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Study of port-city spatial relationship in Shanghai

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Study of port-city spatial relationship in Shanghai

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DECLARATION

I hereby certify that all the material in this dissertation that is not my own work have all been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and not necessarily endorsed by the University.

(Signature):_____

(Date):_____

Supervised by Professor

SHI XIN

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ABSTRACT

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For a long time, the spatial relationship between port and city has been discussed following Bird's (1963) 'anyport' model and Hoyle's (1988) 'waterfront redevelopment'. However, the development of contemporary port-city relationship is different from it was 20 years ago although the main principle does not change very much. In a national scale, the port-city spatial relationship in China not only follows the general rules but also has its own characteristics. To be specific, Shanghai Yangshan deep water port and Lingang harbor city happen to be a couple of new port-city relationship appearing in Shanghai recent years. The purpose of this paper is to 1) study the relationship between Yangshan deep water port and Lingang harbor city 2) analyze the influence of the Yangshan-Luchao relationship on the traditional port-city relationship mode 3) explore the sustainable development of such new mode by applying the pole-axis theory

Keywords: port-city spatial relationship, Yangshan deep water port, Lingang harbor city, pole-axis theory

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Chapter 1 Introduction

1.1 Background of Research

As the largest port in China, Shanghai port shoulder the main task of external trade. As early as 1995 the Chinese government set the goal of establishing Shanghai international shipping center. The content is to form a joint port group by ports of Yangtze River delta focusing on Shanghai port with Zhejiang and Jiangsu as two wings to develop hinterland-oriented transshipment combinatorial ports system by advantage of Shanghai's trade and economics, Ningbo and Zhoushan's deep water and delta's container traffic. It is a complex project involves activities and considerations in all aspects, among which the study of spatial relationship between port and city is of great significance because on one hand it provides theoretical basis for further development and on other hand help Shanghai position itself reasonably.

1.2 Literature Review

Study of port evolution was initiated by Bird's (1963) "Anyport" model which describes how port infrastructures evolve in time and space. A five-stage model was developed and it can be summarized into the following three steps: initial setting, expansion and specialization. Notteboom and Rodrigue (2005) argue the three phases depict well port development process, especially in large traditional ports, however it has some weaknesses in view of explaining contemporary port development.

In terms of the spatial development of port system[1], Taaffe et al (1963) suggests an increasing level of port concentration and port system would evolve from an initial

[1] A port system is defined as a group of ports sharing a similar geographic characteristic, e.g. coastline, bay and to some extent serving overlapping hinterland regions.

pattern of scattered, poorly connected ports along the coastline to a network consisting of links between gateway ports and hinterland centers. However, Barke (1986) and Hayuth (1981) introduce a process of port system deconcentration. Meanwhile, Wang (1998) proposes modifications to the above in order to reflect the uniqueness of some particular ports— Hong Kong in that case.

The concept of the port-city interface was introduced by Hayuth in 1982. Later on, Hoyle (1988) proposed "port-city interface" model, which instead of stressing the port infrastructure development, emphasized the changing linkages between the port and the city. One of these urban linkages is the redevelopment of old waterfront sites for other urban uses. Examples of the redevelopment of waterfronts include the Thames ports in London, redevelopments in Bristol (Bassett & Hoare, 1996) and Darling Harbor in Sydney. As Gilliland (2004) argued, "one effect of incessant technological innovation is to periodically destroy past investments and radically transform the urban landscape".

In addition to Bird's (1963) model, Notteboom and Rodrigue (2005) introduced a 'regionalization' phase in port and port system development and further substantiated it. Regionalization expands the hinterland reach of the port through some market strategies and policies linking it more closely to inland freight distribution centers. Similarly, as an extension of Hoyle's (1988) model, Olivier and Slack (2006) discussed the likelihood of the expansion of ports from the local to the regional scale, citing examples such as the Hong Kong – Pearl River Delta complex and Los Angeles – Long Beach. In addition, they talk about the behavioral approach based on the fact that the control of transport networks by shippers and ocean carriers is increasing. Daamen (2007) introduces a new interpretation of the contemporary port-city interface to support its sustainable development. The approach focuses on

the interests of the actors involved in the development of the port-city interface, and the need for relationships and coalitions between them in order to reach sustainable development results.

Regarding current world-wide transportation situation, logistics have not only subsumed the port within a global system but also within transcending corporate agendas (Olivier and Slack, 2006). There is a tendency of port and maritime industry towards logistics integration and the impact of changes in logistics on the functional role of ports in value chains involve much discussion. Robinson (2002) considers ports as elements in value-driven chain system within the new paradigm. Notteboom and Winkelmans (2001) elaborate how port authorities face the challenge out of structural changes in logistics, while Martin and Thomas (2001) address structural changes in the container terminal community. Appropriate port governance structures are required to face the challenges caused by the changing port-hinterland relationship. Brooks (2001) discuss compatible issues between good governance of port and economic development. Notteboom and Rodrigue (2005) think the port-hinterland relationship is heavily influenced by political imperatives rather than by the 'invisible hand' of an efficient market. Port is intended to serve an entire economic region and therefore should be decided at the local level. Any regionalization strategy developed by a port authority or local government has the intention to improve the competitive position of the port, but this dose not necessarily imply that the final configuration of the related load center network provides the most optimal solution for serving the larger hinterland regions as a whole.

City differences in labor costs, land costs, availability of land, level of congestion, the local market and government policy are among the factors affecting more or less

the relationship between port and its associated city. The development of ports and their cities became increasingly differentiated and often took place more independently in the face of regional competition and globalization (Daamen, 2007).

On the other hand, global production and consumption are changing the relationship between port and city constantly. Port-City relationship is still a hot issue to be discussed. The 5th International Ports and the Environment Conference and exhibition GreenPort 2010 have taken place in Stockholm on 24-25 February 2010, in association with EcoPorts and ESPO. One of issues delegates discussed a lot is port-city relationship, which shows that the port-city relationship is highly concerned by the industry.

Ports today face serious challenges on their way to achieve acceptable sustainability levels in two major respects: global and local. On the global consideration, all ports today operate in an increasingly complex and competitive environment. On the local side, both the city and the port need to achieve a balance among vibrant political, economic, social, and technological considerations. Therefore, how port and city relate to each other to face the global competitiveness and how to reach the local balance become problems remain to be solved.

1.3 Contents

The first part will make a brief introduction of classic theories of port-city spatial relationship in academic circles. Then overview a few world-famous port city development and summarize the features of the evolution in order to compare those with Chinese current port-city situation. The main existing problems concern unreasonable design and layout of land use of port and city, miscommunication and

misunderstanding result from different administrative divisions, etc.

The second part introduces the development of the newly built Yangshan deep water port and Lingang harbor city in Shanghai. Yangshan port was built to circumvent growth limitations for the port of Shanghai as a result of shallow waters and now it is capable of handling the largest container ships. Lingang harbor city is situated in the south-east corner of Nanhui District, about 30 kilometers away from Yangshan port, 55 kilometers from downtown Shanghai. The new harbor city will be the administrative centre of Nanhui District and the rear basis of the deepwater port, bearing comprehensive functions including container distribution and storage, offshore processing, shipping market, logistic centre, residence, financial and commercial services, amenity and tourism. A yacht club and a series of large cultural facilities including theatre, maritime museum, aquarium, etc. will be established on the two islands in the lake. In about 20 years the city will host a population of 300,000 inhabitants.

The third part is supposed to discuss in detail three kind port-city relationships in space and function: Relationship between 1) Yangshan deep water port and Lingang harbor city 2)Yangshan deep water and Shanghai (as a city) 3) Lingang harbor city (as a city inside of a city) and Shanghai downtown area. Then try to find out the influence of Yangshan-Luchao mode on the traditional port-city development in Shanghai.

In the fourth part, the pole-axis theory will be used to look into the sustainable development of such extraordinary port-city relationship. As it is known, factors affecting the coordination of port and city are complex, and the sustainable development of port-city relationship involves a number of considerations, namely

social, environmental, functional, institutional and economic issues, etc. My study will apply PEST (political, economical, social and technology) methodology in arguing possible solutions or recommendations to the sustainable development of port-city relationship in Shanghai in the future.

Analogy (comparative study), PEST analysis and the pole-axis theory are supposed to be used as the methodology in this paper.

Chapter 2 Evolution of port-city spatial relationship

2.1 Development history of port-city spatial relationship

2.1.1 Theory introduction

"Anyport" is a model proposed by Bird (1963) demonstrating the port-city spatial relationship and how facilities in a typical port develop. There are five stages in this model Generally three main steps are mentioned (see Figure 2-1). The first stage is initial setting with small lateral quays adjacent to the city center. With the improvements in maritime technology and amounts of cargo handling, the spatial relationships between the port and the urban core is changing, as docks are built further away from the central business district. Then the evolution steps into stage of expansion. The final stage involves the construction of specialized infrastructure to deal with specialized cargo (ores, grain, coal…) or container ships, which result in port facilities extending to sites far removed from the oldest facilities. The "anyport" model contributed a lot in explaining the changing spatial relation between ports and their host cities. Based on the "anyport" model, Hoyle (1989) further demonstrated the changing linkages between the port and the city which mainly discussed the redevelopment of old water front for urban uses.

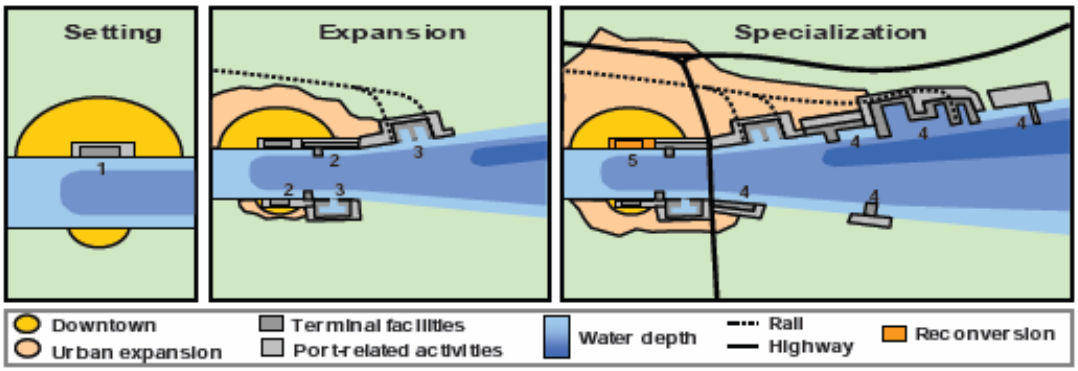

Figure 2-1 Bird's Anyport model

Source: http://people.hofstra.edu/geotrans/eng/ch4en/conc4en/portdev.html

From a chronological growth perspective, the evolution of port-city relationship will experience four stages, namely embryonic stage, growth stage, maturity stage and decline stage (or turning point).

1) Embryonic stage: In the beginning of the formation of a harbor city, port often plays a key role in its relationship with the city. The development of the harbor city is highly dependent on the port's activities. At this time, there is little space between port and its related city, so the relationship shows a clear spatial integration feature.

2) Growth stage: With the rapid development of the port, the city functions keep being improved along with the port berths and throughput are continuously growing. Harbor city begins to lead the development of local industry and corresponding activities relying on the port and its hinterland resources. Cluster expansion of port facilities affects the harbor city's land use. In this period, significant changes in spatial structure will happen: Because of imbalance and lack of coordination in the relationship of port and city, there appear many contradictions on the interface. If the "spatial conflict" is successfully dealt with, the city as well as the port will be promoted in an orderly fashion and continue to grow in a fast pace.

3) Maturity stage: When the dominant and satellite industries are established, harbor city will enter the spatial relatively stable stage. The pace of growth slows down and the port-city relationship is becoming mature. In this stage, the city functions take shape and seek for diversification. The spatial influence and dominance of port on the city decline but still play an important role. Motivation for development comes from the interior area and hinterland's need, and thus the relationship shows a clear diversification characteristic.

4) Decline stage or turning point: When the port-city relationship has stayed in maturity stage for a long enough time, it will meet a turning point. Longtime functional stability is very likely to result in lags in response of the city's space. The city becomes not that sensitive to the need of port and market which restrict the development of a healthy relationship. If the problem is ignored, the development of port and city will enter decline stage; otherwise it will step into a new realm if efforts are made to increase coordination, emphases are paid to diversification and optimization is achieved in the internal spatial structure.

2.1.2 World famous port city overview and their evolution features

1) Port of Rotterdam's case

The Port of Rotterdam is the largest port in Europe, located in the city of Rotterdam, South Holland, the Netherlands. From 1962 until 1986 it was the world's busiest port. Most important for the port of Rotterdam are the petrochemical industry and general cargo transshipment handlings. The harbor functions as an important transit point for transport of bulk and other goods between the European continent and other parts of the world (From Wikipedia).

Kop van Zuid projects, a waterfront project in Rotterdam from the 1990's, had

indicated that it was very costly to abandon obsolete port areas. Therefore, the Rotterdam municipal government adopted a pro-active attitude to accept the foundation of Rotterdam CityPorts Development Corporation (RCDC) Ltd. on January 1st 2004. RCDC was dedicated to invest in the remaining port areas which were renamed as 'CityPorts' for urban use in the next several decades (Daamen, 2007).

The Rotterdam municipal government and the RCDC equally own 50% of the RCDC's stock. The idea of the RCDC foundation was initiated by the 'Maasvlakte II' plan- a land reclamation plan of North Sea expected to expand port activities- which attracts stevedoring companies to locate themselves from the CityPorts area to deeper waters. (see Figure 2-2)

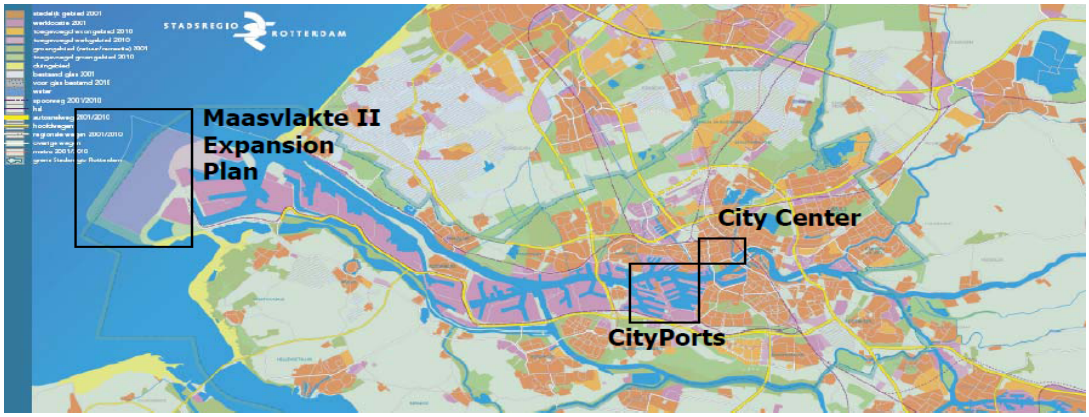

Figure 2-2 Rotterdam CityPorts Area

Source: RCDC website

The CityPorts area is about 2,300 acres with more than 850 port-related companies providing 20,000 job opportunities and takes care of 40% of the container transshipment. 'In the next decennia, the Rotterdam CityPorts area is going to change strongly. The port will remain present in all its dynamics, but the city will

increasingly interweave with its fabric. The ships, the cranes, the continuing industry and the fabulous views will become the background of a very special living and working environment. City and port are entering a new alliance.' (RCDC, 2005)

2) Port of Hamburg's case

Hamburg is named Germany's "Gateway to the World" and is the largest port in Germany. The harbor is located 110 kilometres from the mouth of the Elbe. It is the third-largest port of Europe after the port of Rotterdam and the port of Antwerp (From Wikipedia). With about 110 million tons of sea-borne cargo handled in 2009 (see Figure 2-3), a year impacted by the global economic and financial markets crisis, Germany's biggest universal port fell short of the previous year's result by around 30 million tons (–21.4 per cent). For 2010, the port sector anticipates modest growth.

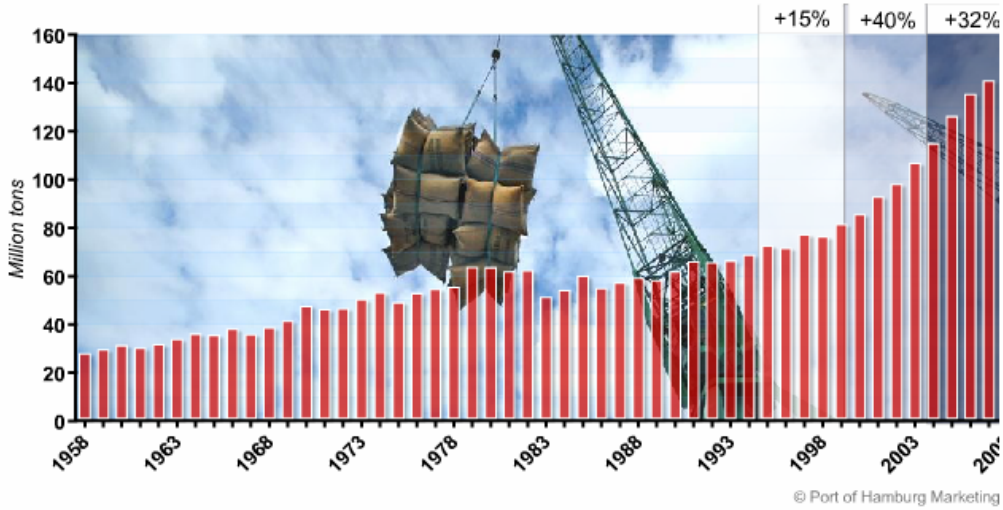

Figure 2-3 Sea borne cargo handling at the Port of Hamburg _1958 to 2009

Source:http://www.hafen-hamburg.de/en/content/sea-borne-cargo-handling-port-hamburg-%E2%80%93-1958-2009

In the restruction of Port of Hamburg, a 'Leap across the Elbe' initiative was proposed for the 2013 International Garden Exhibition and the 2013 Building

Exposition. This initiative is supposed to make the port-city of Hamburg leap across the Elbe and upgrade the covered area, which encompasses almost 1700 acres, adjacent to the port (see Figure 2-4). However, discussions and debates followed arouse a lot controversy about the plan. The result is that the Hamburg Chamber of commerce and the Ministry of Urban Development present its own plan respectively (Daamen, 2007). Finally Port of Hamburg decided the final plan in 2005, as follows:

Figure 2-4 'Leap across the Elbe' initiative in Hamburg

Source: http://www.marketing.hamburg.de/

'All planning processes will have to take into consideration that the important buffer functions of eastern shore land uses be retained to protect Wilhelmsburg's residential areas from noise and dust from the port. The general clarification needed for transitional areas of city and port over how a lasting coexistence between housing,

workplaces and leisure can be achieved, is being effected' declaimed by Free and Hanseatic City of Hamburg in 2005. On the other hand, the port authority announced to renew its application, relocate the ro/ro-terminals to host high-profile events like the Olympics, and take charge of restructuring Veddel and Kleiner Grasbrook area to save more space for urban use (see Figure 2-5).

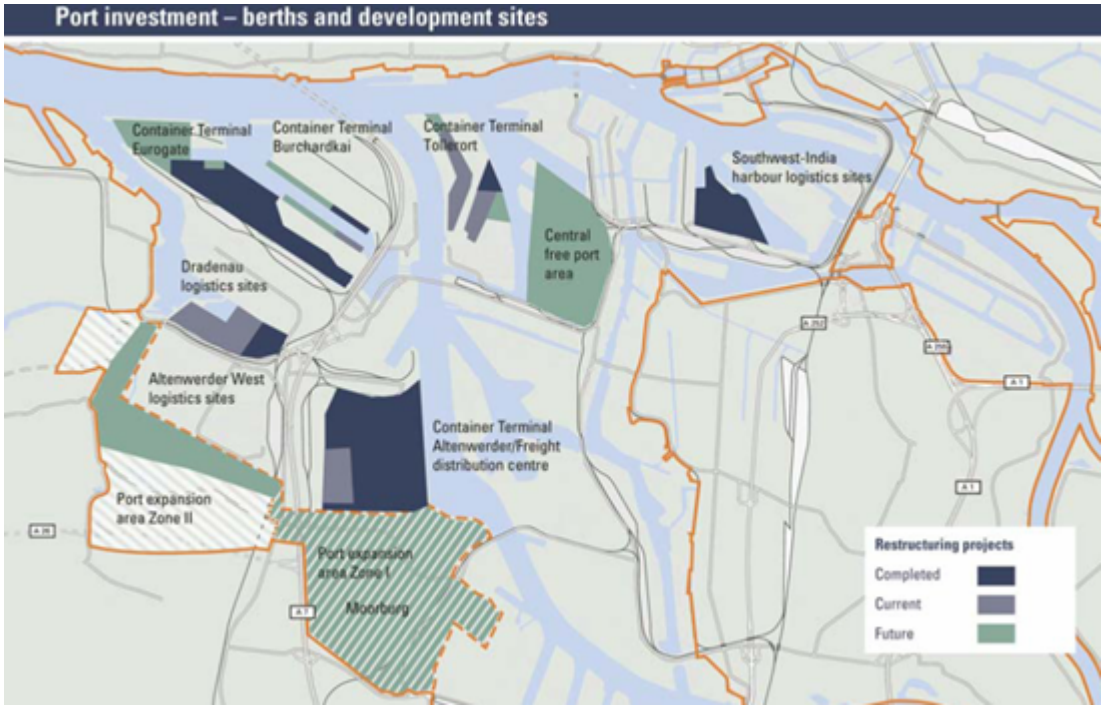

Figure 2-5 Hamburg Port Authority investment plans

Source:Hamburg Port Authority and Ministry of Economics and Labor, 2005

The spatial relationships between port and city take very concrete shapes in the two cases above. Since Rotterdam and Hamburg are two of Europe's largest ports, port scale increase in scale and capacity is urgent for the two seaport-cities. The expansion and redevelopment of port functions not only strengthen their competition but also attract a range of stakeholders and their capital flow to drive relevant value-added industries which may exert more social influence such as housing,

employment and other port city functions.

In the past, we mainly focused on the reinvest of waterfronts or redevelopment of the city centre alone while now the focus is transferred to the interface areas between seaport and city centre as the demand for port area close to the urban area diminishes and the need for transition of port area for urban use increases. Furthermore, a trend can be seen from the above review of Rotterdam and Hamburg cases is that the joint interests of urban area and port are given the top priority in the process of harbor city planning. Port and its related city are tending to coordinate and cooperate more closely rather than coming to blows, although the partnerships are established in various ways. Therefore, the city planning authority, the business community and the port authority are supposed to communicate more and prepare themselves to face up to the challenge of new port-city relationship today.

2.2 Asian port-city relationship discussion

2.2.1 Current situation

Although European ports have long history and thus more experience we can learn, situation in Asia is a little bit different from the pattern in Europe, mainly due to the geographical layout and history of trade, in my opinion. Port-city relationships in Asia have their own characteristic such as coastal concentration, establishment of entrepots and depots in strategic locations and free trade zones.

The major differences between European and Asian port-city relationships are reflected in the following aspects:

1) In Europe, port cities contribute inappreciably to the economics. In other words, port cities are inferior to inland cities in respect of economic importance (Rozenblat

& Cicille, 2002). In Asia, port cities are driving forces and cores of the national economic development (Gipouloux, 2001). In a word, port city economy is a residual market in Europe and core market in Asia (Ducruet, 2006).

2) European cities have their clear division of tasks: inland cities are in charge of political, financial and cultural activities while port authorities are engaged in connecting inland cities efficiently by offering intermodal services. Since most European port cities specialize in transport activities and distribution, the level of hinterland transportation network and regional integration is higher than other places. However, Asian port cities are always national economic centers at the same time. Urban and port combines along the coastal regions and develops faster than other areas. Therefore, inland connections are underdeveloped by contrast. As a consequence, there is little communication between one port and another country's hinterland market.

3) As discussed in 2), there is a complex and integrated transportation network in the European continent, so the European market can be regarded as a whole single one market whereas Asian area are developing hub functions for national economy and thus the markets are scattered and isolated. Considering the difference, European ports are competing for more overlapping hinterlands, and Asian ports are competing for transshipment flows.

4) As observed by César (2006), port-city interdependence index in Europe is lower and more stable than that in Asia but which has sharply decreased. This phenomenon is particularly keen in the Indian subcontinent (Kidwai, 1989).

Region	2005	2000	1995	1990	1985	1980	1975	1970
Northwest Europe	0.408	0.574	0.594	0.594	0.563	0.540	0.519	0.378
Scandinavia Baltic	0.572	0.337	0.162	0.153	0.156	0.234	-	-
West Med. Iberian Peninsular	0.146	0.122	0.232	0.367	0.365	0.193	0.262	0.174
East Med. Black Sea	0.330	0.305	0.510	0.278	0.061	0.752	0.898	1.000
Northeast Asia	0.292	0.349	0.407	0.457	0.584	0.625	0.614	0.636
Southeast Asia	0.308	0.304	0.286	0.336	0.416	0.312	-	-
Indian Subcontinent	-0.149	0.020	0.303	0.461	0.437	-	-	-
Europe	0.179	0.174	0.190	0.162	0.179	0.215	0.222	0.127
Asia	0.264	0.300	0.347	0.429	0.565	0.592	0.634	0.664

Data sources: Moriconi-Ebrard, 1994; Brinkhoff, 2005; Helders, 2005; Lahmeyer, 2005; Containerisation International Yearbooks

Figure 2-6 Correlation between urban population and container throughput by port region, 1980-2005

2.2.2 Existing problems

From the above, we see some potential problems Asian areas might have. First is the confusion of the functions of port cities. Port cities in Asia play too many roles in the economy of a country: not only act as a traffic node but also a trade and financial center, which prevent them from specialization and high efficiency. Besides, Asian ports depend too much on the short-term transshipment opportunities. The absence of hinterland integration results in incommunication between markets and dramatic profit loss.

2.3 Interaction between port and city

2.3.1 Port influence on city

There is no doubt that with the development of the port, new opportunities might arise for its city. “The city is promoted with harbor; harbor is used for the city” is regarded as the goal of many ambitious port cities. Generally speaking, there are four aspects of the influence port might exert on city:

1) Influence on economic development of the city

External trade developed by the port definitely booms the economics of its related city. A port gathers different kinds of worldwide production elements and plays an important part in international trade and distribution throughout comprehensive sea/land transportation network, which makes a great contribution to local industries and its hinterland booming by economy of scale. Added value is a major indicator to evaluate port's economic contribution.

2) Influence on urban morphology

The economic development of the city results in increase in population and expansion in infrastructure, which finally leads to extension of city land to urban fringe areas. According to the pole-axis theory[2], the extension follows the path of main lines of city traffic. Starting from the original port infrastructure with sereral lateral quays adjacent to the city center, facilities are built further down the river and away from the urban core with the development of technologies and improvements in cargo handling. Larger ships often require dredging or the construction of long jetties granting access to greater depths. In the final stage, increasing demands for space for cargo handling results in port activity being concentrated at sites far removed from the oldest facilities.

3) Influence on city infrastructure construction

Increasing flows of material and labor produce urban revenue, among which part of it is taken as government revenue and other part of it is used to develop port related industries to produce more revenue. At the same time, construction of city infrastructure and facilities are supposed to accommodate port layout. Smoothly connected traffic flows between city and port form comprehensive transportation

[2] The pole-axis theory is presented by Lu Dada, which regards point, line and surface as three main factors in the regional development.

system which promotes the port-hinterland relationship and increases the efficiency of cargo distribution.

4) Influence on social development

The construction of port gives rise to the concentration of people and then will lead to expansion of urban scale. On the other hand, in the process of port construction, there must form a number of supporting industries. These industries will also result in city expansion. That's why port cities represent a large proportion of world's major cities. In addition, ports create huge amounts of direct job opportunities to the society. According to the experience of Hong Kong, each additional container berth will provides more than twenty thousand direct or indirect jobs.

2.3.2 City influence on port

Generally speaking, one function of the city is supposed to attract sorts of resource, such as capital, information and labor. These create a good environment for the development of a port. When the conditions are mature enough, an international shipping center is possible to come into being. The international shipping center refers to a multi-functional combination port system or a large-capacity distribution hub responsible for comprehensive services of shipping, trading, market, financial and information, which has a close relationship with regional economy. Therefore the overall strength of city has a great impact on the future path of the port.

Now that Shanghai international shipping center is being constructed, it is a hot issue discussed widely. International shipping center usually has four main characteristics: 1) superior port conditions 2) complete and professional shipping related service 3) free and open organizational system 4) vast hinterland markets. These requirements set a high benchmark for Shanghai port authority to make the strategic decision.

Finally, they proposed the plan of Yangshan deep water port. Now the construction of Yangshan deep water port is regarded as the core task in the project. The completion of Shanghai international center is of great significance to enhance the international competitiveness of our country.

Chapter 3 Pattern of Yangshan deep water port and Lingang harbor city spatial relationship

3.1 Development of port-city spatial relationship in Shanghai

3.1.1 History of port-city relationship in Shanghai

Shanghai is situated at 31 14' north latitude and 121 29' east longitude. Bordering on Jiangsu and Zhejiang provinces on the west, Shanghai is washed by the East China Sea on the east and Hangzhou Bay on the south. North of the city, the Yangtze River pours into the East China Sea. It also assumes the central location along China's coastal line. Thanks to its advantageous geographic location, Shanghai has become an excellent sea and river port, boasting easy accesses to a vast hinterland.

The city covered an area of only 636 square kilometers in 1949. By the year 1958, after Shanghai took over 10 counties from Jiangsu Province, the area under the city's jurisdiction expanded to 5,910 square kilometers, nearly 10 times the figure in 1949. The city had a total area of 6,340.5 square kilometers at the end of 2008, 0.06% of China's total territory. Shanghai extends about 120 kilometers from north to south and about 100 kilometers from east to west. The city has three islands -- Chongming, Changxing and Hengsha (www.shanghai.gov.cn).

With aforementioned advantage of location, Shanghai became to play a role of foreign trade site dates back to Tang and Song Dynasties. In 1685, Qing government began to set customs in Shanghai and port activities developed subsequently. It was not until Dec. 1843, port of Shanghai officially opened to the worldwide trade. During the First World War, Shanghai port had been equipped with reinforced concrete piers and comprehensive lifting machinery. However, the facilities were ruined during the anti-Japanese war from 1937 to 1945, and the cargo throughput plunged to 194 million tons. Along with the establishment of the People's Republic of China, Shanghai port recovered gradually afterwards. In 1983, Shanghai started to accommodate containers. Then a rapid growth was seen in the 1990s with the accomplishment of Shanghai Container Terminals. Through these processes, Shanghai steps into the largest and most prominent port city within China. The city and the port mutually support each other perfectly in the last century, particularly when break-bulk transport worked as means connecting areas in Yangtze River Delta. Now Shanghai is leading the global ports with a throughput of 590 million tons and 25 million TEUs in 2009. At the same time, it is national economic, financial and shipping centers. The prosperity of port city Shanghai perfectly verifies the statement that"T he city is promoted with harbor; harbor is used for the city".

In terms of harbor layout and spatial structure, there is a trend that port construction is transferred to coastal areas. Many old terminals with prime locations along the Huangpu River were built in the late nineteenth or early twentieth century. At that time, they played an important role in promoting the economic construction in Shanghai. Nevertheless, most of them are now moved from the inland river to the south bank of Yangtze River. The main reason is the narrow waterway and depth of water cannot catch up with the requirement of growing large-scale ships.

At the beginning of 1990s, the port administration decided to head for construction of an array of container terminals and carried out the old port reform as well as the aforementioned port transfer. During that period of time, several new large harbor districts were successively built, namely Zhujiajiao, Guangang, Baoshan, Luojing and Waigaoqiao district (see Figure 3-1). On the other hand, the old port areas along the Huangpu River stepped into functional readjustment stage: four main port areas, Nanpu, Yangpu, North Bund and Shiliupu, were put into commercial, tourist use or just green belt. The situation of Dongchang, Minsheng and Lanlu harbor districts is similar. Up to 62 docks between Yangpu Bridge and Nanpu Bridge were replaced by a series of waterfront entertainment zone for shopping, leisure or coastal activities.

From the perspective of layout, the harbor area in Shanghai completed the shift from old inner location to the mouth of Yangtze River. The port area extends to the Hangzhou Bay and the total area achieves over 3618 square kilometers. Its hinterland includes more than 20 provinces. Now, these ports along with Yangshan deep water port undertake the most of the shipping task in Shanghai.

In general, the port-city spatial relationship in Shanghai has entered the stage of geographic and functional differentiation, which means the new and old harbor areas are developing their own functions respectively to realize port and city evolution.

Figure 3-1 Port area and terminals in Shanghai (Drawn by author)

3.1.2 Development of Lingang harbor city and Yangshan deep water port

1) Introduction of Lingang harbor city

Lingang harbor city is a newly built harbor city located at the utmost southeast tip of Shanghai. The central living area of Lingang harbor city lies at the gathering point of Yangtze River and Hangzhou Bay. It is adjacent to East China Sea in the east, Chengsi Island, Da Yangshan and Xiao Yangshan Islands in the south.

There are four main districts in the Lingang harbor city. They are the industrial zone in the northwest, the heavy equipment & the logistics park in the southwest, the comprehensive zone in the north and the main city area including four communities in the south (see Figure 3-2). The objective for Lingang harbor city is to become 1) a

national scale manufacturing base of modern heavy equipment industry 2) an international production pivot with logistics service 3) a living community featuring ocean culture. A picture of an integrated industrial and living system is intended to be shown according to the plan (http://www.shharborcity.com/english/lingang.asp).

Figure 3-2 Lingang harbor city map

Source: http://www.shharborcity.com/english/lingang.asp

2) Introduction of Yangshan deep water port

Yangshan deep water port, a natural and international port blessed with 15-meter-deep water, is located between Hangzhou Bay and the mouth of the Yangtze River, about 27 kilometers away from Lingang harbor city and just 45 nautical miles

from high seas. It is planned to have over 30 berths with a handling capacity of 15 million TEUs when fully completed in 2020. The construction is divided into four phases. The first two phases were made to commence in 2002 and finished in 2006. They are currently operational, with 9 berths in total along a 3 km quayside. The third phase was scheduled in two stages with 7 berths and completed in the last month of 2008. By then, the northern port area had been essentially built and came into use, after which the focus of construction transferred from northern part to western area. Since 2009, another 10 to 12 berths have been under construction along a 4 km quayside which target 7 million TEUs and expected to be completed and put into use in 2013. It is sure that the construction of Yangshan deep water port is supposed to be an important footstone for Shanghai in the process of being an international shipping center (www.yangshanterminal.com).

3.2 Analysis of the new port-city spatial relationship

3.2.1 Relationship between Yangshan port and Lingang harbor city

Yangshan Deep Water Port and Lingang harbor city is connected by Donghai Bridge which spans over the north Hangzhou Bay (see Figure 3-3). According to the plan, Lingang harbor city is meant to be an auxiliary supporting district of Yangshan Deep Water Port. As the rear base and cargo distribution center, Lingang harbor city has its integrated function of cargo collection and distribution, processing, logistics, financial, living and entertainment.

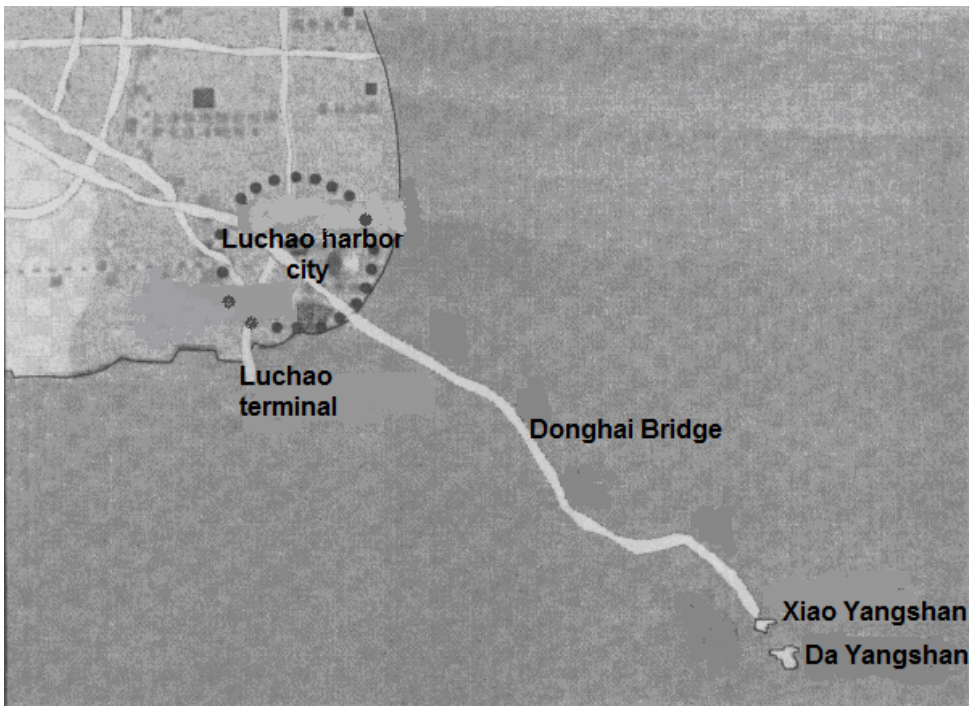

Figure 3-3 Location of Yangshan port, Lingang harbor city and Donghai Bridge

Source: Yangshan Terminal website. Drawn by author.

The logistics park in Lingang harbor city (see Figure 3-4) as the linkage between Yangshan deep water port and Luchao area provides comprehensive logistics solutions to the shipping operations from Yangshan port, which plays a key role in Yangshan-Luchao relationship. There are three main parts in the logistics park:

1) The distribution and storage area

The distribution and storage area covers an area of 5.9 square kilometers. It has inland transshipment area and dangerous goods storage area. Production companies or chain enterprises in this area are supposed to build their own distribution centers to complete their delivery or transshipment service. The ideal clients are those large-scale logistics enterprises with a solid financial strength and extensive network.

2) The international logistics area

The international logistics area covers an area of 4.1 square kilometers. It includes railway & container area and the international logistics area. The whole area is owned and managed by Prologis China Holding. All of the logistics network, facilities and technology are in accordance with the international practice to achieve the cargo flow exchange. Its overall goal is to serve international trade and multinational business. Besides, the warehouses and container yard in the area can be rented so as to attract world's top 500 to move in.

3) The land part of Yangshan free trade zone

The Yangshan free trade zone (land) covers an area of 11.4 square kilometers. It is responsible for port activity auxiliary, customs inspection and export processing. Cargo within this area enjoys the tax bonded and rebate policy. Customs implement rigid supervision to ensure smooth trade.

Figure 3-4 The logistis park in Lingang harbor city

Source: From Lingang harbor city website

In summary, the logistics park has a clear division of function and enough space for future development, with facilities meeting the international standards, all of which ensuring the smooth and efficient transit of goods from Yangshan port. Located between the heavy equipment Industry zone and the main city area, the Luchao logistics park plays a role of a good link between Yangshan port and Lingang harbor city in space.

3.2.2 Relationship between Yangshan port and Shanghai as a city

Construction of Yangshan deep water port to make Shanghai international shipping center is a major strategic decision made by the State Council of China. And it is also a key initiative to further improve Shanghai's urban functions and city's comprehensive competitiveness, as well as accelerate the economic, financial and trade development. Such a large project indicates that China is determined to solve the lack of deep water port in Shanghai which is the bottleneck plaguing China's rapid economic development. Besides, it shows the sincereness to fulfill the commitment of accelerating logistics infrastructure when China entering the WTO.

There is no doubt that the construction of Yangshan deep water port will definitely attract more of the third generation, fourth generation, and even larger scale container ships to directly call port of Shanghai. Shanghai will become a true hub of the world's largest container port addressing the problem of "congestion explosion" with annual 30% growth rate over the past three consecutive years.

However, in order to ensure the full implementation of plan that the container throughput of Yangshan deep water port must increase continuously, Shanghai International Port Group forces the carriers by means of administrative leadership to transfer their loading and unloading operation from previous terminals to Yangshan.

The carriers are often reluctant to accept the order because in that case the transit time and distance will be stretched which finally causes increase in costs. For this reason, a lot of ocean carriers choose port of Ningbo to call. With good environmental and geographic conditions (better than port of Shanghai, not far from Yangshan), port of Ningbo will be arrived 30 to 45 minutes sooner than the time of Yangshan. Certain amounts of container transport cost are saved.

The solution might be SIPG adjusts its management strategy: to increase more added value to Yangshan deep water port to truly attract oceans carriers to call. Or the city and its port could magnify the brand effect of Shanghai international shipping center to the best. Another alternative is to build strategic alliance with port of Ningbo. All in all, SIPG needs more research and thinking to handle the fierce competition from Port of Ningbo.

3.2.3 Relationship between Lingang harbor city and Shanghai downtown area

Lingang harbor city is 65 kilometers away from Shanghai downtown area, 20 kilometers to Huinan Town, Nanhui District, and 10 kilometers to Suburban Ring. Central living area is connected with downtown area of Shanghai by efficient traffic system, such as Expressway A2, Expressway A30 and Metro Line 11.

In the discussion on relationship between Lingang harbor city and Shanghai downtown area, a dual-core structure model should be introduced beforehand. The idea of dual-core structure model originated from Francois Perroux's (1950) "growth pole" theory. The "growth pole" was defined as "…centers from which centrifugal forces emanate and to which forces are attracted. Each center being a center of attraction and repulsion has its proper field, which is set in the field of all other

centers." Then a Chinese economist, Lu Dadao developed it to the "dual-core structure" theory with Chinese characteristics. The meaning of "core" in the case is similar to the previous concept of "growth pole".

Dual-core structure model illustrates a kind of spatial coupling relationship between two functional different cities within a region. To be specific, a port city and a regional central city in the same area are able to form a dual-core model to realize the local economic growth, since the two cores in this combination are complementary to each other in function and space. Supposing central city is dedicated to play its full role in one area with other factors being equal, the basic requirement is to be in the geometric center. However, the need to communicate with the outside area at the same time requires the central city located near the border area. Therefore, contradiction appears. To the central city, where to locate became a question. In this case, dual-core structure model perfectly deals with the problem and satisfies both of the needs. The coastal port center as one of the cores in the model handles the outside contact business and the city center as the other core focuses on regional business. To sum up, the dual-core structure accomplishes the organic combination of central as well as border tendency and proved to be effective and efficient.

Now turn to the case of Lingang harbor city and Shanghai downtown area, the relationship between them can be explained by the dual-core structure theory. The traditional Shanghai downtown area functions as internal-oriented and regional city center dealing with normal business such as politics, economics and cultural activities, while Lingang harbor city works as external supporting area in charge of shipping related activities and logistics solutions. It is very clear that the authority intends to realize the regional specialization and base on which to improve the efficiency of a metropolis's soaring. This kind of functional division strategy, in my

opinion, helps to achieve the local development balance to the maximum extent.

Chapter 4 Application of the pole-axis theory in Lingang-Yangshan spatial relationship

4.1 Introduction of the pole-axis theory

The pole-axis theory was put forward by Lu Dadao in 1984. It originated from the central place theory by W. Christaller. The pole-axis theory argues that the regional development theory is based on three factors: the point such as city, the lines such as traffic, and the surface such as hinterland resources. The difference between the theory of central place and the theory of pole-axis lies in that although the traffic factor is added to both, the central place theory still focuses on the point factor; however the pole-axis theory concentrates on the organic combination of the point and the line among which particular consideration is given to the line. Therefore, the regional accessibility can be regarded as innovation of the pole-axis theory, and facts show that the application of it turns out to be desired and ideal in Chinese regional development practice.

The main principle of pole-axis theory is to take ‘pole’ and ‘axis’ as basic elements to form a spatial network model to analyze national economy. Regional development is a dynamic process: always start with the development of some points (also called poles) and then extend in space along certain axes (traffic lines). Interweave of such axes ultimately forms a piece of network and generates regional economic effects. The poles in the case represent city centers, which have three characteristics: 1) have their own core leading industry as well as a set of industrial complex that highly

relevant to the surrounding areas 2) have prominent advantages in one area or several, such as technology or market advantage 3) equipped with a certain level of infrastructure. The axes refer to linear infrastructure links that connect various poles, including traffic lines, power and water supply lines, etc. They can be regarded as vehicles by which flows move. However, the nature of them is industrial development belt that rely on city centers. Thus axes usually have two characteristics: 1) carriers of a number of resources, products and labor services, not isolated single kind of them 2) must situated on the trunk of transportation in order to reduce the distance and save time

In the pole-axis theory, the pole and axis form a system and spur the regional development through polarization and diffusion effect. Generally speaking, the pole-axis system takes effect by reasonable organizing of population, capital, information and material flow in the process of growth. The polarization means cities rely on the advantage of resource concentration and thus boom themselves at the cost of their outskirt area development. This happens when the growth is in the early stage of the development. The economic imbalance is inevitable and temporary. When entering the advanced stage, as soon as the core cities reach certain level of size and strength, the economic growing effect will diffuse from inner to outside. That is to say the pole's prosperity will promote surrounding regional areas and the economy reaches a relative balance again. On the other hand, the move of economic flows is achieved through the axes. For this reason, the fluency and accessibility of the axes will influence the speed and effect of the regional progress. The high quality axes results in strong economic radiation. Consequently, those in a higher level of quality are often emphasized to be key development projects.

To conclude, establishment of pole-axis system can effectively promote regional

economic development by regulating its polarization and diffusion effect mechanism.

4.2 Application of the pole-axis theory for sustainable development of Lingang-Yangshan relationship

4.2.1 Political

In the early stage of Lingang harbor city, Yangshan deep water port, and even Donghai Bridge's construction, the whole project was driven and invested by the government. As the project progressed, certain amount of foreign investment is gradually poured in. Now the government is trying to play a guide role rather than an investor. In fact, the construction of Shanghai international shipping center is undergoing such an encouraging transition.

In order to guide the effective allocation of port elements to ensure a seamless network of different nodes in the port, the Shanghai Municipal Government encourages Shanghai International Port Group Co., Ltd. (who is managing Shanghai port) to establish capital bond with the Yangtze River Delta port industry group by means of horizontal merger or asset injection to build Luchao harbor logistics network. In terms of capital operation, either state owned or the form of joint venture is practicable.

However, considering national economic policies and social objectives in the market economy, it is necessary to set up an industry association. The industry association is neither dependent on government funding nor enterprise funding. It is like an intermediary between the enterprise and the government but has its own responsibility, right and interest. The duty of the association is to coordinate the requirements of enterprise and government policies, as well as provide services of

information, technology, external cooperation and vocational training, etc.

4.2.2 Economic

In terms of industrial cluster mode, there are four kinds of modes, according to classification of urban industrial structure and operational mechanism, for the new or developed areas to attract and sustain industrial clusters, namely, Marshallian Industrial District (local small businesses dominate the economy), Hub-and-Spoke Industrial District (individual large enterprises work as hub & suppliers and related activities work as spoke), Satellite Plat-form (large enterprises with headquarters outside the region and thus lack of long-term cooperation with local suppliers), and State-anchored District (government formulate the investment strategies and state public utilities dominate the district).

Modern cities often integrate several kinds of industrial cluster patterns. A mode could gradually shift to another over time. Although the four kinds of modes have the advantages of appealing to different production elements, the capability to handle the external economic challenges change with time and place. At present, Shanghai industrial economy can be divided by spatial structure into 1) Baoshan and Jinshan State-anchored District 2) Jinqiao, Hongqiao, Waigaoqiao and Zhangjiang Satellite Plat-form 3) the remaining regions are close to Marshallian Industrial District.

Begin with the project of Donghai Bridge and Yangshan Port phase 1, the construction of Lingang harbor city features government investment by majority with foreign capital participation, which is engraved “state-anchored” mark firstly. With more and more foreign manufacturers and logistics service enterprises stationed in Lingang harbor city, the “Satellite Plat-form” characteristic gradually shows up: The headquarters of these foreign-funded enterprises often located in the downtown area

or overseas so investment is decided by outside management board. The result is there is few long-term cooperation and commitment between foreign enterprises and local suppliers; instead there is frequent exchange with the outside region, including capital, technology, professionals and different kinds of commercial services. For this reason, it is hard to form local culture and characteristics. One important solution to work out the situation is that local government provides infrastructure or tax relief to encourage horizontal cooperation to lead the transition from Satellite style to Hub-and-Spoke style. The point is to convince the headquarters as well as their production bases to settle in Lingang harbor city. Hence, it is necessary to build a set of modern commercial buildings to meet the requirement of headquarter operations and regional R&D centers.

4.2.3 Social

According to Lingang harbor city construction planning, in 2020, it will show the world a picture of blue sky, green belt and clear water with over 300,000 resident population covering an area of 95 square kilometers. It is expected to bring a new look to the coastal area of Shanghai. On the other hand, the newly developed area and port will consume huge amounts of labor force and create a lot of job opportunities in Yangtze River Delta region.

4.2.4 Technological

With the social development, the proportion of information search costs to the total costs is increasing. The information search costs include searching a sufficient number of trading partners and get the information of their product design, quality, reliability and so on. This involves information searching technology. Enterprises can achieve it through their own organization or purchase from professional information searching companies. Figure 4-1 shows the advantage and disadvantage of different

kinds of information searching approaches.

Approaches	Advantage	Disadvantage	Applications
Professional information searching company	Low cost High seurity		Information require confidentiality & low cost
Enterprise search by itself	Highest information security	High cost	Absolutely confidential information
Industrial association searching service	Lowest cost	Low information security	General industrial and market information

Figure 4-1 Information searching approaches (drawn by author)

Information technology works as the bridge of communication among different parties. The selection of information search method will somehow influence the output of a company. For the professional information search organizations, it is important to increase the professional competence and service level. For company side, it is necessary to find out an appropriate method that exactly suits itself. In this way, smooth communication and active interaction can be realized between port and city as well as regional inside and outside.

4.3 Possible solutions and recommendations

The newly built Yangshan deep water port is put into use, however it encounter a lot of service problems like any other new thing does. To my knowledge, there could be three possible solutions to handle the current bottleneck.

1. Develop in all respect of container collection and transmission system of international shipping center

1) Optimize the way and structure of container transportation

The precondition of becoming an international shipping center is to keep container traffic flow unobstructed. No matter from which perspective, economic efficiency, system stability or environmental protection, the optimization of container transportation structure is one of the most effective way. So, the relative department should strengthen guidance and gradually increase the proportion of rail and water transport to improve the structure: the target is to make the ratio of road: rail: water to 70: 5: 25 in five years and reach 60: 10: 30 before year 2020 to form a real comprehensive container transport system finally.

2) Speed up railway and highway construction to new port area

On one hand, in order to improve the railway network, railway construction should be speeded up to form a major thoroughfare along the coast as soon as possible. It is recommended to construct railroad into the major logistics park and Waigaoqiao port area in the short term as well as Yangshan deep water port in the long term, to realize the “seamless” interface between water transport and railroad transport. Three tasks are: advance the level of inland waterways network, improve the navigation conditions and emphasis on the construction of backbone waterways.

On the other hand, containers are mostly transported by highway, and therefore the road network layout should be optimized and upgraded to adapt to container transport at the same time. It is necessary to increase external transport links and cross-river channels.

3) Establish logistics bases based on Yangshan and Waigaoqiao port area, Pudong

and Hongqiao international airport, as well as the railway, road and inland freight station, to promote the intermodal transport development. Propagandize the sea-rail intermodal transport and inland container transportation to attract more business from freight forwarder companies. Provide preferential policies to enterprises who are engaged in intermodal transport, such as tax incentives, loan interest subsidies and long-term low-interest bank loans, to encourage more enterprises to participate in the intermodalism.

In addition, make efforts to accelerate the research of ships for dual use of river and sea, to service Yangshan port and reduce the traffic pressure of Donghai Bridge at the same time. With the opening of Yangshan port, more containers are supposed to be transported from the Yangtze River ports to Yangshan port extension. Because of the different characteristics of river and sea, current inland river vessels can not directly enter into sea area according to the ship specifications and rules. The cargo should be transshipped to sea vessels, which not only increased the handling costs and transportation costs, but also reduces the transport efficiency. From an economic point of view, it is necessary to develop river-sea intermodalism, and it would be best if the container volume of dual-use vessel is between 100-400 TEUs.

4) Build intelligent transportation management system focusing on container transport. Based on highway network and information management system and by use of satellite positioning system, geographic information system, logistics information and network technology, the intelligent transportation management system is ought to effectively organize container transportation. It is necessary to strengthen EDI access facilities of Yangshan port, especially the information connection with ports in Yangtze Rive Delta so as to realize the real-time release of logistics information in order to maximize the port efficiency.

2. Strengthen the information network and become first-class digital port

Considering the special geographical conditions of Yangshan deep water port, advanced infrastructure and a sound information system are required to attract customers and improve operational efficiency. For sake of becoming a world-class digital port featuring modern information technology, Yangshan port should be equipped with a comprehensive information service platform, including infrastructure, applications and an emergency response center. The first sector, infrastructure, consists of machine room, network, server and so on. Applications include public data transmission system, customs-inspection-port interaction system, business support system and platform management system. Emergency response center mainly refers to video surveillance and command system to respond to Yangshn port emergencies in a timely manner.

3. Enhance the awareness of customer service and improve the quality of service

It is recommended to set up customer-oriented conception and always keep in mind respect for the customers. All port staff must establish and continually strengthen quality service to customers. This concept should be taken as a real sense of port culture meanwhile a more complete customer-oriented solution or mechanism should be worked out. A high-qualified and vital team is better than any hardware facility in satisfying customers which will lead to excellent performance. Therefore, it is necessary to provide training programs for the staff, especially frontline staff, to improve service level and set a good image of the port. In the training, the staff's look, attitude, behavior and language should be guided, as well as the interpersonal skill and the ability to handle emergency.

On the other hand, customer satisfaction and customer loss rate should be paid attention. Specific methods to improve the customer satisfaction could be: 1)

Establish standardized service processes. Each item of service should not be isolated and random but systematic and standardized. Besides, modern technology is required to guarantee the realization of the service process and workflow. 2) Offer the highest added value to customers. Customer satisfaction has a close relationship with their specific sense of which one could provide maximum product value. That is to say customers tend to choose the company who provides the highest added value. 3) Provide specialized service. Port should not only make product market segmentation but also make service market segmentation; not only carry out “one to one” sales, but also “one to one” service. It is important to segment customers and provide differential service. 4) Respond actively to customer complaints. The way port handles customer complaints somehow determine customers’ loyalty. In the era of customer’s market, the loyalty sometimes influences the future of a port. 5) Classify customer data and implement fine humane service. For example, today some companies send customers birthday cards or VIP tickets of concerts and performances according to different customer interest. These fine humane services usually make customers feel respected and superior, which subtly enhance brand loyalty.

Conclusion

Yangshan deep water port and Lingang harbor city is built to adapt to new needs for cargo handling and meet the “international shipping center” goal. This new kind of port-city relationship along with the traditional one constitutes a special present situation of Shanghai port, especially the dual core spatial structure, which is supposed to accommodate more worldwide shipping business and drive the regional economic development by use of pole-axis effect.

Yangshan deep water port as well as Lingang harbor city are constructed according to international standards, and the schedule is very well planned. However, the sustainable development of port-city relationship requires more considerations, such as the policy support, labor quality, the correlation and coherence between port and city, to name just a few. Further research could be done in these aspects.

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