Study on function evaluation and development directions of Chinese ports

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Abstract. The definitions of a port and of port functions under new circumstances were presented based on the traditional definition of a port, combining economic and social development demands. In order to fully recognize the current situation of Chinese port functions, an investigation into port functions was conducted in Guangdong, Hebei and Shandong etc. Taking the investigated ports as reference samples, generational characteristics, port importance, port throughput, proportion of foreign trade cargo throughput, proportion of container throughput and proportion of container throughput on international routes are chosen as the major investigation objects. Furthermore, qualitative or quantitative partition methods are employed respectively to assess the present situation of ports and development stage of Chinese coastal ports and major river ports. Finally, a basic framework of Chinese port service function system and future development directions are established, combining characteristics of Chinese ports and by drawing lessons from port functions developments in foreign advanced countries.

1. Introduction

The normative descriptions for the definition of a port appear in many laws, regulations and books, whereas in the traditional sense, a port always be regarded as a static and limited space, which only differentiates the specific space from other form. A port should be a dynamic concept of services, whose position, space, function of service and scope of service will change with the change of a series of needs. A set of ever-changing port services should meet the economic needs of the existing users to acquire service at the best performance-price ratio. It also need to meet the financial requirements of the investors to gain the optimal input-output ratio. And it ought to meet not only both existing and potential users’s commercial requirements to obtain service of convenience and completeness, but also port employees’s social requirements to work decently and safely as well. In addition, the requirements to develop in accordance with its community, city and surrounding environment in order to operate constantly and healthily should also be satisfied. The combination of the static space in the traditional sense and the dynamic service concepts mentioned above is the relatively comprehensive understanding of the connotation of a port.

With the economic and social development, some international ports gain increasing importance not only as the hub of transportation and logistics, but also as the frontier and source of innovation of managerial concept, innovation of means of service and innovation of business models with the inherent advantage of industry cluster and factor accumulation. Further, the innovations play more radiation and driving effect on the economic development of the hinterland through the port regional hub. For large international ports, the port definition is promoted further by not only being the joint of
comprehensive transportation, but also acting as a powerful support and enhancement engine of the regional economy. In order to fully recognize the current situation of Chinese port functions, in this paper the present situation of ports and development stages of Chinese coastal ports and major river ports were evaluated, and the future development directions were established.

2. The Comprehensive Evaluation of Chinese Port Functions

The United Nations Conference on Trade and Development (UNCTAD) drew lesson from generational classification of container ships and classified ports into four generations according to the port development characteristics, as shown in Tab.1. The first to third generation ports are differentiated by the richness of port functions, whereas the phenomenal diversity of a fourth generation port lies in the network. In addition, it should be noted that port generations belong to the scope of managerial concept, and develops with the social demand, which does not represent superior or inferior status. The development of port functions should adapt to local conditions and its demand situations rather than come beyond actuality or evolve blindly regardless of costs.

Table 1. Function characteristics of the port generations.

| Generation   | Function Characteristics                                                                 |
|--------------|-----------------------------------------------------------------------------------------|
| First Generation | Node of cargo loading and discharging: cargo transfer, temporary storage and dispatch. |
| Second Generation | Based on the first generation, industry functions are added and port becomes the center of cargo processing and service. |
| Third Generation | Based on ports of the first and second generation, port community is established to strengthen the link between the port city and port users; many services beyond the port scope are provided, integrated information service is provided as well, and ports become logistics platform. |
| Fourth Generation | Linked by the same operator or managerial organization; geographically separated port networks. |

To fully recognize the present situations of Chinese ports, an investigation on port functions and generation division was conducted in 24 ports in 10 provinces including Fujian, Guangdong, Guangxi, Hebei, Shandong and Tianjin etc. According to the investigation results, loading, unloading and storage are still the major functions of Chinese ports at present, in addition port-centered industry is of primary scale while the functions are relatively simple. A few main ports have already tried to take up modern service industries such as cold-chain, car logistics, trade, finance, consulting and so on. As the statistics of port generation division based on the investigation shown in Fig.1, the first-generation ports account for 13%, the second generation ports take up 79% and 8% respectively among 24 investigated objects. For 14 coastal ports, 86% ports are the classified as the second generation ports and 14% as the third generation ports; while among 10 river ports, 30% river ports are the first generation ports and the remaining 70% are categorized as second generation ports.

Figure 1. The results of investigation of port functions.

According to the division of port generations of UNCTAD, generational characteristics, port importance, port throughput, proportion of foreign trade cargo throughput, proportion of container
throughput and proportion of container throughput on international routes are chosen as the major
investigation objects. Taking the 24 ports mentioned above as reference samples, qualitative or
quantitative partition methods are employed respectively to each investigated object. Based on the port
statistics of 2014, a comprehensive evaluation is established of large-capacity Chinese coastal ports
and river ports, and the results are shown in Fig2.and Fig.3. Within 38 major coastal ports above scale
in China, a minority of ports (approximately 15%) still belong to the first generation ports, a majority
of ports (about 60%) have become second generation ports; while a few ports (around 25%) have
rudiment of third generation ports; port of Shanghai, port of Tianjin and port Dalian etc. are equipped
with some features of fourth generation ports by making efforts to establish their port service networks.
Within 25 major river ports in China, approximately 1/3 ports are categorized into the first generation
ports, and 2/3 ports show some characteristics of the second generation ports, and some specific ports
have become the second generation ports and shown some features of third-generation ports.

3. Weaknesses of Chinese Port Functions

3.1. Large scale of infrastructure, but few comprehensive hub functions
By the end of 2014, there were 31705 productive berths, among which 2110 berths had capacity of
over 10 thousand tons per annum (306 berths with capacity over 100 thousand tons per annum).
Though rapid progress was made in the scale of Chinese port infrastructure, comprehensive hub
functions of ports are not fully utilized. Collecting and distributing systems are not quite fluent,
seamless connection of all means of transportation is still absent, rail distribution system and rail-sea
intermodal transportation make sluggish progress, all of which restricts ports to develop and enhance
service for the economy and society.

3.2. Strong handling capacity, but limited capacity logistics service
Handling capacity of Chinese ports have been developing rapidly. Chinese coastal port throughput
reached 8.033 billion tons in 2014 year, with 22 ports over 100 million tons and 23 ports handling over
1 million TEUs. Compared to traditional handling industry, port logistics is still at a starting stage, for
traditional low-end activities such as transport, storage and handling comprise a large proportion of
port logistics functions. A complete logistics supply chain with ports as its core element has not
established, and ability to provide all-through transportation, professional and flexible logistics service
is still deficient and efficiency and degree of service of port still needs improvement.

3.3. Rich traditional port activities, but little derivative and value-added activities
Port functions, mainly cargo handling, storage and transfer, are relatively singular in China, still lack
derivative and value-added services. Port companies always weigh cargo quantity over customer
service, rather than dig into the service demand of customers. Value-added port services are still
developing passively, and services such as ship transactions, freight trade, freight derivatives are initiated recently with little international influence.

3.4. High operating costs and low profit of principal business
At present, port handling operation serves as the profit source for Chinese port companies. However, operational costs have climbed significantly due to the increase of land and labor prices as well as the mounting costs of berth operations, which diminishes the gross profit ration of port handling. Meanwhile, Chinese port companies lack both the ability and the desire of “going out” because of local protectionism, heavy burden of local construction and plan of self-development.

4. Development Directions of Chinese Port Functions
The period of rapid growth for Chinese port throughput has passed, while expansion of port service functions is the top priority for the transformation and update of Chinese ports. By drawing lessons from experience of port function evolution in advanced countries, with combination of characteristics of Chinese ports, the expansion directions of Chinese port functions are summarized as follows: starting from establishing Chinese port service function system, every port should expand its service functions and bolster port logistics and modern service businesses according to its positioning and actuality on the basis of strengthening port handling business.

4.1. Establish a port service functions system
To fulfill the potential of port resources and avoid homogeneous competition among ports, port functions positioning shall be taken into consideration at the level of port groups. Ports within the same group should take the road of differentiation and coordination so as to form distinctly positioned, clearly layered, soundly allocated, and concordantly connected service system (as shown in Fig.4.)

The fourth generation ports and the formation of international shipping center are closely connected to and complement each other. Therefore, Chinese ports aiming to become world shipping centers should make efforts to evolve into the fourth-generation ports in order to enhance international competitiveness and influence.

Major coastal ports and inland waterway maritime centers have already become the second generation ports and mature with the development of industries of the surrounding areas. A few ports show the rudiment of third generation ports by establishing bonded-area, bonded-logistics area, shipping exchange market and electronic ports so as to increase the ability of distribution and resources allocation. The development of third generation ports are closely connected with service needs such as international logistics and all-through transportation. Therefore, the above mentioned ports should endeavor to evolve into the third generation ports with features of modern logistics, commerce and information service with the aim of efficiency and convenience. Not only as a port of the municipality, but also as a comprehensive hub which drives the regional development and participates in international competition.

The functions of coastal regionally important ports, major inland river ports and regional important ports are not limited to pure port handling, but have already expanded to other industries and formed
some port-centered industry cluster. As a result, it is their function positioning that they bolster industrial activity and fuel the development of its city.

Ordinary ports are influenced by regional economy and development environment of the hinterland. Meanwhile, major needs of port clients lie in cargo handling, transfer and minor processing. Therefore, it is their priority to improve efficiency of traditional businesses such as port handling and storage in order to strengthen the status of port handling.

4.2. Expand port logistics functions
Based on the development of basic operations such as distribution and processing, a port should actively carry out professional logistics and advanced logistics shipping services, and strengthen its multimodal transport hub status so as to transform the traditional “port to port” service into modern “door to door” ones. Speed up the establishment of inland dry ports network with ports as nodal points to provide all-through logistics planning and multi-modal transport service.

4.3. Improve port service functions
To improve port service functions, it is necessary to improve the construction of e-ports, link the information platforms, innovate supervision models and improve clearance efficiency. Secondly, service functions of port should also be promoted by setting up bulk commodity trade and clearance platform and bringing up trans-border e-commerce and logistics finance. Furthermore, urging the development of modern port services and supporting ports to transit from manufacturing services to carry out leasing, information service, settlement of claims and ship brokerage, and expanding service functions of international cruisers base ports are also the measures which can enhance the port service functions.

4.4. Develop global service functions
With the aim of providing service to port-centered industries and boosting development of the municipality that surrounds the port, ports should actively seek the opportunity of “going out” to perfect regional and global cooperative network of ports through overseas investment and trans-country businesses, finally making a competitive and giant global terminal operator of multi-regional port operations.

5. Conclusion
At present, most Chinese ports still belong to second generation ports, and a few ones are categorized into first generation ports. Their major functions are loading and unloading and storage, which are relatively simple. As operating costs have increased year by year, port company profits are declining continuously. Some major ports have transformed into the third generation ports by conducting cold-chain and cars logistics services as well as modern services such as trade, finance, consulting and so on. By learning lessons from function expansion of ports in foreign advanced countries, the partition of positioning of each port as a shipping center, a major port, a regionally important port or an ordinary port is determined through the establishment of port service function system in China. On the basis of strengthening the activities of loading and unloading, Chinese ports should attempt to extend service functions according to its positioning and actuality, promote port logistics and modern services, expand the functions of multi-modal transport services, port service functions and global service functions. Meanwhile, qualified ports should try to evolve into the fourth generation ports.

References
[1] UNCTAD secretariat. (1999) Ports Newsletter. 19: 1-26.
[2] Zeng, Y., Yang, H.Y., Xiong, C.B. (2006) Study and Application of Harbor Function Evaluation Method. Coastal Engineering., 25:100-106.
[3] Yang, H.Y., Yu, D.Y. (2006) The Research and Apply of the Port Function's Evaluation Based on AHP- Fuzzy. Port Engineering Technology., 3:7-9.
[4] Huang, S.Q., Qu, L.C., Yu, S.Q. (2011) Clustering and discrimination of port function in China. Journal of Traffic and Transportation Engineering., 11: 76-83.

[5] Wang, N., Zhao, B., Yang, C.X. (2010) Essential characteristics and Evolution Law of Port Generation. China Harbour Engineering., 4: 74-76.