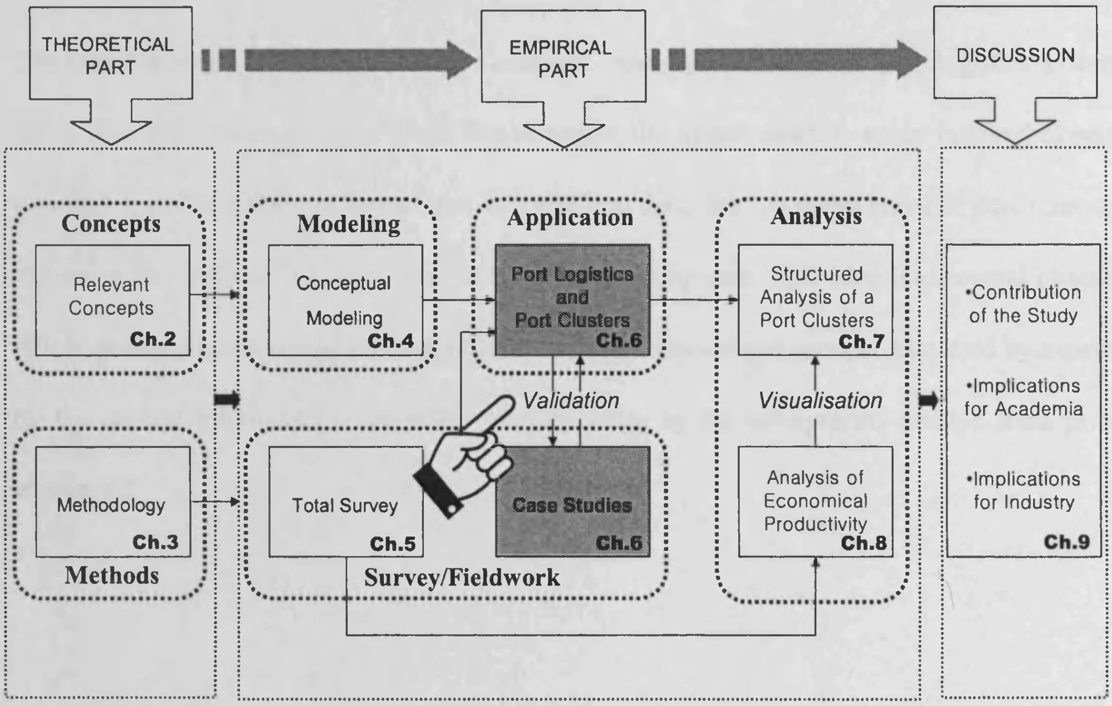


Figure 6-1 Position of 'A Systematic Approach to the Port Cluster' in the thesis
Source: Author

This chapter also compares the classification of Port Logistics Relevant Companies (PLRCs) extracted at Chapter and the contents of a port cluster obtained from new field work. This helps us to compare the results more easily with the others among the separate classifications relevant to the port logistics companies

The third part of this chapter handles the eight cases for verifying the conceptual model suggested in **Chapter 4** using serial fieldworks, too.

6.2 Relevant Industries in the Port Logistics Process

The research target of this study is port relevant industry related to the port logistics system rather than port logistics system itself. Nevertheless, the reason that this study inquired closely into port logistics system in the section **4.2** was that there are too many types of port relevant industries to handle at the same time unless the whole process is divided into several phases. In this section, therefore, the relevant industries were extracted and grouped/clustered by experts by the several interlinked group-interview, according to the sub-systems divided from prior section **4.2**.

6.2.1 Fieldwork

The three field visits for extraction and clustering of the port relevant industries were held between December 2004 and January 2005 in Busan, Korea with six experts who were working in the Busan Port.

The respondents were chosen among the practical experts who had worked in Busan Port around 10 years or more in the business. Each of the six practical experts came from cargo handling, shipping agent, terminal operation, stevedoring, ocean shipping company and general warehousing.

The average working period of these experts in their fields was 13.8 years (See **Table 6-1**.)

Table 6-1 Interview Respondents

Respondent	Position	Business	Career (years)
A	Manager	Cargo Handling	10
B	Manager	Shipping Agent	9
C	Team Manager	Terminal Operation	20
D	Manager	Stevedoring	16
E	Manager	Shipping	8
F	Director	General Warehousing	20

Source: Author

The group interviews with these six experts were held three times. The aim of the first group interview was to extract all of the port relevant companies, whether the companies have high relevance to the port logistics or not. At the first group interview they discussed freely without any prior consultation about port related sectors or port activities. Any judgement and notes were made in all aspects of their discussion. Before the second interview the list of points discussed on the port relevant companies was arranged in order and printed out neatly.

At the second group meeting, a combination of Group Interview Method, Conference Method and Delphi Method was used. Port logistics process concept was introduced and the arranged list also was presented to them before the discussion. They discussed the function of the companies and arranged the companies onto the port logistics process considering the function. After the second meeting, classified companies were expressed as several cluster diagrams which resembled the shape of bunches of grapes for easy understanding. The diagrams consist of the seven phases of port logistics process shown in **Figure 4-2**.

At the final group meeting, the cluster diagrams were examined thoroughly and consequently revised.

6.2.2 Voyage Supporting System

The role of the voyage supporting system is to support and supply goods or services to a ship regardless of port entry. This includes activities such as the supply of physical goods or service to a ship and the ship building or repairing belong to the sub-system category.

The experts arranged the relevant companies after dividing them into directly relevant companies, indirectly relevant companies, port users, and public institutions for the convenience of sorting (See **Figure 6-2**). There is no significance in the "two-tiers (inner/outer tier)" presentation of **Figure 6-2** to **Figure 6-8.** Two tiers are arranged for presentational purposes only.

First, if we list the companies who support the voyage of the ship and are directly relevant to the port, the list would include the Bunkering Service, Cargo Lashing Service, Disinfection Service, Hold Cleaning Service, Logistics Equipment Repairer, Nautical Chart Distributor, Rubbish Disposal Service, Ship Chandler, Ship Repair Shop and Spare Part Supply.

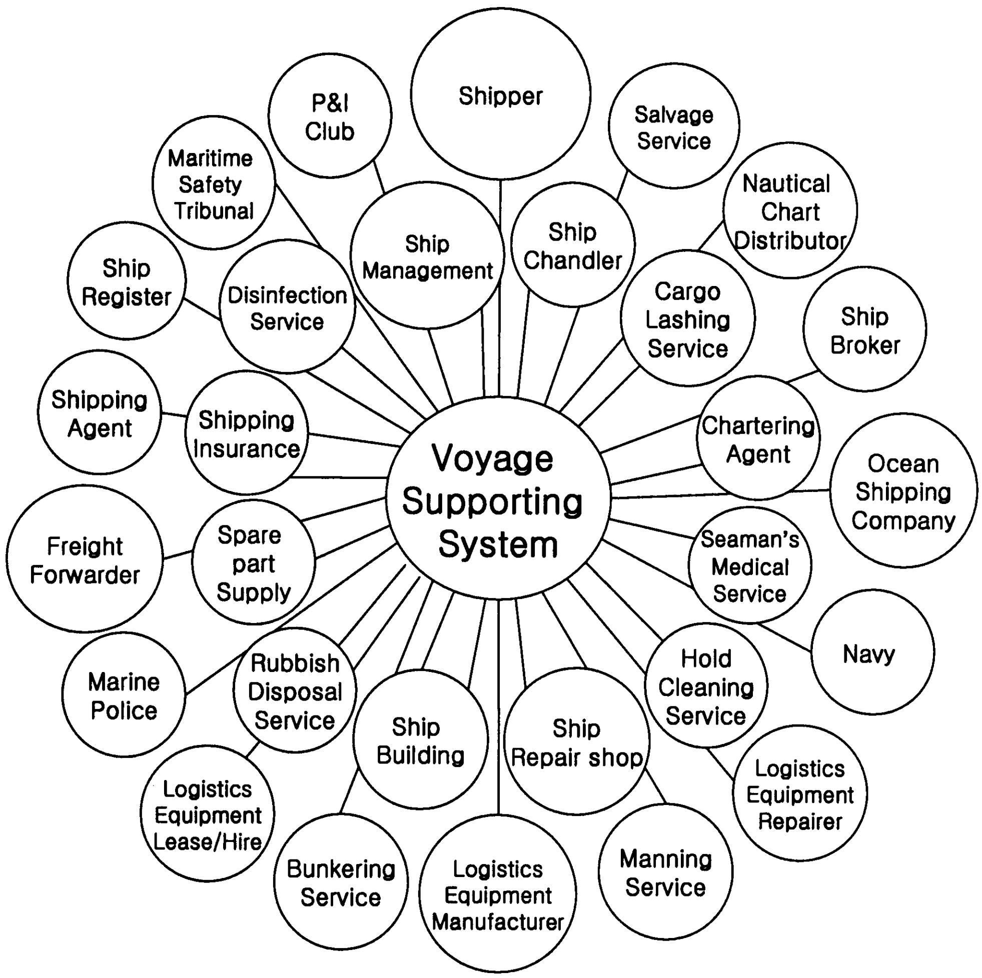


Figure 6-2 Cluster of the Voyage Supporting System
Source: Author

Second, the companies who support the voyage of the ship and are indirectly relevant to the port are: Chartering Agent, Logistics Equipment Lease/Hire, Logistics Equipment Manufacturing, Manning Service, P&I Club, Salvage Service, Seaman's Medical Service, Ship Broker, Ship Building, Ship Management, Shipping Agent and Shipping Insurance.

Third, the port users in the stage of the voyage support are Freight Forwarder, Ocean Shipping Company and Shipper.

Finally, the public institutions who are involved in the port logistics activities and also directly or indirectly involved to the voyage support are the Marine Police, the Maritime Safety Tribunal, the Navy.

6.2.3 Port Entry System

The role of the port entry system is to support safe and convenient port entry of a ship to the port.

First, if we make a list of companies who support the port entry of the ship and are directly relevant to the port, they are Customs Clearance Service, Launch Boat Service, Line Handling Service, Pilot Service, Port and Waterway Management, Port Communication Service, Ship Security Service, Shipping Agent and Tug Boat Service.

Second, there are no companies who support the port entry indirectly.

Third, the port users in the stage of the port entry are Freight Forwarder, Ocean Shipping Company and Shipper.

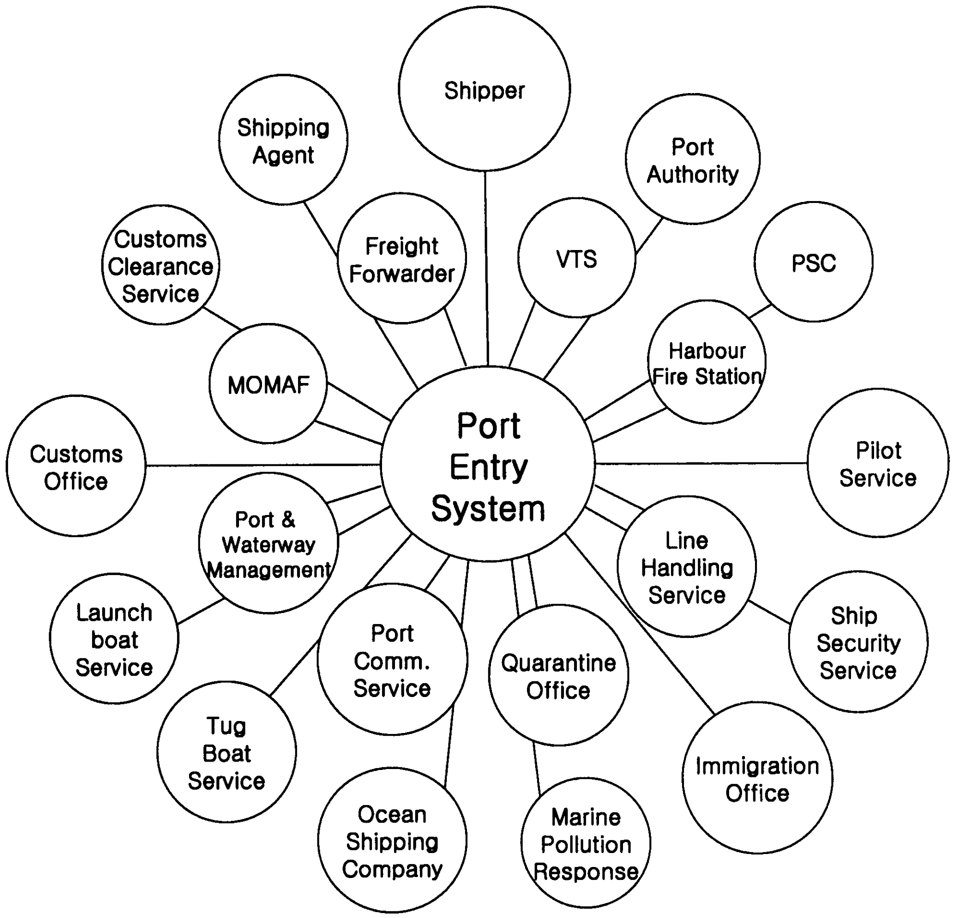


Figure 6-3 Cluster of the Port Entry System
Source: Author

Finally, the public institutions who are involved in port logistics activities and are either directly or indirectly involved to the port entry are the Customs Office, Harbour Fire Station, the Immigration Office, the MOMAF (Ministry of Maritime Affairs & Fisheries), the Port Authority, the PSC (Port State Control) Office, the Quarantine Office and the VTS (Vessels Traffic Station) Office (See **Figure 6-3**).

6.2.4 Stevedore System

The role of the stevedore system is to support the safe and speedy cargo loading or discharging between a ship and the port.

First, the companies who support the stevedore directly are Harbour Labour Union, Measure Service, Shipping Agent, Shipping Cargo Handling Service, Tally Service and Terminal Operating Company.

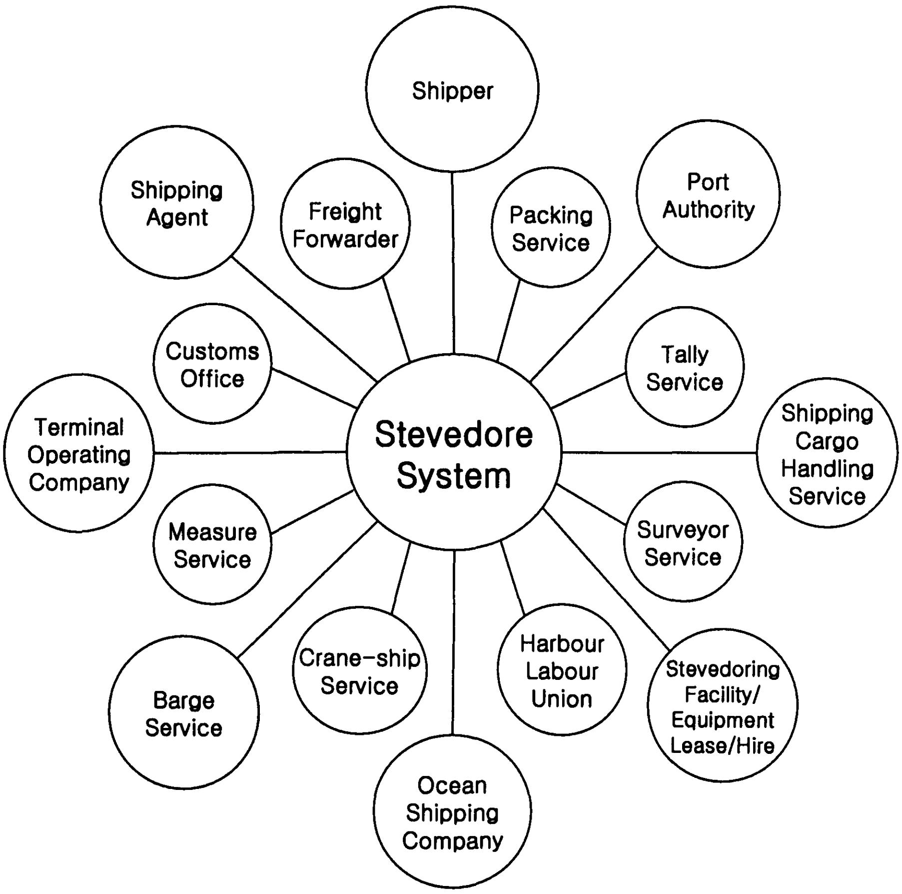


Figure 6-4 Cluster of the Stevedore System
Source: Author

Second, the companies who support the stevedoring being indirectly relevant to the port are Barge Service, Crane-Ship Service, Packing Service, Stevedoring Facility/Equipment Lease/Hire and Surveyor Service.

Third, the port users in the stage of the stevedoring are Freight Forwarder, Ocean Shipping Company and Shipper.

Finally, the public institutions who are involved in the port logistics activities and directly or indirectly linked to the stevedoring are Customs Office and the Port Authority (See **Figure 6-4**).

6.2.5 Transit System

The role of the transit system is to support safe and speedy transit connecting between stevedoring and storage (or inland transport).

First, the companies who support the transit directly are Harbour Labour Union, Shipping Agent and Shipping Cargo Handling Service.

Second, the companies who support the transit being indirectly relevant to the port are Barge Service, Cargo Transportation Labour Union, Coastal Shipping, Pipe-Line, Railways Company and Truck Company.

Third, the port users in the stage of the transit are Freight Forwarder, Ocean Shipping Company and Shipper.

Finally, the public institution which is involved in the port logistics activities and linked directly or indirectly to the transit is the Customs Office (See **Figure 6-5**).

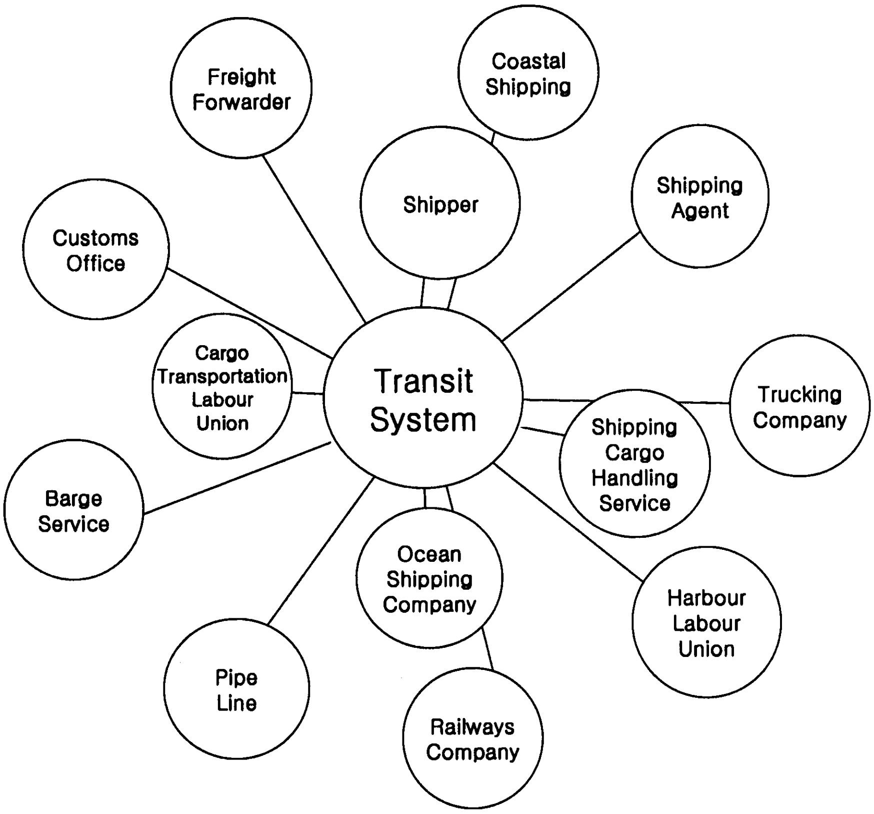


Figure 6-5 Cluster of the Transit System

Source: Author

6.2.6 Storage System

The role of the storage system is to support safe storage of the cargo until the shippers need them.

First, the companies who support the storage directly are Container Freight Service (CFS), Dangerous Articles Warehouse, Farm Warehouse, General Warehouse (including CY - Container Yard), Harbour Labour Union, Refrigeration /Freezing Warehouse, Shipping Agent, Shipping Cargo Handling Service, Tally Service, Tanker and other warehouses.

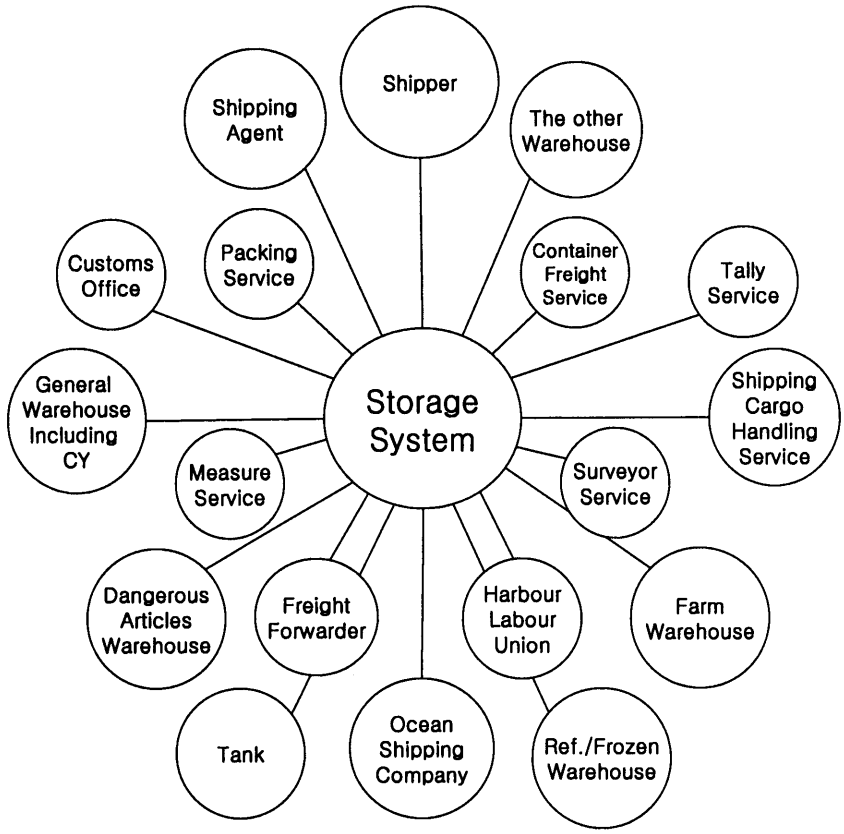


Figure 6-6 Cluster of the Storage System
Source: Author

Second, the companies who support the storage being indirectly relevant to the port are Measure Service, Packing Service and Surveyor Service.

Third, the port users in the stage of the storage are Freight Forwarder, Ocean Shipping Company and Shipper.

Finally, the public institution which is involved to the port logistics activities and linked directly or indirectly involved to the storage is the Customs Office (See **Figure 6-6**).

6.2.7 Inland Transport Connecting System

The role of the inland transport connecting system is to support safe and speedy connecting between stevedoring (or transit) and inland transportation.

First, the companies who support the inland transport connection directly are Harbour Labour Union, Shipping Agent and Shipping Cargo Handling Service.

Second, the companies who support the inland transport connection being indirectly relevant to the port are Barge/Inland Shipping, Pipe-line company, Cargo Transportation Labour Union, Van and Individual Trucking, Air and Trucking Cargo Handling, Railways Company, General Cargo Trucking, Airways Company and Coastal Shipping.

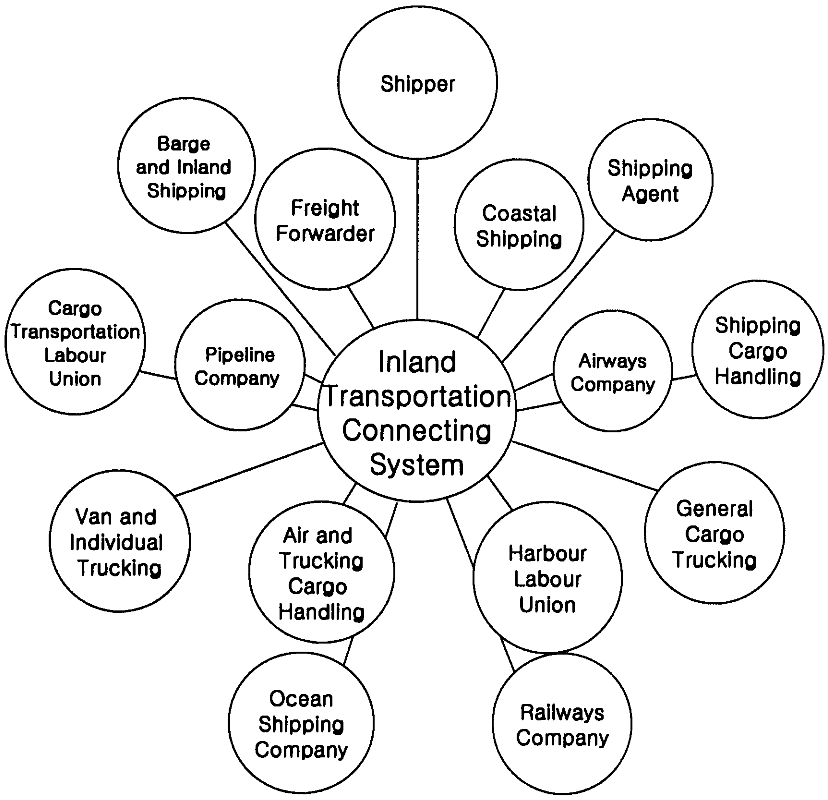


Figure 6-7 Cluster of the Storage System
Source: Author

Third, the port users in the stage of the inland transport connection are Freight Forwarder, Ocean Shipping Company, and Shipper.

Finally, there is no public institution which is involved in the inland transport connection activities (See **Figure 6-7**).

6.2.8 Port Information System

The role of the port information system is to supply correct and speedy information to the shipper and the relevant companies.

First, there is no company who supports the port information directly.

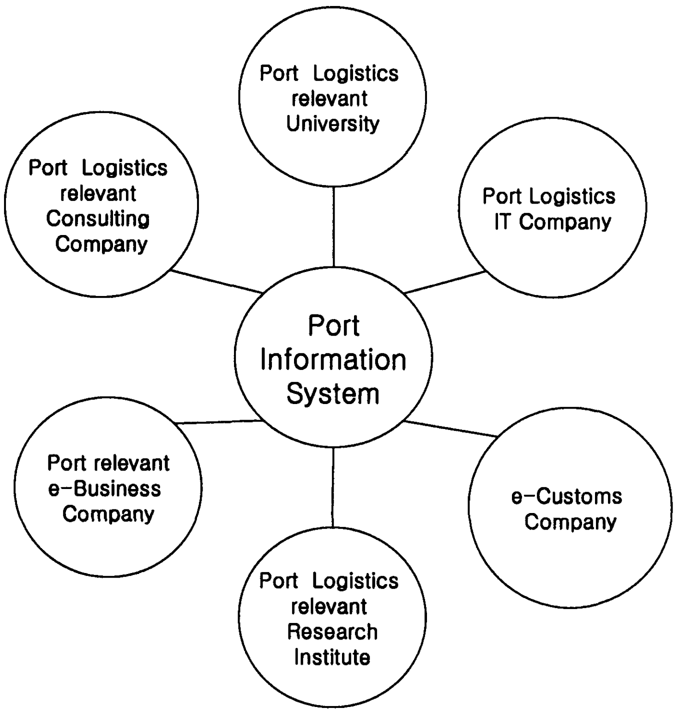


Figure 6-8 Cluster of the port information System
Source: Author

Second, the companies who support the port information being indirectly relevant to the port are Port Logistics relevant Consulting Company, Port Logistics IT Company, e-Customs Company and Port relevant e-business Company.

Third, the port users connecting to the port information system are not only Freight Forwarder, Ocean Shipping Company and Shipper but also all the companies working in the port.

Finally, the public institutions that are involved in the port logistics activities and directly or indirectly linked to the port information are port logistics relevant universities and port logistics relevant research institutes (See **Figure 6-8**).

6.3 The Port Clusters and the Classifications

Table 6-2 contains the KSIC (Korean Standard Industrial Classification), a classification of Port Logistics Relevant Companies (PLRCs) extracted at Chapter 5 for a total survey on the port logistics relevant companies in Busan Port and the contents of a port cluster obtained from new field work. This helps us to compare the results more easily with the others among the separate classifications relevant to the port logistics companies.

Simultaneously, the indications such as 'STB: Shipping Transport Business,' 'IBTP: Incidental Business for Transport in Port,' 'TBP: Transport Business in Port' and 'SWB: Storage and Warehousing Business' help us to understand Korean legal point of view towards PLRCs.

The industries that have no legal categories could be criticised as to whether they are PLRCs or not. However, this did not pose a great problem in this study because the total survey had a rule that stated that in a situation where the annual gross sales (AGS) relevant to the port activity exceeds 50% of AGS, it should be included preferentially even if it does not belong to the legal category of PLRCs (See **Chapter 5**).

Table 6-2 Various Classifications Relevant to the Port Clusters

1 Direct Port Logistics Industry

KSIC	PLRCs (used for the total Survey)	Port Clusters (subdivided by the Fieldwork)	Legal Category
1	Transport		
60311	General Freight Trucking	Trucking Company	
60312	Freight Trucking By Small Truck and Self-Management	Van and Individual Trucking	
61112	Oceangoing Foreign Freight Transport	Ocean Shipping Company	STB
61122	Coastal Water Freight Transport	Barge/Inland Shipping	STB
		Coastal Shipping	STB
2	Operation of Cargo Transport Facilities		
63201	General Warehousing	Container Freight Service	SWB
		General Warehouse(including CY)	SWB
63202	Refrigerated Warehousing	Ref./Frozen Warehouse	SWB
63203	Farm products warehousing	Farm Warehouse	SWB
63204	Dangerous Goods Warehousing	Dangerous Articles Warehouse	SWB
		Tanker	SWB
63209	Other Warehousing	The other Warehouse	SWB
63921	Operation of Harbour and Marine Terminal Facilities	Terminal Operating Company	TBP
3	Supporting and Auxiliary Transport Activities		
63101	Air Freight and Land Freight Handling	Air and Trucking Cargo Handling	
63102	Water Freight Handling	Harbour Labour Union	TBP
		Shipping Cargo Handling Service	TBP
63991	Freight Transport Arrangement	Freight Forwarder	
63992	Packing and Crating	Packing Service	TBP
63999	All Other Supporting Transport Services n.e.c.		
a	*Ship Broker*	Chartering Agent	STB
		Ship Broker	STB
b	*Manning Services*	Manning Service	STB
c	*Shipping Agent*	Shipping Agent	STB
d	*Tallying Services*	Measure Service	TBP
		Surveyor Service	TBP
		Tally Service	TBP
e	*Port Services*	Hold Cleaning Service	IBTP
		Launch Boat Service	IBTP
		Line Handling Service	IBTP
		Rubbish Disposal Service	IBTP
		Ship Security Service	IBTP
f	*Ship Approaching Services*	Pilot Service	IBTP
		Tug Boat Service	IBTP

STB: Shipping Transport Business
IBTP: Incidental Business for Transport in Ports
TBP: Transport Business in Ports
SWB: Storage and Warehousing Business

Table 6-2 Various Classifications Relevant to the Port Clusters (Continued)

KSIC	PLRCs (used for the total Survey)	Port Clusters (subdivided by the Fieldwork)	
g	*Supply Services*	Nautical Chart Distributor	IBTP
		Ship Chandler	IBTP
		Sparepart Supply	IBTP
h	*Bunkering Service*	Bunkering Service	IBTP
i	*Port Telecommunication*	Port Communication Service	
j	*Shipping Management*	Ship Management	STB
k	*Customs Clearance Service*	Customs Clearance Service	
z	*The Others*	Cargo Lashing Service	IBTP
		Crane-Ship Service	
		Disinfection Service	IBTP
		Port and Waterway Management	
		Salvage Service	IBTP
72209	Other Software Consultancy and supply	Consultancy &nd Software supply	
4	**Renting of Transport Equipment**		
71121	Renting of Containers	Renting and repairing of Containers	
71129	Other Renting of Transport Equipment n.e.c.	Logistics Equipment Lease/Hire	
71290	Renting of Other Machinery and Equipment	Stevering Facility/Equipement Lease/Hire	
5	**Manufacture of Cargo Transport Equipment**		
35111	Building of Steel Ships	Logistics Equipment Repairer	
		Ship Building	
		Ship Repair Shop	IBTP
2 Indirect Port Logistics Industry			
		Airways Company	
		Cargo Transportation Labour Union	
		P&I Club	
		Pipe-line company	
		Railways Company	
		Seaman's Medical Service	
		Shipping Insurance	
		Ship Register	
3 Port Users			
		Shipper	
4 Public Institutes			
		Customs Offfice	
		Harboure Fire Station	
		Immigration Office	
		Marine Police	
		MOMAF	
		Maritime Safety Tribunal	
		Navy	
		Port Authority	
		PSC	
		Quarrantine Office	
		VTS	

STB: Shipping Transport Business
IBTP: Incidental Business for Transport in Ports
TBP: Transport Business in Ports
SWB: Storage and Warehousing Business

Source: Author

This study also categorised the PLRCs in a port cluster into four groups, namely 'Direct Port Logistics Industry,' 'Indirect Port Logistics Industry,' 'Port Users' and 'Public Institutes' for convenience of the study.

6.4 Port Clusters in the Port Logistics Process

Figure 6-9 shows us that the PLRCs extracted from the prior section linked to the port logistics process. Some relationship is connected not only with one sub system but also with others. For example, Port Information System is related to whole of the port logistics process. Freight Forwarder acting on behalf of shippers and Shipping Agent acting on behalf of ship owners are related to the whole of the port logistics process either.

Meanwhile, Harbour Labour Union, Shipping Cargo Handling Service Company, Tally Service, Surveyor Service, Measure Service and Packing Service, are related to the cargo handling. However, these also have the relationships with at least two sub-systems on the port logistics process. Among the public institute, Customs Office has comparatively high concerns compared to others.

As shown above, this study tried to clarify the relationships between the relevant companies and the port logistics process. However, the matches between the companies in port cluster and the port logistics processes still provide obvious restrictions in understanding the mutual relationship or the interaction among them. The solution of this problem will be handled in **Chapter 7**.

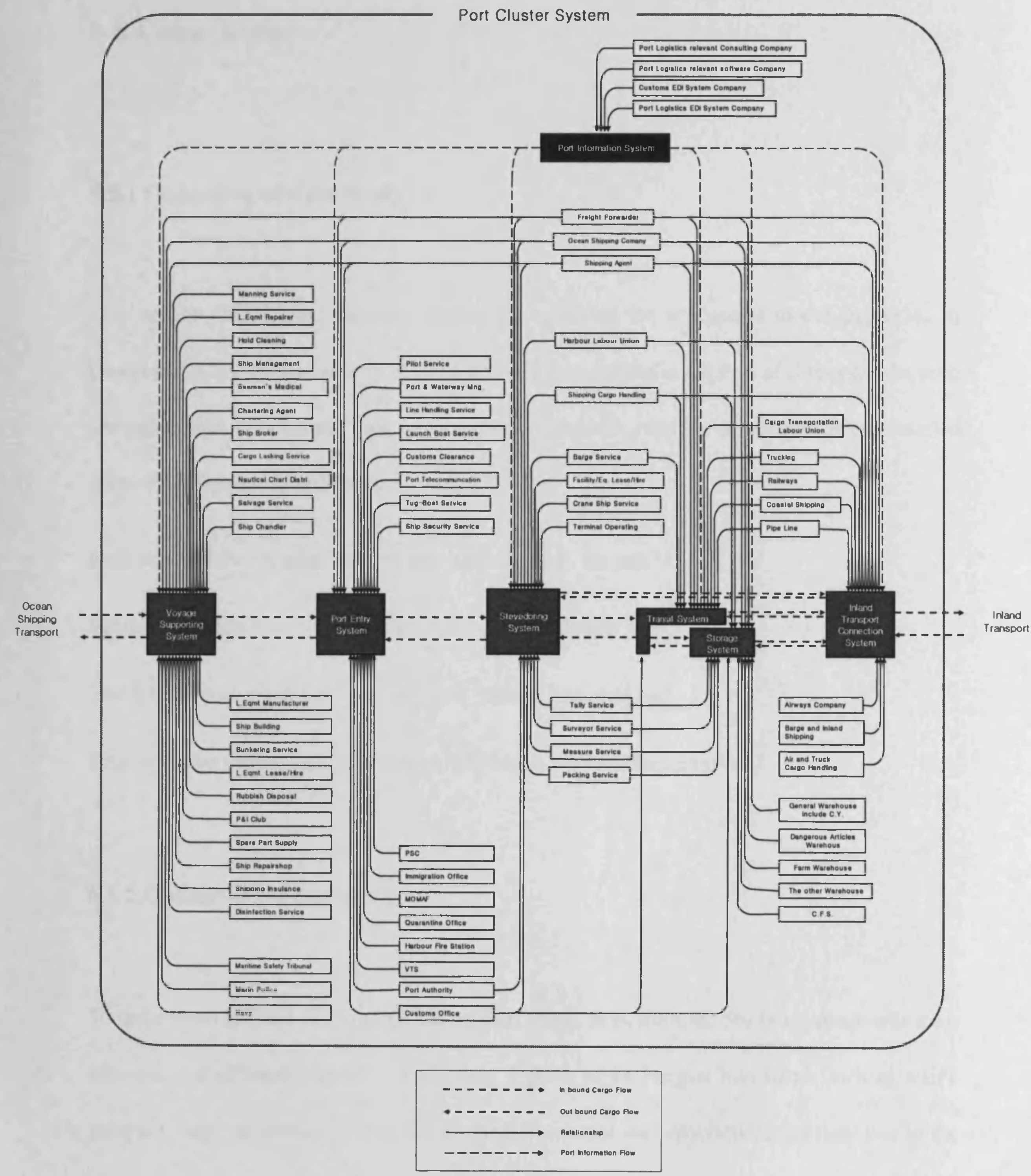


Figure 6-9 PLRCs in a Port Cluster on the port logistics process

Source: Author

6.5 Case Study

6.5.1 Objectives of Case Study

This section will handle the case studies for verifying the conceptual model suggested in **Chapter 5**. This chapter aims to observe how the ships calling at the Port of Busan use the port, and what kind of relations they have with port logistics relevant companies. More detailed research questions are as follows;

First, what do the ships calling in a port actually do in the port?

Second, what kinds of companies are involved in their port activities?

Third, how much money do they spend on various port services?

Fourth, do the various port activities correspond to the port cluster system?

6.5.2 Outline of the fieldwork

To understand purpose of the ships calling into Busan Port, the Case Study approach was most effective and efficient method. In addition, it gives us an insighst into issues such as which company they had contact with and what kind of services they received during they stay in the port.

For the case studies, three visits were made between December of 2003 and January of 2004 to three different shipping agent companies located in Busan.

At the first visit, a manager from a company was chosen to be in charge of correspondence with the researcher. The purpose and background of the research were explained to the manager. At the second visit, a summary of expenses made by ships during their stay at the port, requested at the first visit, was obtained.

122 expense summaries from 2002 and 2003 were provided, . All of them were similar but, they could be categorised into eight cases depending on the port logistics process. From this data, eight typical cases of port use were defined.

Expenses that were missed or only partly recorded on the summary were examined during an interview with the manager at the third visit.

The reason for restricting the target of the case studies to shipping agents is because they work on behalf of ship owners or charterers of ships which call into the port. The shipping agents are involved in almost all aspects of activities related to ships from the moment they arrive to the time when they depart. Therefore carrying out the case studies with shipping agents would be sufficient and appropriate in understanding the whole process of port use.

Among the three shipping agent companies included in the study, one of them was the company who had participated in the group interview for Chapter 6, and the other participants in this case study were recommended by him. In this case study, the name of the ship and interviewee remain anonymous as agreed between the company and the researcher prior to the interview.

The reason why I restricted the target of the case study to shipping agents is because they work on behalf of ship owners or charterers of ships which call into the port. The shipping agents are involved in almost all aspects of activities related to ships from the moment they arrive to the time when they depart. Therefore carrying out the case study against shipping agent would be sufficient and appropriate in understanding the whole process of port use.

Among the three of shipping agent companies, one of them was the company who had participated in the group interview for Chapter 6, and the other participants in this case study were recommended by him. On this case study, the name of the ship and interviewee remain anonymous as agreed between the company and the researcher prior to the interview.

Table 6-3 shows us the number of the ships entering Busan Port and **Figure 6-10** gives us the location of the major port facilities in Busan Port.

Table 6-3 Ships Entry in Port of Busan

Year	Total		Ocaen going Ship		Coastal Ship	
	Numbers	Tonnage	Numbers	Tonnage	Numbers	Tonnage
2004	47,809	329,633,073	27,804	311,891,719	20,005	17,741,354
2003	47,241	313,284,377	27,275	294,554,905	19,966	18,729,472
2002	46,321	291,363,482	26,166	273,939,517	20,155	17,423,965
2001	41,782	270,398,499	23,359	253,664,234	18,423	16,734,265
2000	37,556	253,536,319	21,875	238,075,844	15,681	15,460,475

Data Source: Busan MOMAF (http://pusan.momaf.go.kr)

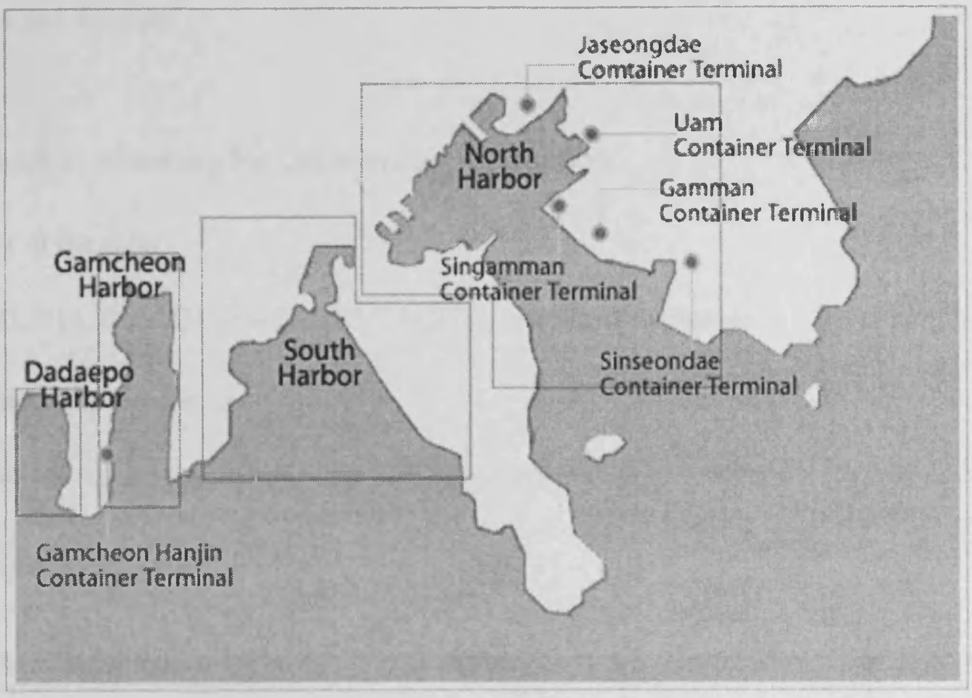


Figure 6-10 Location of Port Facilities in Port of Busan

Source: Busan MOMAF (http://pusan.momaf.go.kr)

6.5.3 Case Studies

a. CASE 1: Mooring for underwater inspection

♦ **Spec of the ship:**

M/V ALPHA, General Cargo Ship (G/T 18,374), mooring in anchorage

♦ **Schedule of the port use:**

Arrival: 17th August 2002 Departure: 18th August 2002

♦ **Situation Summary:**

M/V ALPHA moored at anchorage of outer harbour in Busan Port for a couple of days without port entry, to receive an underwater inspection and to remove some rubbish by placing an order through a shipping agent. It seems that M/V ALPHA employed a ship security guard (watchman) while she was moored for night duty. She neither entered the port nor discharged any cargo.

♦ **Expenses and relevant companies**

Table 6-4 Expenses Summary of M/V ALPHA

	USD	KRW	GBP	Relevant Company
1. Shipping Agency Fee	$1,300	₩1,560,000	£780	Shipping Agent
2. Watchman Service Charge	$95	₩113,400	£57	Ship Security Service
3. Rubbish Disposal Service Charge	$332	₩397,800	£199	Rubbish Disposal Service
4. Underwater Inspection Charge	$1,600	₩1,920,000	£960	Ship Building Company*
Total	$3,326	₩3,991,200	£1,996	

Source: Author

* Most of the ship building companies not only build ships but also repair them and perform ship inspection.

As shown in **Table 6-4**, during her stop-over, M/V ALPHA contacted a shipping agent company, a ship security service company and a rubbish disposal service company only. She had no concern with cargo handling, but spent almost GBP 1,998 pounds for the port services.

b. CASE 2: Mooring only for ship supply

♦ **Spec of the ship:**

M/V BETA, Full-Container Carrier (G/T about 40,000), mooring in anchorage

♦ **Schedule of the port use:**

Arrival: 30th April 2002 Departure: 30th April 2002

♦ **Situation Summary:**

M/V BETA moored at anchorage of outer harbour in Busan Port for a day without port entry, to receive spare parts and fresh water. At the same time, it seems that M/V BETA asked the shipping agent to carry out miscellaneous activities (to post goods and have spare parts delivered). She neither entered the port nor discharged any cargo from the ship.

♦ **Expenses and relevant companies**

As it is shown in **Table 6-5**, during her stop-over, M/V BETA contacted a shipping agent company, a port telecommunication service company, a rubbish disposal service and a spare-part supply company. She had no concern with cargo handling, but spent almost GBP 6,230 pounds for using port services.

Table 6-5 Expenses Summary of M/V BETA

	USD	KRW	GBP	Relevant Company
1. Shipping Agent Fee	$600	₩720,000	£360	Shipping Agent
2. Transportation Charge	$60	₩72,000	£36	Shipping Agent
3. Telecommunication Charge	$60	₩72,000	£36	Port Telecommunication Service
4. Petties	$110	₩132,000	£66	Shipping Agent
5. Postage	$26	₩31,700	£16	Shipping Agent
6. Water Supply Charge	$969	₩1,162,500	£581	Rubbish Disposal Service*
7. Spare Part Handling Charge	$416	₩498,926	£249	Shipping Agent**
8. Spare Part Cost	$8,143	₩9,771,192	£4,886	Spare Part Supplier
Total	$10,384	₩12,460,318	£6,230	

Source: Author

* In Busan Port, water supply is usually handled by a rubbish disposal service company.

** Most of the ship building companies not only build ships but also repair the ship and perform the ship inspection.

c. CASE 3: Calling for crew shifting and ship supply

♦ **Spec of the ship:**

M/V GAMMA, Bulk Carrier (G/T about 5,498) mooring in anchorage

♦ **Schedule of the port use:**

Arrival: 21st December 2003 Departure: 22nd December 2003

♦ **Situation Summary:**

M/V GAMMA was mooring at anchorage of outer harbour in Busan Port for two days without port entry for crew shifting. While she was mooring, crew shifting was accomplished and spare parts, fresh water and nautical charts were taken on board during that time.

From the expenses summary, it seems that M/V GAMMA moved to another anchorage in the port for some reason. She neither entered the port nor discharged any cargo from the ship.

◆ **Expenses and relevant companies**

During M/V GAMMA's stop-over for one night without port entry, a shipping agent was contacted for general arrangement and crew shifting, a nautical chart distributor for charts, a pilot office for shifting the anchorage, a launch boat service for crew transport, a rubbish disposal service company for disposal of bilge water and supply fresh water, ship chandler for provisions and spare-parts supply company for spare parts (See **Table 6-6).**

Table 6-6 Expenses Summary of M/V GAMMA

	USD	KRW	GBP	Relevant Company
1. Shipping Agency Fee	$1,500	₩1,800,000	£900	Shipping Agent
2. Chart Supply Charge	$100	₩120,500	£60	Nautical Chart Distributor
3. Pilotage & Pilot Boat Charge	$430	₩516,240	£258	Pilot Service
4. Launch Boat Charge	$112	₩134,160	£67	Launch Boat Service*
5. Water Supply Charge	$504	₩604,500	£302	Rubbish Disposal Service
6. Bilge Water Disposal Charge	$888	₩1,065,600	£533	Rubbish Disposal Service
7. Provisions Supply Charge	$25,085	₩30,102,000	£15,051	Ship Chandler
8. Spare Part Handling Charge	$854	₩1,024,438	£512	Spare Part Supplier
9. Crew Handling Charge	$1,198	₩1,437,079	£719	Shipping Agent**
Total	$30,670	₩36,804,517	£18,402	

Source: Author

* Launch boat was used for transport of crews shifting

** Crew handling means collecting the crew from the airport to the ship and the ship to the airport

As it is shown in **Table 6-6**, M/V GAMMA spent almost GBP 18,402 pounds without cargo handling but only for port service use.

d. CASE 4: Calling of non commercial ship

♦ **Spec of the ship:**

M/V DELTA, Training ship (G/T 362), alongside the berth at Korea Maritime University.

♦ **Schedule of the port use:**

Arrival: 15th August 2002 Departure: 29th August 2002

♦ **Situation Summary:**

M/V DELTA berthed alongside the Korea Maritime University for 15 days, only for non-commercial (educational) purposes without cargo handling.

♦ **Expenses and relevant companies**

During berthing time of M/V DELTA, whenever there were some miscellaneous tasks (posting items and for trainees' landing) the shipping agent arranged them. Just before her departure they disposed some rubbish through a rubbish disposal service company. For her port entry a pilot service and a line handling company were necessary but Port Due and Dockage was exempted for education purpose.

One of the interesting elements in this case is that they did not use the port telecommunication but, used mobile phones provided by shipping agent or landline connected from the berth.

As it is shown in **Table 6-7**, M/V DELTA spent almost GBP 2,055 pounds without cargo handling charge and without port charge.

Table 6-7 Expenses Summary of M/V DELTA

	USD	KRW	GBP	Relevant Company
1. Shipping Agency Fee	$1,270	₩1,524,000	£762	Shipping Agent
2. Telephone Charge	$70	₩84,461	£42	Shipping Agent
3. Transportation Charge	$142	₩170,000	£85	Shipping Agent
4. Petties	$110	₩132,000	£66	Shipping Agent
5. Cash Advance to Master	$295	₩353,592	£177	Shipping Agent
6. Mobile Phone Usage	$208	₩249,480	£125	Shipping Agent
7. Non-Office Hours Clearance Fee	$13	₩15,000	£8	Customs Office
8. Customs Attending Fee	$12	₩14,000	£7	Customs Office
9. Postage	$3	₩3,700	£2	Shipping Agent
10. Transportation Charge(for Traine	$379	₩455,000	£228	Shipping Agent
11. Pilotage + Pilot Boat Charge	$315	₩378,170	£189	Pilot Service
12. Line Handling Charge	$34	₩40,350	£20	Line Handling Service
13. Rubbish Disposal Service Charge	$576	₩691,200	£346	Rubbish Disposal Service
Total	$3,426	₩4,110,953	£2,055	

Source: Author

e. CASE 5: Calling of a cruise ship with tourists

♦ **Spec of the ship:**

M/V EPSILON, Cruise ship (G/T 5,218), berthing in Cruise Terminal

♦ **Schedule of the port use:**

Arrival: 29th April 2002   Departure: 29th April 2002

♦ **Situation Summary:**

Non liner Cruise ship M/V EPSILON visited Busan for tourism purpose with tourist. During her half day staying in the port, the tourists went on a tour and the ship supply companies supplied fresh water and spare parts and some of crews were shifted. Rubbish was also removed from the ship. It was a cruise ship, different from general passenger ships, as provision of welcoming events took place on the wharf for tourists on board as the ship arrived. Except for those things, not many things were different from a general cargo ship in port entry procedure. One of the differences was that they did not use any tug boat while berthing the ship. This may be because M/V EPSILON equips the bow thrusters like most modern cruise ships.

◆ **Expenses and relevant companies**

Table 6-8 Expenses Summary of M/V EPSILON

	USD	KRW	GBP	Relevant Company
1. Port Dues	$278	₩333,950	£167	MOMAF
2. Dockage	$80	₩96,150	£48	MOMAF (PBA) *
3. Shipping Agency Fee	$1,400	₩1,680,000	£840	Shipping Agent
4. Attendance Fee	$590	₩708,000	£354	Shipping Agent
5. Transportation Charge	$75	₩90,000	£45	Shipping Agent
6. Wireless Telephone Charge	$81	₩97,137	£49	Shipping Agent
7. Entertainment Fee	$167	₩200,000	£100	Shipping Agent
8. Non-Office Hours Clearance Char	$6	₩7,000	£4	Customs Office
9. Petties	$110	₩132,000	£66	Shipping Agent
10.Pilotage+Pilot Boat Charge	$411	₩492,860	£246	Pilot Service
11.Line Handling Charge	$47	₩56,240	£28	Line Handling Service
12. Water Supply Charge	$450	₩539,400	£270	Rubbish Disposal Service
13. Rubbish Disposal Service Charge	$2,330	₩2,795,400	£1,398	Rubbish Disposal Service
14. Spare Parts Handling Charge	$463	₩555,308	£278	Shipping Agent
15. Crew Handling Charge	$1,431	₩1,717,160	£859	Shipping Agent
Total	$5,246	₩6,295,368	£3,148	

Source: Author

* It is only cruise ships that do not pay any wharfage since they do not carry any cargo, but they still have to pay port due and dockage. From 2003 when PBA (Port of Busan Authority) was established, dockage has been received by PBA.

As seen in **Table 6-8**, during her berthing time M/V EPSILON received not many supplies except fresh water and small spare parts. However she spent about GBP 3,148 pounds without any cargo handling charge. If she was a liner cruise then it would have been completely different as liner cruise ships need to receive regular and huge supplies from the port. For example, a liner cruise ship that had visited Busan Port 96 times in 2000 spent about GBP 10 million pounds only for ship supplies and GBP 200,000 pounds for port charge within a year.

f. CASE 6: Calling of a full container ship only for T/S

♦ **Spec of the ship:**

M/V ZETA, Full Container ship (G/T 17,940), berthing in North Harbour

♦ **Schedule of the port use:**

Arrival: 17th September 2003 Departure: 17th September 2003

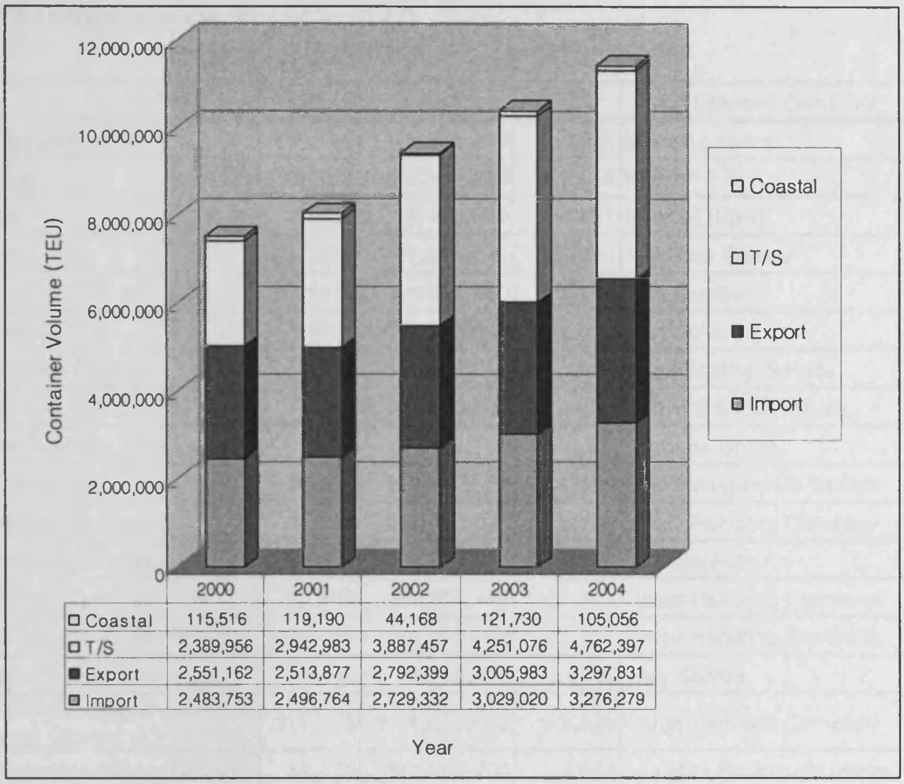
♦ **Situation Summary:**

M/V ZETA shows us T/S cargo handling situation in Busan Port. If we take into account the fact that recent T/S cargo volume has been increasing consistently, then we can understand how this case might be worth considering as a typical case of Busan Port (See **Figure 6-11**).

♦ **Expenses and relevant companies**

Except for the fact that all of the discharged container cargoes were loaded again to other ships for T/S, the cargoes bear no relationship to the inland transport connecting system.

In this case, the port entry procedure and the other port activities were quite usual. One noticeable thing is that M/V ZETA received regular check for ship maintenance by a ship management company and received P.P.O. (Pollution Prevention Obligation) certificate from the PSC (Port State Control). Nowadays an increasing number of ports are refusing to call in ships without this certificate. M/V ZETA seems to have been in a rush as they did not even have supply of fresh water.



	2000	2001	2002	2003	2004
Coastal	115,516	119,190	44,168	121,730	105,056
T/S	2,389,956	2,942,983	3,887,457	4,251,076	4,762,397
Export	2,551,162	2,513,877	2,792,399	3,005,983	3,297,831
Import	2,483,753	2,496,764	2,729,332	3,029,020	3,276,279

Figure 6-11 Change of the container volume in Busan Port during recent 5 years
Data Source: PBA (Port of Busan Authority, www.pba.or.kr)

Nevertheless, in order to enter the port she contacted a pilot service, a tug boat service and a line handling company. During her stay in Busan Port, she received services from a port MIS & EDI company, a cargo handling companies, a tally service and a logistics equipment lease/hire company. She also paid all port charges namely port due, dockage and wharfage collected by the port relevant public offices. As shown in **Table 6-9**, M/V ZETA spent almost GBP 20,108 pounds to port relevant companies for various services.

Table 6-9 Expenses Summary of M/V ZETA

	USD	KRW	GBP	Relevant Company
1. Shipping Agency Fee	$1,159	₩1,390,320	£695	Shipping Agent
2. Port Dues	$1,914	₩2,296,320	£1,148	MOMAF
3. Dockage	$636	₩762,800	£381	MOMAF (PBA)
4. Tuggage	$1,305	₩1,565,470	£783	Tug Boat Charge
5. Pilotage	$499	₩599,250	£300	Pilot Service
6. Pilot Boat Charge	$169	₩202,680	£101	Pilot Service
7. Line Handling Charge	$102	₩122,000	£61	Line Handling Service
8. Port MIS and EDI Charge	$25	₩30,000	£15	Port MIS & EDI Service
9. Customs Overtime Clearance Fee	$8	₩9,750	£5	Customs Office
10. Husbanding Fee	$1,800	₩2,160,000	£1,080	Ship Management Service
11. Stevedorage(Discharge)	$2,082	₩2,498,637	£1,249	Cargo Handling Company
12. Tally Charge(Discharge)	$224	₩268,260	£134	Tally Service
13. T/S Stevedorage(Discharge)	$3,509	₩4,210,445	£2,105	Cargo Handling Company
14. T/S Stevedorage(Loading)	$3,509	₩4,210,445	£2,105	Cargo Handling Company
15. T/S Tally Charge(Discharge)	$342	₩410,040	£205	Tally Service
16. T/S Shore Handling & Transportation Charge	$11,725	₩14,070,000	£7,035	Cargo Handling Company
17. T/S Equipment Service Charge	$1,075	₩1,290,000	£645	Logistics Equipment Lease/Hire
18. T/S Storage Charge	$833	₩1,000,000	£500	General Warehouse(include CY)
19. T/S Wharfage	$433	₩519,380	£260	MOMAF
20. Cargo Handling Fee	$1,700	₩2,040,000	£1,020	Cargo Handling Company
21. Fees for Certificate of P.P.O	$167	₩200,000	£100	PSC
22. Rubbish Disposal Service Charge	$300	₩360,270	£180	Rubbish Disposal Service
Total	$33,513	₩40,216,067	£20,108	

Source: Author

g. CASE 7: Calling of a bulk carrier only for discharging the cargo

♦ **Spec of the ship:**

M/V ETA, Bulk Carrier (G/T 30,767), berthing in Gam-Cheon Harbour

♦ **Schedule of the port use:**

Arrival: 23rd September 2003 Departure: 23rd September 2003

♦ **Situation Summary:**

M/V ETA is a typical case of bulk cargo import. During her berthing in Busan Port, there were crew shifting and regular check for ship maintenance. They employed a watchman during discharging of the bulk cargo and also removed some rubbish and sludge from the ship. It seems that M/V ETA departed without any loading of cargo.

♦ **Expenses and relevant companies**

As shown in **Table 6-10**, M/V ETA spent only GBP 12,974 pounds even though she is not a small vessel (G/T 30,767). One reason would be that she did not receive any other ship supply and the other reason is she did not load any cargo so that half of the cargo handling did not occur.

As a matter of fact, other expenses coming from the next process are not shown in Table 6-20, but we can assume that more expenses for storage and inland transportation must have been necessary.

Table 6-10. Expenses Summary of M/V ETA

	USD	KRW	GBP	Relevant Company
1. Shipping Agency Fee	$1,136	₩1,362,960	£681	Shipping Agent
2. Port Dues	$3,282	₩3,938,170	£1,969	MOMAF
3. Dockage	$872	₩1,046,180	£523	MOMAF (PBA)
4. Tuggage	$2,086	₩2,503,010	£1,252	Tug Boat Service
5. Pilotage	$927	₩1,111,840	£556	Pilot Service
6. Pilot Boat Charge	$271	₩325,200	£163	Pilot Service
7. Line Handling Charge	$113	₩136,000	£68	Line Handling Service
8. Guard Fee	$42	₩50,000	£25	Ship Security Service
9. Port MIS and EDI Charge	$25	₩30,000	£15	Port MIS & EDI Service
10. Husbanding Fee	$1,800	₩2,160,000	£1,080	Ship Management Service
11. Stevedorage(Discharge)	$6,636	₩7,963,094	£3,982	Cargo Handling Company
12. Tally Charge(Discharge)	$727	₩872,100	£436	Tally Service
13. Cargo Handling Fee	$1,700	₩2,040,000	£1,020	Cargo Handling Company
14. Fees for Certificate of P.P.O	$377	₩452,000	£226	PSC
15. Crew Handling Charge	$436	₩523,543	£262	Shipping Agent
16. Sludge Disposal Charge	$563	₩675,801	£338	Rubbish Disposal Service
17. Rubbish Disposal Service Charge	$632	₩757,800	£379	Rubbish Disposal Service
Total	$21,623	₩25,947,698	£12,974	

Source: Author

h. CASE 8: Typical Calling of a full-container carrier for discharging and loading the cargo

◆ **Spec of the ship:**

M/V THETA, Full Container Carrier (G/T 44,397), berthing in North Harbour

◆ **Schedule of the port use:**

Arrival: 21st July 2003 Departure: 22nd July 2003

◆ **Situation Summary:**

M/V THETA is a typical case of container cargo transport in normal condition. Her cargo stevedoring activity covered exports and imports. During her berthing there were crew shifting and regular checks for ship maintenance. A tally man for loading/discharging and cargo lashing service after loading were necessary. She also removed some rubbish from the ship.

◆ **Expenses and relevant companies**

Table 6-11. Expenses Summary of M/V THETA

	USD	KRW	GBP	Relevant Company
1. Shipping Agency Fee	$1,170	₩1,403,400	£702	Shipping Agent
2. Port Dues	$1,914	₩2,296,320	£1,148	MOMAF
3. Dockage	$636	₩762,800	£381	MOMAF (PBA)
4. Tuggage	$1,305	₩1,565,470	£783	Tug Boat Charge
5. Pilotage	$499	₩599,250	£300	Pilot Service
6. Pilot Boat Charge	$169	₩202,680	£101	Pilot Service
7. Line Handling Charge	$102	₩122,000	£61	Line Handling Service
8. Port MIS and EDI Charge	$25	₩30,000	£15	Port MIS & EDI Service
9. Customs Overtime Clearance Fee	$8	₩9,750	£5	Customs Office
10. Husbanding Fee	$1,800	₩2,160,000	£1,080	Ship Management Service
11. Stevedorage(Discharge)	$2,082	₩2,498,637	£1,249	Cargo Handling Company
12. Tally Charge(Discharge)	$224	₩268,260	£134	Tally Service
13. Stevedorage(Loading)	$3,509	₩4,210,445	£2,105	Cargo Handling Company
14. Tally Charge(Loading)	$3,509	₩4,210,445	£2,105	Tally Service
15. Shore Operation Charge & Truckage (Discharge Equip. Charge)	$11,725	₩14,070,000	£7,035	Cargo Handling Company / Stevedoring Equipment Lease/Hire
16. Lashing/Shoring Service Charge (Loading)	$1,075	₩1,290,000	£645	Cargo Lashing Company
17. Cargo Handling Fee	$1,700	₩2,040,000	£1,020	Cargo Handling Company
18. Fees for Certificate of P.P.O	$167	₩200,000	£100	PSC
19. Crew Handling Charge	$718	₩861,924	£431	Shipping Agent
20. Rubbish Disposal Service Charge	$300	₩360,270	£180	Rubbish Disposal Service
21. Vessel's Mailing Service Charge	$300	₩360,270	£180	Shipping Agent
Total	$31,465	₩37,758,251	£18,879	

Source: Author

M/V THETA shows us what the normal port entry is. Even though there was no ship supply, she took all the cargo loading and discharging activities. From the expenses for hiring of the extra stevedoring equipment, it is not difficult to imagine that she was operating under a tight schedule.

According to **Table 6-11,** M/V THETA spent only GBP 18,879 pounds even though she was not a small vessel (G/T 44,397). However, we have to take into consideration that she would have had to spend more expenses for the next logistics process (storage and inland transport).

6.5.4 Application of the Case Studies to port logistics system

From these case studies, we can derive some useful outcomes. First, it is clear that not all the ships come to the port only for cargo loading and discharging. Second, the port logistics system does not always consist of all the sub systems suggested in **Chapter 4**. Most cases of port logistics activities follow the sequence of all of the sub systems, but sometimes this may not hold.

Figure 6-12 clarifies the various port usage phases that were recognised through the case studies. Those six phases was made of six sub systems of the port logistics system suggested in Chapter 6 except port information system.

Situation (A) in **Figure 6-12** illustrates the case of a ship not entering the port for loading or discharging cargo, but rather for the purpose of ship repairing or ship supply. However, in case of Busan Port, since 1998 "Passing Ship Free-port System" had been activated and hence cases like this have become very rare, whereas cases similar to Situation **(B)** have increased instead.

Case 1: M/V Alpha and Case 2: M/V Beta belong to this category.

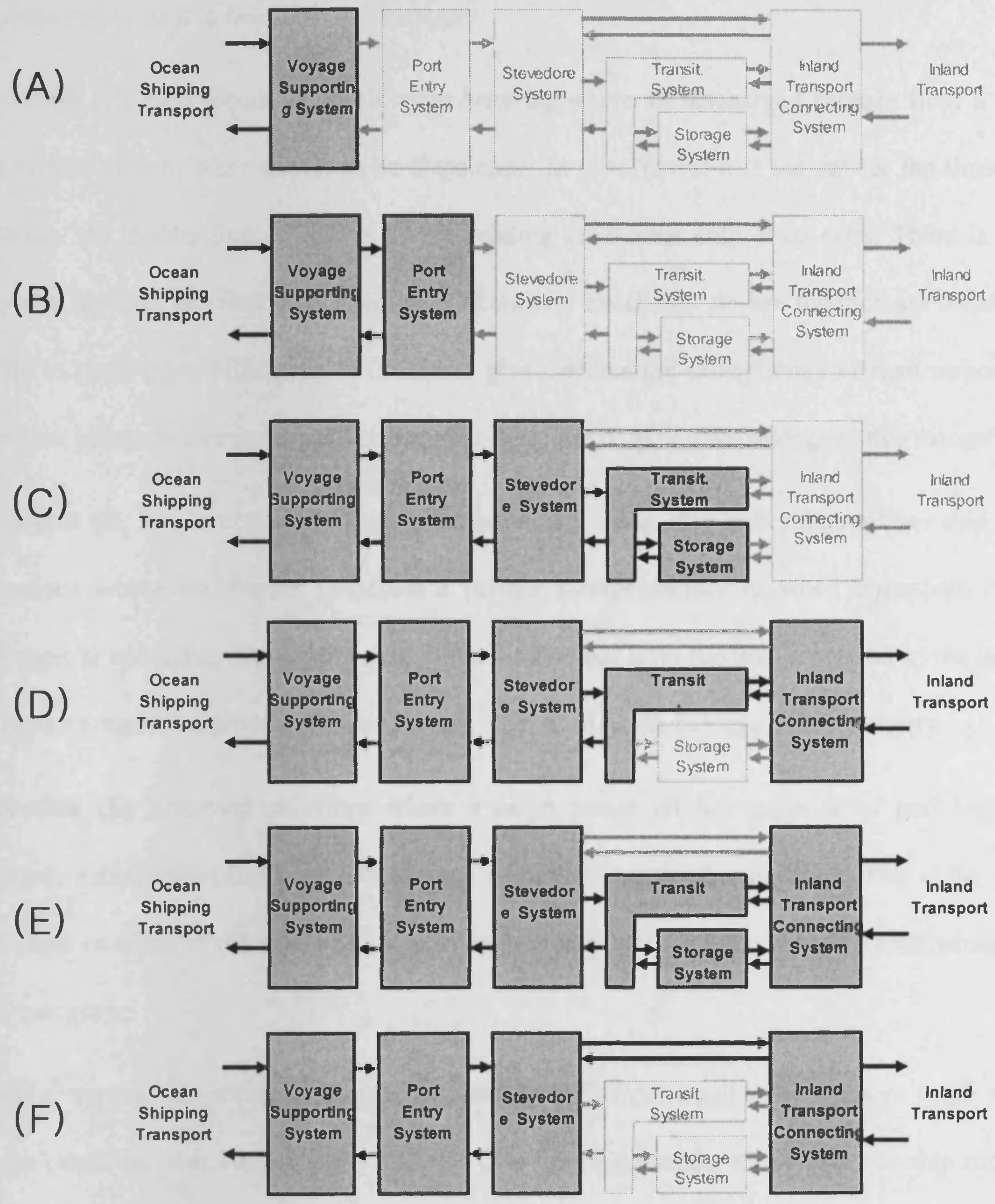


Figure 6-12 Six situations of the Port Logistics Process by the Phases

Source: Author

Situation (B) is only different from **Situation (A)** in the respect that it considers situations when the ship enters the port. Even though there are no exemption benefits, if the ship needs to carry out a task in the port without cargo handling, that is categorised in this case. Case 3: M/V Gamma can be said to belong to this category.

Situation (C) corresponds to transit cargo handling where all discharged cargoes from a ship are re-loaded onto other ship(s) to be dispatched. In most cases, it is natural for the time gap between the discharging of ship A to the loading of another ship B to exist. There is also physical distance between these two ships. Therefore, transit and storage function are necessary to fill in these gaps. Most ports in the world give customs tax exemptions to transit cargoes in the form of bonded transport and bond warehouse. Case 6: M/V Zeta belongs to this category.

Situation (D) is a matter of frequent occurrence in a tramp ship rather than a liner ship. In situations where the shipper possesses a private storage facility or when immediate cargo transport is necessary, the cargo would directly move out from the transit process to the inland transport connecting process without storage. Case 7: M/V Eta belongs to this category.

Situation (E) illustrates situations where a cargo passes all the sequence of port logistics process, namely stevedoring, transit, storage and inland transport connecting. This is the most common situation of the export and import cargo transportation. Case 8: M/V Theta belongs to this category.

Finally, we can see situations similar to **Situation** (F) from small sized ports or small sized cargo handling. Also, we can easily find this case from a passenger ship or a cruise ship without cargo handling. Case 4: M/V Epsilon and Case 5: M/V Delta may belong to this category, although they do not completely fit into this category, since they handled passengers, not cargoes.

6.6 SUMMARY

Secondary data and set theory were utilised in this chapter to visualise the intra-relationship within a port cluster. This helps to clarify the confusion that sometimes arises between the various terms, together with the Roh (2004) research that was related to the interrelationship between various assemblages, such as ports, port clusters, maritime clusters and port ranges, around the port clusters.

We referred the possibility of inter-industry analysis to port logistics relevant company (PLRC) and we verified a couple of the reasons why we can not apply the inter-industry analysis technique to PLRC, if the industrial classification index was not prepared for the specific industry.

According to RQ1 (What are the defining boundaries of port cluster system?), this study applied induced systematic approach to observe the port logistics process in detail from a functional perspective. This study also subdivided the port logistics system into 6 sub-systems; namely Voyage Supporting System, Port Entry System, Stevedoring System, Transit System, Storage System and Inland Transport Connection System. Simultaneously, this study tries to visualise not only the boundary of the port cluster system but also the relationship between PLRCs and port logistics process by drawing the relation diagram in detail.

A diagram (Figure 6-9) attempted to provide the answer of RQ 4 (Which systems method and techniques are appropriate for modelling port logistics process and the port cluster system?) showing how port users and port cluster companies engage in the port logistics process. However, this matching of companies and the port logistics processes has obvious restrictions in understanding mutual relationship or the interaction among them because of the complexity of diagram. Another proper engineering technique is necessary to visualise these relationship or the interaction properly and this will be handled in **Chapter 7**.

This chapter also examined eight of case studies to answer the three research questions outlined at the beginning of the chapter as follows

- What do the ships calling in a port actually do in the port?
- What kinds of companies are involved in their port activities?
- How much money do they spend on various port services?

From these eight case studies, we can confirm that the main purpose of port activities is discharging and loading of cargoes from or to a ship. However, another function of equal importance is the provision of support for a ship for safe and comfortable voyage.

It was also confirmed that even if a ship call into a port only for miscellaneous businesses for a short while without any cargo handling, many port relevant companies are involved in handling of the ship.

From a financial perspective, we also found that a port can make as much profit without occupying a berth, as normal cargo handling process would.

In a situation like that of the port of Busan, where the demand on the port (cargo volume) exceeds the supply (cargo handling capacity), creating added value by supplying various goods and services to the ships were seen to be an effective means of increasing port competitiveness within a short period of time. This compares favourably to the expansion of the port capacity, which requires a large scale investment.

In this chapter, based on observing the various cases of the port use, we divided the type of port use into 6 conceptual models according to the degree of application of the sub-systems of the port logistics process.

We have also verified the conceptual model of port logistics system including added voyage supporting system and separated cargo flows into in-bound and out-bound.

Nevertheless, despite the success in confirming what kind of companies are related on each sub-system, these case studies have limits in the sense that they could not visualise what kinds of relationships are established between different companies.

The ways to overcome these limits will be discussed in more detail in the next chapter.

CHAPTER 7

RELATIONSHIPS WITHIN A PORT CLUSTER

7.1 Chapter Overview

This chapter presents several diagrams called SADT (Structured Analysis and Design Technique) diagram as an appropriate industrial engineering technique to visualise intra-port clusters.

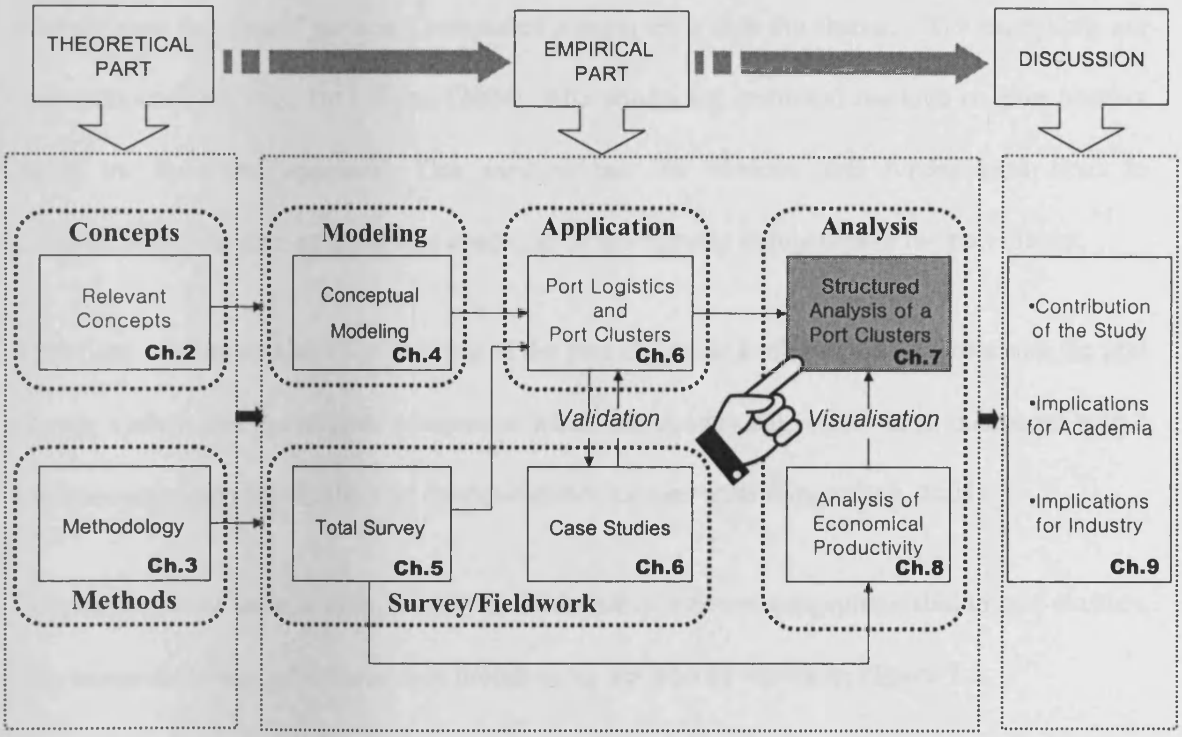


Figure 7-1 Position of 'Relationship within a Port Cluster' in the thesis
Source: Author

Such visualisations will help in developing our understanding of the interrelationships between associated companies in the port cluster and of figuring out the whole picture of the port cluster. This chapter bears a relationship with RQ3 (How do port users and port cluster companies engage in the port logistics process?), and RQ4 (Are systems methods and techniques, such as soft systems methodology and structural analysis & design technique appropriate for modelling the port logistics process and the port cluster system?)

7.2 Background of the Structured Modelling

There has been little research in analysing port clusters and their impact on the operational performance and that of ports and associated companies within the cluster. The exceptions are Hezendonck(2001) and De Langen (2004), who conducted empirical research on port clusters using an inductive approach. This method has the obvious and fundamental limit to understanding the data on the actual condition of the relevant companies or the port cluster.

This thesis define another characteristic of the port cluster as a microscopic approach on the port cluster system and the relevant companies which are constituent factors of it; compared with a macroscopic approach on the port cluster and the relevant assemblage (Roh, 2004).

To gain a clearer understanding about the relationship between concepts related to port clusters, this research developed a conceptual model using Set Theory shown in **Figure 7-2**.

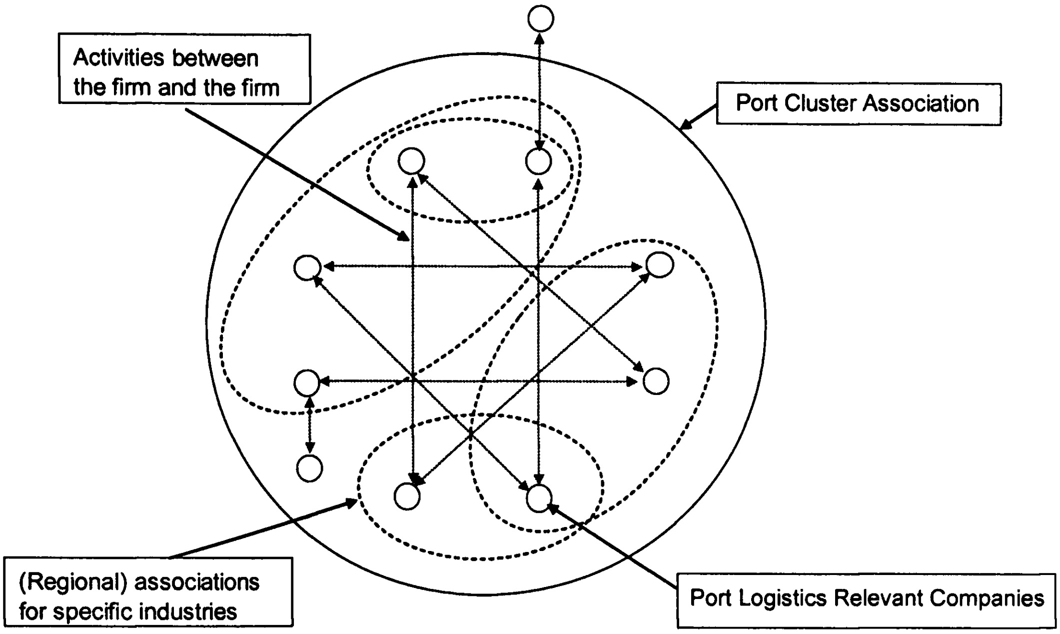


Figure 7-2 Conceptual model of the intra port cluster system
Source: Author

In a port cluster system many and various PLRCs work together with various relationships between each other. Most of them belong to one or more (regional) associations for specific industry, although some work independently. The port cluster association can include several (regional) associations for a specific industry in it. However those who do not want to join can remain outside the port cluster association. In other words, the port cluster system is on a higher level in the hierarchy than the (regional) associations for specific industry and this means the (regional) associations is a higher level concept than PLRC (See **Figure 7-3**).

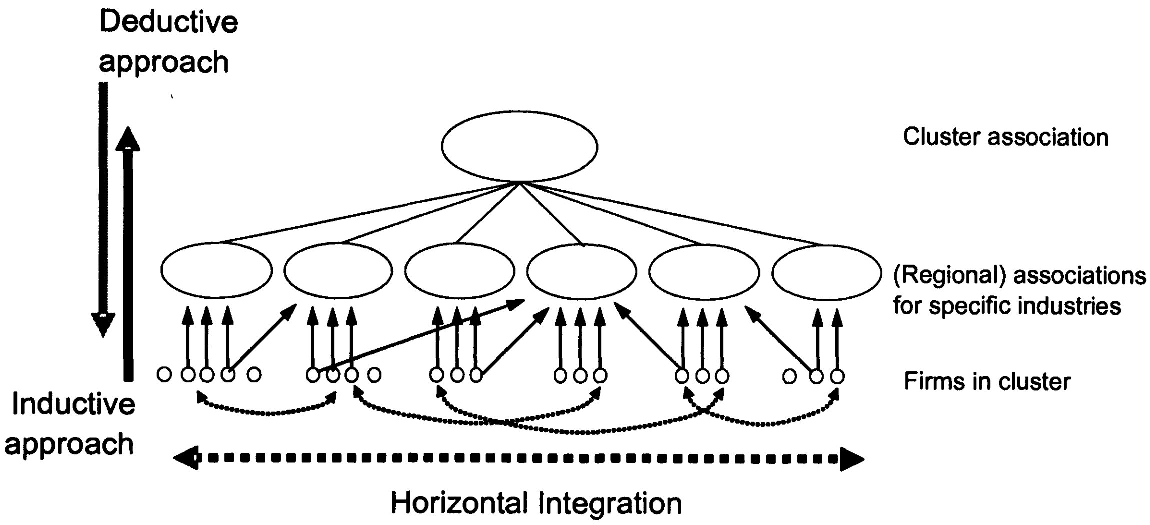


Figure 7-3 Deductive and Inductive approach to port cluster system
Source: Modified from De Langen (2004) p.13 by author.

7.3 Building of Structured Models and Analysis

- SADT Modelling for Port Cluster System (Case of Busan Port: Korea)

7.3.1 Purpose of the Model

In **Chapter 3**, the use of systems analysis, and specifically the SADT technique, in analysing port clusters was verified. These techniques enable the structure of a port cluster system, however complicated, to be simplified. Therefore, port clusters, port logistics system and port logistics process which were introduced in **Chapter 6** will be used for the decomposition process.

As we have seen from **Chapter 5**, the port cluster system is a complicated system consisting of many port related companies and public institutes.

Ports require their associated actors (port relevant companies and public institutes) to be working in coordination. However only when the coordination goes on smoothly can the maximum benefits or Added Value be guaranteed. This effective coordination is a fundamental part of a port cluster. Consequently it is important to understand which organisations are connected and what kind of business relationship they have, for both establishing the port cluster and developing it. The only problem is that this creates complexity, making decomposition of the port cluster difficult.

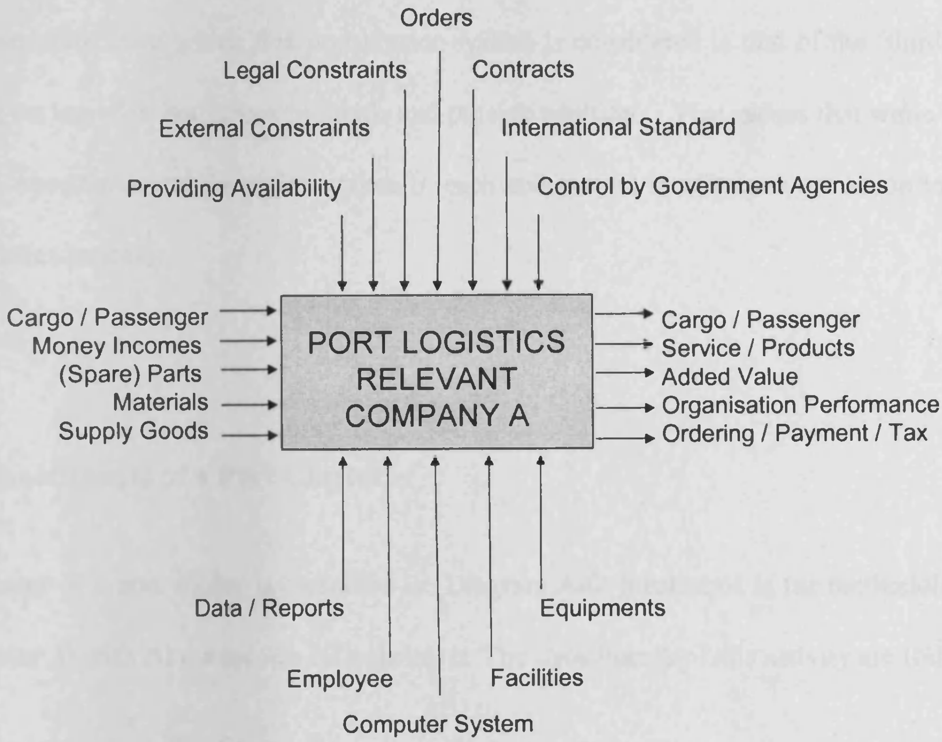


Figure 7-4 Typical function box and interface arrows using for a port cluster system
Source: Author

Therefore, this thesis solves the problem as to analyse the port cluster system that not only the decomposition but also structuralisation and omission; particularly about input, output, control, mechanism and supplements. The sort of the business is replaced with the activity in the Function Box using verb describing.

Figure 7-4 shows us that typical function box, major inputs, outputs, controls, mechanisms and supplements using for SADT diagram of port cluster system (See **Figure 7-4** compared with **Figure 3-3**).

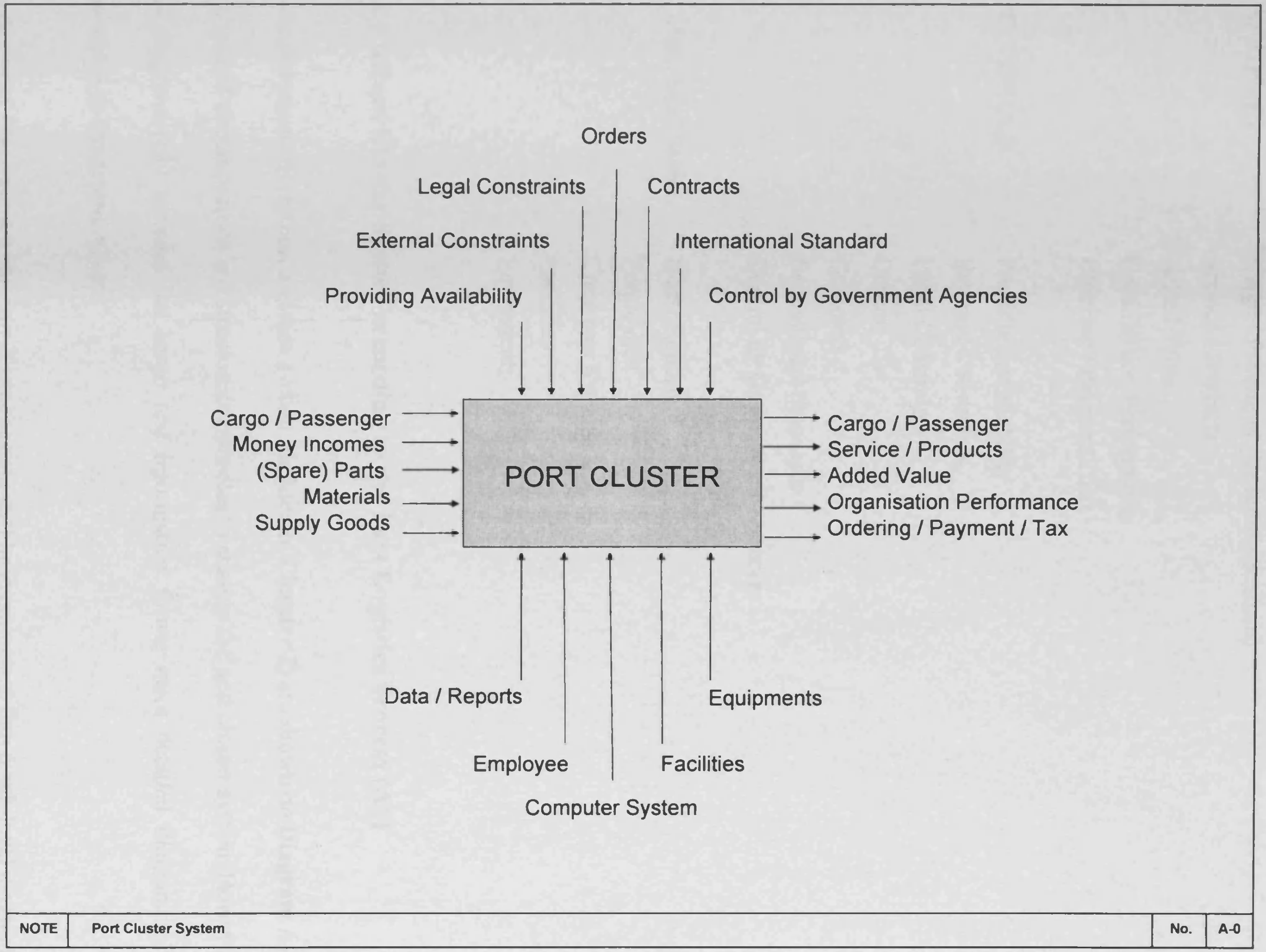
7.3.2 Viewpoint

The perspective from which this port cluster system is considered is that of the 'third person' standing on top of it, both from an inside and outside position. That means that while being in the port, operations and the actions taken in each sub system in sequence are according to the port logistics process.

7.3.3 Constituents of a Port Cluster

The activity of a port cluster is presented in (Diagram A-0: mentioned in the methodology part of **Chapter 3)** with all the aspects influencing it. The constituents of this activity are follows:

INPUTS	Cargo / Passenger (Including Seaman)
	Money Income
	Spare parts for ships
	Materials (for Manufacturing and Cargo Packing)
	Supplies (Provisions, Fuel, Nautical Charts)

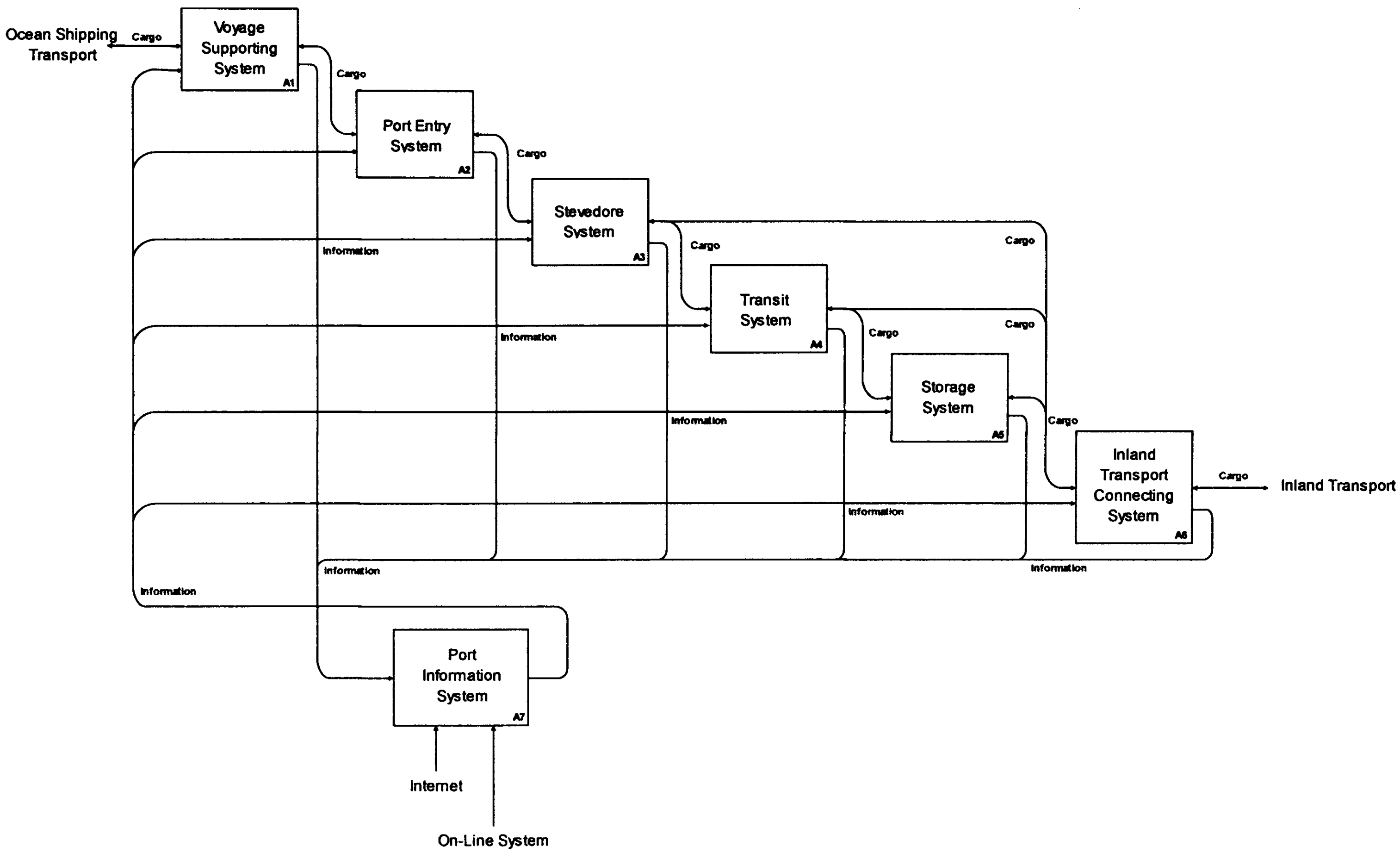

Orders
Legal Constraints
Contracts
External Constraints
International Standard
Providing Availability
Control by Government Agencies
Cargo / Passenger
Money Incomes
(Spare) Parts
Materials
Supply Goods
PORT CLUSTER
Cargo / Passenger
Service / Products
Added Value
Organisation Performance
Ordering / Payment / Tax
Data / Reports
Equipments
Employee
Facilities
Computer System
NOTE
Port Cluster System
No.
A-0

OUTPUTS	Cargo / Passenger (Including Seaman) Service / Products Added Value Organisation Performance Ordering / Payment / Tax
CONTROLS	Providing Availability External Constraints Legal Constraints Orders Contracts International Standards Control by Government Agencies
MECHANISMS	Data / Reports Employees Computer Systems Facilities Equipment

7.3.4 A Port Cluster System according to the Port Logistics Process (A0)

The sub-systems of the port logistics system (defined in **Chapter 2**) are shown on **Diagram A0,** as a trial of decomposition and structurising process to analyse the port cluster system. However, this diagram only includes the cargo and information flows; more detailed diagrams are developed in **Diagrams A1-A6**.

As drawn in **Diagram A0**, the port cluster system will be decomposed into 6 sub-level diagrams, such as voyage supporting system (**Diagram A1**), port entry system (**Diagram A2**), stevedore



NOTE	Port Cluster System by Sub-systems of Port Logistics Process	No.	A0

system (**Diagram A3**), transit system (**Diagram A4**), storage system (**Diagram A5**) and inland transport connecting system (**Diagram A6**).

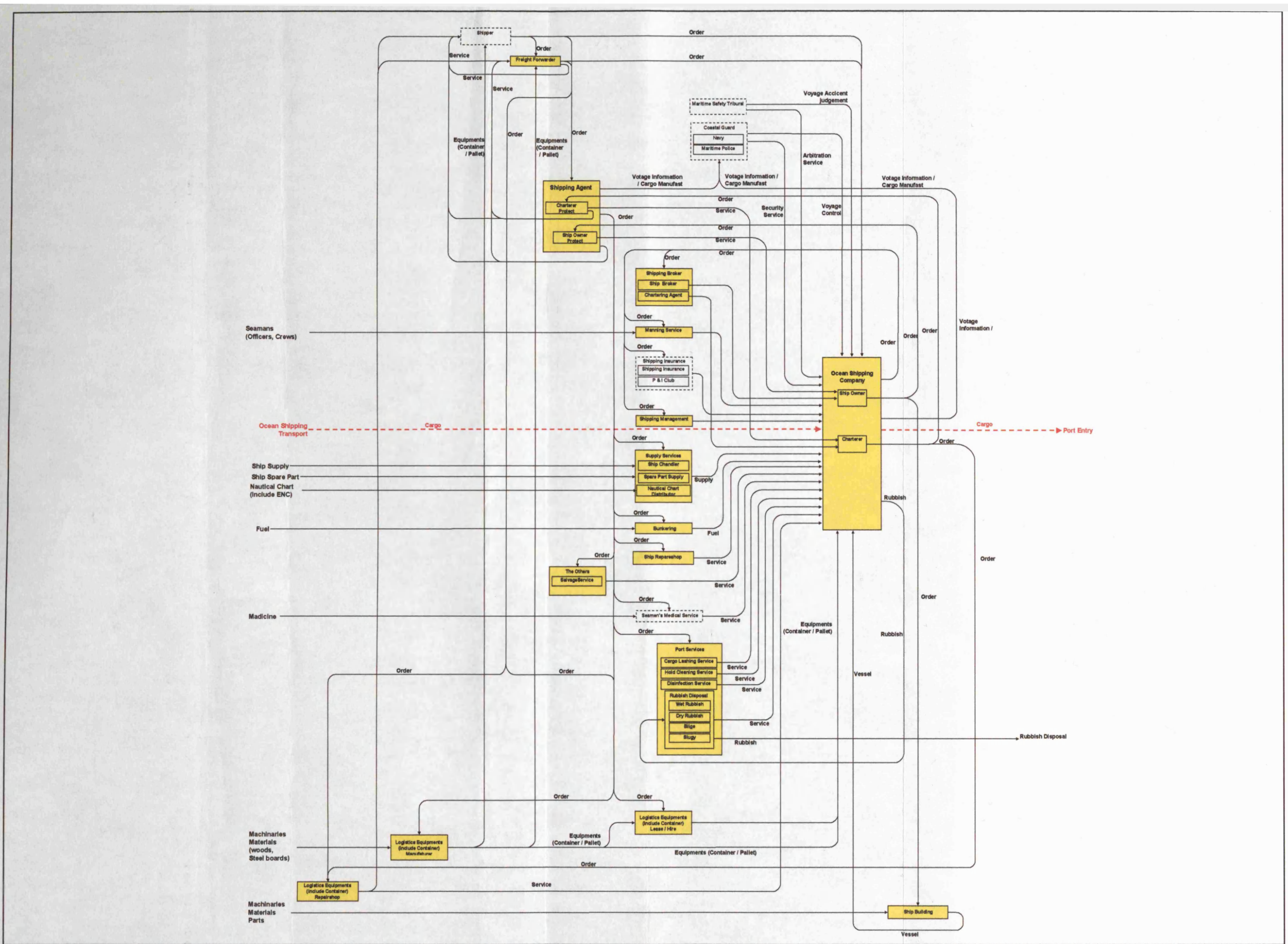
In case of port information system, this research does not draw separate diagrams since it is linked to every firm or public institute with nothing significant.

7.3.5 Voyage Supporting System Diagram (A1)

The role of the voyage supporting system is to supply goods or services to a ship regardless of the port of entry. Activities such as the supply of materials to ship buildings and repairers belong within the relevant sub systems.

As can be seen in **Diagram A1**, the ocean shipping company is located in the centre of the diagram with the directly relevant port companies connected to it. Most of these companies receive orders directly from ocean shipping companies or through shipping agents, while most of the indirect port relevant companies receive orders directly from shippers or Freight Forwarders. Financial flows associated with these order have been omitted on this diagram to avoid complexity. General office equipment like stationery and personal computers were also omitted.

Organisations represented by dotted line boxes on the diagram are companies or public institutes not included in the total survey (in **Chapter 6**) while the red coloured dotted line stands for cargo flow. On this diagram only inbound cargoes were considered since, for outbound cargoes, the direction of dotted the red line and arrows will be reversed.



NOTE	Voyage Supporting System	No.	A1

181

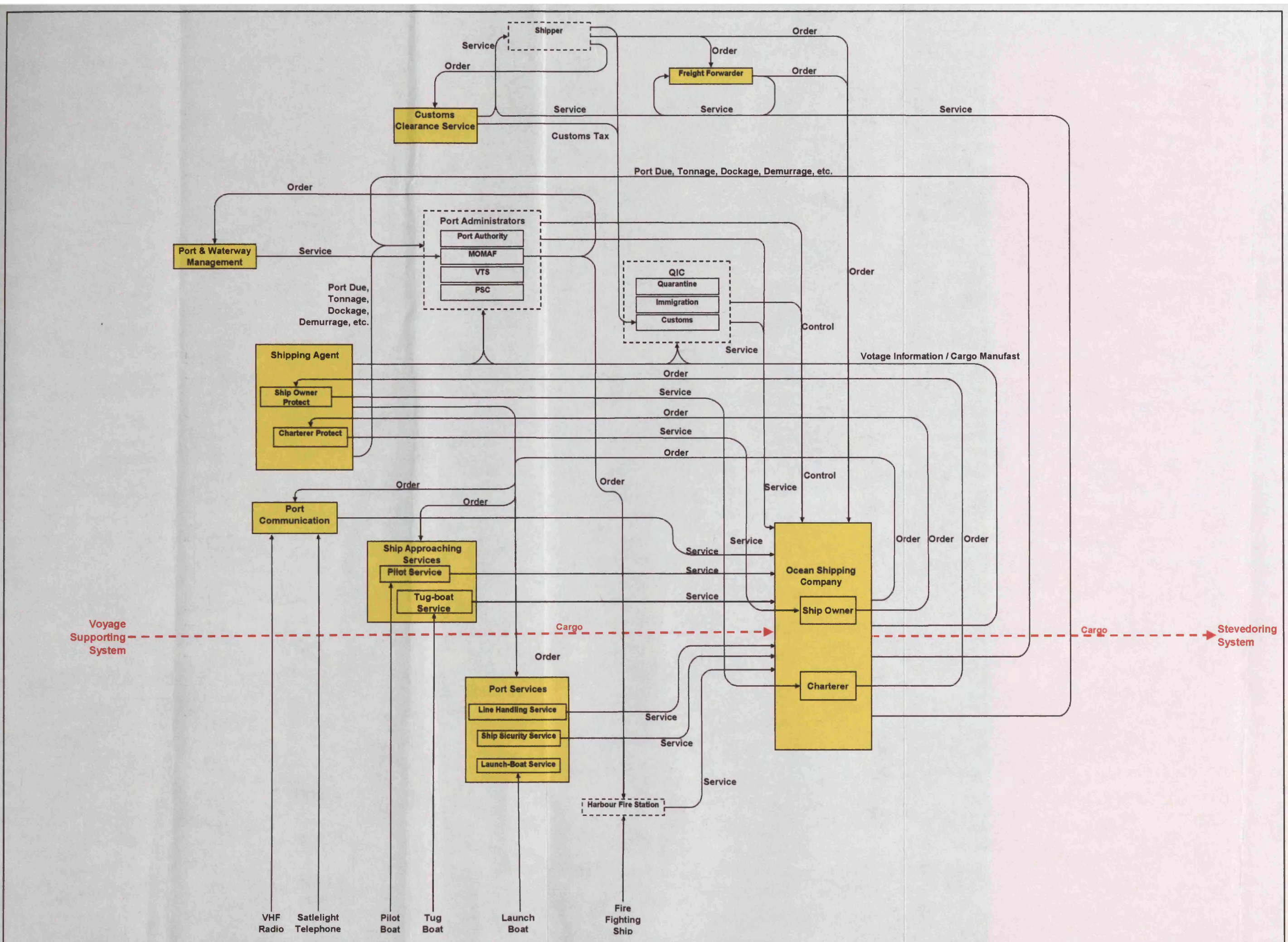
There are many kinds of inputs that are external to this system, since the voyage supporting system aims to support and to replenish ships for a safe journey. According to the type of the ocean shipping companies such as ship owners or Charterer, the role of the shipping agents also changed such as the ship owner protector or the charterer protector.

The diagram is more complex as there are more and more service or product suppliers involved in the system.

As can be seen in **Diagram A1 (Voyage Supporting System)**, direct by relevant companies to the ocean shipping company are Bunkering Service, Cargo Lashing Service, Disinfection Service, Hold Cleaning Service, Logistics Equipment Repairer, Nautical Chart Distributor, Rubbish Disposal Service, Ship Chandler, Ship Repair Shop and Spare Part Supply. The companies who support the voyage of the ship indirectly are Chartering Agent, Logistics Equipment Lease/Hire, Logistics Equipment Manufacturing, Manning Service, P&I Club, Salvage Service, Seaman's Medical Service, Ship Broker, Ship Building, Ship Management, Shipping Agent and Shipping Insurance. Port users directly involved with ocean shipping company in the voyage support system were Freight Forwarder and Shipper. Finally, the public institutions who were involved in the port logistics activities and also directly or indirectly involved with voyage support are the Marine Police, the Maritime Safety Tribunal, and the Navy.

7.3.6 Port Entry System (A2)

The main role of port entry system is to support the safe and convenient arrival of a ship to the



NOTE	Port Entry System	No.	A2

port. As seen in **Diagram A2 (Port Entry System)**, the ocean shipping company operating the ships is still located in the centre of the diagram, with the directly relevant port companies connected to it, including the Customs Clearance Service, Launch Boat Service, Line Handling Service, Pilot Service, Port and Waterway Management, Port Communication Service, Ship Security Service, Shipping Agent and Tug Boat Service.

Most of these companies received their orders directly from ocean shipping companies or through shipping agents.

The cargo flow (represented by a red dotted line) comes from Voyage Supporting System and goes to Stevedoring System.

No Inputs originate from outside the Port Entry System since it only relates the approaching of the ships to the berth.

Compared to the other diagrams(**A1** and **A3 - A6**), **Diagram A2** contains more public institute such as Port Authority, Vessel Traffic Control (VTS) centre, Port State Control (PSC), Quarantine office, Immigration office and Customs office, because of the international nature of the port. Ministry of Marine Affairs and Fisheries (MOMAF) is the only agency specific to Korea.

There are no companies who support the port entry indirectly but the port users directly involved with ocean shipping company in port entry system were Freight Forwarder and Shipper. The public institutions who are involved in were the Customs Office, Harbour Fire Station, the Immigration Office, the MOMAF (Ministry of Maritime Affairs & Fisheries), the Port Authority, the PSC (Port State Control) Office, the Quarantine Office and the VTS

(Vessels Traffic Station) Office.

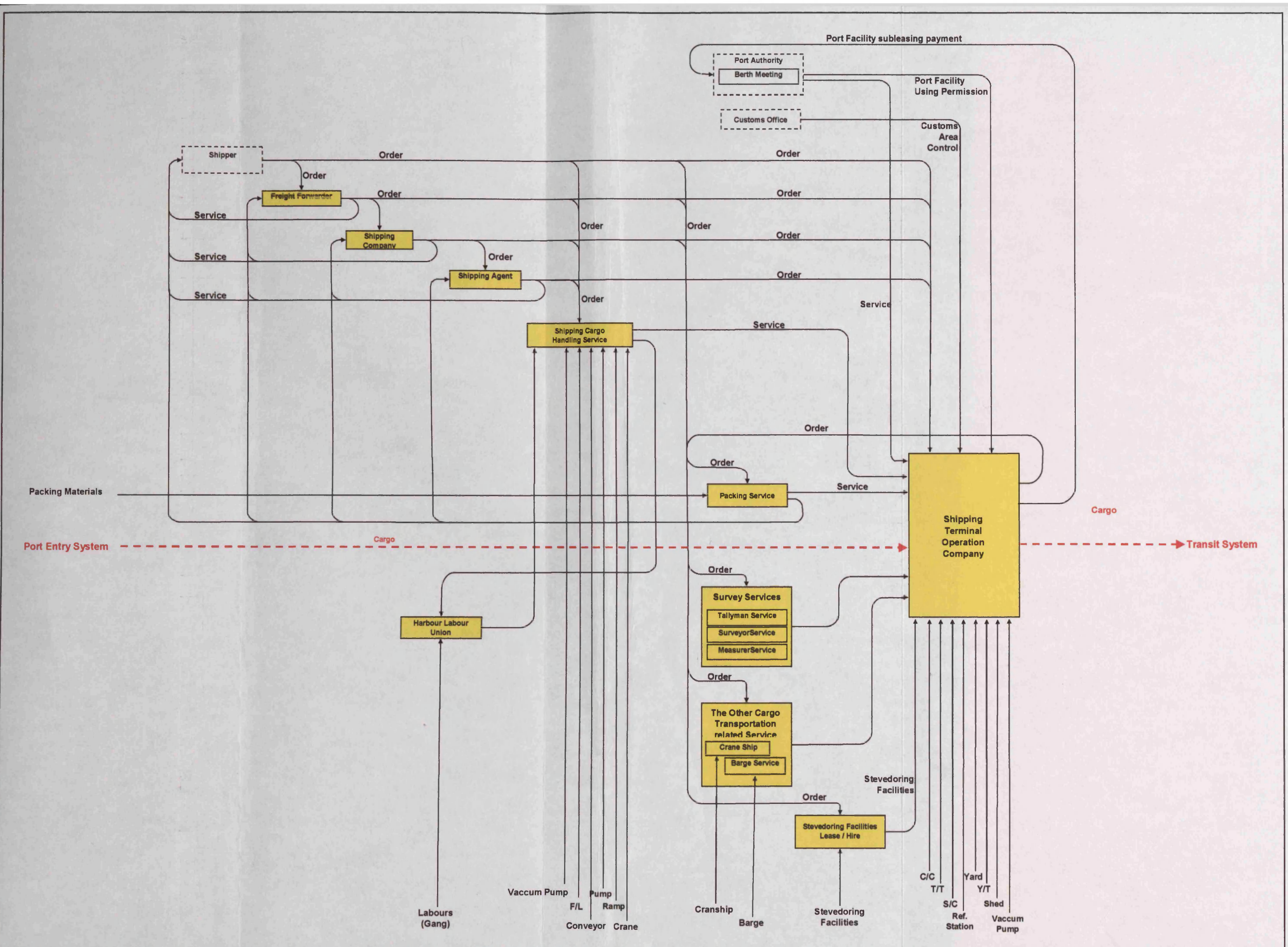
7.3.7 Stevedoring System (A3)

The role of the stevedore system is to support the safe and speedy cargo loading or discharging between a ship and the port. As it seen in **Diagram A3**, shipping terminal operation company is located in the centre of the diagram and the direct port relevant companies are near by connected with it. Most of the direct port relevant companies received the orders directly from shipping terminal operation company. Sometimes shipping cargo handling service companies received the orders from shippers or Freight Forwarders and harbour labour union received the order from the shipping cargo handling service companies.

The cargo flow comes from Port Entry System and goes to Transit System. In case of out-bound cargo flows the direction of dotted the red line and arrows will be reversed.

No Inputs from outside to this system since Stevedoring System is related only to loading and discharging cargo from/to the ships. Compared to the other diagrams, **Diagram A3** contains more mechanism arrows from below to the company. Most of them are kinds of equipments for cargo shifting namely: Vacuum Pump, Fork Lift (F/L), Conveyor, Pump, Ramp, Crane, Crain ship, Barge. Container Crane (C/G), Transtainer (T/T), Straddle Carrier (S/C), Ref. container Station, Stacking Yard, Yard Tractor (Y/T), Shed, Vacuum Pump and so on.

On **Diagram A3 (Stevedoring System)**, direct relevant companies to shipping terminal operation company were Harbour Labour Union, Measure Service, Shipping Agent, Shipping Cargo Handling Service and Tally Service.



NOTE	Stevedoring System	No.	A3

186

The companies who support the stevedoring being indirectly relevant to shipping terminal operation company were Barge Service, Crane-Ship Service, Packing Service, Stevedoring Facility/Equipment Lease/Hire and Surveyor Service.

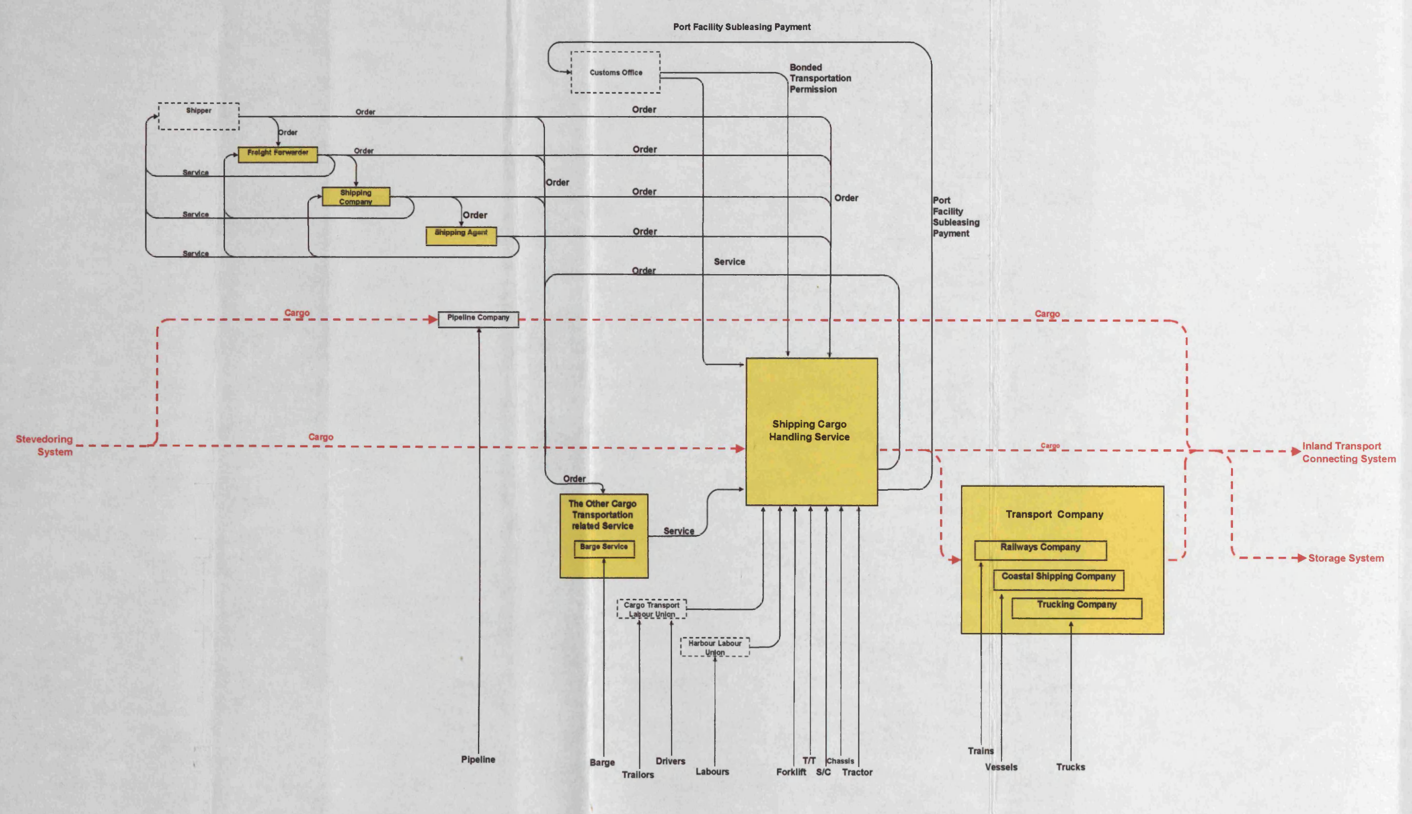
The port users in the stage of the stevedoring were Freight Forwarder, Ocean Shipping Company and Shipper and the public institutions involved in the port logistics activities and directly or indirectly linked to the stevedoring were Customs Office and the Port Authority.

7.3.8 Transit System (A4)

The role of the transit system is to support safe and speedy transit connecting between stevedoring and storage (or inland transport). The cargo flow comes from Stevedoring System and goes to Inland Transport Connecting System or Storage System.

For most ports, this transit process can be excluded since it is a quite short process handling the cargo, and could be included in the stevedoring or storage system. However, in the case of Busan Port, the importance of the Transit System is quite high because most of the container yards in Busan Port are located out of the main port area.

In the diagram, Shipping Cargo handling Service Company and Transport Company are located in the centre of the diagram. In the case of transit from one to another, the Barge Service could be used. For most containers, however, the transit process consists of loading/discharging cargoes from/to the ship and transporting them to Storage Facilities or Inland Transport Connecting Points by Trucks or Container Trailers. Therefore, only the Shipping Cargo Handling Service Company and Transport Company were necessary in this process.



NOTE	Transit System	No.	A4

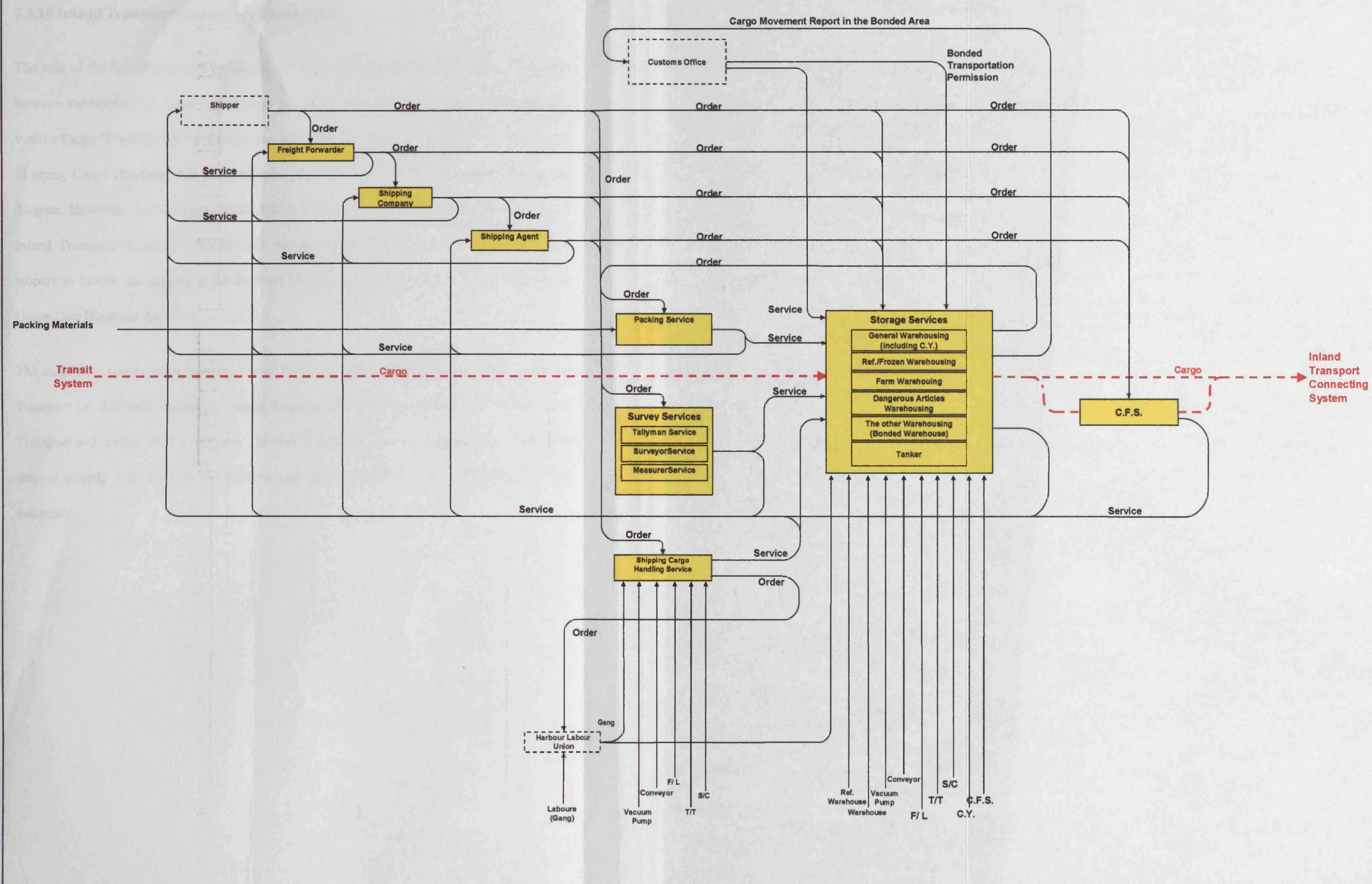
Compared to the other diagrams, **Diagram A4** contains comparatively many mechanism arrows come from below to the company. Most of them related to equipment for cargo handling, namely: Pipeline, Barge, Trailers, Fork Lift (F/L), Transtainer (T/T), Straddle Carrier (S/C), Chassis, Tractors, Trains, Feeder Vessels and Trucks.

7.3.9 Storage System (A5)

The role of the storage system is to support safe storage of cargo. As can be seen in **Diagram A5**, various Storage Service Companies, i.e., Dangerous Articles Warehouse, Farm Warehouse, The Other Warehouse, Tank Facility for liquid cargo and General Warehouse (including Container Yard) are located in the centre of the diagram. Shipping Cargo Handling Service helps to move the cargoes and Tally Service, Measurer help to check and measure the cargoes in the storage facilities. Container Freight Service (C.F.S.) is necessary only when consolidation/deconsolidation of the cargo is necessary.

Mostly, the storage facilities have their own equipment to handle the cargo. If not, they seek help to Shipping Cargo Handling Service (See **Diagram A5**).

The cargo flow comes from Transit System and goes to Inland Transport Connecting System. Transit cargoes stored in the facilities could go back to the Transit System without coming from Inland Transport Connecting System.



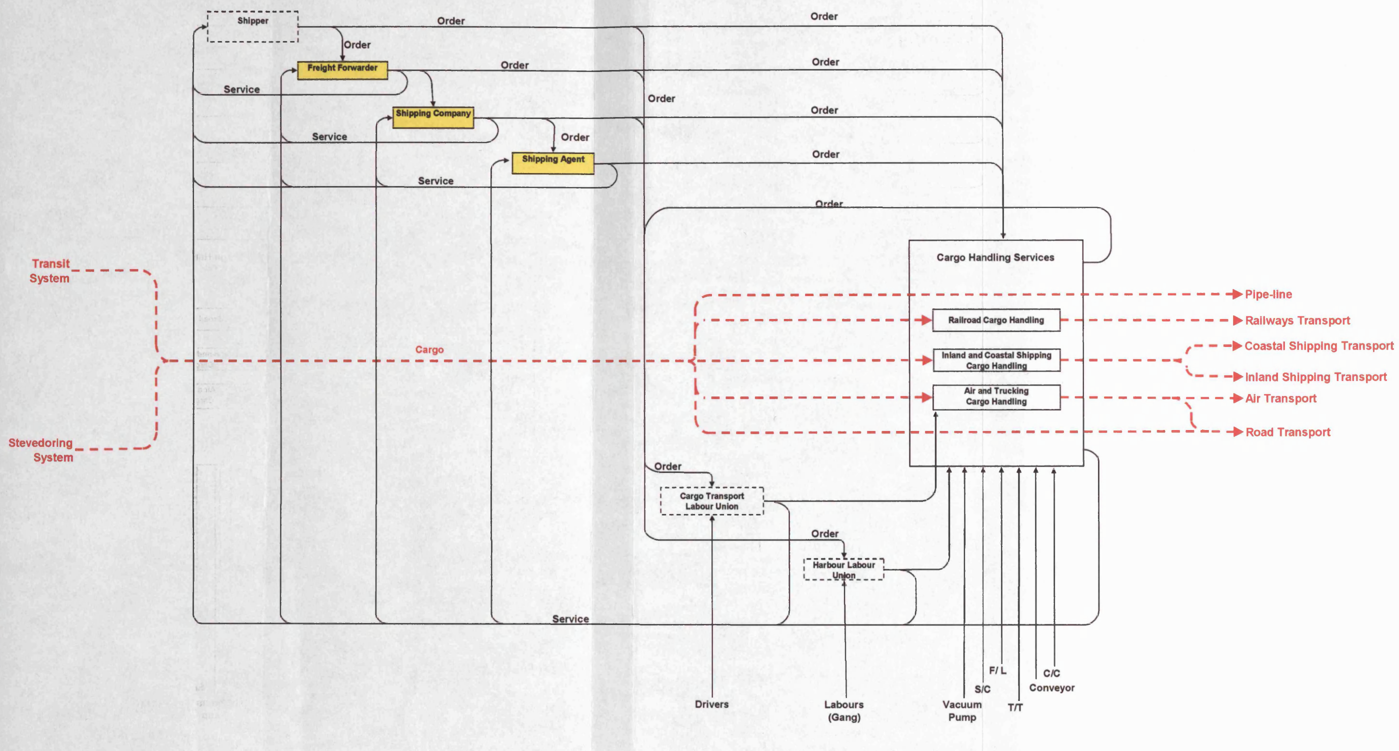
NOTE	Storage System	No.	A5

190

7.3.10 Inland Transport Connecting System (A6)

The role of the inland transport connecting system is to support safe and speedy connecting between stevedoring (or transit) and inland transportation. As can be seen in **Diagram A6,** various Cargo Handling Service Companies, i.e., Railroad Cargo Handling, Inland and Coastal Shipping Cargo Handling, Air and Trucking Cargo Handling are located in the centre of the diagram. However, they were not included in the total survey since they mainly belonged to the Inland Transport Company. Mostly, the storage facilities have their own equipments and labours to handle the cargoes in the facilities but just in case they could ask help to Harbour Union (See **Diagram A6**).

The cargo flow comes either from the Transit System or Stevedoring System, and goes to Inland Transport i.e. Railways Transport, Coastal Shipping Transport, Inland Shipping Transport, Air Transport and mainly Road Transport. In case of Pipeline, the cargo after stevedoring from a ship is directly connected to the pipeline and Inland Transport Connecting System is not necessary.



NOTE	Inland Transport Connecting System	No.	A6

192

7.4 Summary

This chapter uses the Structured Analysis and Design Technique (SADT) to visualise a port cluster with particular reference to the Port of Busan in Korea.

This procedure was verified by experts who work in field of Busan port during three weeks period. SADT provides an opportunity to define and analyse the cluster in terms of its flows, activities and actors. The port cluster system model consists of a total of six subsystems and three support modules. Each subsystem is numbered from **A1** (voyage supporting system) to **A6** (inland transportation connecting system) and is connected according to the cargo flow in port logistics process.

The Port Information System (including Port Logistics relevant Consulting Company, Port Logistics IT Company, e-Customs Company and Port relevant e-business Company) was omitted to simplify the diagram.

CHAPTER 8

INDUSTRIAL PRODUCTION OF A PORT CLUSTER

8.1. Chapter Overview

The aim of this chapter is to estimates how much Value Added is created within a port cluster by the associated companies, with a particular focus on Busan port.

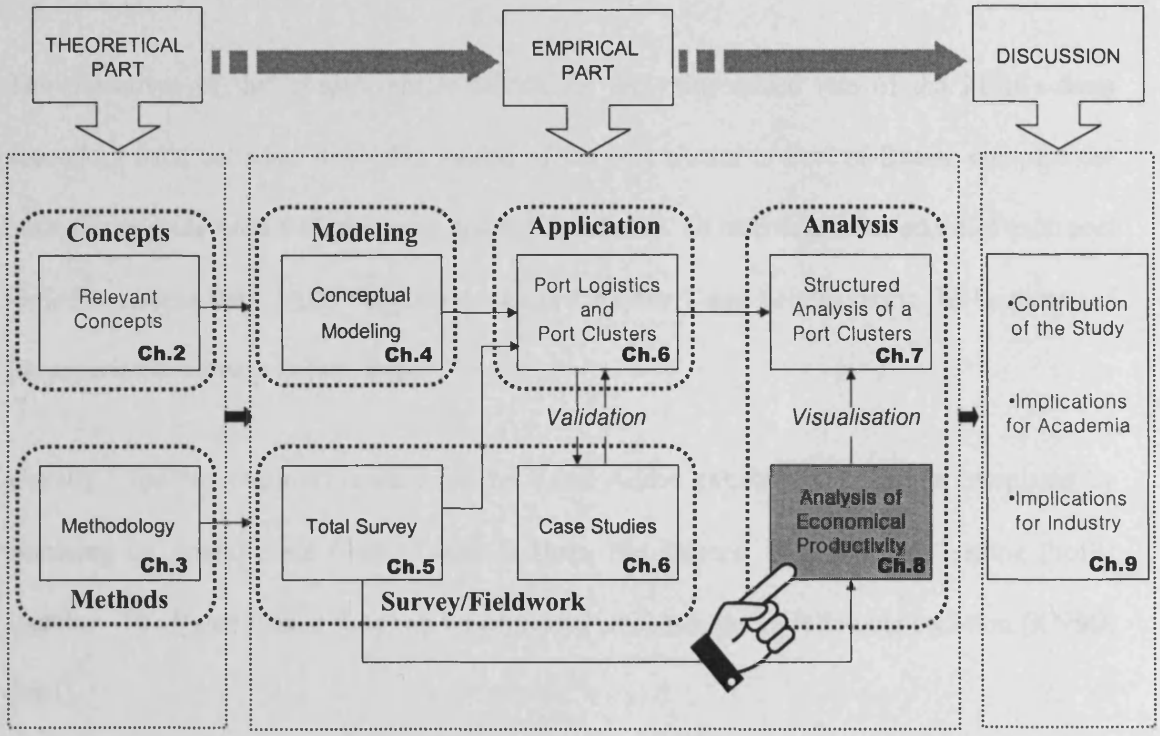


Figure 8-1 The Position of 'Industrial Production of a Port Cluster' in the thesis
Source: Author

In **Chapter 6**, this study has discussed the total survey results for port relevant companies in Busan Port, observing exactly how many relevant companies and employees are working in the Busan Port and how much Gross Sales they earn. This is because; only with the gross sales of a certain industry could we still compare the scale of each industry. However it was not enough to compare the industrial production in full scale.

By analysing the value added from the port cluster, their under economic benefits can be understood and can influence investment and policy decisions.

The objectives of this chapter are to search for the value added rate of the PLRCs from secondary data; calculate the Value Added of the port cluster in Port of Busan, compare the scale of the gross sales with the value added per industry. To calculate value added of each port logistics process step, SADT diagram drawn in **Chapter 7** was helpful fixing the boundary of the associated industry in each steps.

Usually 'Addition Method' is used for the Value Added calculation. It can be calculated by summing up Employment Costs, Taxes & Dues, Net Interest Expense, and Trading Profits together. The Value Added Rate can be expressed as shown in the following equation (KNSO, 2001)

8.2 The Value Added Rates of PLRCs in Korea

In 2002, Korea Ministry of Maritime Affairs and Fisheries (MOMAF) published a report entitled "A Study on the Spreading Economical Effect of the Port Industry" in which the average Value Added rate of the port relevant industries in Korea was calculated. This report was based on the method of calculation the Value Added in "Report on the Transport Survey", published by Korea National Statistical Office (KNSO) annually.

Therefore this study directly refers to the national average Value Added Rate as indicated in the report (See **Table 8-1**), since the data was collected from all relevant industries in Korea during the same period (based in year 2000) as when the total survey on the PLRCs in Busan Port was carried out. In addition, the amount of the Value Added on that report also originally comes from the annual "Report on the Transport Survey" published by KNSO. Yet, the difference between them is that MOMAF subdivided and estimated the Value Added Rate on the classification of 'The other industries' in the KNSO's survey report, based on the trends of the past gross sales.

The Value Added Rate of 'The other industries' were split into Ship Chandler (16.73%), Ship Bunkering (22.7%), Container Repair (46.99%), Rental of Port Facilities (44.37%) and Port Construction (54.54%) in the MOMAF report.

Value Added Rate = Value Added / Gross Sales x 100

Table 8-1 Estimated Value Added of Port Relevant Industries

(Unit: 100 million KW)

	Year	1991			1996			2000		
		Gross Sales	Value Added	V.A.rate	Gross Sales	Value Added	V.A.rate	Gross Sales	Value Added	V.A.rate
	Total	**90,327**	**47,669**	**52.77%**	**208,251**	**96,594**	**46.38%**	**326,784**	**129,129**	**39.52%**
Port Inudstry	Sub-Total	9,643	6,247	64.78%	18,726	11,562	61.74%	24,894	12,573	50.51%
	1. Shipping Cargo Handling	5,217	3,920	75.14%	8,750	6,653	76.03%	9,831	6,478	65.89%
	2. Pilot Service	108	67	62.04%	157	104	66.24%	221	142	64.25%
	3. Storage, Warehousing	1,903	1,421	74.67%	3,617	2,865	79.21%	4,124	2,912	70.61%
	4. Supply Service	932	180	19.31%	3,502	742	21.19%	7,813	1,751	22.41%
	5. Income from Port Facilities	1,483	658	44.37%	2,700	1,198	44.37%	2,905	1,289	44.37%
Port Relevant Industry	Sub-Total	77,563	39,720	51.21%	183,272	81,621	44.54%	292,151	111,244	38.08%
	6. Cargo Transport relevant Service	11,088	8,707	78.53%	24,950	19,235	77.09%	33,713	24,800	73.56%
	7. Other Cargo Transport relevant Service	1,964	1,377	70.11%	4,117	2,069	50.26%	6,100	4,030	66.07%
	8. Sub-Total of Shipping	38,849	13,051	33.59%	99,209	23,837	24.03%	176,880	35,800	20.24%
	Coastal Shipping	3,928	2,075	52.83%	8,689	5,691	65.50%	8,816	3,922	44.49%
	Ocean Shipping	34,504	10,710	31.04%	89,657	17,568	19.59%	166,884	31,079	18.62%
	Inland Shipping	417	265	63.55%	863	579	67.09%	1,180	799	67.71%
	9. Cargo Transport	23,509	14,578	62.01%	48,105	30,337	63.06%	64,920	37,900	58.38%
	10. Cargo Terminal Operation	22	18	81.82%	95	49	51.58%	362	245	67.68%
	11. Road and Relevant Facility Operation	2,131	1,989	93.34%	6,795	6,094	89.68%	10,177	8,468	83.21%
Port Construction	12. Port Construction	3,120	1702	54.55%	6,253	3,411	54.55%	9,739	5,312	54.54%

Source: MOMAF (2002) A Study on the spreading economical effect of the port inudstry

8.3 The Value Added of PLRCs in Busan

The only problem when we apply the national average of the PLRCs in Korea to the PLRCs in Busan classified by the industrial classification was that we could not acquire every Value Added Rate on a company by company basis, because the new classification suggested in **Chapter 6** based on the fieldwork is more detailed and specific rather than the classification used in the MOMAF (2002)'s report or in the total survey (in **Chapter 6**). For example, Coastal shipping was not distinguished from Barge Shipping, Tally Service, Measure Service and Surveyor Service was also grouped together.

Therefore, where companies had an unspecified Value Added Rate the Value Added Rate for the two most similar industries was considered. The criteria for the standard industry within the subdivision were to have a higher participation rate relative to the others in ordinary port activities and to have the Value Added Rate acquired (Refer to * marks in **Table 8-2**).

According to the criteria as stated previously, the selected standard industries were Tallying Service in Tallying Service, Line Handling Service in Port Service, and Pilot Service in Ship Approaching Service, Ship Chandler in Supply Service, and Port and Waterway Management in The Other Support Transport Service. However, in the case of those industries which cannot set the standard industry, we referred to another Value Added Rate used for the taxation of the value-added tax in Korea (Actual enforcement decree of 'the value-added tax act in Korea 74-3-4', http://etaxkorea.net/) (Refer to 'Rate Source B' in **Table 8-2**)

Table 8-2 The value added of the port relevant companies in Busan

	Industry/Sector (Classification used in the Total Survey)	Sort of Company (Classification used in the Fieldwork)	Gross sale (mm KW)	Gross sale (thousand GBP)	Value Added rate	Rate Source	Value Added (mm KW)	Value Added (thousand GBP)
		Grand Total	19,518,585.00	9,759,292.50	-	-	8,101,571.81	4,050,785.91
1	**Transport**	**Sub Total**	**8,632,683.00**	**4,316,341.50**	-	-	**1,899,480.61**	**949,740.31**
1-1	Land Transport; Tranport via Pipelines	sub total	638,219.00	319,109.50	-	-	372,592.25	186,296.13
	General Freight Trucking	Trucking Company	634,680.00	317,340.00	0.5838	A	370,526.18	*185,263.09*
	Freight Trucking By Small Truck and Self-Management	Van and Individual Trucking	3,539.00	1,769.50	0.5838	A	2,066.07	1,033.03
1-2	Sea and Coastal Water Transport		7,994,464.00	3,997,232.00	-	-	1,526,888.36	763,444.18
	Oceangoing Foreign Freight Transport	Ocean Shipping Company	7,846,342.00	3,923,171.00	0.1862	A	1,460,988.88	730,494.44
	Coastal Water Freight Transport	Barge/Inland Shipping Coastal Shipping *	148,122.00	74,061.00	0.4449	A	65,899.48	32,949.74
2	**Operation of Cargo Transport Facilities**	**Sub Total**	**2,281,349.00**	**1,140,674.50**	-	-	**1,610,331.84**	**805,165.92**
2-1	Warehousing	sub total	2,263,305.00	1,131,652.50	-	-	1,598,119.66	799,059.83
	General Warehousing	Container Freight Service General Warehouse(including CY)	161,700.00	80,850.00	0.7061	A	114,176.37	57,088.19
	Refrigerated Warehousing	Ref./Frozen Warehouse	150,637.00	75,318.50	0.7061	A`	106,364.79	53,182.39
	Farm products warehousing	Farm Warehouse	6,924.00	3,462.00	0.7061	A`	4,889.04	2,444.52
	Dangerous Goods Warehousing	Dangerous Articles Warehouse * Tanker	1,914,044.00	957,022.00	0.7061	A`	1,351,506.47	675,753.23
	Other Warehousing	The other Warehouse	30,000.00	15,000.00	0.7061	A`	21,183.00	10,591.50
2-2	Other Services Allied to Transport Agency	sub total	18,044.00	9,022.00	-	-	12,212.18	6,106.09
	Operation of Harbour and Marine Terminal Facilities	Terminal Operating Company	18,044.00	9,022.00	0.6768	A	12,212.18	6,106.09
3	**Supporting and Auxiliary Transport Activities**	**Sub Total**	**6,759,893.00**	**3,379,946.50**	-	-	**3,809,099.97**	**1,904,549.98**
3-1	Cargo Handling	sub total	755,877.00	377,938.50	-	-	497,835.20	248,917.60
	Air Freight and Land Freight Handling	Air and Trucking Cargo Handling	6,956.00	3,478.00	0.6284	B	4,371.15	*2,185.58*
	Water Freight Handling	Harbour Labour Union Shipping Cargo Handling Service *	748,921.00	374,460.50	0.6589	A	493,464.05	*246,732.02*
3-3	Other Supporting Transport Services n.e.c.	sub total	5,967,648.00	2,983,824.00	-	-	3,298,717.81	1,649,358.90
	Freight Transport Arrangement	Freight Forwarder	1,465,300.00	732,650.00	0.7356	A	1,077,874.68	*538,937.34*
	Packing and Crating	Packing Service	160,933.00	80,466.50	0.6607	A`	106,328.43	*53,164.22*
	All Other Supporting Transport Services n.e.c.	sub total	*4,341,415.00*	*2,170,707.50*	-	-	*2,114,514.70*	*1,057,257.35*
	Ship Broker	Chartering Agent Ship Broker	451,098.00	225,549.00	0.7356	A	331,827.69	*165,913.84*
	Manning Services	Manning Service	54,239.00	27,119.50	0.7356	A	39,898.21	*19,949.10*
	Shipping Agent	Shipping Agent	1,707,469.00	853,734.50	0.7356	A	1,256,014.20	*628,007.10*
	Tallying Services	Measure Service Surveyor Service Tally Service *	17,332.00	8,666.00	0.6607	A	11,451.25	*5,725.63*

GBP1=KW2000

A MOMAF (2002) Economical Spread Effect of Port Industries, pp.221-222.

A` Application of the data from source A

B Actual enforcement decree of the value-added tax act in Koera 74-3-4 (http://etaxkorea.net/)

urce: Author

Table 8-2 (continued) The value added of the port relevant companies in Busan

	Industry/Sector (Classification used in the Total Survey)	Sort of Company (Classification used in the Fieldwork)	Gross sale (mm KW)	Gross sale (thousand GBP)	Value Added rate	Rate Source	Value Added (mm KW)	Value Added (thousand GBP)
	Port Services	Hold Cleaning Service Launch Boat Service Line Handling Service * Rubbish Disposal Service (Fresh Water Supply) Ship Security Service	24,209.00	12,104.50	0.6607	A	15,994.89	*7,997.44*
	Ship Approaching Services	Pilot Service * Tug Boat Service	10,792.00	5,396.00	0.6425	A	6,933.86	*3,466.93*
	Supply Services	Nautical Chart Distributor Ship Chandler * Sparepart Supply	1,551,825.00	775,912.50	0.1673	A	259,620.32	*129,810.16*
	Bunkering Service	Bunkering Service	361,016.00	180,508.00	0.2270	A	81,950.63	*40,975.32*
	Port Telecommunication	Port Communication Service	29,891.00	14,945.50	0.7033	B	21,022.34	*10,511.17*
	Shipping Management	Ship Management	40,850.00	20,425.00	0.7356	A	30,049.26	*15,024.63*
	Customs Clearance Service	Customs Clearance Service	48,353.00	24,176.50	0.7356	A	35,568.47	*17,784.23*
	The Others	Cargo Lashing Service Crane-Ship Service Disinfection Service Port and Waterway Management * Salvage Service	44,341.00	22,170.50	0.5454	A	24,183.58	*12,091.79*
3-4	Other software Consultancy and supply	sub total	36,368.00	18,184.00	-	-	12,546.96	*6,273.48*
		Consultancy & Software supply	36,368.00	18,184.00	0.3450	B	12,546.96	*6,273.48*
4	**Renting of Transport Equipment**	**Sub Total**	**45,126.00**	**22,563.00**	-	-	**34,413.16**	**17,206.58**
4-1	Renting of Containers	sub total	28,283.00	14,141.50	-	-	21,577.10	10,788.55
		Renting and repairing of Containers	28,283.00	14,141.50	0.7629	B	21,577.10	*10,788.55*
4-2	Other Renting of Transport Equipment n.e.c.	sub total	16,103.00	8,051.50	-	-	12,284.98	6,142.49
		Logistics Equipment Lease/Hire	16,103.00	8,051.50	0.7629	B	12,284.98	*6,142.49*
4-3	Renting of Other Machinery and Equipment	sub total	740.00	370.00	-	-	551.08	275.54
		Stevedoring Facility/Equipement Lease/Hire	740.00	370.00	0.7447	B	551.08	*275.54*
5	**Manufacture of Cargo Transport Equipment**	**Sub Total**	**1,799,534.00**	**899,767.00**	-	-	**748,246.24**	**374,123.12**
5-2	Manufacture of Cargo Transport Equipment	sub total	1,799,534.00	899,767.00	-	-	748,246.24	374,123.12
	Building of Steel Ships	Ship Building * Ship Repair Shop Logistics Equipment Repairer	1,799,534.00	899,767.00	0.4158	B	748,246.24	*374,123.12*

GBP1=KW2000

A	MOMAF (2002) Economical Spread Effect of Port Industries, pp.221-222.
A`	Application of the data from source A
B	Actual enforcement decree of the value-added tax act in Koera 74-3-4 (http://etaxkorea.net/)

ırce: Author

The amount of value added by each industry/business can be used to judge their relative importance in the port cluster, since the level of gross sales and value added are representative of industrial production. The value added rate is also useful in estimating the degree of vertical integration of the industry/business. If the industry/business merges/integrates perfectly with another industry/business vertically, then the degree of vertical integration can be 100%, meaning that there will be no purchases from the outside at all. Thus, the value added rate (value added / gross sales) is useful for evaluating the degree of vertical integration of systematised enterprises. The variability of the value added rate depends on the enterprises' dependence on outside parts and raw materials. Higher internal transactions between vertically-integrated systematised enterprises bring about a lower value added rate. Consequently, a higher supply from external enterprises leads to higher value added rate (Yun, S. S and Wee, J. B (2000), p.41).

According to the results illustrated in **Table 8-2**, the total amount of the Value Added generated by PLRCs in Busan is KW 8,101,571.81 million (GBP 4,050,785.91 thousand, 100%). Amongst them, the Value Added from the transport sector was KW 1,899 billion (GBP 949,740.31 thousand, 23.45%), Cargo Facilities Operation sector was KW 1.610 billion (GBP 805,165.92 thousand, 19.88%), Supporting and Auxiliary Transport Activities sector was KW 3.809. million (GBP 1,904,549.98 thousand, 47.02%), Renting of Transport Equipment sector was KW 34.413 billion (GBP 17.206.58 thousand, 0.42%), and Manufacture of Cargo Transport Equipment sector was KW 748.246 billion (GBP 374,123.12 thousand, 9.24%).

In order to facilitate greater understanding of the above results, the comparative proportions of those sectors in the port cluster, from the Value Added perspective and the Gross Sales perspective are given in **Figure 8-2** and **Figure 8-3**.In comparing **Figure 8-2** and **8-3**, the most significant feature is the change in the proportion in the Transport sector. This sector represents 44.23% of gross sales but only 23.45% of value added.

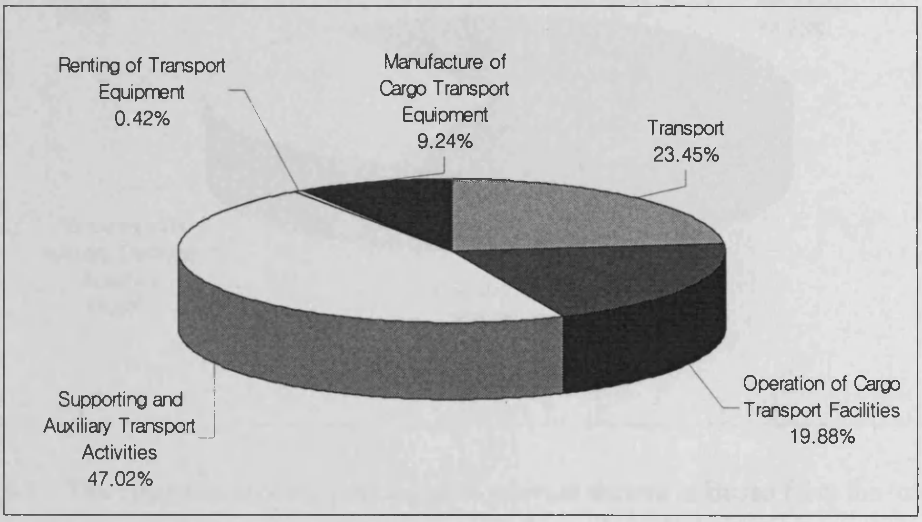


Figure 8-2 The comparison of the port logistics relevant sectors in Busan from the total amount of Value Added perspective

Source: Author

This is comparatively lower than the other sectors. This lower value added rate also indicates that the outside purchase rate of the sector is higher, and that it would be more prone to receive negative effects if raw material supplies are cut off.

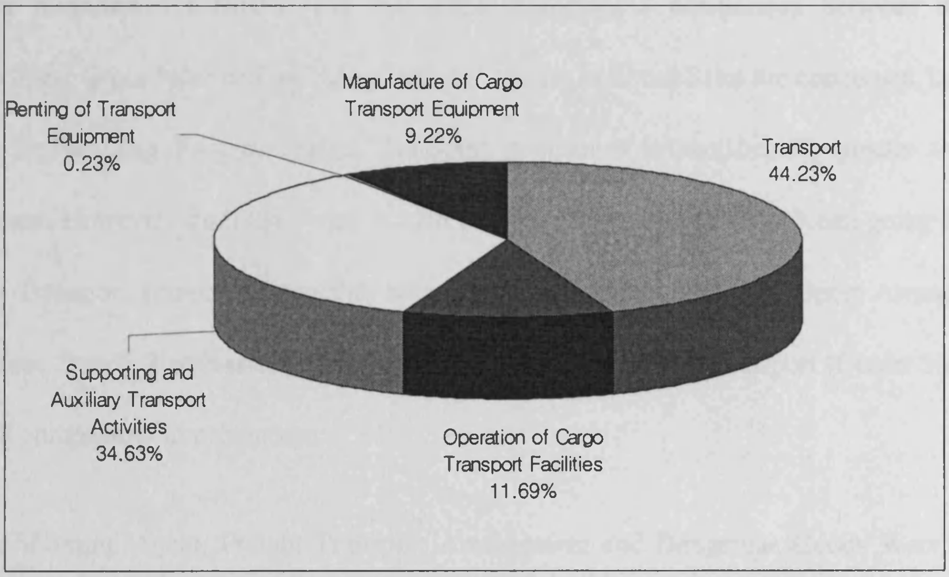


Figure 8-3 The comparison of the port logistics relevant sectors in Busan from the total amount of Gross Sales perspective

Source: Author

Even so, in the case of the Supporting and Auxiliary Transport Activities sector, the percentage of Value Added (47.02% against 35%) increased by 1.5 times when compared to Gross Sales as one of the highest in the port cluster associated with Busan. The proportion of the Operation of

Cargo Transport Facilities Sector was also greater from the Value Added perspective than Gross Sales. This higher value added rate indicates that the outside purchase rate of the sector is lower, and it would not be harmed by disruptions in the supplies of raw materials.

Figure 8-4 visualises the Percentages for gross sales and added value by the port logistics relevant businesses in Busan. The bar graph illustrates a comparison between the two perspectives; Gross Sales and the Added Value. As far as Gross Sales are concerned, the share of the Ocean-going Foreign Freight Transport companies is significantly greater than the businesses. However, from the Value Added perspective, it showed that Ocean-going Foreign Freight Transport companies, together with Shipping Agent, Freight Transport Arrangement, Dangerous Goods Warehousing and Ocean going Foreign Freight Transport (Ocean Shipping) were all comparable in percentage.

Hence, Shipping Agent, Freight Transport Arrangement and Dangerous Goods Warehousing account for a comparatively high percentage of industrial productivity. It can be assumed that they would be less influenced by fluctuations in raw material supplies or service market changes. Meanwhile Supply Service and Ocean going Foreign Freight Transport companies' industrial productivity were comparatively lower (See **Figure 8-4**) and they could be more sensitive to raw material or service market changes.

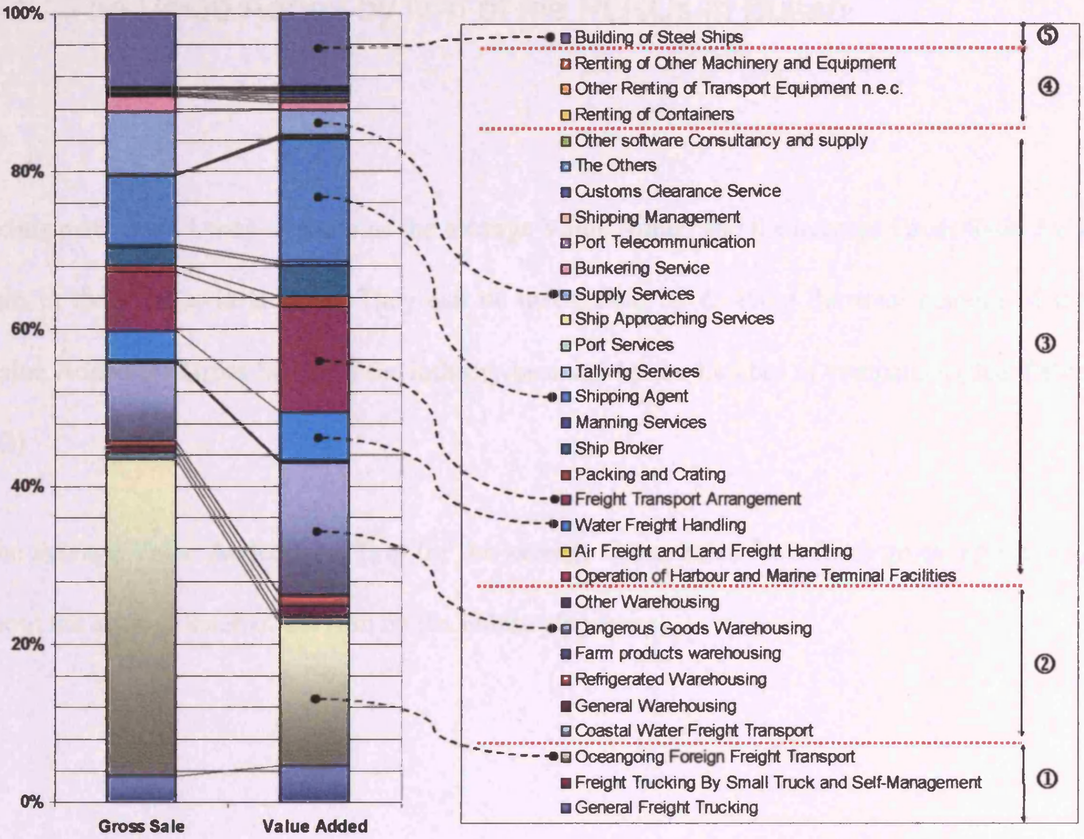


Figure 8-4 Comparison of the share by specific sorts of port logistics relevant business in Busan
Source: Author

8.4 The Value Added by firm of the PLRCs in Busan

In this paragraph, I wish to examine the average Value Added and the average Gross Sales for a firm in the PLRCs in Busan. They can be determined by dividing the total amount of the Value Added (or Gross Sales) of the industry/business by the number of companies (See **Table 8-3**).

The average Value Added for a firm (or the average Gross Sales for a firm) gives information about the average scale of the firm by the industry/business.

Table 8-3 The Value Added Per Company of the PLRCs in Busan

	Industry/Sector (Classification used in the Total Survey)	Sort of Company (Classification used in the Fieldwork)	Number of Companies (companies)	Value Added (mm KW)	Value Added per company (mm KW)	Gross Sale (mm KW)	Gross Sale per company (mm KW)
1	**Transport**		**376**	**1,899,480.61**	**-**	**8,632,683.00**	**-**
1-1	Land Transport; Tranport via Pipelines		273	372,592.25	-	638,219.00	-
	General Freight Trucking	Trucking Company	269	370,526.18	1,377.42	634,680.00	2,359.41
	Freight Trucking By Small Truck and Self-Management	Van and Individual Trucking	4	2,066.07	516.52	3,539.00	884.75
1-2	Sea and Coastal Water Transport		103.00	1,526,888.36	-	7,994,464.00	-
	Oceangoing Foreign Freight Transport	Ocean Shipping Company	57	1,460,988.88	25,631.38	7,846,342.00	137,655.12
	Coastal Water Freight Transport	Barge/Inland Shipping Coastal Shipping *	46	65,899.48	1,432.60	148,122.00	3,220.04
2	**Operation of Cargo Transport Facilities**		**121**	**1,654,335.85**	**-**	**2,281,349.00**	**-**
2-1	Warehousing		117	1,642,123.67	-	2,263,305.00	-
	General Warehousing	Container Freight Service General Warehouse(including CY)	68	114,176.37	1,679.06	161,700.00	2,377.94
	Refrigerated Warehousing	Ref./Frozen Warehouse	31	106,364.79	3,431.12	150,637.00	4,859.26
	Farm products warehousing	Farm Warehouse	3	48,893.04	16,297.68	6,924.00	2,308.00
	Dangerous Goods Warehousing	Dangerous Articles Warehouse * Tanker	11	1,351,506.47	122,864.22	1,914,044.00	174,004.00
	Other Warehousing	The other Warehouse	4	21,183.00	5,295.75	30,000.00	7,500.00
2-2	Other Services Allied to Transport Agency		4.00	12,212.18	12,212.18	18,044.00	4,511.00
	Operation of Harbour and Marine Terminal Facilities	Terminal Operating Company	4	12,212.18	3,053.05	18,044.00	4,511.00
3	**Supporting and Auxiliary Transport Activities**		**884.00**	**3,444,600.26**	**-**	**4,812,051.00**	**-**
3-1	Cargo Handling		159.00	497,835.20	-	755,877.00	-
	Air Freight and Land Freight Handling	Air and Trucking Cargo Handling	25	4,371.15	174.85	6,956.00	278.24
	Water Freight Handling	Harbour Labour Union Shipping Cargo Handling Service*	134	493,464.05	3,682.57	748,921.00	5,588.96
3-3	Other Supporting Transport Services n.e.c.		714.00	2,934,218.10	-	4,019,806.00	-
	Freight Transport Arrangement	Freight Forwarder	464	1,077,874.68	2,323.01	1,465,300.00	3,157.97
	Packing and Crating	Packing Service	4	106,328.43	26,582.11	160,933.00	40,233.25
	All Other Supporting Transport Services n.e.c.		*246.00*	*1,750,014.99*	-	*2,393,573.00*	-
	Ship Broker	Chartering Agent Ship Broker	9	331,827.69	36,869.74	451,098.00	50,122.00
	Manning Services	Manning Service	43	39,898.21	927.87	54,239.00	1,261.37
	Shipping Agent	Shipping Agent	31	1,256,014.20	40,516.59	1,707,469.00	55,079.65
	Tallying Services	Measure Service Surveyor Service Tally Service *	18	11,451.25	636.18	17,332.00	962.89

GBP1=KW2000

Source: Author

Table 8-3 (Continued) The Value Added Per Company of the PLRCs in Busan

	Industry/Sector (Classification used in the Total Survey)	Sort of Company (Classification used in the Fieldwork)	Number of Companies (companies)	Value Added (mm KW)	Value Added per company (mm KW)	Gross Sale (mm KW)	Value Added per company (mm KW)
	Port Services	Hold Cleaning Service	13	15,994.89	1,230.38	24,209.00	1,862.23
		Launch Boat Service					
		Line Handling Service *					
		Rubbish Disposal Service (Fresh Water Supply)					
		Ship Security Service					
	Ship Approaching Services	Pilot Service *	6	5,933.86	988.98	10,792.00	1,798.67
		Tug Boat Service					
	Supply Services	Nautical Chart Distributor	117	259,620.32	2,218.98	1,551,825.00	13,263.46
		Ship Chandler *					
		Sparepart Supply					
	Bunkering Service	Bunkering Service	21	81,950.63	3,902.41	361,016.00	17,191.24
	Port Telecommunication	Port Communication Service	8	21,022.34	2,627.79	29,891.00	3,736.38
	Shipping Management	Ship Management	25	30,049.26	1,201.97	40,850.00	1,634.00
	Customs Clearance Service	Customs Clearance Service	85	35,568.47	418.45	48,353.00	568.86
	The Others	Cargo Lashing Service	27	24,183.58	895.69	44,341.00	1,642.26
		Crane-Ship Service					
		Disinfection Service					
		Port and Waterway Management *					
		Salvage Service					
3-4	Other software Consultancy and supply		11.00	12,546.96	-	36,368.00	-
		Consultancy & Software supply	11	12,546.96	1,140.63	36,368.00	3,306.18
4	**Renting of Transport Equipment**		**26.00**	**34,413.16**	**-**	**45,126.00**	**-**
4-1	Renting of Containers		16.00	21,577.10	-	28,283.00	
		Renting and repairing of Containers	16	21,577.10	1,348.57	28,283.00	1,767.69
4-2	Other Renting of Transport Equipment n.e.c.		8.00	12,284.98	-	16,103.00	-
		Logistics Equipment Lease/Hire	8	12,284.98	1,535.62	16,103.00	2,012.88
4-3	Renting of Other Machinery and Equipment		2.00	551.08	-	740.00	-
		Stevedoring Facility/Equipement Lease/Hire	2	551.08	275.54	740.00	370.00
5	**Manufacture of Cargo Transport Equipment**		**134.00**	**748,246.24**	**-**	**1,799,534.00**	**-**
5-2	Manufacture of Cargo Transport Equipment		134.00	748,246.24	-	1,799,534.00	-
	Building of Steel Ships	Ship Building *	134	748,246.24	5,583.93	1,799,534.00	13,429.36
		Ship Repair Shop					
		Logistics Equipment Repairer					

GBP1=KW2000

Source: Author

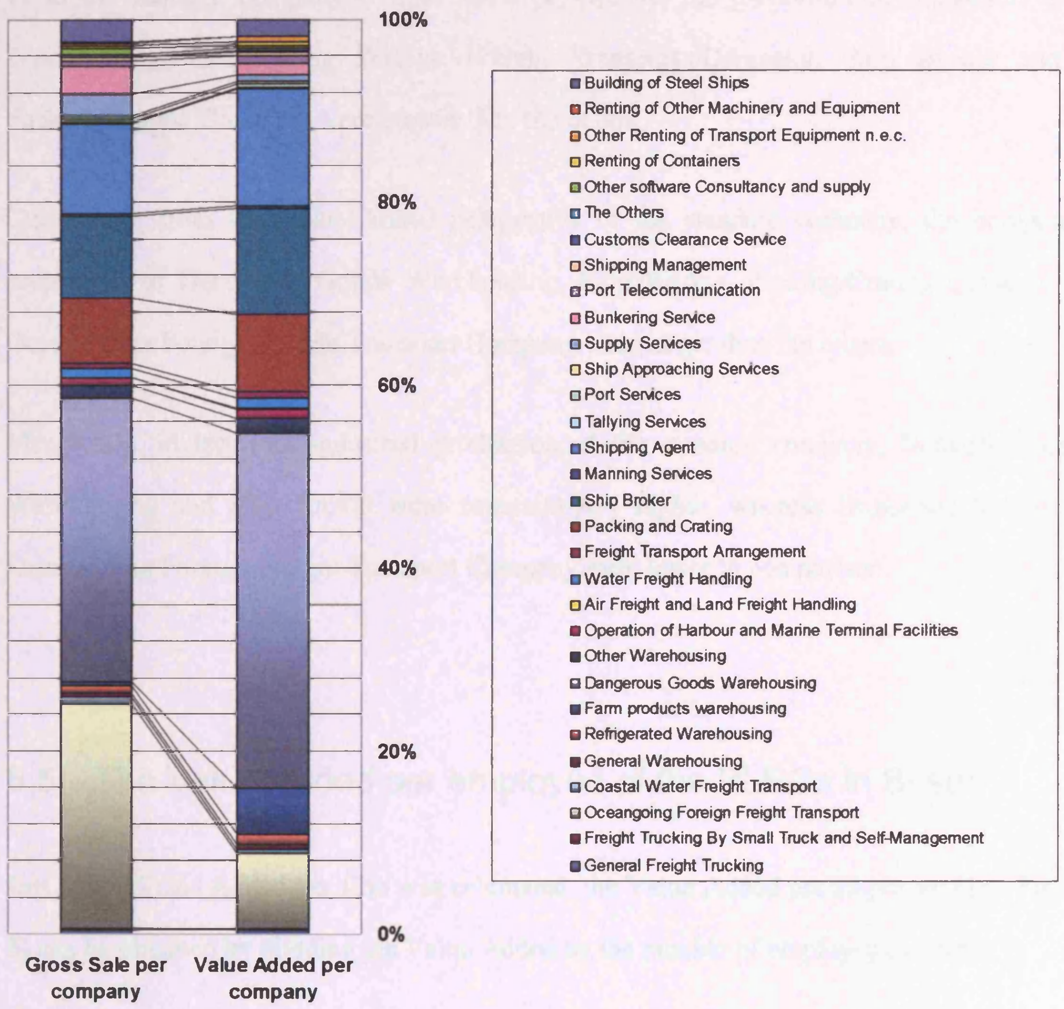


Figure 8-5 Comparison of the share by the standard companies of port logistics relevant business in Busan

Source: Author

In **Figure 8-5**, the comparative proportion of a firm in the PLRCs in Busan are visualised on a comparison bar graph from both of the Gross Sales and the Value Added perspective.

From the standard company's Gross Sales perspective, the proportion of Dangerous Goods Warehousing, Ocean-going Foreign Freight Transport Company, Ship Broker and the Packing/Crating Company were greater than the others.

Conversely, from the Value Added perspective of the standard company, the comparative proportion of Dangerous Goods Warehousing, Ship Broker, Packing/Crating Company and Ocean-going Foreign Freight Transport Company were larger than the others.

Meanwhile, in terms of industrial production of the standard company, Dangerous Goods Warehousing and Ship Broker were comparatively higher, whereas Bunkering Service and Ocean-going Foreign Freight Transport Company were lower in comparison.

8.5 The Value Added per employee of the PLRCs in Busan

Just as the Value Added per firm was calculated, the Value Added per employee (See **Table 8-5**) can be obtained by dividing the Value Added by the number of employee as below;

Labour Productivity = Value Added / Number of Employee

The Value Added per employee can be used as an important index to measure the Labour Product. A large value for Labour Productivity means that the product per capita is high, and that is the result of a skilled labour force that is highly motivated, and a high level of technical innovation.

Table 8-4 The Value Added Per Capita of the PLRCs in Busan

	Industry/Sector (Classification used in the Total Survey)	Sort of Company (Classification used in the Fieldwork)	Number of Employees (persons)	Gross Sale (mm KW)	Gross Sale per Employee (mm KW)	Value Added (mm KW)	Value Added per Employee (mm KW)
1	**Transport**		**7,038**	**8,632,683.00**	-	**1,899,480.61**	-
1-1	Land Transport; Tranport via Pipelines		3,627	638,219.00	-	372,592.25	-
	General Freight Trucking	Trucking Company	*3,608*	634,680.00	175.91	370,526.18	102.70
	Freight Trucking By Small Truck and Self-Management	Van and Individual Trucking	*19*	3,539.00	186.26	2,066.07	108.74
1-2	Sea and Coastal Water Transport		3,411	7,994,464.00	-	1,526,888.36	-
	Oceangoing Foreign Freight Transport	Ocean Shipping Company	*2,509*	7,846,342.00	3,127.28	1,460,988.88	582.30
	Coastal Water Freight Transport	Barge/Inland Shipping	902	148,122.00	164.22	65,899.48	73.06
		Coastal Shipping *					
2	**Operation of Cargo Transport Facilities**		**2,818.00**	**2,281,349.00**	-	**1,654,335.85**	-
2-1	Warehousing		2,438	2,263,305.00	-	1,642,123.67	-
	General Warehousing	Container Freight Service	*1,394*	161,700.00	116.00	114,176.37	81.91
		General Warehouse(including CY)					
	Refrigerated Warehousing	Ref./Frozen Warehouse	*657*	150,637.00	229.28	106,364.79	161.89
	Farm products warehousing	Farm Warehouse	*73*	6,924.00	94.85	48,893.04	669.77
	Dangerous Goods Warehousing	Dangerous Articles Warehouse *	275	1,914,044.00	6,960.16	1,351,506.47	4,914.57
		Tanker					
	Other Warehousing	The other Warehouse	*39*	30,000.00	769.23	21,183.00	543.15
2-2	Other Services Allied to Transport Agency		380	18,044.00	47.48	12,212.18	32.14
	Operation of Harbour and Marine Terminal Facilities	Terminal Operating Company	*380*	18,044.00	47.48	12,212.18	32.14
3	**Supporting and Auxiliary Transport Activities**		**17,039.00**	**4,812,051.00**	-	**3,444,600.26**	-
3-1	Cargo Handling		5,593.00	755,877.00	-	497,835.20	-
	Air Freight and Land Freight Handling	Air and Trucking Cargo Handling	*129*	6,956.00	53.92	4,371.15	33.88
	Water Freight Handling	Harbour Labour Union	*5,464*	748,921.00	137.06	493,464.05	90.31
		Shipping Cargo Handling Service*					
3-3	Other Supporting Transport Services n.e.c.		10,968.00	4,019,806.00	-	2,934,218.10	-
	Freight Transport Arrangement	Freight Forwarder	*4,404*	1,465,300.00	332.72	1,077,874.68	244.75
	Packing and Crating	Packing Service	*67*	160,933.00	2,401.99	106,328.43	1,586.99
	All Other Supporting Transport Services n.e.c.		*6,497.00*	*2,393,573.00*	*7,815.57*	*1,750,014.99*	*5,730.99*
	Ship Broker	Chartering Agent	*139*	451,098.00	3,245.31	331,827.69	2,387.25
		Ship Broker					
	Manning Services	Manning Service	1,944	54,239.00	27.90	39,898.21	20.52
	Shipping Agent	Shipping Agent	404	1,707,469.00	4,226.41	1,256,014.20	3,108.95
	Tallying Services	Measure Service	*1,534*	17,332.00	11.30	11,451.25	7.46
		Surveyor Service					
		Tally Service *					

GBP1=KW2000

Source: Author

Table 8-4 (Continued) The Value Added Per Capita of the PLRCs in Busan

	Industry/Sector (Classification used in the Total Survey)	Sort of Company (Classification used in the Fieldwork)	Number of Employees (persons)	Gross Sale (mm KW)	Value Added per Employee (mm KW)	Value Added (mm KW)	Value Added per Employee (mm KW)
	Port Services	Hold Cleaning Service Launch Boat Service Line Handling Service * Rubbish Disposal Service (Fresh Water Supply) Ship Security Service	*670*	24,209.00	36.13	15,994.89	23.87
	Ship Approaching Services	Pilot Service * Tug Boat Service	*141*	10,792.00	76.54	5,933.86	42.08
	Supply Services	Nautical Chart Distributor Ship Chandler * Sparepart Supply	*1,711*	1,551,825.00	906.97	259,620.32	151.74
	Bunkering Service	Bunkering Service	*223*	361,016.00	1,618.91	81,950.63	367.49
	Port Telecommunication	Port Communication Service	*251*	29,891.00	119.09	21,022.34	83.75
	Shipping Management	Ship Management	*629*	40,850.00	64.94	30,049.26	47.77
	Customs Clearance Service	Customs Clearance Service	*969*	48,353.00	49.90	35,568.47	36.71
	The Others	Cargo Lashing Service Crane-Ship Service Disinfection Service Port and Waterway Management * Salvage Service	*627*	44,341.00	70.72	24,183.58	38.57
3-4	Other software Consultancy and supply		478.00	36,368.00	-	12,546.96	-
		Consultancy & Software supply	*478*	36,368.00	76.08	12,546.96	26.25
4	**Renting of Transport Equipment**		**485.00**	**45,126.00**	**-**	**34,413.16**	**-**
4-1	Renting of Containers		347.00	28,283.00	-	21,577.10	-
		Renting and repairing of Containers	*347*	28,283.00	81.51	21,577.10	62.18
4-2	Other Renting of Transport Equipment n.e.c.		122.00	16,103.00	-	12,284.98	-
		Logistics Equipment Lease/Hire	*122*	16,103.00	131.99	12,284.98	100.70
4-3	Renting of Other Machinery and Equipment		16.00	740.00	-	551.08	-
		Stevedoring Facility/Equipement Lease/Hire	*16*	740.00	46.25	551.08	34.44
5	**Manufacture of Cargo Transport Equipment**		**6,788.00**	**1,799,534.00**	**-**	**748,246.24**	**-**
5-2	Manufacture of Cargo Transport Equipment		6,788.00	1,799,534.00	-	748,246.24	-
	Building of Steel Ships	Ship Building * Ship Repair Shop Logistics Equipment Repairer	*6,788*	1,799,534.00	265.11	748,246.24	110.23

GBP1=KW2000

Source: Author

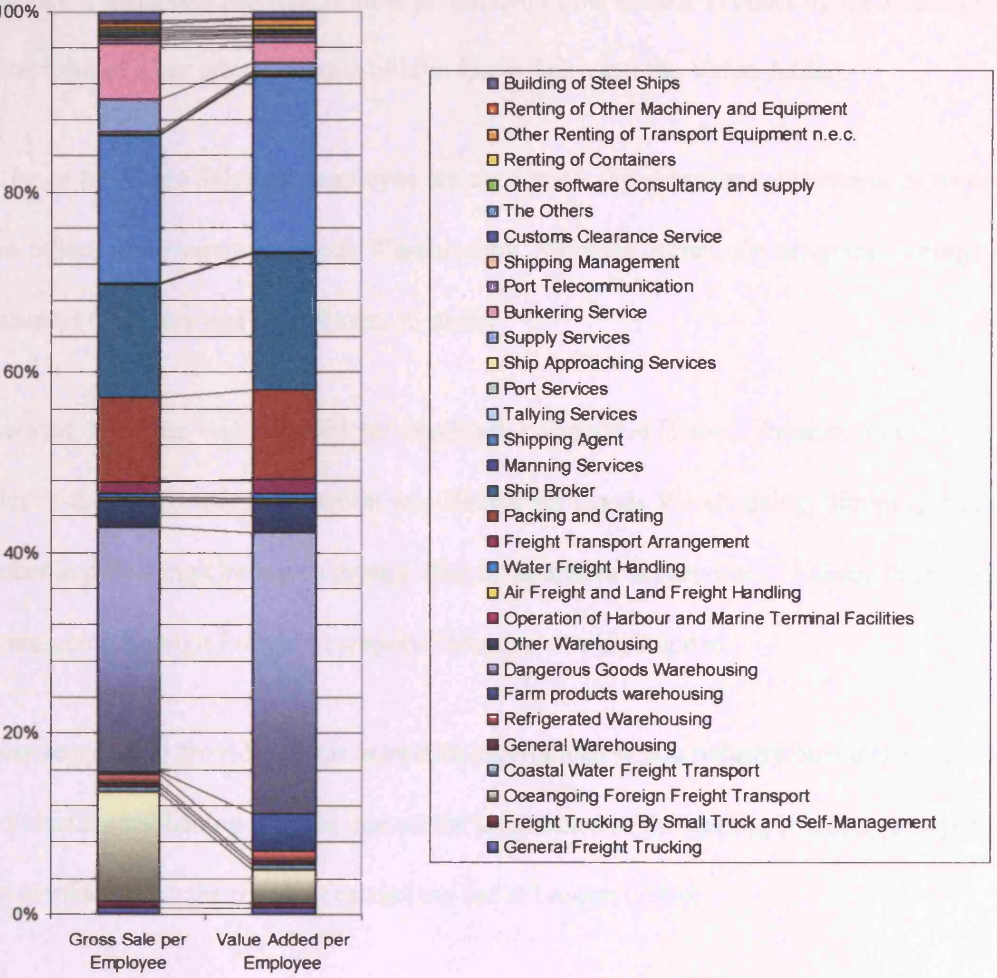


Figure 8-6 Comparison of the proportion by the Labour Product of port logistics relevant business in Busan

Source: Author

Figure 8-6 visualises the comparative proportion of the Labour Product by the PLRCs in Busan in the form of a bar graph in terms of both Gross Sales and the Value Added.

As far as the Gross Sales per employee are concerned, the comparative proportions were greater than others for Dangerous Goods Warehousing, Shipping Agent, Ocean-going Foreign Freight Transport Company and Ship Broker in order.

However, from the Value Added per employee perspective (Labour Product point of view), the order of the comparative proportion was Dangerous Goods Warehousing, Shipping Agent, Ship Broker and Packing/Crating Company. The comparative depression of Labour Production from Ocean-going Foreign Freight Transport Company was highlighted.

These results will provide a clear answer in ascertaining which industry/business should lead the port cluster establishing process, just as the importance of the leading company in a port cluster was emphasised in the research carried out in De Langen (2004).

At the same time, these results would also provide useful information for a port authority or a municipal government to establish their industrial policy on the port relevant industry.

8.6 The industrial Productivity of the PLRCs in Busan on the SADT diagrams

In **Table 8-5**, the amounts of Value Added of 51 kinds of business/industries were sorted. In addition, to improve discrimination of their comparative order, the companies/industries were divided up to 10 grades (from A to J) by Value Added. The interval was 10% between each grade and they were variegated by the grade. The Gross Sales also were divided as same way as the Value Added due to compare the comparative rank of Value Added and of Gross Sales.

As seen in **Table 8-5**, Dangerous Articles Warehouse, Tank Storage, Shipping Agent, Ship Broker got double 'A', Ocean Shipping Company got single 'A' from the Gross Sales. This means that the scale of this kind of business is comparatively big and productivity is also high.

In contrast, Van and Individual Trucking, Customs Clearance Service, Stevedoring Facility/Equipment Lease/Hire and Air and Trucking Cargo Handling got double 'J', which means that the scale of this kind of business is comparatively small and productivity is also low.

Farm Warehouse's rank was the most rapidly increased at the Added Value perspective, rather than the Gross Sales perspective ('I' → 'B'). This means that the scale of this kind of business is comparatively small but the productivity is comparatively high.

In case of Renting and Repairing of Container Service, Hold Cleaning Service, Launch Boat Service, Line Handling Service, and Ship Security Service, mark from the Added Value improved rather than from the Gross Sales ('H' →'F'). Ship Management Service's rank also was two steps increased ('I' → 'G').This means that the scale of this kind of business is comparatively not so big but the productivity is comparatively lower .

These results means if they select the leader from the whole scale, Dangerous Articles Warehouse, Tank Storage, Shipping Agent, Ship Broker, Ocean Shipping Company could be a strong candidate.

Table 8-5 Order of Value Added per Company and Gross Sales per Company

Sort of Company (Classification used in the Fieldwork)	Value Added per company (mm KW)	Order	INDEX	Gross Sale per company (mm KW)	Order	INDEX
Dangerous Articles Warehouse	122,864	1	A	174,004	1	A
Tanker	122,864	1	A	174,004	1	A
Shipping Agent	40,517	3	A	55,080	4	A
Chartering Agent	36,870	4	A	50,122	5	A
Ship Broker	36,870	4	A	50,122	5	A
Packing Service	26,582	6	B	40,233	7	B
Ocean Shipping Company	25,631	7	B	137,655	3	A
Farm Warehouse	16,298	8	B	2,308	28	F
Logistics Equipment Repairer	5,584	9	B	13,429	9	B
Ship Building	5,584	9	B	13,429	9	B
Ship Repair Shop	5,584	9	B	13,429	9	B
The other Warehouse	5,296	9	B	7,500	15	C
Bunkering Service	3,902	13	C	17,191	8	B
Harbour Labour Union	3,683	14	C	5,589	16	D
Shipping Cargo Handling Service	3,683	14	C	5,589	16	D
Ref./Frozen Warehouse	3,431	16	D	4,859	18	D
Terminal Operating Company	3,053	17	D	4,511	19	D
Port Communication Service	2,628	18	D	3,736	20	D
Freight Forwarder	2,323	19	D	3,158	24	E
Nautical Chart Distributor	2,219	20	D	13,263	12	C
Ship Chandler	2,219	20	D	13,263	12	C
Sparepart Supply	2,219	20	D	13,263	12	C
Container Freight Service	1,679	23	E	2,378	25	E
General Warehouse(including CY)	1,679	23	E	2,378	26	F
Logistics Equipment Lease/Hire	1,536	25	E	2,013	29	F
Barge/Inland Shipping	1,433	26	F	3,220	22	E
Coastal Shipping	1,433	26	F	3,220	22	E
Trucking Company	1,377	28	F	2,359	27	F
Renting and repairing of Containers	1,349	29	F	1,768	37	H
Hold Cleaning Service	1,230	30	F	1,862	30	H
Launch Boat Service	1,230	30	F	1,862	30	H
Line Handling Service	1,230	30	F	1,862	30	H
Rubbish Disposal Service (Fresh Water Supply)	1,230	30	F	1,862	30	H
Ship Security Service	1,230	30	F	1,862	30	H
Ship Management	1,202	35	G	1,634	43	I
Consultancy & Software supply	1,141	36	H	3,306	21	E
Pilot Service	989	37	H	1,799	35	G
Tug Boat Service	989	37	H	1,799	35	G
Manning Service	928	39	H	1,261	44	I
Cargo Lashing Service	896	40	H	1,642	38	H
Crane-Ship Service	896	40	H	1,642	38	H
Disinfection Service	896	40	H	1,642	38	H
Port and Waterway Management	896	40	H	1,642	38	H
Salvage Service	896	40	H	1,642	38	H
Measure Service	636	45	I	963	45	I
Surveyor Service	636	45	I	963	45	I
Tally Service	636	45	I	963	45	I
Van and Individual Trucking	517	48	J	885	48	J
Customs Clearance Service	418	49	J	569	49	J
Stevedoring Facility/Equipement Lease/Hire	276	50	J	370	50	J
Air and Trucking Cargo Handling	175	51	J	278	51	J

	INDEX	
top 10%	A	1st-5th
11-20%	B	6th-10th
21-30%	C	11th-15th
31-40%	D	16th-20th
41-50%	E	21st-25th
51-60%	F	26th-30th
61-70%	G	31st-35th
71-80%	H	36th-40th
81-90%	I	41st-45th
below 91%	J	below 45th

Source: Author

The serial figures from **Diagram A1-included order index** to **Diagram A6-included order index,** these order index are marked on the previous SADT diagrams drawn from **Chapter 8**,.

From the **Diagram A1-included order index (Voyage Support System),** the index of Shipping Agent, Shipping Broker, and Ocean Shipping Company was high, but, Port Service Providers' was low.

From the **Diagram A2-included order index (Port Entry System),** the index of Shipping Agent and Ocean Shipping Company was high, but, Customs Clearance Service, Port & Waterway Management Service, Ship Approaching Service Providers and Port Service Providers were comparatively paltry.

From the **Diagram A3-included order index (Stevedoring System),** the index of Shipping Agent and Ocean Shipping Company, Packing Service and Shipping Cargo Handling Service (including Harbour Labour Union) was comparatively high, but, Survey Service, The other Cargo Transportation related Service and Stevedoring Facility Leas/Hire Service were comparatively paltry.

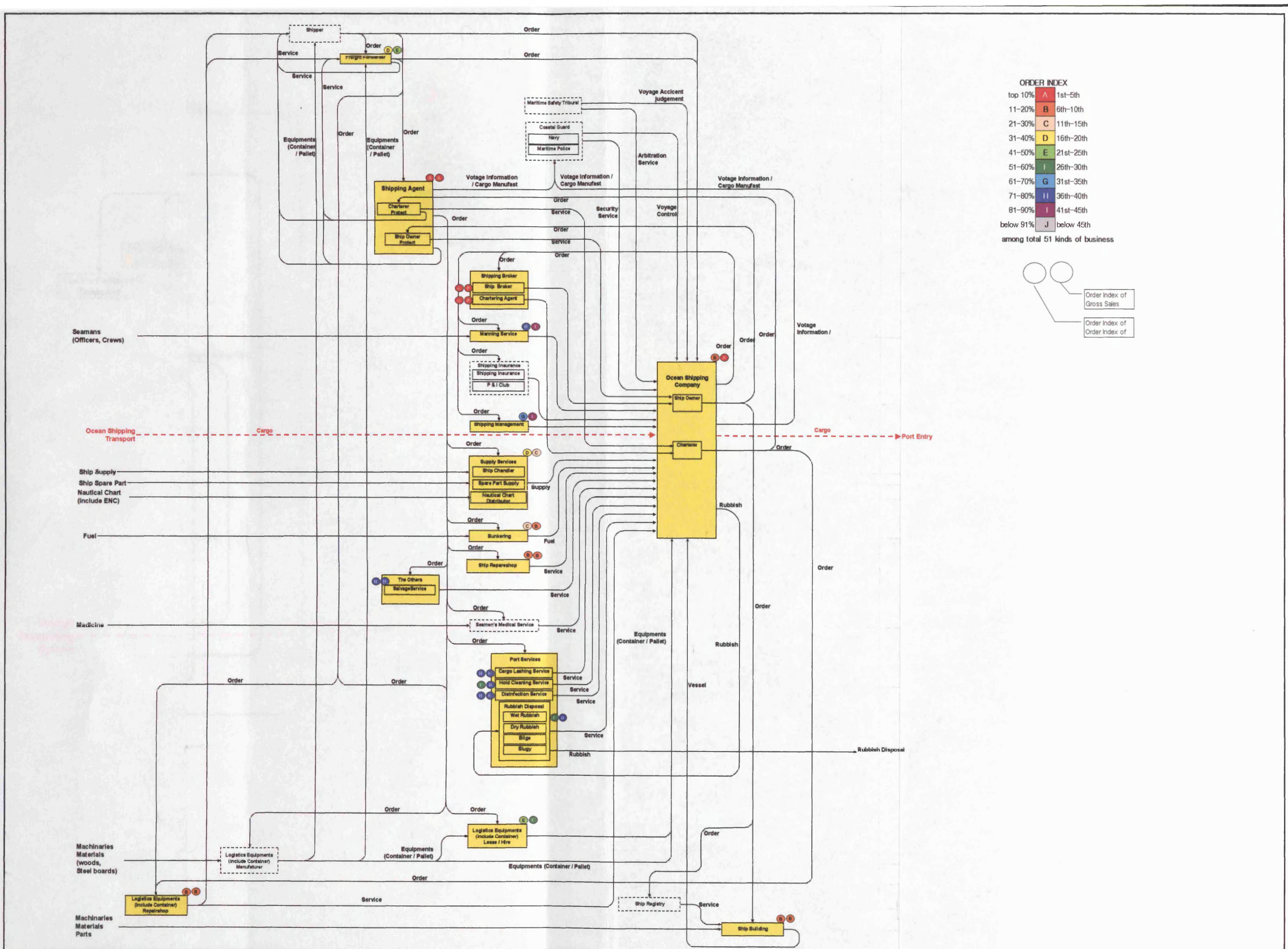
From the **Diagram A4-included order index (Transit System),** except for Shipping Agent and Ocean Shipping Company, the index of Shipping Cargo Handling Service and Harbour Labour Union was comparatively high; Barge Service and other Transport Company were intermediate; but, Cargo Transport Labour Union who driving container tailor was paltry.

From the **Diagram A5-included order index (Storage System),** except for Shipping Agent and Ocean Shipping Company, the index of Storage Service is above the middle in average, but Survey Service's was paltry.

From the Diagram A6-included order index (Inland Transport Connecting System), most relevant companies/industries were paltry.

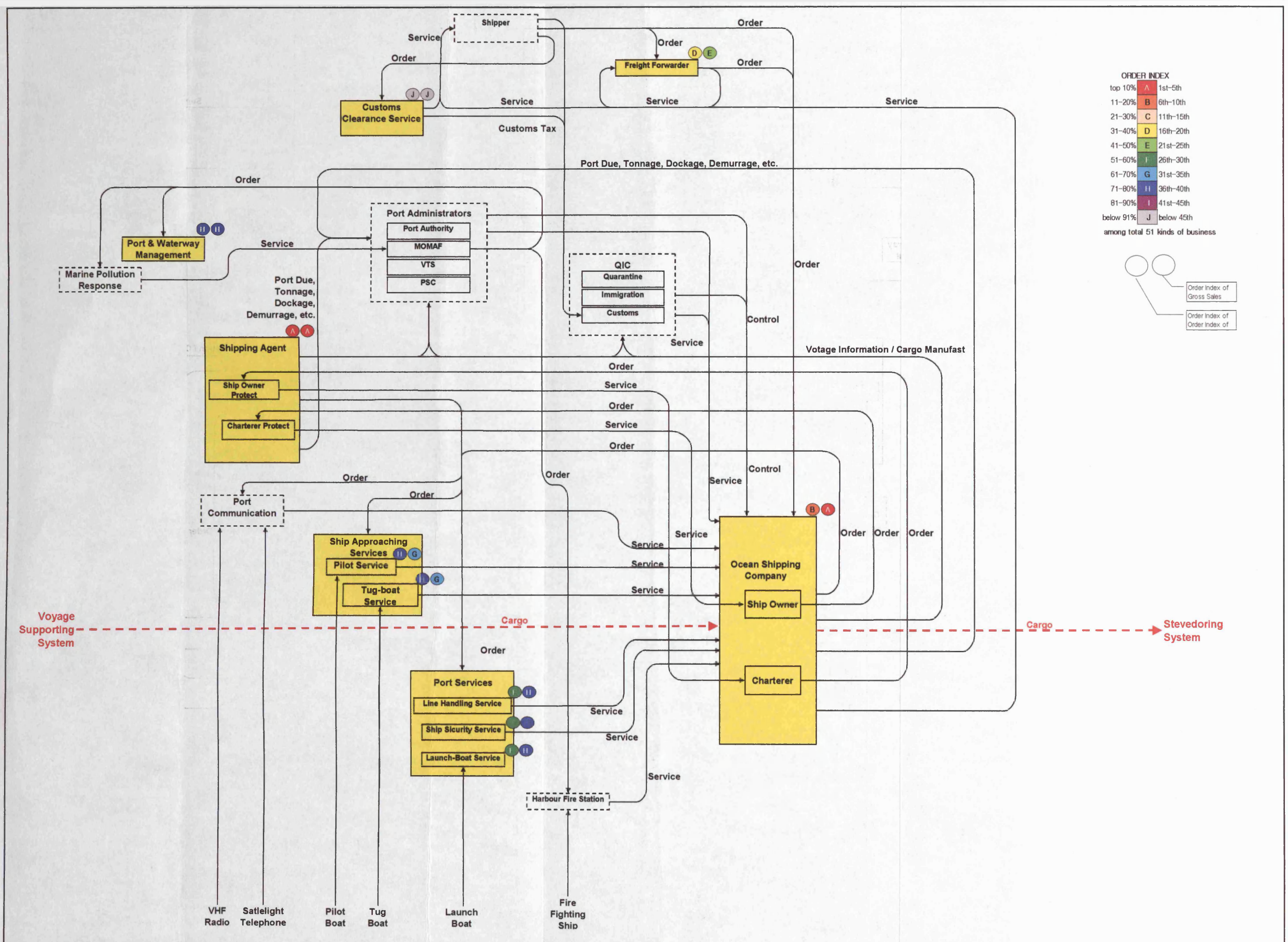
Whereas earlier works are tables which merely enumerate statistical figures, this SADT diagram with the data aids the understanding of industrial product and labour product of participating companies by allocating the statistical figures on the port logistics process.

At the same time, these figures will provide a clearer picture as to which industry/business should be the leader on each of the port logistics process.

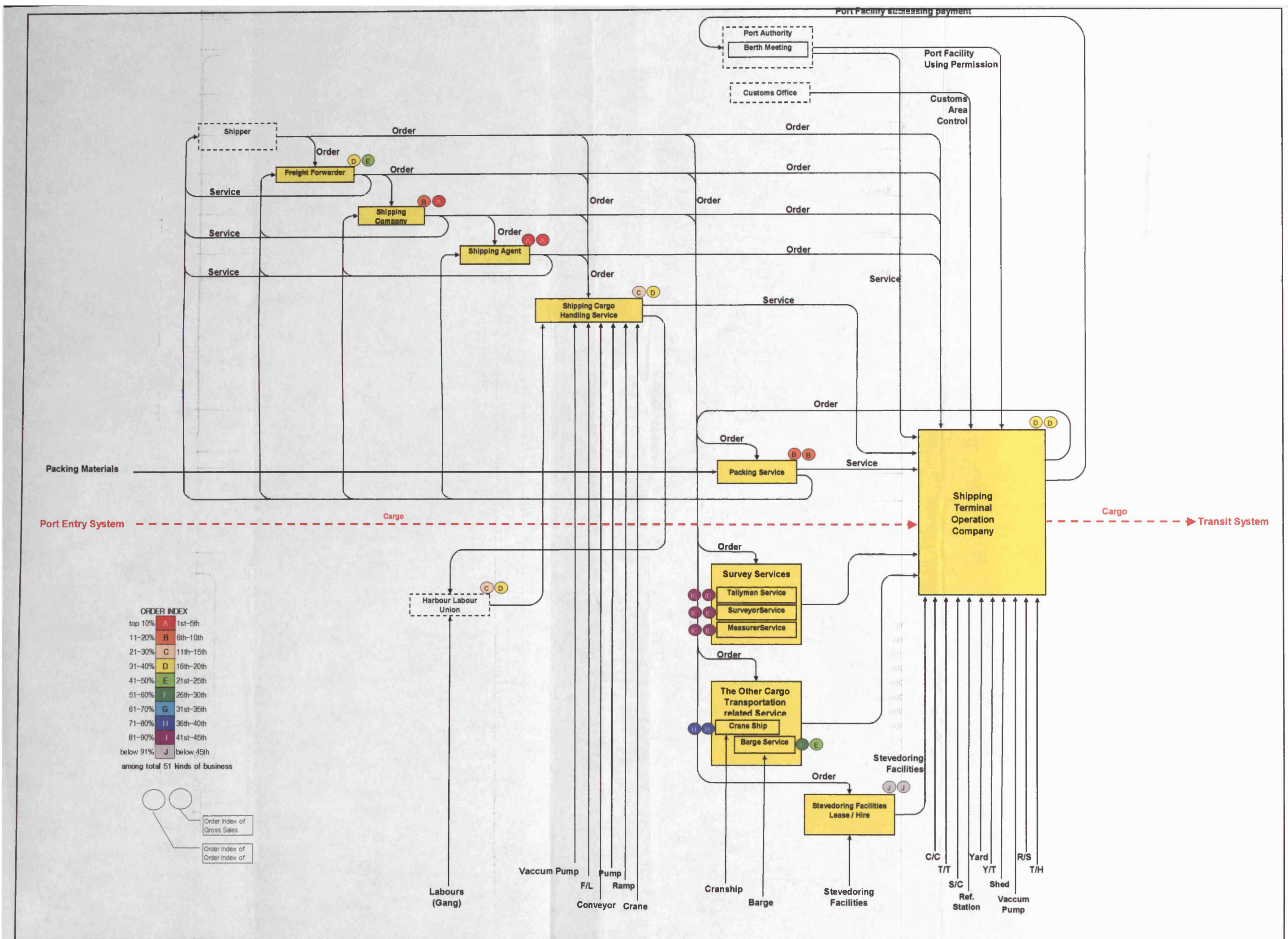


NOTE	Voyage Supporting System	No.	A1

220

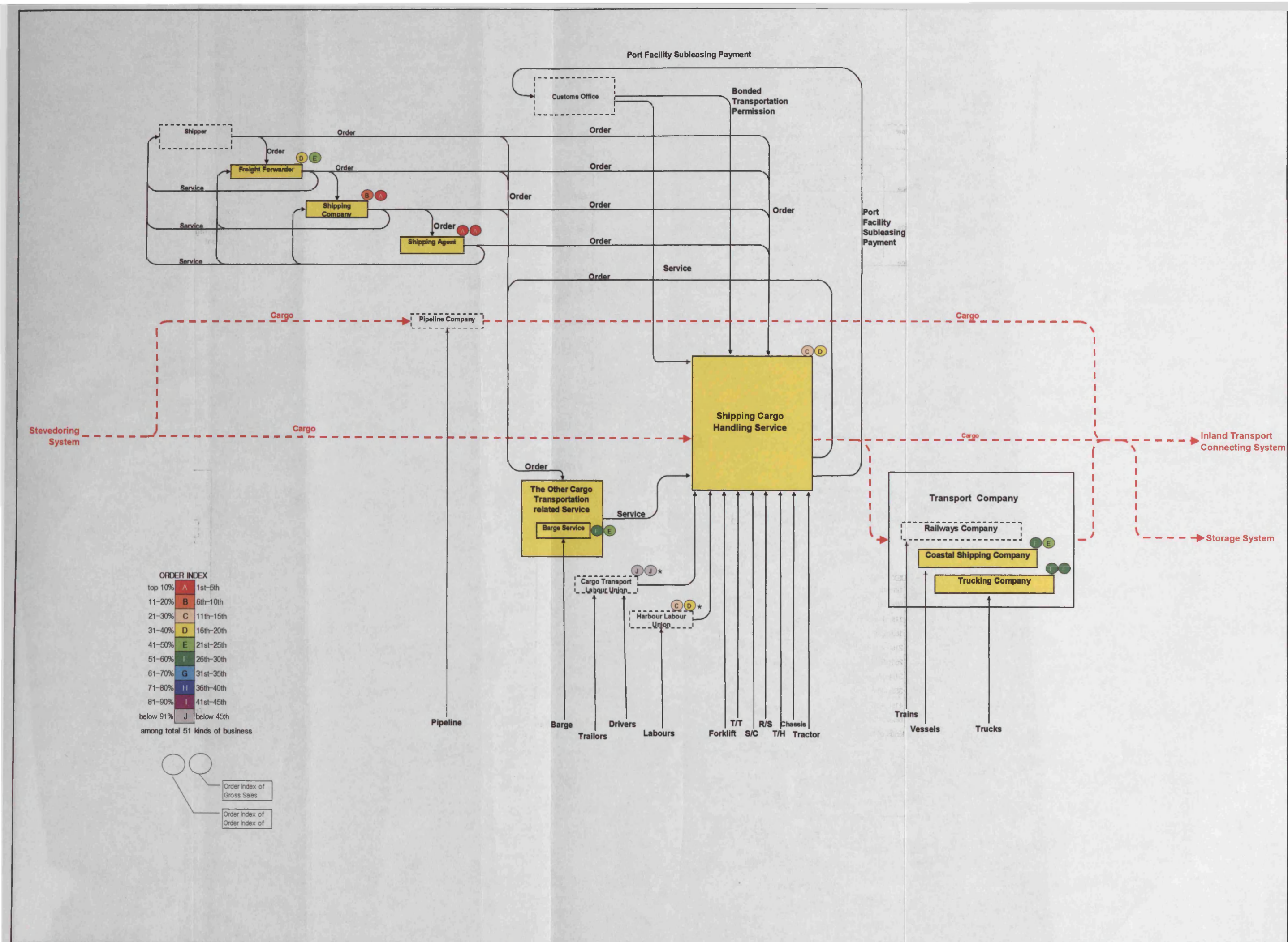


NOTE	Port Entry System (order index is included)	No.	A2



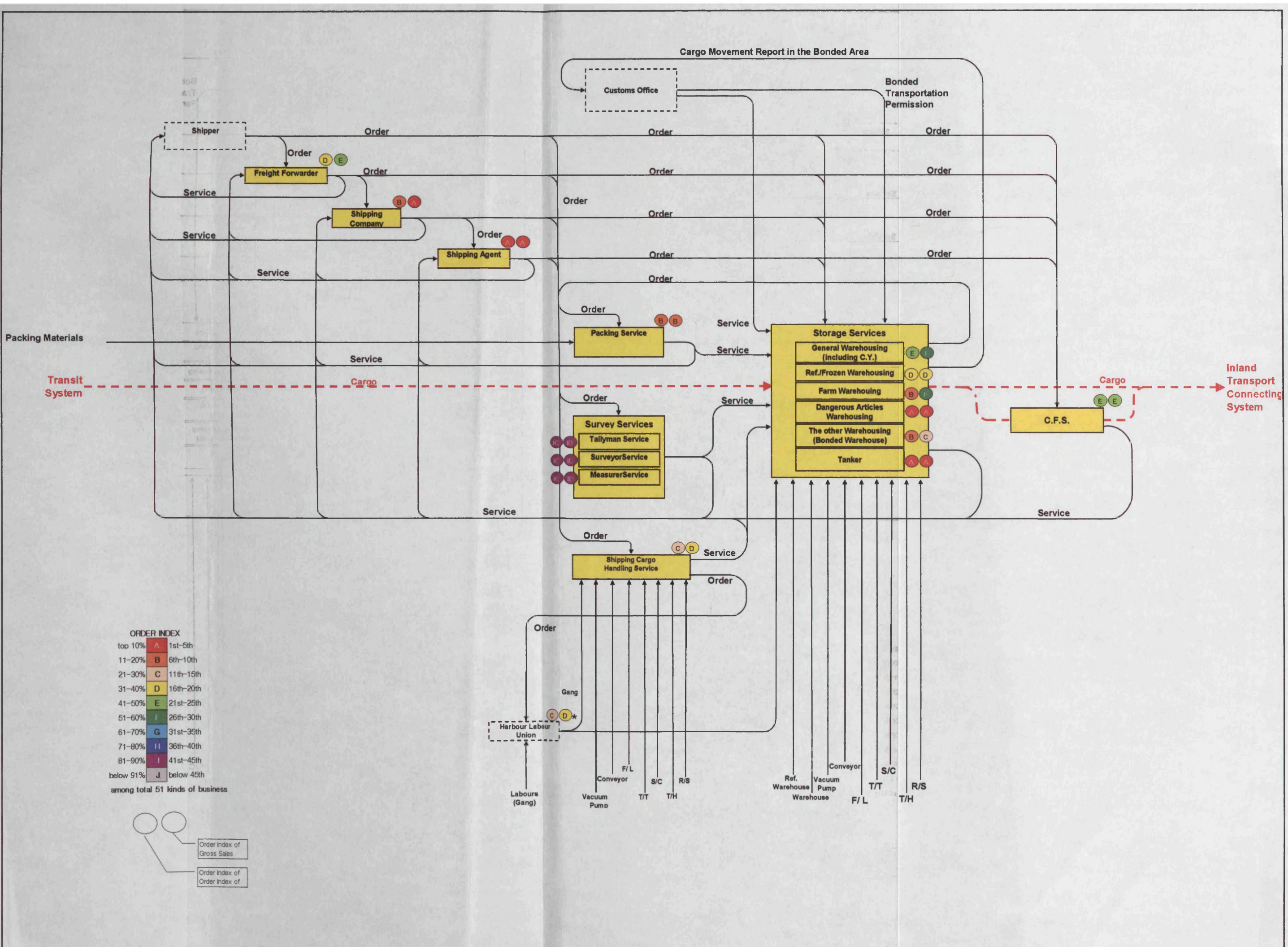
NOTE	**Stevedoring System** (order index is included)	No.	A3

222



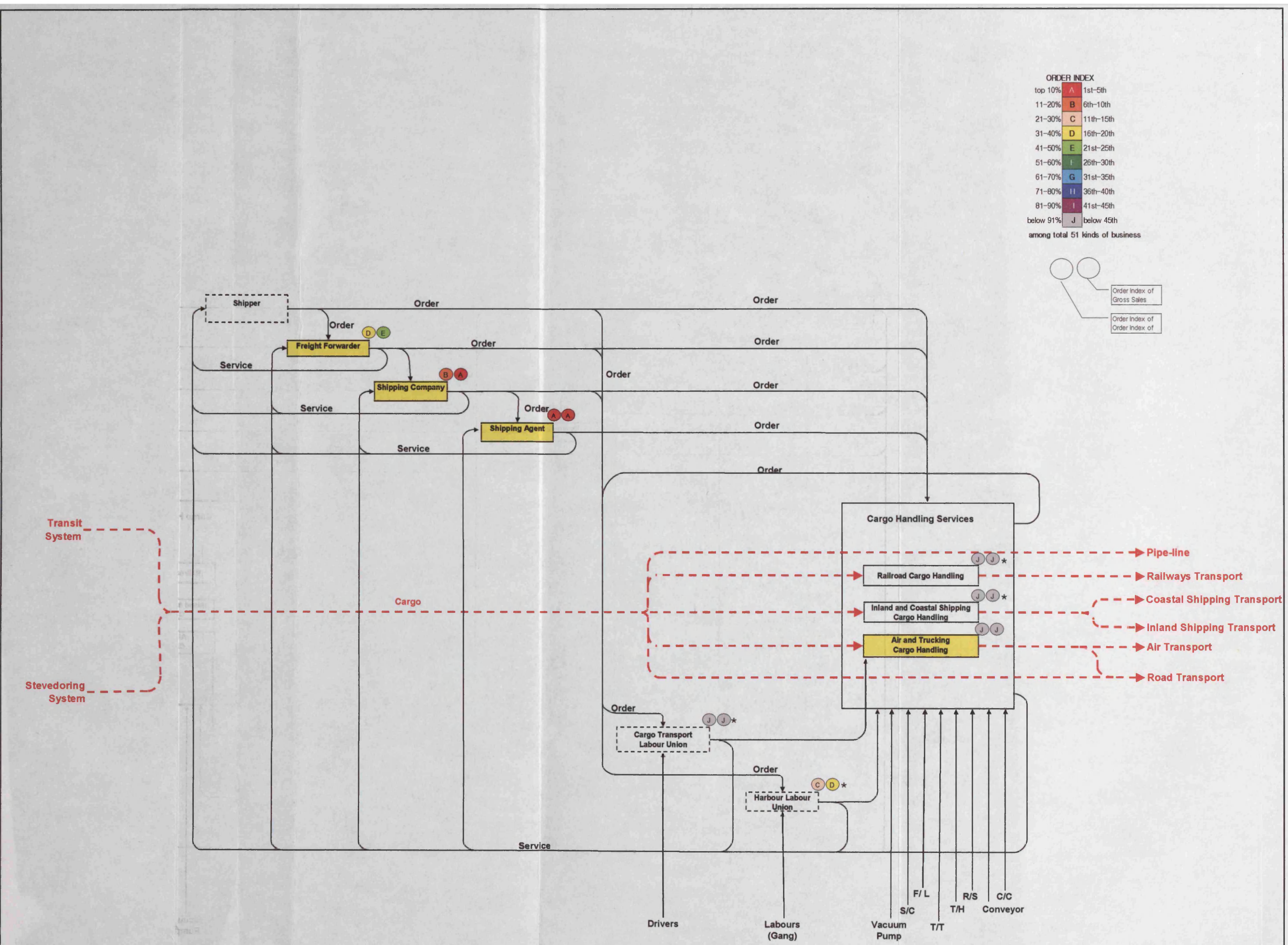
NOTE	**Transit System** (order index is included)	No.	A4

223



NOTE	Storage System (order index is included)	No.	A5

224



NOTE	Inland Transport Connecting System (order index is included)	No.	A6

225

8.7 Summary

In this chapter, we surveyed the value added rate of the PLRCs from the secondary data; and calculated the Value Added of the port cluster in Port of Busan using the obtained value added rate. We could also calculate the scale of the gross sales and the value added per industry/business, the value added per company, the value added per capita.

Whereas earlier works are tables which merely enumerate statistical figures, this SADT diagram with the data aids the understanding of industrial product and labour product of participating companies by allocating the statistical figures on the port logistics process. At the same time, these figures will provide a clearer picture as to which industry/business should be the leader on each of the port logistics process.

The amounts of Value Added of 51 kinds of business/industries were sorted by the amount of Value Added and were ranked from A to J grade.

At the results, Dangerous Articles Warehouse, Tank Storage, Shipping Agent, Ship Broker got double 'A', Ocean Shipping Company got single 'A' from the Gross Sales. This means that the scale of this kind of business is comparatively big and productivity is also high.

In contrast, Van and Individual Trucking, Customs Clearance Service, Stevedoring Facility/Equipment Lease/Hire and Air and Trucking Cargo Handling got double 'J'. This means that the scale of this kind of business is comparatively small and productivity is also low.

If we subdivide the port cluster associated companies/industries by the port logistics process, Shipping Agent, Shipping Broker, and Ocean Shipping Company were good, but Port Service Providers was paltry in the Voyage Supporting System from the scale and industrial productivity perspective.

In Port Entry System, Shipping Agent and Ocean Shipping Company were high, but Customs Clearance Service, Port & Waterway Management Service, Ship Approaching Service Providers and Port Service Providers were comparatively paltry.

In Stevedoring System, Shipping Agent and Ocean Shipping Company, Packing Service and Shipping Cargo Handling Service (including Harbour Labour Union) were comparatively high, but Survey Service, other Cargo Transportation related Service and Stevedoring Facility Leas/Hire Service were comparatively paltry.

In Transit System, except of Shipping Agent and Ocean Shipping Company, Shipping Cargo Handling Service and Harbour Labour Union was comparatively good; Barge Service and other Transport Company were intermediate; but, Cargo Transport Labour Union who driving container tailor was paltry.

In Storage System, except for Shipping Agent and Ocean Shipping Company, Storage Service is above the middle in general, but Survey Services was paltry.

In Inland Transport Connecting System, most relevant companies/industries were paltry.

CHAPTER 9

CONCLUSIONS

9.1 Chapter Overview

This concluding chapter of the thesis will summarise the contribution of this study and discuss the implications of the findings for academia and industry. Limitations of the research and possible future research are also mentioned in this chapter.

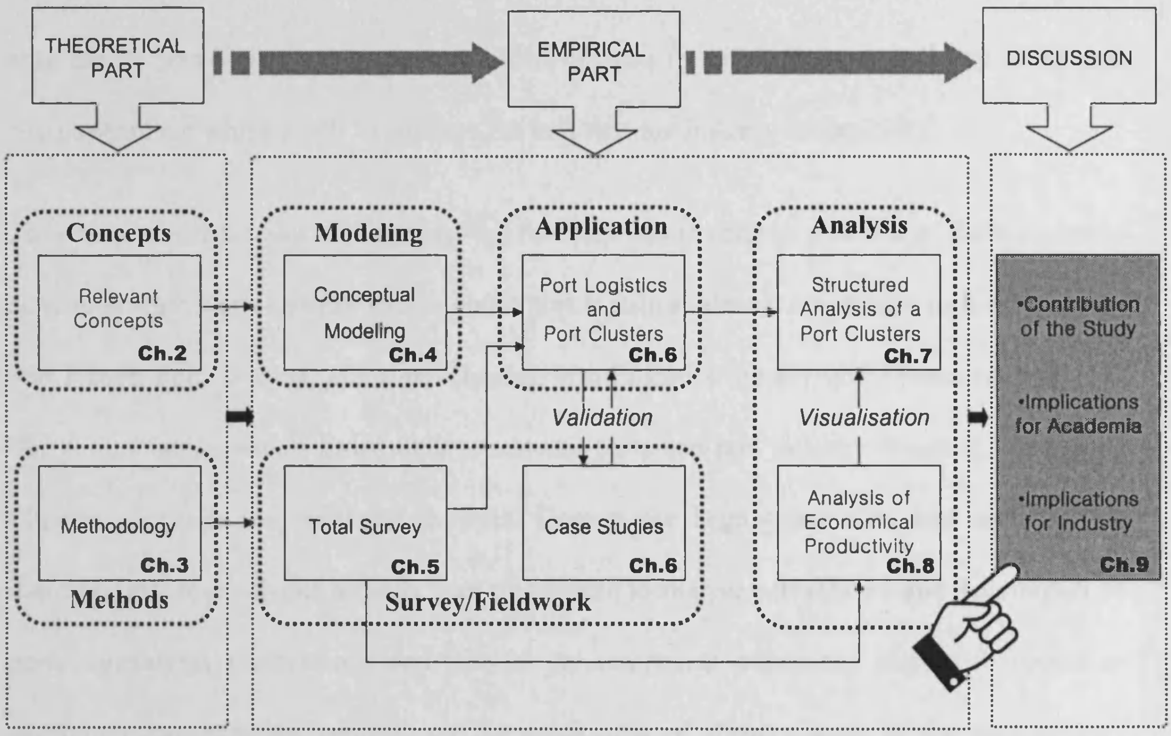


Figure 9-1 Position of Chapter 9 in the thesis
Source: Author

9.2 Summary of the Study

There are very few ports in the world that have exclusive statistics of activities in which port relevant companies are involved. Therefore, all the existing researches relevant to port logistics industry were heavily dependent upon sampling surveys. This method has the obvious and fundamental limits to understanding the actual condition of the relevant companies or the port cluster. Therefore, this study has been based on the results of conducting a total survey in year 2000, in order to investigate the actual conditions of relevant companies based in the port of Busan, the biggest port in South Korea (**Chapter 5**).

The ultimate aim of this study has been to explore the theoretical and empirical knowledge not only for the port logistics relevant companies, but also for either the port authority or the port city government which needs to promote the port relevant industry strategically.

To achieve the above aim in this study, the first step was to conduct a review of the literature to determine what was currently known about port logistics relevant companies such as Seaports, Port Range, Port Clusters, Maritime Clusters, Port Logistics System, and System (**Chapter 2**). The review began with a broad look at relevant ports and port industry literature. Then, Port Clusters approach was explored in-depth. Despite the huge expectation and needs of the industry, little research had actually been undertaken to analyse port clusters and their impact on ports' operations performance and that of the companies within the cluster. A couple of exceptions has been the research on the application of cluster theory in the port industry (Haezendonck, 2001) and performance measuring of existing three port clusters (De Langen, 2004). Haezendonck may be the first scholar to use the term 'port cluster' and she defined what a port cluster is. The history of port cluster research is no longer than 5 years, thus it is difficult to find any studies on the subject before Haezendonck's.

While Haezendonck and De Langen have distinct related definitions of port clusters, we feel that the conceptual boundary of the port cluster is not clear. The unclear conceptual boundaries of port clusters make it difficult to progress analysis and design effective systems. There is also a lack of clarity between ports and other related terms such as port ranges and maritime clusters. The situation within a port cluster is similar as above; there is no research on the relationship among the constituents associated in a port cluster. Therefore, this study is conducted to define port clusters in terms of their distinct characteristics and system boundaries (**Chapter 4**)

In the process to visualise the relations among the constituents associated in a port cluster, there was a need to apply appropriate industrial engineering tools and techniques in order to visualise such clusters as whole systems without the need for excessively complex models. Such visualisations would help develop our understanding of the interrelationships between the various parts and aid in the development of structured design methods.

To solve this problem, the next step was to conduct a review of the literature about appropriate industrial engineering tools and techniques in order to visualise them. On the way to visualise the relationships among the constituents associated in a port cluster, appropriate industrial engineering tools and techniques were necessary, and SADT acted as an effective vehicle to visualise the relationship with function box and arrows. Furthermore, the hierarchical concept of SADT diagrams was very effective in expressing the assemblage such as the port cluster. Even huge and complex systems could be decomposed using the hierarchy system. Such visualisations helped develop our understanding of the interrelationships between the various parts and aid in the development of structured design methods. SADT proved to be a really effective technique to visualise a port cluster as a system of systems within the system hierarchy.

In addition, in order to systematically conduct this study, this study started from an examination of Soft System Methodology (SSM) first. This is because SSM helps formulate and structure thinking on problems in complex situations with frequent human errors. Its core is the construction of conceptual models, based on the understanding of human activity systems outlined above, and the comparison of those models with the real world. **(Chapter 3)**

To apply the SADT technique to port cluster system, port logistics process system relevant literature was reviewed. Despite expectation, little research had actually been undertaken to analyse port logistics process and there were several weak points which could be explored in my research. Therefore this study established a new conceptual model related to the port logistics process. Serial fieldworks were conducted for validation of the conceptual model **(Chapter 5)**, and on the procedure of validation, extraction and grouping of the port relevant industries were conducted in parallel by experts **(Chapter 6)**. Based on the conceptual model on port logistics process, field work data, and total survey data, finally, SADT diagram could be drawn. The relationship within a port cluster has been clarified with this effective technique **(Chapter 7)**.

From the total survey data and serial SADT diagrams we could get knowledge of who is linked with whom, who is bigger than who from gross sales point of view. However, in spite of those efforts, we could not identify the proportion or importance of the port cluster in the regional economy. In order for a proper comparison with regional economy to take place, another index named industrial product was required. Industrial product, represented by Value Added, could be used externally, to emphasise the importance of port cluster or port relevant industry to political governors who could support the industry with industrial policy. Otherwise, it could be used internally, as a standard method of selecting the leading industries/companies who will lead the cooperation of the relevant industries/companies in the port cluster.

Fortunately, a report was found, published by MOMAF (Korea Ministry of Maritime Affairs and Fisheries) in 2002, named "A Study on the Spreading Economical Effect of the Port Industry" in which the average Value Added rate of the port relevant industries in Korea was calculated. It was not fully sufficient to apply to this study, but the lacking elements were further investigated and supplemented in the fieldwork and we could finally obtain the Value Added in the port cluster (**Chapter 8**).

9.3 General Findings and Contributions of the Study

In the process of answering the five research objectives highlighted in the introduction, this study has led to these six contributions.

9.3.1 Closed boundary of the Port Cluster system (RQ.1)

Firstly, a small number of researches on the port cluster have been conducted recently, and it was still not clear how far actually a port cluster system boundary stretches to. Therefore this thesis contributes to the theoretical knowledge on the close boundary of the port cluster system from the similar assemblages surrounding it using Set Theory (See. **Figure 4-6**). This is relevant to answer both of RQ.1 and RQ.2.

9.3.2 A conceptual model around port competition

This study has contributed in classifying competition between Port Ranges, Maritime Clusters, Ports and Port Clusters in a strategic perspective. Furthermore, it has also contributed in clarifying these interrelationships using Set Theory (See. **Figure 4-5).**

9.3.3 The first total survey on port relevant companies in Busan Port

There are very few ports or port cities in the world that have exclusive statistics of activities in which port relevant companies are involved in. Therefore, the third contribution is to conduct a total survey on port logistics relevant companies working in Port of Busan: Korea (against 1,699 companies, 36,894 employees). It was not a sample survey, but the first total survey on port logistics relevant companies in Korea. (See. **Table 5-7**)

9.3.4 New conceptual model of Port Logistics Process including PLRCs (RQ.3)

The forth contribution is the application of the system theory to the port logistics process and suggestion of new conceptual model in the port logistics system from the port logistics process perspective. This conceptual model is important for the visualisation of the relation between the company and the company working in the port logistics process (See. **Figure 6-9**) This is relevant to answer RQ.3.

9.3.5 Visualisation of the relationship between constituents of the Port Cluster (RQ.4)

The fifth contribution of this study is that it has applied appropriate industrial engineering technique (SADT) to visualise the inter port cluster which is becoming increasingly complex due to recent development in construction of port clusters **(See SADT Diagram A1 to A6)**. This is relevant to answer RQ.4.

9.3.6 Estimation of Value Added in a Port Cluster (RQ.5)

The last contribution of this study is to estimate how much Value Added was created within a port cluster and to create an order of the associated companies in the port cluster by the industrial productivity i.e., Value Added and Gross Sales (See. **Table 8-5** and See also **SADT Diagram A1 including order index to A6 including order index**). This is relevant to answer RQ.5.

9.3.7 Weight of port cluster in the region

There have been several trials to estimate the weight of port industry in Busan from the regional economy, but it is the first time to calculate it using total survey data.

In year 2000, value added from port cluster in Busan was GDP 4.05078591 billion (KW 8.10157181 billion) and it accounts for 26.73% of the GRDP[1] (gross regional domestic product) of Busan in year 2000.

However, the matter of fact to deserve our attention is that 64.0% of the companies in the port cluster is not a head /independent office, but a branch or business office. In other words, 64% of the value added from port cluster in Busan is taking out from the region. Therefore substantial influence of port cluster in Busan to regional economy will be around 9.62%.

9.4 Limitations of the Study

There are several limitations to this study and they are detailed below:

1. Conceptual Models

This study has a tendency to suggest many conceptual models, due to the introduction of many undeveloped concepts. Developed conceptual models were verified by the experts at the prominent international conference (IAME 2004) or the experts working in the field over 8 years. However, it is impossible to ascertain whether respondents truthfully and thoughtfully answered the questions.

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[1] In year 2000, GRPD (gross regional domestic product) in Busan was GBP 15.1525 billion (30,305 billion Won).

2. A Single Total Survey

As with any other total surveys, this type of survey is almost impossible to conduct just on individual efforts.

This total survey on the port logistics relevant companies (**Chapter 6**) was only made possible by full-scaled support of a local government – Busan Metropolitan City Government in Korea, and incurred enormous financial and labour costs as well as being time-consuming and requiring great endurance from the researcher and all participants. It was the first and only total survey carried out on port logistics industry since year 2000. Therefore this study could not include comparison study using sequential data. Thus, it cannot be reliably established whether such data would hold true over time.

3. Limits of the Survey

We made it a rule that every surveyor visits every target company and has an interview directly with those above departmental managers. There were situations where a surveyor had to visit one company up to seven times to conduct a direct interview with the appropriate person and collect the completed questionnaire. However, on rare occasions where surveyors could not collect questionnaires from the survey site or when they could not continue the interview for various reasons, the company was asked to fax the completed questionnaire to the person appointed as the respondent in charge of the survey site.

In addition, when it was difficult to decide whether a company could be included in the survey target or not, we made it a rule that if part of the annual gross sales relevant to the port activity exceed 50% of gross sales, then it was included preferentially.

Therefore, there can be a possibility with the real situation, even though the data was collected from a total survey.

4. Accuracy of the Value Added Rate

As mentioned above, in order to calculate the Value Added in the port cluster, this study referred to the national average Value Added rate of the port relevant industries in Korea. However, it was not fully sufficient to be applied to this study and experts' advice was incorporated in extracting relevant data and information. This procedure might have resulted in less accurate outcomes and results.

9.5 Issues for Further Research

First, a conceptual model concerned with port competitions could act as a benchmark or yardstick for strategic comparative studies relevant to the port competition and port cluster competition.

Second, a classification standard for port relevant industries/companies could act as a point of reference for port relevant industrial statistics.

Third, a new conceptual model of the port logistics system from the port logistics process perspective could be applicable to the studies relevant to improvement of a port logistics process.

Forth, the visualised relationships between port relevant industries/companies would be useful reference for the research of integrated port industry information system (network). It is also applicable for the study related on business unification or joint business, joint resource management (including facility)

Fifth, the results of Added Value of a port cluster will be used for comparison between Gross Regional Product (GRP) and Gross National Product using for regional comparison study or regional economics study.

Sixth, the amount of Added Value per employee or per company of PLRCs could be used for the negotiation base of employee's wages, and for labour management.

Seventh, the results concerned with industrial product could be applied to regional industrial policy especially for a port city.

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