기본연구 2005-25

A Study on Port Performance Related to Port Backup Area in the ESCAP Region

December 12, 2005

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SUMMARY

Over the past three decades, globalization has become a general trend in many countries. One of the major engines to this trend is China's opening of its industries through the Economic Reforms in 1978.Due to the fact, a lot of multinational corporations (MNCs) have been concentrated at the Asian region. Especially, globalization has significantly effects on the port industry in Asia. Therefore, the competition among the ports, shipping lines and terminal operators to get more container traffic has been intense. To get more container traffic, most Asian countries has been making a great effort to be a logistic hub in Asia region and in the world through investing a large amount of funds on port facilities, managementsystems and port operation systems. As a result of the high competitions on the port industry, there were lots of demands on studying for port productiveness, competitiveness, effectiveness, efficienciesor performances. However, most recent studies have studied inner factors of a container terminal without concerning the outerfactors of a container terminal, named as port-backup area. Therefore, this study has been planned to figure out the influences on port performance by outer factors. In order to analyze that, this study has selected 10 international ports from different six countries. This study also used one dependent variable, container throughputs of 2003, and 16 independent variables related to container terminal and port-backup area. Furthermore, this study has used Multi-Regression and Factor Analysis as the methodology of this paper. From the analysis, this study can be

concluded as followings: (1) the influences of container terminal factor and backup area factor are indicated as significant in the ports of which cargo traffic volume is more than about 5 million TEU, (2) correlationship of backup area factor indicates high figure in high value-added creating ports, such as Hong Kong and Singapore, (3) the container terminal factor on Hong Kong, Singapore (PSA) and Busan is indicated high while backup area factor on Busan is indicated as meagre, (4) the other ports excluding the abovementioned three ports have not high correlationship comparatively on container terminal factor and backup area factor, and (5) the effect of DC (Distribution Center) indicates bigger effects than that of ODCY (Off-Dock Container Yard) and FTZ (Free Trade Zone) among backup area factors.

Chapter 1

Introduction

1. Background

Over the past three decades, globalization has become a general trend in many countries, especially in the Asian countries. One of the major engines to this trend is China's opening of its industries through the Economic Reforms in 1978. Due to the fact, a lot of multinational corporations (MNCs) have been concentrated at the Asian region, especially at China as their prime focus.

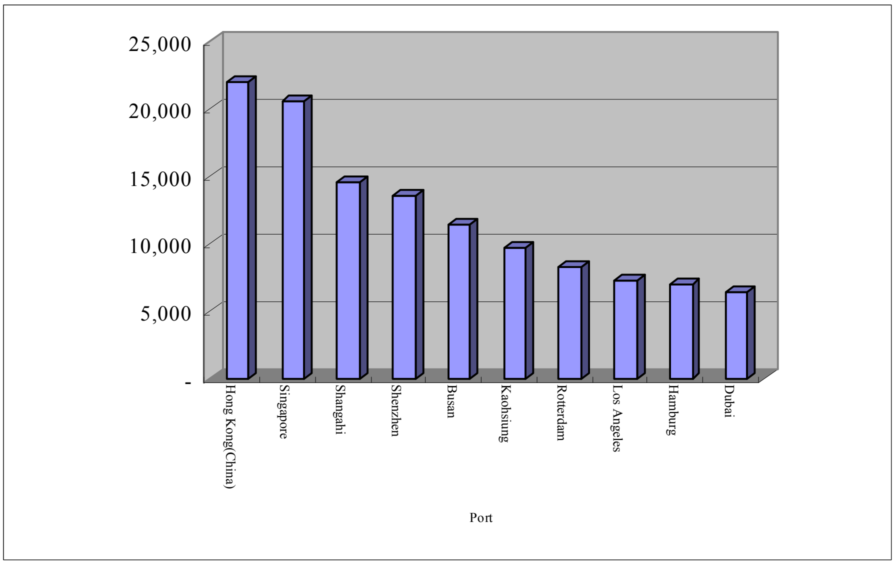
As a result of the globalization, there was a high competition on the port industry and several changes have been occurred on the industry during the last 20 years.

More concentrated container in a specific region: has changed the world seaborne trade trend. In 1980, the world top five container ports have handled 21 percent of the world seaborne trade volume. However, after 23 years later, the world seaborne trade volume has increased 37 percent compare to 1980. And the world top five container ports have handled 27 percent of the world seaborne trade volume and all of them were located in the Asian region as depictedin Figure 1-1. Furthermore, the 20 Asian ports were ranked in the world top 30 container ports in 2004. Compare to the current situations, the top five Asian container ports had been ranked in the world top 30 container ports in 1980 (Containerisation International Yearbook, various years).

Enlarged of shipping liners and port operators: have concentrated on meeting economies of scale as a way of survival. This is the reason why mergers, acquisitions and alliances among large shipping corporations have been occurred and major port operators have geographically and functionally diversified their business as a means to find new sources of income and to reduce risk. In order to cope with these challenges, disparities among container ports in terms of economies of scale have to be reduced, compared to the past(Rimmer, 1998).

Severe port competition: was resulted by globalization. Globalization has intensely raised competition between international and regional ports, especially in Asian ports. Asian container ports have faced the surprisingly high competition for attracting the container traffic more and more because of the enlargement of shipping liners through mergers and alliance. Furthermore, the giant shipping liners have started ordering large size of container vessels and reduce the calling ports in order to meet economies of scale. To fight with the new trend on the shipping industry and to attract more containerized trade volume, the container ports have had to find out the way of securing their own containerized trade volume by developing the hinterlands, which have industrialized thank to the investments made by MNCs, of container ports and advancing the intermodal systems for logistics efficiency. Consequently, ports compete locally as well as regionally against other ports, even in long-distance, serving the same inland areas (Wang & Slack, 2000; Song, 2003 Notterboom & Rodrigue, 2005).

〈Figure 1-1〉 World Top 10 Container's Port as of 2004



Source : modified from United Nations(2004).

Such series of transitions have intensely happened in Asian ports. Due to the changes in the port industry, most Asian countries are making a great effort to secure their ports as a hub by investing enormous funds on port facilities and by improving efficiency in port operations and management. Asian countries have experienced remarkable economic growth over the past three decades. Since their international trade is carried predominantly by sea transport, their ports play a pivotal role in national and regional economic development as mentioned above (Song and Han, 2004).

Under these circumstances, many port authorities have tried to improve their facilities and systems. However, due to the quick increasing container cargoes, they still suffer from "… diseconomies of scale in some load centres emerge in the form of a lack of space for expansion and limited foreland or hinterland accessibility" as mentioned by Notteboom (1997, p.

100). To deal appropriately with these problems and to advance their competitiveness, the port authorities in the region have implemented various efforts, such as building logistic centers, expanding port backup areas, cooperation between port authorities in the same areas and advancing Information Technology (IT) systems.

Meanwhile, among the factors yielding on a port's competitiveness, performance or efficiency is considered as one of the most influential elements (Tongzon 1995 & 2001; Song et al, 2001; Song & Han, 2005). The impact of a port's performance is not only confined to its competitiveness, but also goes beyond the industry to effect on a country's overall competitiveness. Port's performance, especiallyrelated to container handling capacity, is the most important factor to maintain and to advance port competitiveness. In this respect, the port authorities have built the facilities (hereafter, named just port backup areas), such as distriparks, logistic centers and off-dock container yards, in peripheryof port to cope with quickly growing rival ports. The port backup areas have advanced their port competitiveness and increased their profit through improving port productivity and advancing value-added logistics.

However, previous studies have rarely handled port backup areas as main factor related to port performance. In other words, the existing works are not powerful enough to account for practical function and effect of port backup areas related to its performance. Furthermore, these studies rarely focus on the relationships between previous factors (i.e. berth length, crane movement, dwelling time and so on) and port backup areas under the new environment through an empirical approach. As an attempt to upgrade this line of research, it is necessary to empirically investigate the phenomena to be advanced port performance by its backup areas.

As new demands for the port backup area in many ports, especially in Asia have rapidly increased, fundamental researches on these port backup areas were asked by many Asian countries including Korea. Therefore, this study is aimed to explore various indexes in order to pave the way for port backup areas, which were not developed yet, on the basis of urgently needed demands from the markets.

2. Research Objectives

With the above background in mind, purposes of this paper are to investigate the port performance related to its backup areas and to suggest the appropriate ways to design and plan its backup areas in ESCAP region. In addition, it will suggest the points of difference between hub ports and regional ports and/ or among the ports in terms of the performance related to port backup areas.

The specific objectives of the research are as follows:

1. To identify the relevant attributes of port performance in terms of port competition.
2. To identify the relevant attributes of port backup areas in terms of port competitiveness.
3. To evaluate the influences of port performance or performance related to its backup areas in port peripheral areas.
4. To investigate the differences between hub ports and regional ports, and among the ports in terms of portperformance related to its backup areas.
5. To suggest the appropriate responses or policies to design and plan port backup areas in ESCAP region.

3. Research Scope

This study will investigate the effect of port performance related to its backup areas. Many Asian ports were inclined to prefer new port construction and port expending plan to overcome their rival ports, excepting some of ports (i.e., Hong Kong). On the other hand, they have tended to ignore the ways related to port efficiency in comparison with port construction. Unless it changes and starts concentrating on various aspects, these ports may be confronted with some constraints or threats in the near future, such as the reduction of cargo throughput resulting from low efficiency and effectiveness (e.g., traffic congestion and space limitation) of port, as well as the growth of peripheral ports and the choice of shipping liners, resulting from its vulnerability to the volatility of transshipment cargo (Slack & Wang, 2003). Therefore, a lot of port authorities start to consider port backup area as a key factor to increase the port performances, such as its function, size and location therefore the ports can jump up to reach or maintain the hub port position. Appropriate development of port backup areas for ports in a country is necessary because such policies are more stable, less risky and efficient to solve the main problems, instead of investing a lot of money for developing infrastructure.

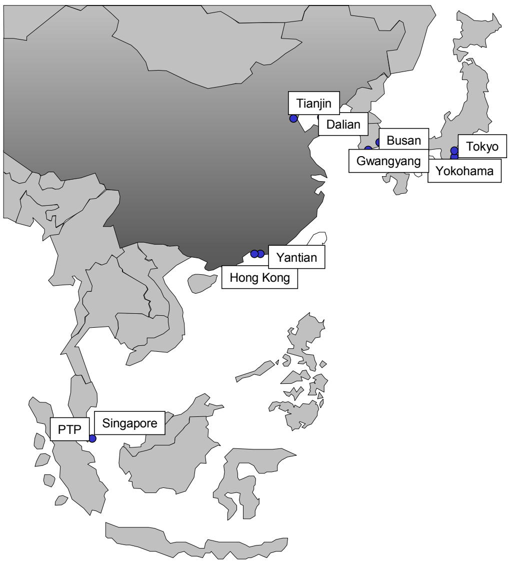
In this context, this study will concentrate on investigating port performance related to its backup areas. It is necessary to improve its competitiveness. The appropriate responsesto be taken by Asian ports will be suggested based on the investigations.

Geographically, this study covers the ten ports (Hong Kong, Singapore, Yantian and Busan as a major port Dalian, Tianjin, Gwangyang, Port of Tanjung Pelepas, Tokyo, and Yokohama as a regional port) in Asia as shown in Figure 1.2. The major port is located in the center of the region. These ports are also ranked in the world top 10 in terms of container throughputs.

On the other hands, the regional port is not located in the international center and it is smaller than their peripheral ports. These ports mentioned above are newly born or modernized port, compared with the major port. The regional port is not ranked in the world top 10 in terms of container throughputs.

Therefore, the target ports may be given to an eminent differential between hub ports and region ports. It is easy to draw a distinction between hub ports and region ports in terms of port performance related to its backup areas. The 10 ports are chosen to be analyzed because of the similarities and disparities in backgrounds as mentioned above.

〈Figure 1-2〉 Major Port Cities in Asia



4. Research Methodology

A literature review will becarried out to provide basic understandings on the concept of port backup areas and performance (or productivity or efficiency).

Issuing and setting steps will be madeto identify the definition and situation of container ports related to the two concepts: (1) introducing current situation of port business environment and characteristics, types and situation of port backup areas through reviewing literature and interview; (2) introducing the concept of port performance through reviewing literature.

Analyzing steps will be made to identify the characteristic of port backup areas based on its performance of 10 ports: (1) testing and setting appropriate model (Factor analysis and Multi-regression) through reviewing literature and possible data; (2) setting an analytical framework for comparative analysis; (3) collecting appropriate data through reviewing literature and checking current situations.

Correlation analysis, Factor analysis and Multi-regression will be adopted to conduct the empirical research. Some descriptive and multiple statistical techniques are employed to analyze data.

5. Research Structure

The structure of the research is shown in Figure 1.3, which can be separated into four parts. The first part includes the introduction and the background research (Chapters 1). The second part reviews current situation related to port backup areasand previous literature (Charter 2, 3). The third part sets an analytical framework and checks out the influence and draws disparities of the port performance related to its backup areas through comparing the Asian ports (Chapter 4). The fourth part includes research findings, policy implications and limitations (Chapter 5). The major coverage of each chapter is summarized here:

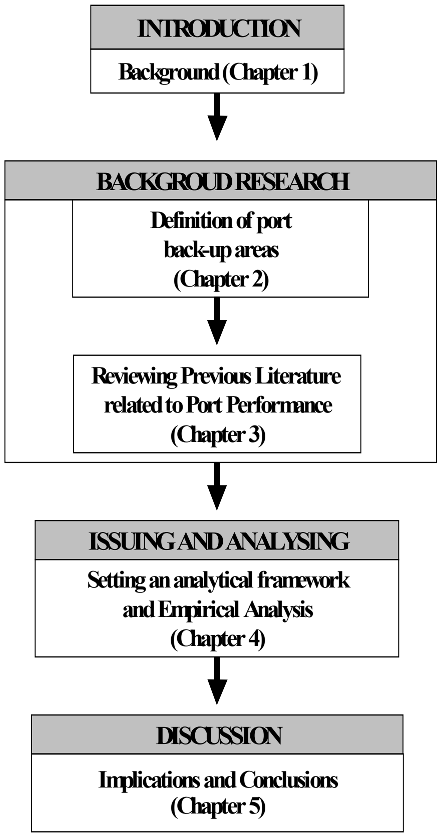
Chapter 2 introduces the changing port business environment and the current situation related to port backup areas in the ESCAP regions. Especially, it highlights type and scope of port backup areas concerning container ports.

Chapter 3 introduces the differential between productivity, efficiency, effectiveness and performance, together with investigating port performance-related previous studies. It is focused on main content, analytical tool and its variables, and implications to find appropriate measurement in terms of port performance. In addition, it extracts useful and acceptable factors (or variables) from the literature review.

Chapter 4 introduces useful models and analytical framework to carry out comparative analysis in Asian ports. It begins by introducing regression analysis and factor analysis. It sets up appropriate analytical tool by considering possibility of analysis and data collection, correlation between data and possibility of clear explanation, together with setting analytical framework. It extracts relationship and effect between port backup areas and port performance from empirical analysis. It explains the differentials of performance of ports in respect of its backup areas and demonstrates the problem like lack of space in peripheral ports

Chapter 5 makes conclusions for the research. Some possible recommendations for ports to improve their port performance regarding port backup areas are discussed. Contributions for the Korean, Asian and world ports are also discussed. Finally, limitations of the current study are pointed out, and suggestions for future researches and investigations are made.

〈Figure 1-3〉 Structure of Research



Chapter 2

DEFINITION OF PORT BACKUP AREA

1. Introduction

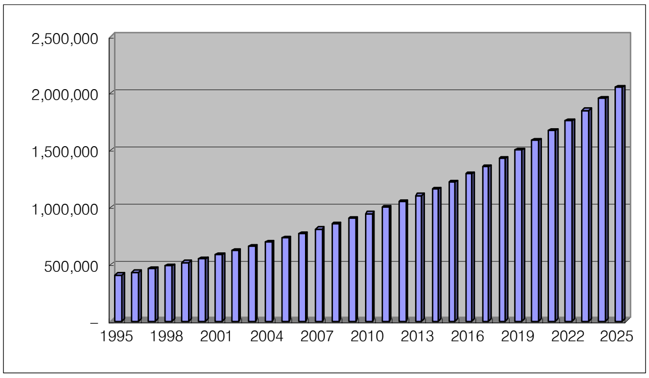
Since the 1980s, globalization has been a key trend over the worldwide trade, business structures and world economics. Especially, globalization has significantly effects on the port industry in Asia. Therefore, the competition among the ports, shipping lines and terminal operators to get more container traffic has been intense. To get more container traffic, most Asian countries has been making a great effort to be a logistic hub in Asia region and in the world through investing a large amount of funds on port facilities, management systems and port operation systems. As the result, their port environment has quickly changed as will be mentioned after.

2. The Changing Port Business Environments

1) Growth of Container Trade Volume

GlobalInsight (2005) has forecasted the containerized world trade, measured in TEU, will be increased by an average annual rate of 5.32 percent between until 2025. The main reason of the forecasting is the sustainable economic growing of China and India. Figure 2.1 indicates the containerized world trade volume between 1995 and 2025.

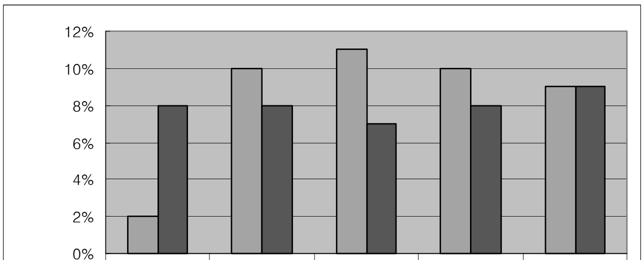
〈Figure 2-1〉 The Containerized World Trade Volume between 1995 and 2005



Source: retrieved from www.globalinsight.com

Besides the growing of the containerized world trade volume, the dependence of the containerized world trade volume on shipping industry has also been increased. The charter rate has been increased since 2000 because of surplus of demand of container vessels. The following Figure 2.2 depicts the imbalance of the demand and supply of container vessels before 2005.

〈Figure 2-2〉 Imbalance of the Demand & Supply Rate of Container Vessels



	2001	2002	2003	2004	2005
Demand	2%	10%	11%	10%	9%
Supply	8%	8%	7%	8%	9%

Source: modified from Clarkson Research Studies (2004).

In order to secure the stability of the holdings of container ships and to fulfill the demand of vessels by shippers, shipping liners have ordered vessels more and more between 2002 and 2004. And the size of the ships has been large. However, those orders have been delivered after 2~3 years later than the order year. Table 2.1 shows the number of delivering between 2005 and 2008 by the size of the ships.

〈Table 2-1〉 The Forecast of the Delivering of Container Ships (2005~2008)

(Unit : 1,000TEU, %)

Size (TEU)	Dec. 2005			Dec. 2006			Dec. 2007			Dec. 2008		
	Deliv.	Num.	Rate	Deliv.	Num.	Rate	Deliv.	Num.	Rate	Deliv.	Num.	Rate
Less 499	-	447	9.8	-	447	7.8	-	447	7	-	447	6.9
Less 999	43	668	14.6	20	688	12	3	691	10.8	-	691	10.7
Less 1,500	36	559	12.2	29	588	10.3	4	592	9.3	-	592	9.2
Less 2,000	33	458	10	28	486	8.5	22	508	8	-	508	7.9
Less 2,500	36	334	7.3	5	339	5.9	-	339	5.3	-	339	5.3
Less 3,000	94	355	7.8	128	483	8.4	55	538	8.4	14	552	8.6
Less 4,000	18	320	7	49	369	6.4	45	414	6.5	7	421	6.5
Less 5,000	150	469	10.3	169	638	11.1	89	727	11.4	4	731	11.3
Less 6,000	202	440	9.6	79	519	9.1	51	570	8.9	-	570	8.8
Less 7,000	39	135	3	100	235	4.1	142	377	5.9	6	383	5.9
Less 8,000	53	126	2.8	79	205	3.6	31	236	3.7	24	260	4
Over 8,000	191	254	5.6	471	725	12.7	210	935	14.7	24	959	14.9
Total	895	4,565	100	1,157	5,722	100	652	6,374	100	79	6,453	100

Source : modified from Drewry Shipping Consultants (2004).

2) Enlargement of Containership

In 2003, Maersk Sealand started operating a containership, which was the first containership over 8,000TEUs as terms of "capacity-ship size"in the world. Since the year 2003, the speed of enlargement of containership has been accelerated. The main reason of enlargement was that the bigger size of containership could fulfill (or satisfy) the needs of the liners with reducing operating costs by an economyof scale phenomenon. This trend resulted in increasing competitiveness of the marine transportation and port industry. Table 2.2 showsthe number of operating containerships by size (in TEU).

〈Table 2-2〉 The Number of Operating Containerships by Size (in TEU)

(Unit : 1,000TEU, %)

Size (TEU)	Dec.1995			Dec. 2000			Dec. 2003		
	Num.	Capacity	Rate	Num.	Capacity	Rate	Num.	Capacity	Rate
Less 499	357	100	3.7	395	115	2.4	388	111	1.7
Less 999	337	247	9.2	472	340	7.2	513	370	5.8
Less 1,500	349	422	15.7	464	552	11.7	501	595	9.2
Less 2,000	231	402	15	355	604	12.8	397	674	10.5
Less 2,500	111	250	9.3	231	519	11	272	616	9.6
Less 3,000	151	409	15.2	176	484	10.2	232	633	9.8
Less 3,500	79	255	9.5	136	440	9.3	167	539	8.4
Less 4,000	65	242	9	95	358	7.6	105	393	6.1
Less 4,500	83	361	13.4	99	415	8.8	161	680	10.6
Less 5,000				66	312	6.6	79	372	5.8
Over 5,000				101	583	12.3	240	1,454	22.6
Total	1,763	2,688	100	2,590	4,720	100	3,055	6,439	100

Source: modified from Lloyd's Register of Shipping (2004)

The number of operating containerships over 4,000TEU, named Post Manamax size, was 83 vessels in 1995, 166 vessels in 2000 and 480 vessels in 2003. In other words, the containerships over 4,000TEU have been dramatically increased by annual growth rate 24.5 percent.

According to Drewry Shipping Consultants (2004), the number of operating containerships, over 6,000TEU, will be 1,602 vessels in 2008.

Among the 1,602 vessels, the number of containerships between 6,000TEU and 7,000TEU will be 383 vessels, and the number of containerships over 8,000TEU will be 959 vessels.

3) High competition in port industry

To attract large containerships more, most of operators of container terminals put their effort to meet their customer's needs through developing their facilities such as building new berths, dredging deeper, renovate their facilities, setting up new loading machines, and so on.

Especially among the Asian container terminals, such as Hong Kong, Singapore, Shanghai, Shenzhen, and Busan, there has been an extremely competition since China opened the door by the Economic Reforms in 1978 to the world. Table 2.3 shows the top 20 container terminals and their throughput between 2003 and 2004.

From Table 2.3, seven container terminals of Asian region rank in top 20 container terminals in terms of their throughput. Especially, four of them are located in China because of the nation's local container throughput, exports and imports. It means that there is a high competition among the Asian container ports. Therefore, in order to attract more customers, port operators have had to improve the port performance.

〈Table 2-3〉 Top 20 Container Terminals and Their Throughput (2003~2004)

(Unit : millions of TEU)

Port	TEUs 2004	TEU's 2003	Percentage Change
Hong Kong(China)	21.98	20.45	7.5%
Singapore	20.60	18.10	13.8%
Shangahi	14.56	11.28	29.1%
Shenzhen	13.62	10.61	28.4%
Busan	11.44	10.41	9.9%
Kaohsiung	9.71	8.84	9.8%
Rotterdam	8.28	7.14	16.0%
Los Angeles	7.32	7.18	1.9%
Hamburg	7.00	6.14	14.0%
Dubai	6.43	5.15	24.9%
Antwerp	6.06	5.45	11.2%
Long Beach	5.78	4.66	24.0%
Port Kelang	5.24	4.84	8.3%
Quingdao	5.14	4.24	21.2%
New York	4.48	4.07	10.1%
Tanjung Pelepas	4.02	3.49	15.2%
Ningbo	4.01	2.76	45.3%
Tianjin	3.81	3.02	26.2%
Laem Chabang	3.62	3.18	13.8%
Tokyo	3.58	3.31	8.2%
Total Top 20	166.68	144.32	16.9%

Source: modified from United Nations (2004).

3. Concept of Port Backup Area

1) Evolution of Port Backup Area

The growing flows of freight have been a fundamental component of contemporary changes in economic systems at the global, regional and local scales. The consideration of these changes must be made within a perspective where they are not merely quantitative, but structural and operational. Structural changes mainly involve manufacturing systems with their geography of production, while operational changes mainly concern freight transportation with its geography of distribution.

As such, the basic purpose of freight movements is *how* this freight is moving. New modes of production are concomitant with new modes of distribution, which brings forward the realm of logistics; the science of physical distribution (Hesse & Rodrigue, 2004).

The evolution of logistics following the changing environment of world may be described as follows:

Although logistics were initially applied to military operation, its most significant impact is being felt through the functions of production, distribution and consumption (Rodrigue and Slack, 2002). Logistics circulation allowed for the transition from use-value to exchange-value, and thus made possible the large-scale capitalization of commodities. Mass distribution and marketing became incorporated in the practice of modern management and have been significant factors of wealth generation.

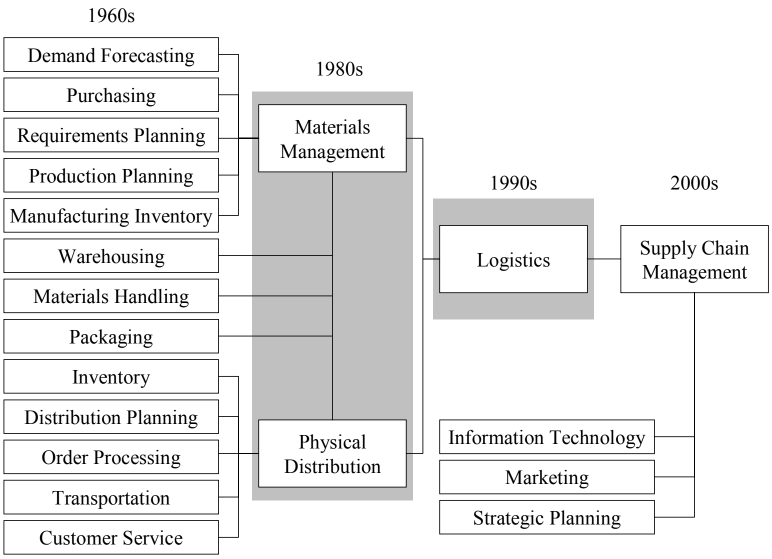
The organization and technology of modern logistics are embeddedin a changing macro- and micro- economic framework. It can be roughly characterized by the terms of flexibility and globalization.

During the 1970s and 1980s, the application of this "principle of flow"permitted the reduction of inventories in time-sensitive manufacturing activities from several days' worth to several hours. Much of these efforts initially took place within the factory, while supply and output flowed as batches from suppliers and to distributors. High rack storages, which later became automatically driven, or the internal movement of packages by flat robots were the early expressions of logistical engineering. Initially, logistics was an activity divided around the supplying, warehousing, production and distribution functions, most of them being fairly independent from the other. With the new organization and management principles, firms were following a more integrated approach, thus responding to the upcoming demand for flexibility without raising costs. At the same time, many firms took advantage of new manufacturing opportunities in developing countries. As production became increasingly fragmented, activities related to its management were consolidated. Spatial fragmentation became a by-product of economies of scale in distribution.

In the 1990s, convergence of logistics and information technologies, this principle was increasingly applied to the whole supply chain, particularly to the function of distribution. In some highly efficient facilities, the warehousing function went down as far as 15minute worth of parts in inventory. It is now being introduced in service functions such as wholesale and retail where inventory in stores are kept at a minimum and resupplied on a daily basis (Hesse & Rodrigue, 2004).

Whereas contemporary logistics was originally dedicated to the automation of production processes, in order to organize industrial manufacturing as efficiently as possible, the subsequent modernization of logistics may have been characterized by an increasing degree of integration. This trend was already on the way in the 1960s, as a key area for future productivity improvements (Bowersox et al., 1968). However, only with the implementation of modern information and communication technologies did this assumption become possible. They allow for the integrated management and control of information, finance and goods flows and made possible a new range of production and distribution systems (Abernathy et al., 2000). Step by step, and according to improvements in information and communication technologies, the two ends of the assembly line became integrated into the logistics of the supply chain as shown in Figure 2.3: the timely supply of raw materials and components from outside, and the effective organization of distribution and marketing.

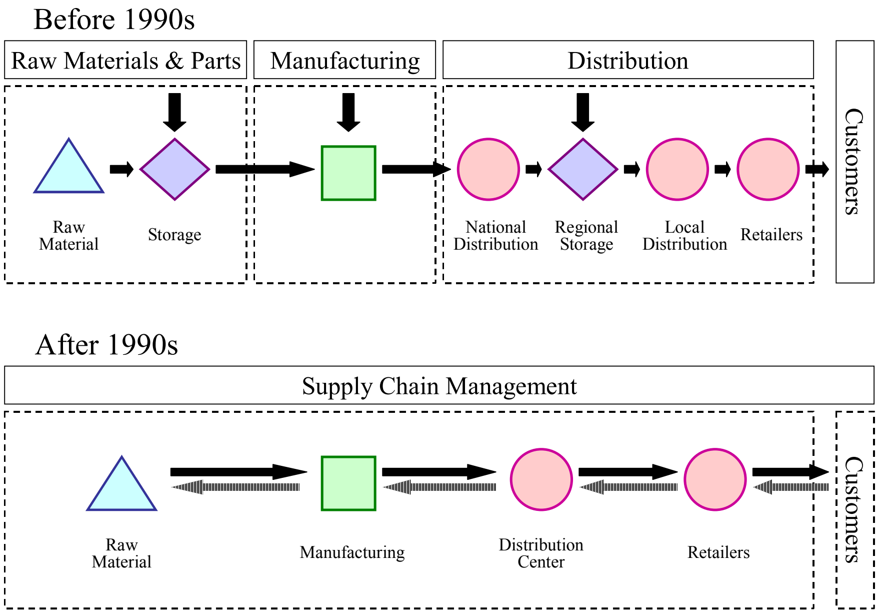
〈Figure 2-3〉 Evolution of logistical integration, 1960-2000



Source : modified from Hesse & Rodrigue (2004).

As a result, recent freight flows tend to be of lower volumes, of higher frequency, often taking place over longer distances. These flows have been associated with modal adaptation. The magnitude of changes may be characterized by the growth of geographical areas of interaction, and by the temporary flexibility of freight flows, both resulting in a rising amount of freight transport. The distribution center, or logistics park thus becomes the core component of such a distribution system as shown in Figure 2.4.

〈Figure 2-4〉 After and before 1990s arrangement of freight flows



Source : modified from Hesse & Rodrigue (2004).

Logistics interaction and network orientation in the port and maritime industry have redefined the functional role of ports in value chains and have generated new patterns of freight distribution and new approaches to port hierarchy by the terms of evolution of logistics as described above. Due to such rapid changing environment of logistics, existing models on the spatial and functional evolution of ports and port systems only partially fit into the new freight distribution paradigm (Goetz & Rodrigue, 1999; Rodrigue, 1999; Notterboom & Rodrigue, 2005).

Under these circumstance, the geographical concentration of logistics companies creates synergies and economies of scale that make the chosen location even more attractive and further encourages concentration of distribution companies in particular areas as shown in Figure 2.4. Port backup area is a product made by the above reason.

Modern concept of port backup areas, first appeared in European and American ports in the mid 1970s, essentially in German and Dutch ports, associated with or included in Free Trade Zones and Distribution parks (IAPH & Spanish Ports Agency, 2003). Those arose as a response from ports to the redesigning of developed country's distribution networks that tend to be concentrated on a limited number of commercial routes and centers, quickly appear as locations where value added functions are performed.

The function of port backup areas has changed over the years, as has the actual term (for 30 years the term 'port backup areas, such as logistic park and distribution center' was not used, instead they were called freight centers), the agents involved in developing them and the development and implementation processes for them. This time-based functional evolution has not been uniform or comparable from country to country with the result that there has been a superimposition of port backup area types as will be mentioned later. The function of port backup areas is also in line with the evolution of logistics as mentioned above.

Types of demand considerably vary between the countries with more mature economies situated in the center of Europe and America and the most peripheral regions. And consequently the types of port backup area also become various. While the state of evolution has led the oldest types to be discarded in some countries, the existence of demand for this type of backup area in other countries means they still need to set up.

In the first stage, the freight centers were set up in France and Italy 30 years ago; those arose in response to the need for restructuring cities and expelling trucks and transport firms from city centers. The second stage showed development towards the need to improve basic sectorial services and to provide a functionally and economically satisfactory supply for the port and logistic operators and freight transport firms. Finally, the progressive function of port backup areas is the one currently existing in many countries that is characterized by its intrinsic links to intermodality and the development of their own scale combined transport (IAPH & Spanish Ports Agency, 2003).

2) Definition and Scope of Port Backup Area

A port is a connecting node between sea-borne and land-based transport, and a interface node between the hinterland and the world overseas (Wang, 1998). Its basic function is to ensure sufficient continuity in the transport chain for the flow of cargos and passengers to be as fluid as possible. A port represents the integration of infrastructure, moving stocks, services and information and communication systems for the purpose of providing intermodality, that is guaranteeing the provision of good value-for-money, door-to-door transport services (Lee, 2005).

However, a port is more than just an intermodal hub. It is also a port backup area (e.g., logistics center and distribution center) with an active role to play in the value-added chain. The fact that the cargo chain is interrupted in a port gives rise to a concentration of port and logistic activity in both the service area and its immediate surroundings or hinterlands. This concentration of logistics activity means that the layout of the space assigned for such purposes in a port needs to be kept under constant review. This gives rise to the port backup area in which the so-called logistic center or distripark takes on special significance as a highly developed logistics space, together with supporting new technologies, such as information and communication technologies (IAPH & Spanish Ports Agency, 2003; Hesse & Rodrigue, 2004).

Port backup areas and in general, the provision of advanced logistic services for handling maritime freight trigger a progressive increase in customer loyalty in the short term and generate new demand in the medium and long term. This commercial effect is becoming progressively more pronounced in the port service markets that is undergoing a process of growing competition, where shore-based transport systems (rail and road) are gradually encroaching upon hitherto captive hinterlands.

In this context, port support and logistic services have ceased to be a novelty and have become a necessity, an option that port customers are beginning to demand. Consequently, Port backup areas are becoming a key tool for the integral development of ports, notably container terminals, representing as they do areas of integrated logistics activity of the highest quality.

Generally, due to carrying out many functions for port as described above, port backup area is hard to define concept. However, for the purpose of this research, port backup area is defined an area where industrial or economic activity takes place, kept relatively or spatially separate from and functionally connect with the main port areas, and universally devoted to the logistics of sea-based cargoes.

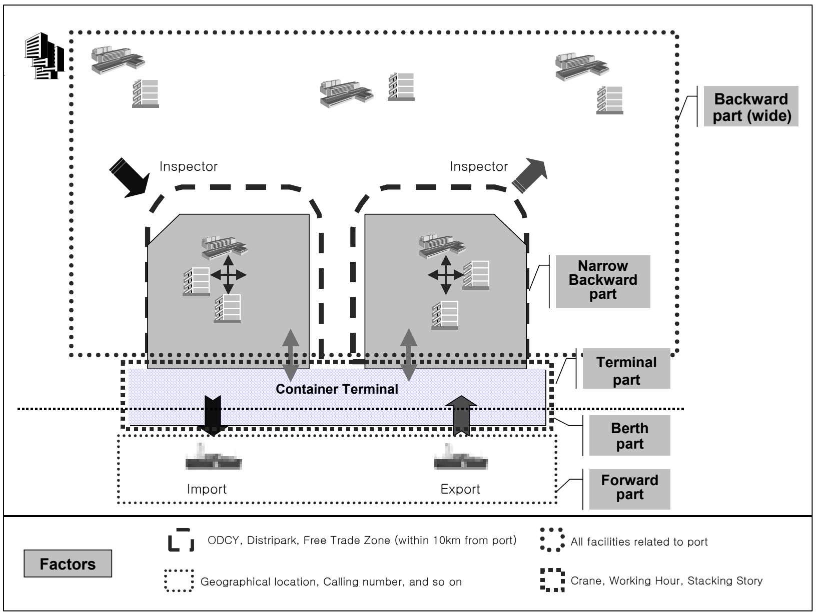
Port backup areas consist of three areas such as logistic areas, intermodal areas and service centers as shown in Table 2.4. The scope of port backup area is quite wide for evaluating the function and role related to port. In addition, this research is focused on container terminal in terms of port competitiveness, compared with rival ports. Therefore, in this study the scope of port backup area is limited to Off-Dock Container Yard (ODCY), Distribution Center (DC), Logistic Center (LC) and Free Trade Zone (FTZ), notably carrying out commercial functions and having the location closed to main container terminal.

〈Table 2-4〉 Type of Port Backup Areas

Category	A Single Transport Mode	Multi Transport Mode
Type	Transport (Service) Center Logistic Center Distribution Park Off-Dock Container Yard Inland Container Depot	Free Trade Zone Port Logistic Activity Zones
Function	Storage, Distribution, Custom Services, Delivery	Consolidation, Processing, Assembly, Manufacturing, Storage, Distribution, Custom Services, Commercial, Trade, Business

Source : modified from IAPH& Spanish Ports Agency (2003); Lee (2005)

〈Figure 2-5〉 Definition of Port Backup Area in terms of Spatial View



As mentioned in the above Figure 2.5[1] container terminal may be roughly classified into container terminal factor, terminal, and backup area parts in terms of spatial view.

The container terminal factor part refers to the spatial range related to the process until a ship berth at terminal from the sea while the terminal part may limit the spatial range up to the gate or fence from the berthing point of the ship. The terminal part is normally classified into berth part and terminal part. The backup area part is largely divided into two categories; the narrow backup area part having a direct relationship with terminal, namely, port backup area (so-called, immediate hinterland) and the wide backup area part comprising a rear city, area of supply, and area of production, namely, hinterland.

Port backup area belongs to narrow backup area part in terms of such spatial classification. As defined in the above, it can be regarded as a logistics space, which interacts mutually as keeping direct relationship with terminal within the terminal or in the right rear. Such a logistics space comprises a single transport mode and multi transport mode as mentioned in the Table 2.4. Therefore, with such a classification, data collection necessary for analyzing a port backup area will be available.

4. Current Situation of Port backup Area in ESCAP Region

In Asian perspective, the development trend of port backup area was in

1) According to IAME & Spanish Port Authority (2003), spatial definition of port backup area consists of Sea Operations Zone (herein named forward part), Land Operations Zone (herein named terminal part) and Complementary or Backside Zone (herein named backward part). The classification is basically similar to the definition of Figure 2.5.

the lined with those of European in a few years ago, except for starting point and changing speed. However, due to globalization and growing Chinese economic, the trend has quickly changed to cope with new demand.

As the development trend of Asian ports has been pushed for approximately 10 years later than that of Europe and U.S.A., owing to the recent globalization and the rapid growth of Chinese economy, the speed of development and growth seems to outpass that of Europe and U.S.A. In addition, port backup areas, which have various types and functions, have been developed one after another.

The development of port backup area in ESCAP region depends on various factors such as corresponding nations economic status, characteristics of ports, size of maritime logistics industry, and competitive edges. Singapore and Hong Kong, the front-runners have started to develop their port backup areas since 1980s.

Singapore has been utilized four to eight stories of apartment style logistics centers with the concept of districpark while Hong Kong has been supporting the value-added logistics services and port functions by utilizing the high-density logistics center of more than ten stories. On the other hand, Japan has been showing the trend to use medium and large scale of logistics centers while Malaysia and China have been developing port hinterland to let the logistics-related facilities of low/medium/high density to be housed by designating the large-scale Free Trade Zone near the port based on sufficient land. Hong Kong and Korea, notably Busan, where are lacking in land of city, carry out port backup function by using a lot of Off-Dock Container Yard (ODCY) dispersed in the cities. Each country's current situation of ports is as follows:

1) Busan Port

To mainly support the port, Busan port of Korea has 1,051,000㎡ area of Free Trade Zone as shown in Table 2.5 designated in accordance with the Act of Customs Free Zone of 2004 and 153,000㎡ of ODCY and operates basic function of CFS, cargo handling, storage, and etc. Free Trade Zone is concentrated at the North Container Terminal of Busan Port and ODCYs are scattered across the whole Busan city along with its ocean.

Although the concerned port backup areas have contributed a lot to the growth of Busan Port in the past, they are facing with the new phase owing to the functional saturation and collision with the urban function resulting from the growth of ports. With the development of New Busan Port (40km from the existing North Container Terminal, opening at December 2005), the area of 4,077,000㎡ designated as Free Trade Zone at December 2004 is to be operated in the near future, and this area is to be expanded continuously. The port backup areas of the corresponding district are expected to carry out logistical hub function for which have been produced in Korea, Japan, and China by providing the value-added logistics carried out in the existing advanced ports.

〈Table 2-5〉 Current Situation of Port Backup Areas (FTZ, ODCY)

Category	Contents
FTZ(Port of Busan)	• 1,051,000㎡, 2 places
ODCY	• 153,000㎡, 5 places
FTZ(Busan New Port)	• 4,077,000㎡, 1 place
Function	• International trade of duty-free goods processing & assembling, storage, labeling, consolidation, and exhibition
Location	• Right hinterland of North Container Terminal at Busan New Port

〈Figure 2-6〉. Port and Its Backup Areas of Busan

Yong Dang ODCY

Jaesong Dong ODCY

Busan New Por

2) Shanghai Port (Waigaoqiao)

The Shanghai Port lies near Yangtze River Delta area of the central China. This port covers Beijing, Hangzhou, Chengdu, and Zhejiang because all of the cargos from those areas are handled through the port. In 2004, the container throughput of the port was 14,55 million TEUs, which was increased 29% compared to 2003. During the last decade, the annual average increase rate of the container throughput of the Shanghai Port is 28.5%.

Since the end of the 1970s, the Shanghai port has been developed. Especially in 1993, the port sets up a joint venture between Shanghai Container Terminal Limited (SCT) and Hutchison Port Holdings. From the time, the Shanghai port authority has started a deepwater project, named as the Waigaoqiao Deepwater Project. As a result of the project, there are 24 berths with 63 quay cranes for container handling. In fact, the average handling moves at the peak time is 52.97 per crane per hour. Average number of input crane for a container vessel is 5.6. Therefore, the handling volume at the peak time is 33,458TEUs.

Even though the development project, the Shanghai port has still faced with the depth of the channel. The average depth of the port is 13m, but it is not enough for container vessels of 7,500TEU capacity. Therefore, the Shanghai port has started a port development project, which is named as "Big Yangsan and Small Yangsan Development Project." Table 2.6 shows the procedure of the development project.

〈Table 2-6〉 Plansfor Big and Small Yangsan Development Project

<table>
<tr><th colspan="3">Category</th><th>Number of Berth</th><th>Length (m)</th><th>Grad Opening</th><th>Remarks</th></tr>
<tr><td rowspan="6">Small Yang-san</td><td rowspan="2">Small Yangsan</td><td>Phase 1</td><td>5</td><td>1,600</td><td>Nov. 2005</td><td>Max. Capacity: 2.2 mill TEU</td></tr>
<tr><td>Phase 2</td><td>4</td><td>1,400</td><td>Dec. 2006</td><td>Max. Capacity: 2.0 mill TEU</td></tr>
<tr><td>Middel of Small Yangsan</td><td>Phase 3</td><td>7</td><td>2,200</td><td>In 2007 : 1 Berth
In 2010 : 6 Berth</td><td>-</td></tr>
<tr><td colspan="2">Eastern Small Yangsan</td><td>-</td><td>-</td><td>-</td><td>Dedicated Terminal for LNG</td></tr>
<tr><td colspan="2">Western Small Yangsan</td><td>-</td><td>-</td><td>-</td><td>Feeder Terminal</td></tr>
<tr><td colspan="2">Sub-Total</td><td>30</td><td>10,000</td><td>2020</td><td>Max. Capacity: 13 mill TEU</td></tr>
<tr><td rowspan="2">Big Yang-san</td><td colspan="2">Eastern Big Yangsan</td><td>-</td><td>4,400</td><td>-</td><td rowspan="2">Undecided</td></tr>
<tr><td colspan="2">Western Big Yangsan</td><td>-</td><td>6,500</td><td>-</td></tr>
<tr><td></td><td colspan="2">Sub-Total</td><td colspan="4">After 2020, Planned an additional development for 20 berths</td></tr>
</table>

Ports of Shanghai, currently the largest port in China, plans to secure the Port Backup area of 3,590,000 ㎡ by 2005 and has already secured an area of 1,090,000 ㎡ in Waigaoqiao FTZ Logistics Center as shown in Table 2.7. In addition, China has been developing Luchao New City Logistics Center of 1,720,000 ㎡, Waigaoqiao Logistics Center of 780,000 ㎡ and Shanghai Port Pudong Logistics Center of 110,000 ㎡ in a new port city of Luchao, backup areas of Yangshan Island by 2005. The Waigaoqiao Bonded Zone in Pudong New District in Shanghai, which was designated as Free Trade Zone in April 1999, has been operated in the area of 990,000 ㎡ at the completion of Phase 1 of the project, and Phase 2 of the project is under process.

〈Table 2-7〉 Status of Shanghai Waigaoqiao Port Backup Areas (FTZ)

Category	Contents
Function	• International trade of duty-free goods, processing export, logistics, storage, exhibition, transaction
Area	• The planned size is 10㎢, currently (as of Year 2000) the area of 6.4 ㎢ has been developed to be operated.
Location	• New District in Shanghai, at the estuary of Yangtz river • Completion of road network (linkage of Yanggao, Yangpu, Nampu Expressway as beltway) • Hongqiao International Airport: 28.7㎞ • Shanghai Railway Station: 16.8㎞ • Pudong International Airport: 20㎞
Main Occupancy Function	• Occupancy of computer industrial complex and electronics industrial complex, etc.

〈Figure 2-7〉 Port and Its Backup Area of Shanghai


Waigaoqiao Terminal


Waigaoqiao Backup Area

3) Tianjin Port

The Port of Tianjin is located at the estuary of the Haihe River in the west of Bohai Gulf. The port is the earliest developed container terminal in China. There are 11 container berths and it handled 3.81 million TEUs in 2004, which was increased 26.5% compared to 2003. As a gateway for the north and the northwest of China, the port of Tianjin covers in and out cargo of Tianjin and Beijing.

From the year 2003, the port has started a 10 year port development project, which needs 3.25 million dollars. According to the port authority, the first phase of the development will be finished in 2005 and it will focus on boosting the port's handling capacity. And the second phase of the development will be finished in 2010. The second phase is for the construction of highways /breakwater and the developing the new navigation systems.

The port backup areas of Tianjin is mostly located in Xingang area, and the size is roughly about 864,300㎡. Though there is wide bonded area in the port of Tianjin, basic port supporting function is carried out by the port backup area in the vicinity of Xingang area. The corresponding type of port backup area is similar to the ODCY of Busan port and the size of the port backup area is comparatively large. The reason why is the port of Tianjin ensures the sufficient site in view of the rapid grow of port environments. Most of ODCY are situated approximately within 6km from the container terminal.

〈Table 2-8〉 Status of Tianjin Port Backup Areas (ODCY)

Category	Floor Size	Distance from CT
Tianjin Port Cntr Freight co.	330,000 ㎡	2
Tianjn Port Storage&Transportation co.	262,000 ㎡	3
Tianjin Port Wu Hua Cntr Depot	130,000 ㎡	1.5
Tianjin Zhen Hua Cntr Depot	82,000 ㎡	6
Huan Han (Tianjin) Cntr Depot	60,000 ㎡	2

Figure 2.8 Port and Its Backup Area of Tianjin

Sky view of Tianjin Port

Container Terminal in Tianjin

4) Dalian Port

With a history of over 100years, Dalian port has developed into a comprehensive port with advanced facilities and complete service functions.

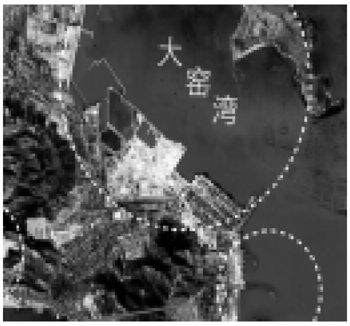
It possesses 38 port-based enterprises and 225 berths. Total length of the berths is 30kilometers with annual throughput of 155million tons and the maximum berthing capacity is 0.3million tons. Dayao Bay Container Logistics Port Zone, Beiliang Port Grain Transshipment Center, Dagushan Ore Transshipment Center, Nianyu Bay Oil Products and Chemicals Transshipment Center, Passenger and Cargo Ro-Ro Vessel Functional Zone, and Dalian Bay General Groceries Functional Zone have initially come into being. And Lushun-Yantai-Dalian Train Ferry Functional Zone is currently under construction. In 2004, Dalian Port handled 145 million tons of cargo, and container throughput reached 2.21million TEUs and passenger 6.17million.

Dayao Bay Container Logistics Port Zone is the largest container transportation and transshipment base in North China. There are 7 working berths at the first-phase construction of Dayao Bay container terminal, 5 of which are linear berths. The maximum water depth is -14.5m, total length of the dock is 1,500m, and the annual handling capacity is 2 million TEUs. Six deep-water berths for containers shall be constructed during the second stage. Two berths have been completed and are now in operation. The berth water is -14.5m in depth, and the dock lines shall be estimated to 2,097 m. After the continuous second-stage project and the third-stage projects of Dayao Bay and the container terminal project at north bank of Dayao Bay are completely finished, the container handling capacity of the whole zone will reach 18 million TEU.

In addition, Dalian Bonded Logistics Zone is the only Bonded Logistics Zone in Northeast China, it is one of the most pilot bonded zones the been endowed with most preferential policies in China. It is adjacent to Dayao container terminal which covers a space of 1.55 ㎢, it is a specialized area for logistics sectors of Dalian Free Trade Zone as shown in Figure 2.8. It is one of the areas approved by the central government implementing integrated operation between FTZ and port; Bonded Logistics Zone was established by referring to international practice, Geographically it is inside Chinese territory, insofar as import duties and taxes are concerned, it is outside the Chinese Customs territory, it is a specialized Customs supervised area which been endowed by Customs border function.

Figure 2.9 Port and Its Backup Area of Dalian

Dayao Bay Port



Location of Dayao Bay

Dalian Terminal

5) Hong Kong Port (KawiChung)

Hong Kong relies on highly efficient port facilities. Container terminals (CTs) are situated in Kwai Chung basin. There are eight terminals under the operation of four different operators, namely Modern Terminals Ltd (MTL), Hong Kong International Terminals Ltd (HIT), COSCO-HIT and CSX World Terminals. They occupy 217 hectares of land, providing 18 berths and 6,592 meters of waterfrontage. A new container terminal, CT9, situated on the southeast of Tsing Yi Island opposite to the existing terminals is currently under construction. The first two berths were put into operation in 2003 and the whole terminal will be completed by 2005. CT9 will take up 68 hectares of land, providing six berths of 1,940 meters of waterfrontage and alongside water depth of 15.5 meters. Owing to the free port system in the urban and port areas, Hong Kong is able to process all services regarding port cargo, such as semi-product, manufacturing and logistic services (Hong Kong Port and Maritime Board, 2004).

Hong Kong as a free port has no special zone in the sense of Free Trade Zone. Instead, logistics centers are located within the port to maximize the usage of land, the concerned facilities has been utilized by constructing the high-density logistics center of more than 10 stories of height unlike China and Malaysia.

The development method is mostly conducted in the private capitalization by joint venture and the representative facilities of a port backup area are ATL Logistics Centre, HIDC, Kerry logistics, and Modern Terminal logistics in the backup areas of Kwai Chung Terminal that are providing intensive and efficient logistics services by installing the modern logistics facilities at the large-size logistics buildings.

ATL Logistics Centre is operated by ATL Logistics Centre Hong Kong Ltd., which is subsidiary of Dubai Port International and is the world's first and largest intelligent multi-story drive-in cargo logistics center as shown in Table 2.9. The corresponding logistics center is located in the middle of Kwai Chung Container Terminal and easily accessible to commercial area airport and mainland border. The center provides omni-directional cargo handling, CFS, logistics and distribution service as well as warehousing and office leasing services.

〈Table 2-9〉 Current Situations of ATL Facilities

Total Area	9,329,000 square feet
Available Area for leasing	5,940,909 square feet
Number of Loading bay	More than 1,730
Ceiling height	17.6 feet/25 feet
Floor Loading	350lb/square feet, 450lb/square feet

Additionally, Hong Kong utilizes Off-Dock Container Yard by scattering in various places across its city including New Territory as shown in Table 2.10. This ODCYs have played a key role in supporting the logistics of Hong Kong.

〈Table 2-10〉 Port Backup Areas in Hong Kong

Category	On-Port (ha)	On-Port (%)	Off-Port (ha)	Off-Port (%)	Total (ha)	Total (%)
Container Depot	17.4	29.9	101.7	37.3	119.1	35.9
Container Yard	7.8	13.4	12.6	4.6	20.4	6.2
Container Vehicle Parking	33.0	56.7	148.4	54.4	181.4	54.7
Container Vehicle Repair	0	0	10.2	3.7	10.2	3.1
Total	58.2	100	272.9	100	331.1	100

Source: Hong Kong Lands Department (2000).

〈Figure 2-10〉 Port and Its Backup Areas of Hong Kong

Modern Logistics Center

ATL Logistics Center

Kwaichung Termina

Kwaichung Termina

6) Singapore PSA port

Singapore also depends on highly efficient port facilities. It has large and highly efficient back-up areas, like business parks and distriparks. Through such backup areas and high-tech cargo handling, it has maintained its position as the second busiest port in the world.

Container terminals are located in Keppel bay near the CBDs. There are fourterminals under the operation of PSA. They occupy 339 hectares of land, providing 21 berths and 10,967 meters waterfrontage. Its cargoes consist of 80% transshipment and only 20% local cargo (Singapore Department of Statistics, 2003). Owing to heavy dependence on overseas countries, a lot of processing industries in Singapore are gathered in port areas, such as business parks and distriparks. It is expanding to 47 berths by 2027, and improving its port techniques and expanding business parks along its south coast. This plan will maintain its reputation through good communications between port and its back-up areas.

With the advent of containerization in Asian region in 1978, Singapore has started to construct distripark to provide total service. PSA operates 4 logistics centers at Keppel, Tanjong Parga, Alexandra, and Pasir Panjang. And Jurong Port has Jurong Logistics Hubs at its backup areas.

Excluding Keppel, the other logistic centers are located out of Port area and three container terminals at Keppel, Tanjong Parga, and Alexandra had been run by PSA. Now the operation has been transferred to private sector in view of profitability except Keppel Distripark.

Tanjong Parga Distripark comprises two 5-stories blocks offering 65,000 m^2 of warehouse and office space and is located between Keppel Terminal and Central Business District. It provides excellent access to the rest of

Singapore as it is connected to the artery road.

Alexandra Distripark comprises five 10-stories buildings of total 200,000 ㎡ and is the largest warehouse and office space in Singapore. Pasir Panjang Distriparkis conveniently located next to the conventional wharf and Pasir Panjang Container Terminal and exclusive use to the single-story warehouses is permitted for the tenants. An area of 250,000㎡ provides warehouse/office space as well as a 3-stories logistics center.

The distriparks excluding Keppel Distripark mainly deal with local cargo and their management has been transferred to the private sector in view of operational strategies and profitability. Singapore who suffered a lot of loss in the competition for the operation of PTP in 2001, borrowed the new model from Hong Kong to build Jurong Logistics Hub (8-stories warehouse, a total of 38,000 ㎡ area, plottage of 13,000 ㎡) near Malaysia's PTP and Jurong region. As the efficiency of Alexandra distripark is low the distripark's operation has been commissioned on Mapletree who is distributing business facilities, logistics facilities, and Research & Development (R&D) facilities related to port. The detailed contents is same as the below Table 2.11.

Among them, Keppel Distripark (KD) located within the FTZ was opened in 1994. KD is an modern cargo distribution complex that provides multi-function warehousing facilities and is connected to Keppel Container Terminal via flyway. KD provides services with new concept of consolidation and non-stop. The building consists of 2-stories structure and packing consolidation and deconsolidation is main function. KD handles about 1,600,000 TEU an year. Most of cargo handled in KD is for transshipment. Some of transhipment cargoes out of the total throughput of PSA are dealt with private distriparks located in the city.

〈Table 2-11〉 Current situationsof port backup areas in Singapore

Distripark	Area	Main Characteristics	Remarks
Keppel Distripark	113,000㎡	• KD, which was opened in 1994, provides extensive warehousing facilities as an ultramodern cargo distribution complex. • Four 2-stories blocks for logistics a 5-stories of office building • KD has 41 warehouse modules with sizes ranging from 1,000㎡ to 5,100㎡ • Storage, redistribution, logistics management, sampling, surveying for small-sized cargo, carrying out of incidental logistics activities such as vanning & devanning of container	Connected to Keppel Terminal via flyway within 10 minute distance to the central business district 25 minute distance to Changi Airport
Alexandra Distripark	200,000㎡	• The largest complex of its kind in Singapore as building of warehouse and office space • Five 10-storey blocks • Other incidental facilities	Conveniently located near to Pasir Panjang Container Terminal
Pasir Panjang Distripark	250,000㎡	• Comprises eight single-storey warehouses and a 3-storey building for logistics • Exclusive use of warehouses are permitted to tenants • Other incidental facilities	Located next to the main conventional terminal and Pasir Panjang Container Terminal
Tanjong Pagar Distripark	65,000㎡	• The first distripark constructed in Singapore in the year of 1976 • Consists of two 5-storey blocks • Other incidental facilities	Located between Keppel Container Terminal and Central Business District

〈Table 2-12〉 Current Situation of Keppel Distripark Facilities

Category	Contents
Characteristics of Location	• 10 minute distance to the central business district and financial center and 25 minute distance to the Changi airport
Size	• KD has 41 warehouse modules of covered storage totaling 113,000㎡and mainly handles general cargo(height of warehouse:13m)
Main Function	• Storage, regional redistribution, logistics management, sampling, surveying for small-sized cargo, CFS business such as vanning & devanning of container and creation of value-added logistics activities are conducted • Container stacking yard of 1,000 empty containers and 1,520 FCL, ample chassis, and lorry packing lots are installed

〈Figure 2-11〉 Port and Its Backup Area of PSA in Singapore

Gate of PSA

Keppel Distripark

Alexandra Distripark

Tanjong Parger Distripark

7) Singapore Jurong Port

Jurong Port has developed a Container terminal to complement its broad range of bulk and general cargo/breakbulk handling facilities as well as logistics services. This is in line with Jurong Port's vision of becoming a premier, multi-purpose port with multi-competency in cargo handling and logistics services. Jurong Port offers the maritime community excellent facilities and support services to meet the divers needs of customers. There are 4 post-panamax quay creanes and 900metres of berth length with 16meters draft alongside to provide an annual handling capacity of over 400,000TEUs.

Singapore opened Singapore's largest multi-purpose warehouse complex, Jurong Logistics Hub, in the middle of 2001 at the backup area of Jurong Port which introduced traditional wharf function and container terminal to solve the limitation of backup area and high land prices. The hub has been developed to disperse the container cargo volume which has been concentrated to PSA and to deal with the container cargo and dry bulk cargo which are to be handled in Jurong Port.

Jurong Logistics Hub, the 8-story ultramodern multi-purpose warehouse complex has been developed to provide the space for storage, transshipment, packaging, and processing to Singapore logistics market. Since the development of 20,000㎡ as Phase 1 in 1999, Phase 2 of 40,000㎡, Phase 3 of 20,000㎡, and Phase 4 of 38,000㎡ were opened respectively in March, 2001. The 8-story warehouse of 43,000㎡'s plottage comprises 118,000㎡ of warehouse space and 62,000㎡ of office space. The hub is a multi-story drive-up warehouse which allows 45ft containers to be trucked up to the 8th flooras shown in Table 2.13. It is provided with port backup functions such as food court, office space, security facilities for cargo inspection, and ample parking space for trucks. The entire rooftop of the 9th floor is used as apparatus and parking space for cargo trucks.

〈Table 2-13〉 Features of Jurong Logistics Hub

Category	Facilities
Floor space	• 43,000㎡
Number of floors	• 8 floors (9th floor is trailer parking lot)
Rentable space	• Warehouse space 118,000㎡, Office space 6,200㎡
Module	• 11.4m × 15.0m
Ceiling height	• Ground floor 10.8m/ Upper floors 6.2m
Floor loading	• Ground floor 40kN/㎡ / Upper floors 22.5kN/㎡

〈Figure 2-12〉 Port and Its backup Area of Jurong in Singapore

Jurong Logistics Hub

Jurong Port

8) Port of Tanjung Pelepas (PTP)

Malaysian government strives to support the processing, assembling, manufacturing, logistics industries of port and port hinterland by using FTZ similar to that of Korea. Especially, it makes the function as port backup areas to be conducted by designating the FTZ in the hinterland.

Malaysian government suggested the direction for the activation of trade & manufacturing industries by legislating "The Free Zones Act of 1990"to make up for the inadequacy of supporting for economic development based on "The Free Trade Zone Act of 1971". The concerned FTZ Act was legislated to ease the function of trade (excluding retail), cargo separation, grading, repacking, labelling and transshipment at ports and offered the big chance to carry out the dynamic role of Malaysia's intermediary trade. The total number of Free Zone facilities across the country was 13 FreeIndustrial Zones and 11 Free Commercial Zones as of August 2005 and currently each of FIZ and FCZ has been additionally underway at PTP.

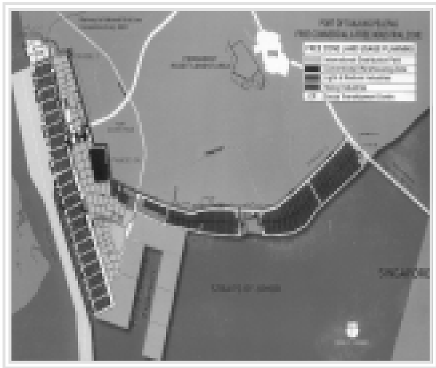
Malaysian government has constructed the PTP as transshipment hub to win in the competition with Singapore. Malaysian government is supporting in multilateral way in the field of logistics activities to support the construction of transshipment hub port by constructing the large-size FZ. PTP was appointed as Free Zone Authority in June 1999 by the Malaysian government for Free Commercial Zone and Free Industrial Zone. Free Trade Zone of PTP is to be completed at the end of 2005as shown in Table 2.14 and Figure 2.12.

〈Table 2-14〉 Creation Plan of FZ facilities at PTP Port Backup Areas

Category	Area	Main activities	Remarks
Free Commercial Zone	520,000 ㎡	Logistics, warehouse, etc.	
Free Industrial Zone	750,000 ㎡	Manufacturing, Processing, etc.	

〈Figure 2-13〉 Port and Its backup Area of PTP

Danzas Warehouse



Design of PTP

PTP Terminal

9) Klang Port (North and West Port)

(1) North port

NSDB(Northport distripark Sdn. Bhd) developed PKDP within the Free Commercial Zone(FCZ) of Port Klang in 1993. An entire area of 296,000㎡

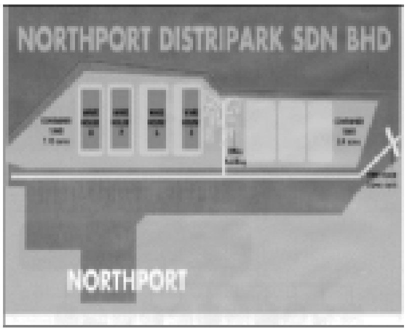
is to be developed and the area of 172,000㎡ which has been completed under Phase 1 is in operation. The facilities are not large size complexes like PTP but are similar to the Singapore Distripark as large-size bonded warehouse. The facilities provide the logistics service to support the cargoes which occur in Port Klang. The Distripark offers activities such as processing, assemblying, labelling, and packaging. Northport aims 80% of Distripark shares while Port Authority owns 20%.

The current status of corresponding facilities is as shown in Table 2.15 and Figure 2.13

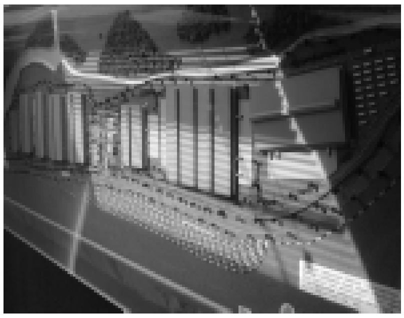
〈Table 2-15〉 Facilities Overview of Northport Distripark

Category	Area(1000㎡)
Total land area	296
Developing area	172
Warehouse facilities	44
Container yard	44
Open storage yard	95
Facilities infrastructure	42
Future development plan	124

〈Figure 2-14〉 Layout of NSDB



Design of Northport Distripark


View Point of the Distripark

(2) Westport

WDP covers a total area of 182,000㎡ and includes a warehouse facilities of 62,000㎡. Indah which has been developed recently in the adjacent region consists of 52,000㎡ including storage facilities of 26,000㎡. The Distripark offers activities such as processing, assembling, labelling, transsshipment, and distribution. Main occupant firms in WDP are 13 companies including Phillip Morris, Colgate Palmolive, Trans-Asia, Maersk Log, APL Log, Allies Whse, Regional Synergy, Century Log, Freight M'gmt, DiPerdana, Advantage W'hse, WP CFS (Al Marine), and Trans Mewah(Cont & Conv). Main occupant firms in Indah are 3 companies including Bridgestone, Nippon X'press, and Dream Mate Furniture

〈Figure 2-15〉 View of Distripark

Sky View of Warehouse

Sky View of Distripark

10) Tokyo Port

Port of Tokyo was ranked in the 17th place of the world container ports in 2003 at the standard of container throughputs by reaching 3,314,000 TEU in 2003 (increase of 22% compared to the 2,712,000 TEU in 2002).

The Tokyo Port Terminal Public Corporation has container terminals at Ooi, Aomi, Sinagawa and the redevelopment project of Tokyo Port's Ooi container terminal was completed in 2003. Ooi container terminal having 7 berths with a total of 2,354m including 3 berths with earthquake resistant quay wall was reborn as a mega terminal. This pier, equipped with 16 quay cranes, can accommodate large size container ships of 8,000 TEU level.

Figure 2.16 Port and Its Backup Area of Tokyo

Backup Area

Ooi Terminal

The View of Tokyo Por

Maersk-Sealand opened Japan's largest container terminal at the Bay of Tokyo in 2002, clearing the waters to accommodateships up to a massive 10,000 TEU level. Two berths equipped with 16-meter-deep quay cranes, which can handle more than two hundred cargoes per hour. Especially these 1,300 tons level quay cranes installed in the terminal have a height of 80 meters, an outreach of 63 meters, which span 22 container rows and 5 columns as shown in Table 2.16. In addition, these two berths, which can store more than 17,000 TEU of containers, boast nation's largest size.

The operation of Tokyo port takes the shape that the pier is owned by state, local government, and public organization. Meantime, the management/operation of the port is commissioned to the local government. Port authorities construct the port and provide cargo handling facilities while cargo handling is commissioned to private sector. The redemption of total cost spent for port construction is to be divided into the rent period. The rent period is 10 years, which can be extended automatically unless otherwise required.

〈Table 2-16〉 Facilities of Tokyo Port

Terminal	Berth	Extension	Water Depth	Vessel Type (D.W.)	# of Berth	# of Crane	Yard(m^2)
Sinagawa Terminal	C~H	574	10	15,000	3	4	71,284
Ooi Terminal	1~7	2,354	15	50,000	7	16	945,750
Aomi Terminal	0~1 2 3~4	520 350 700	12 14 15	35,000 50,000 50,000	2 1 2	4 2 5	361,610

10) Yokohama Port

Logistics-related services in Yokohama Port have been initiated by Port & Harbor Bureau of Yokohama City, Yokohama Port Development Public Corporate, and Port of Yokohama Promotion Association and are actively supported through the administrative services including the inducement of firms and the financial incentives provided by local government and public corporation. Port of Yokohama has carried out the central role of global logistics as a drive engine to expand imports at the airports, ports, and the surrounding area by establishing Foreign Access Zone(FAZ) based on the "Law on Temporary Provision for Promoting Import and for Smoothing Domestic Investment Activities" as part of hub port in Asia as well as Japan.

Port of Yokohama may be largely classified into the 5 regions including Honmoku, Daikoku, Yamashita, Osanbashi, and Shinko piers and carries out port-related activities including distribution, storage, and processing by placing large port-related sites in the port backing-up area. In addition, Port of Yokohama strives to create user friendly waterfront to prevent the mutual collision by maintaining the distance from urban sites through these facilities. The 26.9% of imports cargo and the 28.1% of export cargo among the total container cargo volumes are passing through processing, packaging,assembling, and distribution in the port-related sites.

In case of Japan including port of Yokohama, as the city carries out some part of functions as a port supporting area, unlike Singapore, China, and Hong Kong, there is no clear distinction between port and port backup area.

In response to the enlargement and the high-efficiency of container ships, work is underway on a deep-water container berth (4) at the southern tip of Honmoku Pier (16M in depth and 350M in length). Integrated logistics hub is to be created in the backup area where a super-large container ship is able to berth by constructing the largest inter-modal terminal. Terminal site, port-related sites(container-related site, storage facilities site, integrated logistics terminal site, business site and waterfront) green belt transportation site under the land use plan are to be developed in the area of 216.9ha. Reclamation period will be 20~30 years and the project will be completed in view of costs, construction costs, and consumer needs. Sales are available after creation of land by the city.

In respect of port backup areas, located at Daikoku Pier, Yokohama Port Cargo Center started operation in 1996 (Construction was started in 1992, completed in 1994). This facility is designated as one of 4 general bonded areas in Japan ((ATC-Osaka, Y-CC-Yokohama, Matsuyama FAZ, Kawasaki FAZ)/ ordinary FAZ 20 → Total of 24 FAZ). It is possible to perform the multiple tasks of cargo distribution, processing, exhibition, and sales as an integrated process with the cargo still in bonded status.

Consolidated distributionfacilities for the distribution, delivery, gathering, processing, and sales have been constructed to provide better services in seaborne/air cargo. Imported products are to be distributed directly to large-size marts after processing. Payment for cargo handled is to be made through seaborne computer system (custom clearance agent → custom office → bank).

City of Yokohama and Prefecture of Kanagawa, respectively, invests 50% of shares equally. Until now the center records red figures because of the payment for construction cost. A total of 60 billion yen was expended for the construction of the center(to be used for 50 years)/operating contract will be renewed by 10 years. Operating income records black figures (profits are shared according to the shares). Personnels are dispatched from the city and the prefecture (more than 50% of the personnels are participating in the management).

YPCC comprised of the 8-story office building which has 63 offices and 5-story cargo building which has 55 warehouses and 35 firms are housed in the center as of 2000. The center has a handling capacity of 4.25 million tons of cargo per year (5% of the entire cargo handled in Yokohama). Cargo building has been classified into 55 sections and office building has been classified into 65 sections (1 section: 400㎡→3 containers or 5 vehicles can be located) as shown in Table 2.17 and Figure 2.16.

〈Table 2-17〉 Current status of Yokohama Port Cargo Center

Category	Cargo Terminal	Office Building
Total floor space(㎡)	305,449	12,700
Districts (number)	55	63
Space / Section	4,300㎡/section	70㎡/section
Facilities	Parking lot 400㎡/section 4 lane road within the building (width: 16M)	Ground parking 260 vehicles

The center is designed for a 24-hour a day service under all weather conditions with two-ramp drive-up warehouse which allows trucks into the building to reduce logistics costs by shortening the transportation hour. The entry & exit of cargo can be passed freely even at the peak time with sufficient parking space and computer system. The center comes complete with various security system such as office environment control system, ITV, Traffic control, Various censors for the optimum management of cargoes.

Main export & import items are food, electric appliances, farm products machinery, synthetic goods, building materials, furniture, cosmetics, and etc. As of the standard of 2002, volume of cargo handled in Y-CC may be classified into import of 33,061,000tons, export of 24,370,000 tons, domestic cargo of 22,986,000 tons and total cargoes of 80,418,000 tons.

〈Table 2-18〉 Volume of Cargo Handled

Category		Year of 2001	Year of 2002
Number of Import		33,06143,345	
Customs clearance		762857	
Number of Export		24,37023,185	
Customs Clearance		1,6971,482	
Total	Export & Import Volume	66,539	57,432
	Number of Customs Clearance	2,339	2,495
Domestic Cargo Volume Handled		22,98621,395	
Bringing in Statistics at Y-CC		80,41887,934	

〈Figure 2-17〉 Bird-eye view of Yokohama Port Cargo Center

Logistics Center

Logistics Warehouse

The View of Yokohama Port

5. Design factors of Back-up Area

As mentioned earlier, port backup areas have been developing the function, size, and location due to the factors such as the change of port business environment, globalization, transportation revolution, and local constraints, etc. Most port supporting zones are situated in the port backup area, which were described in section 2.4. On the basis of the cases in the main Asian regions and the location thereof has been decided in view of the characteristics of ports and regions.

Generally speaking, the most important factors for planning port supporting zones are connectivity, flexibility, and efficiency (Rodrigue, 1997: IAPH & Spanish Ports Agency, 2003).

Connectivity is the matter related to the terminal and port backup area, port backup area and hinterland (demanded site), and number of gate or its lanes, train system and distance from the main container terminal are its variables. Flexibility is the matter related to the expandability of port backup area or acceptability of port facilities arising from the enlargement of terminal. Floor size and average number of floor, etc. are its variables. And efficiency is systematic correlation between port backup area itself and terminal/supporting area and operating system, total number of operations and ownership are its variables.

This study aims to collect the analysis data on the port backup area by establishing examined factors in the related cases as collectable items of data on the basis of the above-mentioned 3 criteria for planning.

Chapter 3

Port Performance

1. Introduction

The rapid changes in the port business environment have led in extremely high competition between world ports, notably among the rival ports as mentioned in Chapter 2. These phenomenahave been revealed in regional ports and in hub ports. The phenomena are more serious if two ports are competing each other within the same region or hinterland. For example, due to the rapid growing of Chinese economic and globalization, especially, Asian ports are heavily faced on the phenomena, such as Hong Kong and Shenzen in southern China, and Shanghai and Busan in northern China.

In this context, these ports need to know how to compare with their rivals and advance their competitiveness for holding dominant market position. Measurement of port performance is a crucial way in checking the competitiveness of a port, comparing with rivalports. In order to measure port performance, manyoperational and functional variables; such as depth of berths, stacking area of container yards, number of terminal ground slots, ownership of container terminals, etc, have been selected within the territory of container terminal itself until the middle of 1990's. However, these days, modern container terminals have to harmonize with cities where the container terminals located because the relationship between container terminals and cities has become the key factor of having competitiveness among rival ports. Therefore, the measurement variables of port performance have been changed from operational and functional factors of container terminal itself to spatial and functional relation factors between container terminals and cities (Notteboom and Rodrigue, 2005). Especially, space limitation of a port itself becomes the main obstacle factor functionally and spatially in Asian ports such as Hong Kong and Singapore. Also, space limitation of a port itself and within the city where the port located caused high traffic congestion; therefore, the harmonizing between functions of ports and urban functions become importance more and more.

In order to increase the degree of harmonizing, port authorities and port operators have started to develop the port backup area, such as logistic center and distripark within the territory of ports and off-dock container yard within the outside of ports with compact designing (Lee, 2005 Lee & Song, 2005). Port backup areas become more important factor to make up port performance under the fierce competitive areas and time.

Therefore, in order to measure port performance related to its backup areas in next chapter, the concept of port performance and the measurement variables of port performance are defined and highlighted by reviewing previous literature in this chapter.

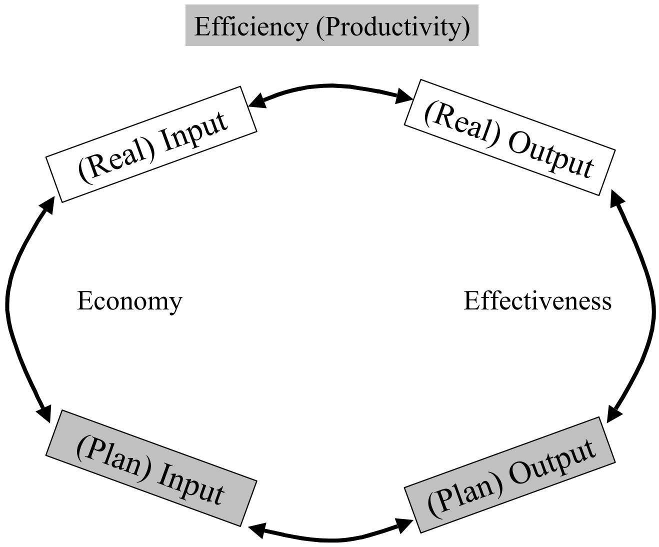
2. Concept of Port Performance

Even though the concept of port performance has been used widely, the concept is until unclear because it includes overall concepts such as port *productivity, port efficiency, port effectiveness, and economy* of a port.

Generally, *port performance* is used as a joint definition of effectiveness and efficiency. First of all, the definition of effectiveness and efficiency of a port are used as a similarconcept because effectiveness is defined as the extent to which an objective has been achieved whileefficiency refers to the degree to which resources are used economically. However, both terms have slightly different meanings because effectiveness involves identifying appropriate service elements while efficiency meansachieving adequate performance of those elements without wasting resources (Ellinger et al., 1997).

In this context, Yoon (1995) identifies the relationship between efficiency, economy and effectiveness in terms of government service as shown in Figure 3.1. *Efficiencyis* for the relationship between output and input of product in real. So, it is to be considered the side of input and output for achieving advancement of efficiency. Effectiveness has defined mainly as way for evaluatingthe level of output in terms of the relationship between real-output and planed output. Namely, the effectiveness advances regardless of the level of input if the output in real achieves higher than the planed output. *Economy* is the concept for evaluating performance of company in terms of the level of input. The growing economy is to be achieved regardless of fluctuation of output measurement if the level of input in origin plan implements less than that of input in real as similar concept of reduction. However, the usage of the concept of productivity is confused with the concept of efficiency until right now, especially in the maritime field.

Figure 3.1 The Relation between Efficiency, Effectiveness and Economy



Source: modified from Oh (2000)

Starling and Grover (1986) explain that is meaningless to sorting between productivity and efficiency in terms of measuring performance. Hatry and Fisk (1992) also point out that productivity and efficiency have the similar meaning in broad categories. In the work of Estache and Rossi (1999), port performance is divided into two categories, port productivity and port production. The port productivity just indicates the relationships between input and output of a container terminal, i.e. the number of moves per a quay crane. And the port production showstechnical relations between inputs and outputs of operators of a container. All concepts related to performance are similar as described above. The concept of performance is resulted from these concepts.

Therefore, in this study performance is addressed to throughputs in container terminal. The performance of container terminal is able to produce a maximum output (TEU) for given inputs (terminal infrastructure including the port backup areas located in outside of a port), or use minimal inputs for the production of a given level of output.

3. Measurements and Factors of Port Performance

1) Measurements of Port Performance

Port performance is an important determinant to evaluate their competitiveness. Measuring port performance is a crucial exercise in strengthening the competitiveness of a port since the results provide a benchmark by which the port can be assessed relative to others. Some of methodologies are introduced as follows.

(1) Regression Analysis (RA)

Regression analysis (RA) is a statistical model to determine the relationship between one dependentvariable and one or more independent variables. In other words, RA explains how independent variables have been affected on a dependent variable when the independent variables are changed by some specific amount. And it is also making a linear equation and line fit plots (as a graph) to depict the relationship. The line fit plots indicates the regression line and residuals between the regression line and each plot; therefore, readers can be understand how the observed data (as a dependent variable) are differed from the estimated (as a regression line). The general equation is shown in Equation 3.1.

$$I = a + \sum_{i=1}^{n} b_i o_i + \upsilon_i \quad \text{……………………(3.1)}$$

where I is dependent variable,

a is intercept,

b_i is individual independent variable contributions,

o_i is the independent variables,

v_i is error term.

From Equation 3.1, if o_i has the positive contribution ($+b_i$), the independent variable effects on the dependent variable (I) positively. On the contrary, if o_i has the negative contribution ($-b_i$), the independent variable effects on the dependent variable (I) negatively.

However, regression model has limitation on explanation because it just explains only one dependent variable (I) with one or more independent variables (o_i). In addition to this limitation, an unified index of the independent variables is needed because it makes more effective regression model to explain the relationship between I and o_i.

To adopt this concept effectively in this paper, each unit of independent variables needs to be unified in monetary value, but it is hard to unify the units because there area lot of independent variables to explain the port performance in terms of container throughputs.

Besides the limitation, the regression analysis can be used effectivelyin analysing the relationship between a dependent variable and various independent variables.

(2) **Cost Benefit Analysis & Cost Effectiveness Analysis (CBA & CEA)**

Cost benefit Analysis (CBA) is a method to measure the performance of an organization through the ratio of invested costs and gained products. Therefore, the pivotal point of doing this analysis is the gathering of financial resourcesfrom organization related to the operational costs and their benefits. The basic equation of CBA is shown in Equation 3.2.

$$\frac{\sum_{t=1}^{n} \frac{B_t}{(1+r)^t}}{\sum_{t=1}^{n} \frac{C_t}{(1+r)^t}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.2)$$

where B_t is benefit in t year,

C_t is cost in t year,

r is rate.

Consequently, CBAis used for the purpose of comparing the multiple choices in decision-making or for the purpose of judging the existence of investment value. Although the application of cost benefit analysis is relatively simple and easy to understand, there are some limitations in evaluating port performance. First, input and output should be expressed in the monetary value. Second, there are technical difficulties because monetary value is different by the interest rate within the time series and market. The third obstacle of using the CBA is the correctness of the forecasting because monetary value is too fluctuated to predict the future value under the current economical circumstances.

In order to overcome the limitations of such a cost benefit analysis, cost-effectiveness analysis is often used because cost-effectiveness analysis uses physical unit without the indispensable indication of amount the limitations. However, the evaluation procedures are complicate and the arbitrary intervention may be happened.

(3) Stochastic Frontier Analysis (SFA)

Stochastic Frontier Analysis (SFA)is a functional formula, which shows the maximum level of output amount obtainable when a certain amount of production factors were invested under the prevailing technology level (Schmidt, 1985). Namely, after defining the maximum level of output amount as frontier in the production function, the difference between actual observation value and frontier, the maximum production amount, is measured as technological inefficiency. Under the premises,the two kinds of statistical errors are independent, the stochastic frontier analysis elicited the presumed method as Equation 3.3 and 3.4..

$$y_i = f(x_i : \beta) + \upsilon_i - u_i \quad \text{................................(3.3)}$$

$$l_n y_i = \beta_0 + \sum_n \beta_n l_m x_{ni} + \upsilon_i - u_i \quad \text{.................... (3.4)}$$

where $(u_i \geq 0)$

υ_i is noise error having two sides

u_i is inefficient error

Inefficiency error overcomes arbitrary measurement error. Therefore, in this case it estimates inefficiency by using stochastic frontier analysis because of existing of inefficiency in an organization[2].

On the other hands, if $\lambda<1$, arbitrary measurement error overcomes inefficiency and to measure the inefficiency by using stochastic frontier analysis has the weakness which cannot have the statistical significance.

(4) Data Envelopment Analysis (DEA)

Charnes, Cooper and Rhodes have developed the concept of Data Envelopment Analysis (DEA) as following Equation 3.5(1978).

$$\frac{\sum_{i=1}^{n} V_i Y_i}{\sum_{k=1}^{m} W_k X_k} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(3.5)$$

(k = 1, 2, …, m, m = 1, 2, …, t)

---

2) vi is an arbitrary measurement error which has two-sided characteristics and cannot be controlled while *ui* is an inefficiency error which has one-sided characteristics. The inefficiency may be evaluated through the ui, inefficiency error. At this time, under the assumption that vi takes normal distribution of average 0, dispersion συ2, namely, takes the form of v-N(0, συ2) and *ui* takes non-negative one-sided distribution, namely, takes u-N+(0, σu2), frontier production equation may be presumed. When stochastic frontier error is also defined as σ=(σu2+συ2)1/2, if λ= σu/συ in case of λ>1, is to be σu > συ.

This model produces the output *Y*by using the input *X* and indicates the performance in case the weight of *W* and *V*was granted to the input and the output. This has the merits that it can measure the inefficiency toward individual facility or organization, it does not demand the price and it can be dealt easily even in case of multiple production of outputs.

DEA has some important attributes in evaluation process of performance toward facilities and organization. First, DEA includes a lot of inputs and outputs, butit does not need the weight of each output and input. Second, inefficient decision-making unit may indicaterelatively inefficient by producing the lesser outputs per unit cost because the actual values of decision-making unit create the efficient frontier. Third, management strategy to improve the efficiency may be developed when controllable inputs are included in the measurement.

On the other hand, DEA has the limitations. First of all, DEA has high possibility to have heterogeneous and time lag constraints as biases while DEA is measuring the relative efficiency among the similar facilities and organizations using multi variable production factors. Second, exaggeration of inefficiency level can be occurred because the result of DEA indicates 1(meaning as the maximum level of accomplishment) and under 1(meaning as inefficient). Third, as DEA analyses the performance by using the data of a single year, it is inappropriate to compare the annual performance of an object or the annual performance of a targeted organization (Tongzon, 2001; Zhu, 2003).

The characteristics, merits, and demerits of the above-mentioned analysis techniques have been summarized in Table 3.1. As each analysis method has its own merits and limitation, it is hard to determine which a specific method is the better way of measurement model of port performance than others. Therefore, the measuring method may be selected according to the research purpose of the researcher and the intention.

2) Factors of Port Performance

There are various methods to evaluate the performance in the econometrics and the variables agreeable to the concerned methods are also various. The selection of variables depends on the research method, the evaluation techniques, the constraint conditions and the characteristics of research (Zhu, 2003).

Owing to the currentsever competition among the port operators and container terminal operators of each country, each country refuses the opening of the concerned data such as the current situation of terminal facilities, the actual operation of terminal and finance-related data to maintain the level of port competitiveness. Due to the refusal of data opening, most researches are limited to the one's own country about which the data collection is easy on the advanced ports; researchers depend on the indirect data rather than the direct data.

Table 3.2 is about the variables of researches on the measurement of container terminals' Performance, Productivity, and Efficiency have been recently conducted. As it is difficult to obtain the direct data in these studies, the performance or productivity has been tried to presume the indirect variables.

Table 3.1 Variables (input & output) of Efficiency Analysis on the Existing Ports

Researcher	Research Method	Variables	
		Input	Output
Dowd & Leschine (1990)	Literature Survey	* Yard throughput * Crane productivity * Berth utilization * Gate throughput * Labor productivity	
Hayuth and Roll (1993)	DEA	* Labor cost * Capital * Characteristics of cargo	* Total cargo volume * Service level * User satisfaction * Number of ships
Martinez-Budria et al (1999)	DEA	* Labor cost * Depreciation	* Total cargo volume * Earnings from rent
Notteboom et al. (2000)	Baysian Stochastic Frontier Model	* Length of quaywall * Size of terminal * Number of G/C	* Container throughput (TEU)
Tongzon, J. (2001)	DEA	* Number of berth * Number of crane * Number of tugboat * Size of CY * Waiting time * Number of personnel	* Container throughput (TEU) * Working rate of vessel
Song, et.al. (2002)	Stochastic Frontier Model	* Length of quaywall * Size of terminal * Number of cargo handling equipment	* Container throughput (TEU)
Wiegmans et.al. (2004)	DEA	* Size of terminal * Number of gate * Number of reachstacker * Length of loading tracks	* Container throughput (TEU)
Song & Han (2004)	Regression	* Terminal berth * Ratio of container * Terminal equipment * Size of CY	* Container throughput (TEU)

Source: modified from various literatures.

In the most studies, container throughputs, service level, and user satisfaction are mainly adopted as dependent (output according to methodology). In case of independent variables, labor costs, capital, depreciation cost, level of computerization, number of berth, number of crane, dwelling time, size of CY, number of personnel and characteristics of cargo are mainly used in the DEA methodology. Length of quaywall, size of terminal and number of stevedoring equipment were mainly used in the stochastic frontier model while berth occupancy rate, size of terminal, berth utilization, and geographic location are mainly used in the regression model.

Most of previous studies have used container throughput (in TEU) as a dependent variable. Besides the dependent variable, there are a bunch of independent variables such as labor costs, depreciation, length of quay wall, size of terminal, number of gantry cranes, number of berth, number of tugboat, waiting time, characteristics of cargo, and so on depending on the research purpose of the researcher and the intention.

At the past, most of previous studies did rarely concern about the spatial expansion of ports because most of researchers have thought that a port is an isolated facility from the function of a city. Thus, the studies have just measured performance, effectiveness, and efficiency of a port within the territory of the port. They just used inner factors of a container terminal, suchas labor costs, depreciation costs of facilities and container handling equipments, length of quay wall, size of terminal, number of gantry cranes, etc, as independent variables as described above.

However, recent studies have started to concern about the spatial expansion of ports into cities because the researchers have started to be aware that a port is no longer an isolated facility from the function of city resulting from the functional changes of ports. Especially owing to the limitation to the expansion of container terminal, it is necessary to take Off-Dock Container Yard, Distripark, Logistic Center, and Inland Depot into consideration at backup facilities. They have greatly influenced on the performance of port. In addition, recent researches have shown the trend to move the scope and focus of research owing to the geographic characteristics of port, especially location, size of hinterland, and the network with hinterland (Notterboom & Rodrigue, 2005; Slack & Wang, 2003; Lee, 2005). For instance, according to the work of Song and Han (2004), the accessibility of hinterland, size of hinterland, global locations of port have been suggested to exert great influence on the performance of port. And port's privatization level and the application of IT system at the operation of terminal have begun to be dealt as main independent variables.

From the previous studies, a dependent variable and 16 independent variables are selected as a dataset in order to accomplish the objective of this research. First of all, a dependent variable is the container throughput in 2003 of the subject ports of this study. Besides the selecting of the dependent variable, this study divided the independent variables into two groups, Container Terminal Factors and Port Backup Factors in terms of spatial view.

Container terminal factors are only dealing with inner factors of container terminals and they are also divided into three subgroups, Forward Factors, Berth Factors, and Terminal Factors, by the functional locations of container terminals. Namely, forwardfactors cannot be directly controlled by port authorities or terminal operators, but they are something kinds of the results of port performance (Song & Cullinane, 1999). They are Number of Direct Callings (NDC)[3] and Average Anchorage Time/Vessel (AATV)[4] (Hayuth & Roll, 1993). Berth factors indicate the berth performance in terms of

Number of Quay Cranes (NQC), Net Crane Product (NCP)[5], Rate of Berth Occupancy (RBO) [6], and Terminal Working Hour (TWH). Lastly, terminal factors have three variables, Average Stacking Story (ASS), Terminal Ground Slots (TGS), and yes or no of EDI System (EDI) (Song and Han, 2004).

In the meantime, Port Backup Factors are divided into two subgroups, General backup Area factors and Detailed Backup Area Factors. These factors are for defining the relationship between the inside and outside of container terminals. First of all, general backup are factors consisted with four categories, Number of Gate (NoG), Number of Gate Lanes (NoGL), yes or no of Train System (TS), and Floor Size (FS)[7].. of port back area. In addition, there are five categoriesin detailed backup area factors such as Average Number of Floors (ANF), Distance from the Main Container Terminal (DMCT), yes or no of IT Operating System (IT), Total Number of Operators (TNO), and Ownership (Public or Private). Table 3.3 shows the overall dataset of this study.

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3) ***Number of Direct Callings*** is consisted with two categories, containerships over 5,000TEU in capacity and less 5,000TEU.

4) ***Average Anchorage Time*** is the total time for anchoring from the boundary line of the port to the berthing; therefore, it includes pilot time and tugging time.

5) ***Net Crane Product*** is calculated by $\frac{TEUsHandledPerWorkingDay}{No.ofCRane \times NetWorkingHoursPerDay}$

6) Total anchorage time of all calling ships in a year is divided by total berthing time for all berth of container terminal is ***Rate of Berth Occupancy***.

7) Unit of size is m²

〈Table 3-2〉 Dataset

Categories		Variables	
Container Terminal Factors	Container terminal factors	Number of Direct Caling	
		Average Anchorage Time/Vessel	
	Berth Factors	Number of Quay Crane	
		Net Crane Product	
		Rate of Berth Occupancy	
		Terminal Working Hour	
	Terminal Factors	Average Stacking Story	
		Total Ground Slots	
		EDI System(Y/N)	
Backup Factors	General Backup rea Factors	Number of Gate	
		Number of Gate Lanes	
		Train System(Y/N)	
		Floor Size	DC
			ODCY
			ICD
			FTZ
			Distripa가
	Detailed Backup Area Factors	Average Number of Floots	
		Distance from the Main Container Terminal	
		IT Operating System(Y/N)	
		Total number of Operators	
		Ownership(Public or Private)	

Chapter 4
Empirical Analysis and Interpretation

1. Introduction

In this section, the estimation results of the technical port productivity are presented. First, the methodology is discussed, and then, data collection, the model and results are presented. Data collection describes the factors of port productive that are using in this paper for analysing port productive

The determination of the technical performance of port is based on the estimation of a multiple regression. Especially, the synthetic variables obtained through factor analysis are applied by the multiple regression. As the purpose of this report is not to find out the methodology but to find out the impact which the variable of backup area (port backup area) influence on the port performance, the classic multiple regression has been adopted instead of the various methods which have been recently highlighted. In case of the various methodologies used currently, the factors affecting on the terminal productivity have been concentrated on the quantification from the point of input and output. Also, studies have focused mainly on the measurement of efficiency. As the study put much emphasis on the influence of port backup area and the patterned characteristics, this traditional multiple regression analysis was adopted to minimize the error occurring in the analysis and to clarify the interpretation on the result.

The analysis of this study is to be carried out by the five steps such as data collection, variable selection, through correlation analysis, factor analysis, multiple regression analysis and interpretation. After reducing many variables into container terminal factor and backup area factor, which we wish to know the influence thereof through factor analysis, we catch the influence on the port performance by using these factors as regression analysis. Particularly, the clarification of relationship between port backup area and port performance is the important matters of this study on the basis of the influence of the port backup area.

〈Figure 4-1〉 Results of Factor Analysis

2. Analytical Tools

1) Multiple Regression

The multiple regression model has the general form:

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{xi} + \cdots + \beta_p x_{pi} + \varepsilon_i \text{ ....} (4.1)$$

where y_i is the value of a continuous response variable for observation i, and $x_{1i}, x_{2i}, \cdots, x_{pi}$ are the values of explanatory variables for the same observation. The term ε_i is the residual or error for individual i and represents the deviation of the observed value of the response for this individual from that expected by the model. The regression coefficients, β_0,, β_1 , ···, β_p are generally estimated by least-squares.

Significance tests for the regression coefficients can be derived by assuming that the residual terms are normally distributed with zero mean and constant variance σ^2. The estimated regression coefficient in the response variable associated with a unit change in the explanatory variable, conditional on all other explanatory variables remaining constant.

For $n$observations of the response and explanatory variables, the regression model can be written concisely as:

$$y = X\beta + \varepsilon \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (4.2)$$

where y is the $n \times 1$ vector of responses; X is an $n \times (p+1)$matrix of known constraints, the first column containing a series of ones corresponding to the term β_0 in Eq. (4.1); and the remaining columns containing values of the explanatory variables. The elements of the vector β are the regression coefficients β_0,, β_1, ···, β_p , and those of the vector ε, the residual terms ε_0, ε_1, ···, ε_n.

The regression coefficients can be estimated by least squares, resulting in the following estimator for β:

$$\hat{\beta} = (X'X)^{-1} X'y \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (4.3)$$

The variance and covariances of the resulting estimates can be found from

$$S_{\hat{\beta}} = s^2 (X'X)^{-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.4)$$

where the residual mean square $s2$ gives an estimate of $\sigma 2$.

A measure of the fit of the model is provided by the multiple correlation coefficients, R, defined as the correlation between the observed values of the response variable and the values predicted by the model, that is

$$\hat{y}_i = \hat{\beta}_0 + \hat{\beta}_1 x_{i1} + \cdots + \hat{\beta}_p x_{ip} \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.5)$$

The value of $R2$ gives the proportion of the variability of the response variable accounted for by the explanatory variables.

2) Factor Analysis

Factor analysis is concerned with whether the co-variances or correlations between a set of observed variables can be "explained" in terms of a smaller number of unobservable latent variables or common factors. Explanation here means that the correlation between each pair of measured (manifest) variables arises because of their mutual association with the common factors. Consequently, the partial correlations between any pair of observed variables, given the values of the common factors, should be approximately zero. At this time, new variables are called factor and each factor is indicated as the linear combination of the original variables. Also, the volume of information each factor holds is measured by the variance each factor has. Due to such reasons, factors are numerated by the order of variance size. The largest factor, which holds the largest information volume, becomes the first factor while the smallest factor, which holds the least information volume, becomes the last factor.

Analysts prefer to analyze through the reduction of level, which lessens the number of variables, by minimizing the loss of information, which several variables have since the loss of information is meager in spite of the inconsideration of the meager information volume. Accordingly, it is more desirable to analyze simply through a few factors that are not correlated with each other instead of the analysis of the variables, which have complicated co-relationship

Factor analysis extracts the primary factor form the correlation matrix of variables and the secondary factor may be extracted to explain the residual variance, which the primary factor cannot explain. Factors are extracted one after another to explain the residual variance to the full, which the already obtained factor cannot explain in the same method. The parameters in the factor analysis model can be estimated in a number of ways, including principal component method, which also leads to a test for number of factors, as described fully in Geoff and Everitt (2002).

Once the extraction of primary factors is conducted, the factor score of individual observation is obtained. The calculation of factor score is necessary for two reasons. First, the location of individual observation may be reviewed in the factor space. Second, the factor score of individual observation can be used as new variable in the following multiple regression, etc. The factor score is obtained by the linear combination of the standardized factor score coefficient and the value of standardized variable.

The formal model linking manifest and latent variables is essentially that of multiple regressions. In detail:

$$x_1 = \lambda_{11} f_1 + \lambda_{12} f_2 + \cdots + \lambda_{1k} f_k + u_1$$

$$x_2 = \lambda_{21} f_1 + \lambda_{22} f_2 + \cdots + \lambda_{2k} f_k + u_2$$

$$\vdots$$

$$x_p = \lambda_{p1} f_1 + \lambda_{p2} f_2 + \cdots + \lambda_{pk} f_k + u_p \text{ .... } (4.6)$$

where $f1, f2, \cdots, fk$ are the latent variables (common factors) and $k<p$. These equations can be written more concisely as:

$$x = \Lambda f + u \text{ .... } (4.7)$$

where

$$\Lambda = \begin{bmatrix} \lambda_{11} & \cdots & \lambda_{1k} \\ \vdots & & \vdots \\ \lambda_{p1} & \cdots & \lambda_{pk} \end{bmatrix}, f = \begin{bmatrix} f_1 \\ \vdots \\ f_k \end{bmatrix}, u = \begin{bmatrix} u_1 \\ \vdots \\ u_p \end{bmatrix}$$

.

The residual terms $u1, \cdots, up$(also known as specific variates), are assumed uncorrelated with each other and with the common factors. The elements of Λ are usually referred to in this context as factor loadings.

Because the factors are unobserved, the factors can be fixed their location and scale arbitrarily. Therefore, the researchers assume they are in standardized form with mean zero and standard deviation one. (We also assume they are uncorrelated, although this is not an essential requirement.)

With these assumptions, the model in Eq. (4.2) implies that the population covariance matrix of the observed variables, Σ, has the form:

$$\Sigma = \Lambda\Lambda' + \Psi \quad \cdots\cdots\cdots\cdots\cdots\cdots \quad (4.8)$$

where Ψ is a diagonal matrix containing the variances of the residual terms, Ψ_i $i=1, \cdots, p$.

3. Data Collection

The data collection method of this study used interview as collecting primary data. The target ports of this study are located in Singapore (PSA), Malaysia (Port of Tanjoung Pelepas), Hong Kong, China (Yantian, Dalian, Tianjin), Japan (Tokyo, Yokohama) and Korea (Busan, Gwangyang). In order to get answers from the selected interviewees, the researchers have emailed the questionnaire to them during July 2005, and then the interviewers have visited each interviewee between on August and October. The detail of data collection is based on previous chapter.

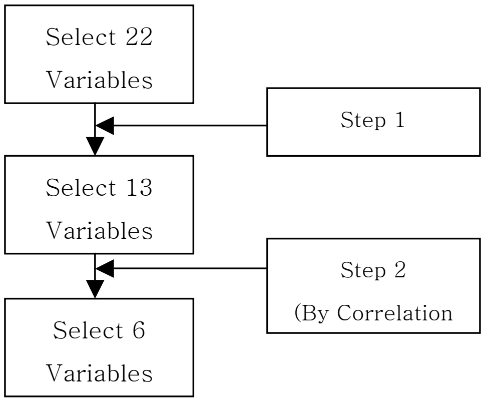
4. Analysis and Interpretation

On the basis of the above-mentioned analysis method, the performance of port backup area is expressed in the model as follows:

$$\ln TEU = \alpha_0 + \alpha_1 F_1 + \alpha_2 F_2 + \cdots + \alpha_n F_n + \varepsilon$$

where n follows the number of obtained factor.

〈Figure 4-2〉 Flow Chart of Variable Selection



〈Table 4-1〉 Variable Selection (Step 1)

Categories		Variables		Selected
Container Terminal Factors	Container terminal factors	Number of Direct Caling		○
		Average Anchorage Time/Vessel		○
	Berth Factors	Number of Quay Crane		○
		Net Crane Product		○
		Rate of Berth Occupancy		○
		Terminal Working Hour		
	Terminal Factors	Average Stacking Story		○
		Total Ground Slots		○
		EDI System(Y/N)		×
Port Backup Factors	General Backup Area Factors	Number of Gate		○ (merge multiplication)
		Number of Gate Lanes		
		Train System(Y/N)		×
		Floor Size	DC	○ (standardize one variable)
			ODCY	
			ICD	
			FTZ	
			Distripa가	
	Detailed Backup Area Factors	Average Number of Floors		○
		Distance from the Main Container Terminal		○
		IT Operating System(Y/N)		×
		Total number of Operators		○
		Ownership(Public or Private)		×

First of all, dependent variable was standardized to get rid of the unit difference between independent variable and dependent variable. In case of the other independent variable, special transformation was not conducted as the difference between the measurement units of variables was standardized by using the correlation matrix in factor analysis.

Henceforth, the variable of low relationship was excluded through the correlation analysis of dependent variable. Although there are various methods to select the variable, the variable was excluded by using the Pearson's correlation analysis without using the other method in view of the characteristics of this research's data. The correlation coefficient between the standardized dependent variable in Throughput and variables is judged to be high mutually in more than 0.5 of absolute value on the basis of the observed result.

〈Table 4-2〉 Result of Correlation Analysis (Pearson) (Step 2)

Variable	Dependent variable (ln Throughput)
No. of direct calling(over 5,000TEU)	0.29
No. of direct calling(less 5,000TEU)	0.285
Average Anchorage Time/Vessel	-0.075
No. of Quay Crane	0.729
NCP	0.353
Rate of Berth Occupancy	0.811
Average Stacking Story	0.423
TGS	0.816
No. of Gate x No. of Gate Lanes	0.681
Size of Port-back up Area	0.722
Average No. of Floors	0.915
Distance from the main CT	-0.141
Total No. of Operators	0.174

As a result, the 6 variables were selected as shown in Table 4.3. The number of already selected 6 variables was reduced through the factor analysis to draw a more clear result of analysis and to prevent any error or confusion on the analysis arising from multiple variables.

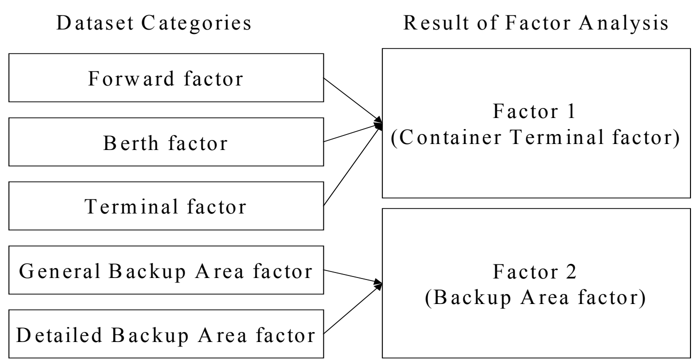
The above-mentioned 4 variables were parenthesized with Factor 1 as shown in Table 4.4 (container terminal factors) through the factor analysis while the under-mentioned 2 variables were simplified into 2 variables by being parenthesized with Factor 2 (Port Backup Factors) (refer to Figure 4.3).

As Factor 2 which were classified through the factor analysis consists of port backup area factors, the impact(significance) which port backup area factor intended in this study gives on the port performance, may be grasped.

〈Table 4-3〉 Result of Factor Analysis (Factor Matrix)

Variable	Factor 1	Factor 2
No. of Quay Crane (QC)	0.871	-
Rate of Berth Occupancy (BO)	0.839	-
TGS	0.918	-
No. of Gate x No. of Gate Lanes (GL)	0.700	-
Size of Port-back up Area (PA)	-	0.967
Average No. of Floors (AF)	-	0.967

〈Figure 4-3〉 Result of Factor Analysis



As a result of factor analysis, each of the variables was classified into two factors. In case of Factor 1, the variables such as number of Quay Crane, Rate of Berth Occupancy, TGS and No. of Gate x No. of Gate Lanes give positive(+) effects. In case of Factor 2, all the variables such as Size of Port-backup Area and Average No. of Floors gave positive(+) effects.

The multiple regression analysis model was created to grasp the impact degree which affects on port throughput through the statistical method, on the basis of factor score drawn through the factor analysis. The analysis model is as follows:

$$\hat{F}_1 = 0.312QC + 0.300BO + 0.328TGS + 0.250GL \quad \cdots\cdots\cdots\cdots\cdots \text{Factor score 1}$$

$$\hat{F}_2 = 0.517PA + 0.517AF \quad \cdots\cdots\cdots\cdots\cdots \text{Factor score 2}$$

$$\hat{y} = 15.251 + 0.524\hat{F}_1 + 0.323\hat{F}_2 \quad \cdots\cdots\cdots\cdots\cdots \text{Regression Model}$$

where y is throughput (ln TEU).

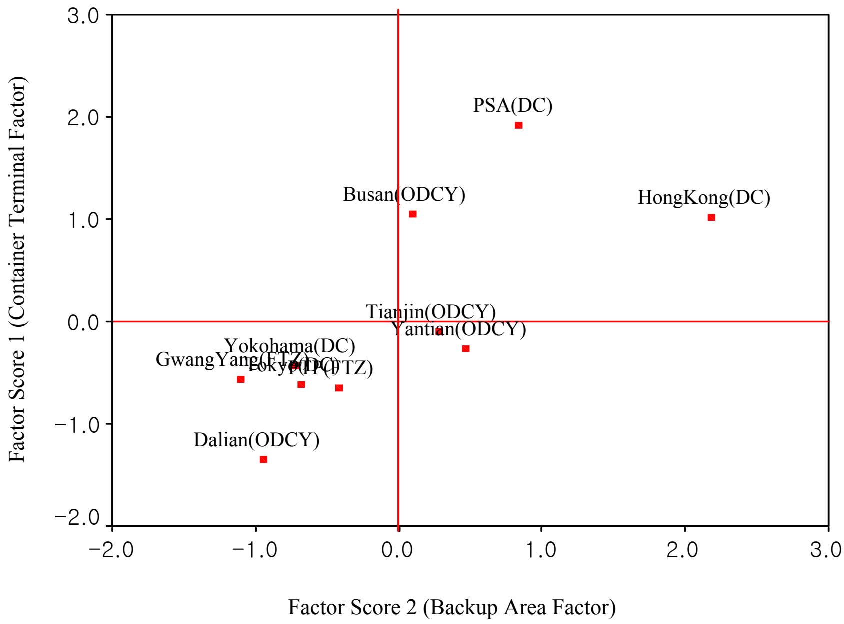
〈Table 4-4〉 Estimation Results of Port Performance Determinants

Dependent Variable	In TEU	
Variable	Cofficient	t-value(p-value)
Contant	15.251	154.605(0.000)
Factor Score 1	0.524	3.390(0.012)
Factor Score 2	0.323	2.086(0.075)
R2	0.893	
Adjusted R2	0.862	
Durbin-Watson Test	2.502	
ANOVA(F-value(p-value))	29.116(0.000)	
Colinearity Statistics(Tolerance)	0.452	

The compatibility of model is judged as excellent as R2 of 0.893 is high and the Durbin-Watson value is near 2 based on the observance of regression model. As the p-value of F-value is smaller than 0.05 in the result of ANOVA test, the compatibility of model is judged as excellent. In addition, the tolerance value of 0.452 calculated for the multi-collinearity test is not judged to have multi-collinearity.

As a result, the both container terminal factor and backup area factor indicated the influence on the port performance. As same with the results of studies which were mentioned in the Chapter 3, the container terminal factor indicated the great influence on the port performance. In the other hand, port backup area factor indicated comparatively low influence compared to the container terminal factor. However, comparative significance was shown in 10% statistical significance, port backup area indicated the influence to some degree on the port performance. The impact degree indicates differently according to the port as shown in Figure 4.4. In factor analysis, interest is usually centred on the parameters in the factor model. However, the estimated values of the common factors, which called factor scores, may also be required. These quantities are often used for diagnostic purposes, as well as inputs to a subsequent analysis (Multiple regression model etc.). Factor scores with a rather pleasing intuitive property may be constructed simply. Group the variables with high loadings on a factor. The scores for factor 1 are then formed by summing the (standardized) observed values of the variables in the group, combined according to the sign of the loadings. The factor scores for factor 2 are the sums of the standardized observations corresponding to variables with high loadings on factor 2, and so forth. Data reduction is accomplished by replacing the standardized data with these simple factor scores.

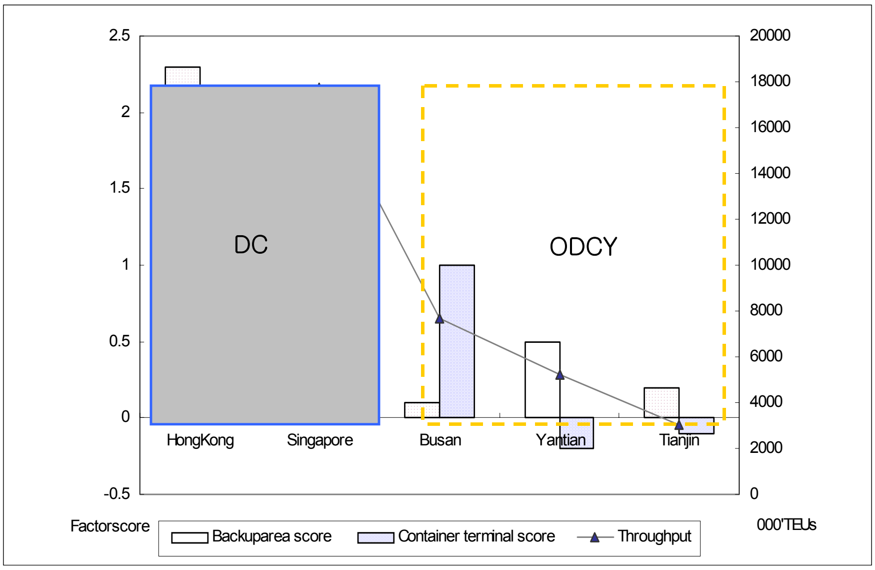
〈Figure 4-4〉 Scatter Plot of Factor Scores



When the locations of each item in Factor 1 and Factor 2 are studied as shown in Figure 4.4, reportedly, Dalian, GwangYang, PTP, Tokyo and Yokohama, the container terminal factor and backup area factor make negative (-) influence on port performance. This is the reason why seems the linkage between port facilities and port cargo traffic volume is very small in view of the newness of investigated ports and the isolation from the main trunk line. In case of Yantian and Tianjin container terminal factors indicate somewhat negative (-) while backup area factor indicates somewhat positive (+). This can be interpreted as the process in which the cargo traffic volume was drastically increased due to activation of port backup area of China's mega ports under rapidly changing international

economy. In case of Busan port, backup area factor indicates little influence while container terminal factor indicates a great influence. The backup area factor indicated relatively low influence due to the failure to secure ample port backup areas arising from the narrow backup area and conflicts of port and urban function. On the other hand, container terminal f
actor indicates very high influence because of good geographical and physical location and high efficiency of port facilities. In case of Hong Kong, both of container terminal factor and backup area factor indicates a very high influence. Particularly, the influence of backup area factor in Hong Kong shows the highest influence among 10 ports. The large size logistics center and ODCY which Hong Kong enjoy indicated the positive influences on the port cargo traffic volume. In case of Singapore (PSA),the both container terminal factor and backup area factors indicate a very high influence. In comparison with Busan, Singapore (PSA), and Hong Kong, container terminal factor of Singapore (PSA) is the highest while backup area factor of Hong Kong is the highest. The container terminal factor of Singapore (PSA) is the highest among 10 ports. This figure is consistent with the results of the past studies in terms of efficiency of Singapore (PSA) (i.e., Tongzon, 2001). In addition, regional port rather than major port were greatly influenced by both of the container terminal factor and backup area factor. The reason why is in line with the findings of Weigmans et. al., (2004) who studied the efficiency of container terminal toward the European ports.

〈Figure 4-5〉 Relationships between Factor Score and Throughput



In view of the port backup area in Figure 4.5, the impact degree of DC (Districenter) typed Hong Kong and Singapore is higher than that of ODCY (Off-Dock Container Yard) typed Busan, Tianjin, Yantian, and Daliand or FTZ (Free Trade Zone) typed PTP. This is due to the well-connected linkage between port facilities and backup area in the DC-typed port for the efficient handling of port traffic cargo volume. Thanks to this, the backup area of relevant ports makes a high influence on the port performance. On the other hand, port facilities and backup area cannot be linked systematically in view of spatial structure of ODCY typed port since backup area indicates comparatively low influence on the port performance. In case of FTZ typed PTP, the impact degree of port performance is indicated as low because the construction of port facilities is under way and there are some factors excluding facilities. In addition, the influence of backup area factor is indicated as significant in the ports of which cargo traffic volume is more than about 5 million TEUs. After a certain level, port cargo volume is strongly affected by backup area factor. The certain level of port cargo volume is a critical index to design and plan for port backup area.

Chapter 5
Conclusion and Political Implication

1. Conclusion

The world port industry environments are rapidly changing due to the globalization, transportation revolutions and local constraint, and the speed of change in Asia, centered on China is faster and more varied than that of many other regions. The 20 Asian ports ranked in the world top 30 container ports are concentrated in the Asian region and the 25% of the total trade volume is occurring in this region. The growth and change of shipping port markets in ESCAP region has stirred the sever port competition and ports are doing theirs best to survive in the competition.

Under these circumstances, port operators put their multi-faceted efforts such as restructuring of port facilities, strengthening of marketing strategies, enhancement of IT systems and alliance between ports enlargement of hinterland and expansion of supporting traffic network. Recently, a lot of researchers have tried to evaluate the level of competitive power among the ports from the aspect of enhancing the competitive edges by analyzing the indexes such as *productivity, performance*, and *efficiency*of ports. However, such approach could not fully reflect the change such as consolidation or advancement into logistics markets by shipping lines, logistics hub arising from intermodalism, the enhancement of value-added logistics industry, and enlargement of port space arising from the enlargement of container. Particularly, Hong Kong and Singapore, the first and second busiest ports of the world maximized the efficiency and performance of the port facilities by constructing large-size logistics centers right beside the port (Zhu, et.al., 2002),. The previous studies did not reflect such factors in the corresponding analysis. Therefore, this study is aimed to grasp the existence of influencing effects on the port backup area (backup area factor) by analysing the influencing effects of backup area factor, together with existing container terminal factor on the 10 large container ports in ESCAP region.

Data set was primarily created on the basis of 22 factors drawn from the previous studies through the direct interview survey on the ports of 10 regions. The 6 variables were drawn through Pearson correlation analysis of 22 mutual significance which were into factor 1 (container terminal factor) and factor 2 (backup area factor), which have similar characteristics based on the factor analysis of 6 variables to raise the accuracy of analysis by protecting mutual disturbances and conflicts of 6 variables drawn from

correlation analysis. By implementing regression analysis on the basis of variables drawn from factor analysis, factor 1 is grasped as having significance level of 0.05 and factor 2 is grasped as having significance of 0.1 on port performance. The significance of factor 1 is already clarified in many studies while the significance of factor 2 is the result clarified in this study as shown in Figure 4.5.

The following results are drawn from the analysis of container terminal factor and backup area factor related to port performance.

First, the influences of container terminal factor and backup area factor are indicated as significant in the ports of which cargo traffic volume is more than about 5 million TEU. After a certain level, major ports compared to regional ports are strongly affected by container terminal factor and backup area factor. In case of backup area factor, the size of cargo volume gives more impact than container terminal factor.

Second, correlationship of backup area factor indicates high figure in high value-added creating ports, such as Hong Kong and Singapore. Hong Kong and Singapore puts various efforts for the creation of value-added, attraction of cargoes and maintenance in addition to already holding container terminal factor.

Third, the container terminal factor on Hong Kong, Singapore (PSA) and Busan is indicated high while backup area factor on Busan is indicated as meager. This seems to be attributable to the limited urban space and the shortage of port backup area due to narrow port space of Busan.

Fourth, the other ports excluding the abovementioned three ports have not high correlationship comparatively on container terminal factor and backup area factor. This seems to be attributable to the fact that cargo volume is not sufficient compared to port facilities and the construction of port facilities are under way.

Fifth, the effect of DC (Distribution Center) indicates bigger effects than that of ODCY (Off-Dock Container Yard) and FTZ (Free Trade Zone) among backup area factors.

On the other hand, Japan's two ports where influence is indicated low in spite of having DC, do not seem to have correlationship because of over-development of facilities and logistics structure centered on imported cargoes.

On the basis of this analysis result, ports located in the main artery routes should make great efforts on the development of backup area factor as well as container terminal factor and on the functional enhancement in view of severe port competition in the future. In addition to this, the pattern of port backup area suitable for the port should be grasped and ensured in view of consideration on port characteristics and circumstances.

Last, this study has difficulty in collecting data because of low recognition on backup area on the part of interviews during the interview for data collection. In addition, there are some problems on some statistical credibility toward population group by trying to collect data on the limited region in the limited period instead of building more than 15 mother groups to secure statistical significance. Particularly, due to shortage of mother group, the analysis has the limit. For better result, the same method on the 20 representative ports in Asia seems to be required. And for more elaborate analysis, the distinction between port backup area within the terminal and port backup area outside of the terminal is needed. Port backup area within the terminal and port backup area outside of the terminal seems impact differently on port performance, but the approach is not available due to the limit of data collection in this study. If further study is able to correct data well, the certain level of port cargo volume when backup area factor strongly influence port performance, can be found significantly.

2. Implication

This empirical analysis and discussion up to this point suggests the governments in ESCAP region the following recommendation on their plan approaches and policies implementation:

In respect of policy;

- To establish port policy for port backup area

- To include port backup area plan when port develop
- To establish urban planning policy for port
- To establish specific control policy for port space;In respect of institute;
- To make urban planning oriented from port (enacted acts, revised laws)
- To induce port related zones (i.e. Logistics zone)
- To establish comprehensive plan including urban planning, transport and port In respect of facility;
- To build high-tech logistics centers and logistics parks
- To expand port areas in city
- To unify port and ODCY, located in adjacent port

The recommendationon its plan approaches and policies implementationfor Korea government, Busan Port Authority and Busan metropolitan government is as follows:

In respect of policy;

- To establish port policy for urban planning, and urban planning policy for port
- To apply different port backup area policy (plan and design) between hub port and regional port
- To establish appropriate port policy for port backup area
- To establish specific control policy for port space
- To induce port related zones (i.e. Logistics zone)
- To establish associated organization including urban plan, transport plan and port plan;In respect of facility;
- To build high-tech logistics centers and logistics parks as early as possible
- To expand port areas in city
- To unify port and ODCY, located in adjacent port and to decrease the area of ODCY, located in out of port

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Appendix

Interview Questionnaire

The purpose of this interview questionnaire is to get information on container terminals, ODCYs, DCs, and ICDs of your side. The following questions are designed to obtain some background information on your side's container terminals, ODCYs, DCs, and ICDs. The information you answered will be used only for statistical analysis. This information will be kept strictly confidential.

Limitations:

Container Terminal: the number one Container Terminal in annual container throughput on your side.

ODCYs (Off Dock Container Yards), DCs (Distribution Centers or Logistic Centers or Free Trade Zone closed to port) and *ICDs (Inland Container Depots)*: ranked in the top five by annual container throughput related to the Container Terminal.

1. Frequency (in 2003)

Container Terminal	No. of Direct Caling		Average Anchorage Time/vessel
	Over 5,000TEU	Less 5,000TEU	

Note 1. *Number of Direct Calling* is divided into two categories. First category is for the number of direct calling of containerships over 5,000TEU(as its capacity) per week. Second categoryis for the number of direct calling of containerships less 5,000TEU(as its capacity) per week.
Note 2. The definition of *Average Anchorage Time* is the average time for anchoring from the boundary line of the port to the berth per a containership. This time is including pilot time and tugging time.

2. Berth (2003)

Container Terminal	No. of Quay Crane	NCP	Rate of Berth Occupancy	Terminal Working Hour

Note 1. *NCP* stems from Net Crane Product and it is calculated by the following equation.
NCP = (TEUs Handled Per Working Day) / (No. of Crane x Net Working Hours Per Day)
Note 2. Total anchorage time of all calling ships in a year is divided by total possible berthing time for all berth of container terminal is *Rate of BerthOccupancy.*
Note 3. *Terminal Working Day* is the total operation day a year.

3. Terminal (in 2003)

Container Terminal	Average Stacking Story	TGS	CFS Floor Size	EDI System (Y/N)

Note 1. *TGS* stems from Total Ground Slots in the main container terminal.
Note 2. The Unit for *CFS (Container Freight Station) Floor Size* is square meters.
Note 3. If the container terminal has an EDI system for the operation, please answer "yes," vise versa.

4. Backward Factors I (in 2003)

Container Terminal	No. of Gate	No. of Gate Lanes	Train System (Y/N)

Note 1. If there is any train systems in the container terminal, please answer "yes," or not.

5. Backward (related to port back-up areas) Factors II (in 2003)

(Unit : square meters)

	DC Floor Size	ODCY Floor Size	ICD Floor Size
# 1			
# 2			
# 3			
# 4			
# 5			

Note 1. If there is CFS area in DC, please include the floor size of CFS in DC floor Size. If CFSs are separated from DC area, please answer the following question number 6.

6. Backward Factors III (in 2003)

(Unit : square meters)

	CFS Floor Size
# 1	
# 2	
# 3	
# 4	
# 5	

Note 1. If there is CFS area in DC, please include the floor size of CFS in DC floor Size.

7. Detailed Backward Factors (in 2003)

(1) For DCs

	DCs				
	# 1	# 2	# 3	# 4	# 5
Average No. of Floors					
Distance from the main Container Terminal					
(Y/N) of IT Operating System					
Total Number of Operators					
Ownership (Public or Private)					

(2) For ODCYs

	ODCYs				
	# 1	# 2	# 3	# 4	# 5
Average No. of Floors					
Distance from the main Container Terminal					
(Y/N) of IT Operating System					
Total Number of Operators					
Ownership (Public or Private)					

(3) For ICDs

	ICDs				
	# 1	# 2	# 3	# 4	# 5
Average No. of Floors					
Distance from the main Container Terminal					
(Y/N) of IT Operating System					
Total Number of Operators					
Ownership (Public or Private)					

8. Connectivity (in 2003)

Variables	By train (Y/N)	Average Trucking Time from the Main Container Terminal (One Way) (hr)

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2005年 12月 28日 印刷)
2005年 12月 30日 發行

編輯兼發行人 李 正 煥
發行處 韓 國 海 洋 水 産 開 發 院
서울특별시 서초구 방배3동 1027-4
수암빌딩
전 화 2105-2700 FAX : 2105-2800
등 록 1984년 8월 6일 제16-80호

組版・印刷 / 정양사(☎ 2263-0066) 정가 15,000원

판매 및 보급 : 정부간행물판매센터
Tel : 394-0337, 734-6818