

# Optimal Management and Allocation of Superior Resources in Port Industries

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## ABSTRACT

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As marine trade and the shipments expand day by day, the port scale also increasingly enlarges; the resource staffing of port industries obviously increases; as valuable resources, the security management facilities equipped by port industries and authorities are wasteful and low in the customs clearance efficiency. Taking port industries and authorities as study cases, this paper describes the allocation and utilization of management resources of port industries, and proposes reasonable measures for optimization collocation of resources in order to reduce operating costs. The findings show that there is a big gap in the resource allocation structure and the customs clearance time between China and those developed countries. There are also different nature and allocation bodies of resources of the two. Driven by the conventions, policies, orders and markets, it is possible to achieve optimal allocation of resources, and reduce the consumption of human and financial resources. This paper provides a theoretical basis for optimizing security inspection and management of resources of port industries.

**ADDITIONAL INDEX WORDS:** *Ocean trade, port industries, equipment resources, optimal allocation.*

## INTRODUCTION

Port is not only an important hub for China's marine economy and maritime trade but also a marine outfall to China's integrated transportation. It enjoys a significant place of coastal defense (Munoz *et al.*, 2017). According to incomplete statistics, China's shipments in foreign trade have exceeded more than 77%, of which, container trade as percentage of the national total share reaches more than 95% (Zhang, Lumetta, and Chiu, 2011). For now, modern logistics in China still has a large gap contrast with advanced level in foreign countries, mainly embodied in logistics security supervision and logistics hardware facilities (Khalili and Chua, 2014; Tournier Goelzer, and Fromion, 2017). Inspired by the port-based development strategies, the China's port construction expands in scale day by day, and there is the surge of relevant management resources at various ports. Port industries actively develop the security works for port facilities, newly build some and replace many of the retired for security inspection and supervision, so that a more standard, scientific and effective management system is gradually established for defending port facilities (Monteiro, Azevedo, and Sztajnberg, 2013).

The fact that port industries are equipped with some supervisory units has greatly improved their defense and management level to effectively drive the development of them. As superior resources available at China's ports (Liu *et al.*, 2012), however, port industries and authorities will have a set of inhouse inspection and supervision equipment as the

customs, the border control station, and other authorities have, which leads to the wasting of resources. In this case, the optimal allocation and the sharing of resources of port industries and authorities, if available, can not only greatly improve the customs clearance efficiency, but also act as a key move to stimulate the development of port companies (Denktas Saka and Karatas Cetin, 2012; Francesco *et al.*, 2015). Taking port industries and authorities as study cases, this paper describes the allocation and utilization of port management resources, proposes reasonable measures for optimizing resource allocation in order to improve customs clearance efficiency and reduce operating costs.

## EXPERIENCE IN OPTIMAL ALLOCATION OF RESOURCES FROM FOREIGN PORT INDUSTRIES

Port industries as the counterparts of the port authorities develop some resources for the purpose of improving their own management level, while the port authorities are also equipped with management equipment to improve their own regulatory capacities. The developed countries have re-adjusted and re-designed the functions for port authorities, thereby to reduce the reallocation of management equipment (Yu, Chavez, and Feng, 2017). In the United States, management resources for port companies are simple, while in developed countries in Europe, some management resources relevant to production services will be available in port companies for optimizing resource allocation, and improving the port control efficiency (María, Morley, and Gunnigle, 2016). In Table 1, there are the types and purposes of inspection and supervision equipment for foreign port industries, mainly including video surveillance systems, X-ray freight inspection systems, container scanning inspection systems, radioactive detection equipment, metal

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Table 1. Types and main uses of inspection and monitoring equipment by foreign port enterprises.

Types	Main Application
Video Monitoring System	Real-Time 24h Security, Production and Port Monitoring, and Storage of Video
X-Ray Cargo Inspection System	Check Baggage and Cargo, Find Suspicious Items, etc.
Container Scanning Inspection System	Check Containers and Find Suspicious Items or Hidden People
Radiation Detection Equipment	Detecting Radioactivity in Vehicles or Cargo
Metal Detection Equipment	The Metal Substance Entrained in The Carry, Baggage or Cargo
Information Collection and Processing System	Information Collection and Transmission Related to Ships, Cargo, Terminals, Collection Vehicles and Their Operation

detection equipment, and information collection and treatment systems. Among them, the last information collection and treatment system enables the information acquisition and transmission involving ships, cargos, terminals, collection and distribution vehicles and their operations.

### SURVEY OF MANAGEMENT EQUIPMENT RESOURCES OF PORT INDUSTRIES AND AUTHORITIES

#### Superior Resources in Qingdao Port Industries

As one of the largest deep-water ports in China, Qingdao Port, suited in Jiaodong Peninsula of China, has excellent water transportation conditions. There are two port industries: Qingdao Gangqianwan Container Terminal Co., Ltd. and Qingdao Yuangang International Container Terminal Co., Ltd. The curves of the cargo throughput and foreign trade volume of Qingdao Port in 2012-2018 are shown in Figure 1. It is obvious that, except for 2015, the foreign trade volume and cargo throughput at Qingdao Port increase year by year. Chemical and manufacturing industries as the main structure of foreign trade are mainly dominated by container transportation. The management facilities at Qingdao Port have become an integral component for normal production and operation and administrative supervision of port industries. For resource allocation, port companies use the video surveillance systems, X-ray inspection systems, electronic access control and perimeter intruder detection equipment, etc. A list

Table 2. Qingdao port enterprise resource management equipment facilities list.

NO.	Security Equipment		Qingdao Port Enterprise
1	Video Security Monitoring System	Camera	392
2	Entrance and Exit Control System	IC Card System	2
		Port Transportation System	2
3	Intrusion Alarm System	Infrared Alarm System	1
4	Anti-Smuggling Inspection Equipment	Carbon Dioxide Detector	2
		Life-Detection Instrument	1
		Heart Beat Microseismic Detection System	1
5	Explosion-Proof Safety Inspection Equipment	Pro-ScanII	22
		Safety-Check	9
6	Guard Tour System	—	1

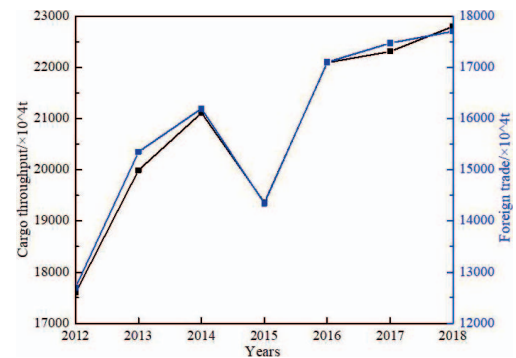


Figure 1. Qingdao Port cargo throughput and foreign trade volume curve in 2012-2018.

of the equipment and facilities for Qingdao port industries is given in Table 2. It could be said that the allocation of equipment resources is a great catalyst for the efficiency of port companies. As shown in Figure 2, the technical efficiency of Qingdao port industries in 2010-2018 showed an upward trend year by year, and Qingdao Yuangang International Container Terminal Co., Ltd reached a technical efficiency higher than Qingdao Gangqianwan Container Terminal Co., Ltd did.

#### Superior Resources in Qingdao Port Authorities

Port authorities include customs, marine bureau, entry-exit inspection and quarantine and frontier inspection station, whose management equipment varies from each other due to their different functions. They cooperate with the port industries. Both of them more concern the security responsibility supervision. Now, the surge of advanced facilities and convenient working conditions has contributed much to the innovation of customs clearance mode and the improvement of inspection efficiency. Port authorities perform their respective duties and have a clear division of labor to jointly offer service conditions for the foreign trade import and export businesses at the ports. The port authorities are service-oriented groups, while the port industries are profit-oriented. They have different bodies for resource management equipment, that is, the former develops it independently, while the latter depends on the government's investments in its construction. There are currently different forms of ownership of port industries including wholly foreign-owned companies, Sino-foreign joint ventures, domestic joint ventures, and solely state-owned

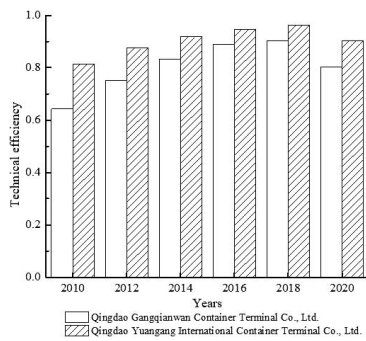


Figure 2. Technical efficiency level of Qingdao port enterprises in 2010-2018.

companies. Figure 3 shows the proportions of China's forms of port ownership. China's current forms of port ownership are mainly Sino-foreign joint ventures and solely state-owned companies. Figure 4 shows the average technical efficiency of port companies in different forms of ownership. As we see, the average technical efficiency of wholly foreign-owned port companies is higher, but that of the solely state-owned port companies is the lowest. That is to say, there is a large gap in the average technical efficiency between China and foreign developed countries.

### IMPLEMENTATION PROGRAM FOR OPTIMAL ALLOCATION OF RESOURCES FOR PORT INDUSTRIES

#### Necessity and Feasibility Analysis of Optimal Utilization of Management Resources

As a main transport mode of international trade, marine shipping takes the ports as an important carrier with the infrastructure constituting the node of the global logistics network. It has laid a solid foundation for the formation and development of the international logistics hub city. Port industries fully harness existing management facilities, tools and platforms to implement security supervision on port areas. Port authorities also deploy field supervision equipment as required by the national laws. From the current resource reserves, port industries and authorities all have inputs in the video surveillance equipment, so that the redeployment of it not only causes overlapping investment and construction but also waste lots of resources. If the

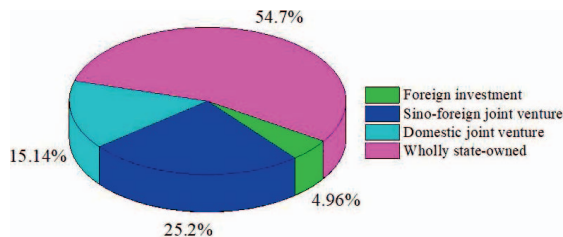


Figure 3. China's port ownership form ratio.

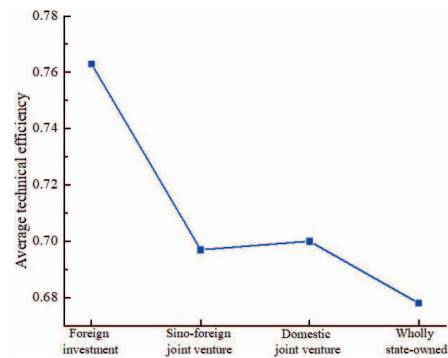


Figure 4. Average technological efficiency of port enterprises with different ownerships.

management facilities of both can be optimized and integrated to enable the information sharing between the two and improve the management quality of each division. In the last decade, the Qingdao port industries invest heavily in the construction of management hardware systems year by year, the number and variety of resources to be allocated have multiplied, which greatly improves the regulatory capacity. The inspection resources of port authorities have also been somewhat strengthened.

There is a competition game between port industries, where those who can timely seize the market opportunities will reap more profits. This game behavior can accelerate the process of optimal allocation of resources and improve the efficiency. The competition game of port industries is shown in Figure 5. For them, port cargo throughput and efficiency are regarded as baits for shippers, while policies and regulations have played a favorable support for resource integration and optimization, existing equipment and standards provide a good material basis for this strategy. There is also successful experience from China and foreign countries in this regard. Today, the developed countries led by the United States have succeeded in the optimal allocation of management equipment resources of port industries. The average customs clearance time slots at domestic and foreign ports are shown in Figure 6. As we see, the transit time of China's LCL (Less Than Contained Load) is obviously longer, and has a bigger gap contrast than developed countries, for example, Germany and the Netherlands.

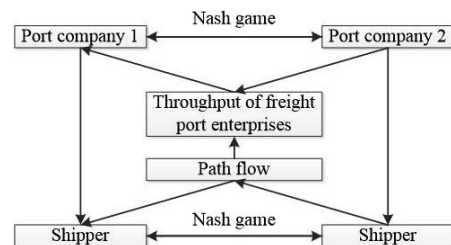


Figure 5. Port enterprise competition game.

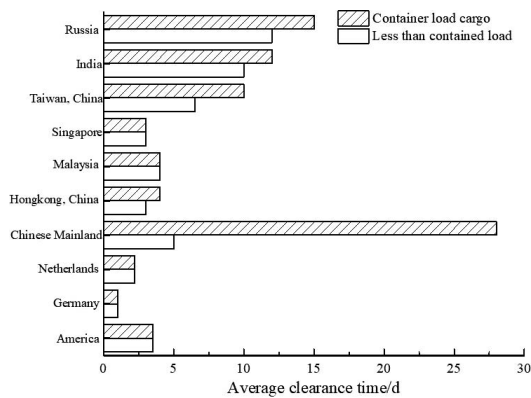


Figure 6. Average time of customs clearance at home and abroad ports.

### Optimal Allocation Program of Resources in Port Industries

Allocation of resources strives for efficiency, fairness and stability. How to allocate the resources is subjected to the decision makers' habits, commands and market? With an aim of integrating and utilizing the management equipment resources, optimal allocation of resources should be achieved to improve port operation efficiency and reduce human and financial consumption. The resource allocation management architecture, as shown in Figure 7, includes three components: management resource allocation preparation, resource optimization management solution, and supporting measures for resource optimization collocation. The optimal allocation of resources follows the principles of resource conservation and scientific development, effective supervision and efficient operation, the innovation technology and mechanism, and the cost reduction and efficiency improvement.

It is particularly important to deploy the personnel posts when optimizing the allocation of resources. The equipment integration reduces the staffing. The personnel deployment in port industries includes distributed and integrated posts, which correspond to the management and service divisions of port industries, respectively, as shown in Figure 8. When rationally optimizing allocation of resources, rational optimi-

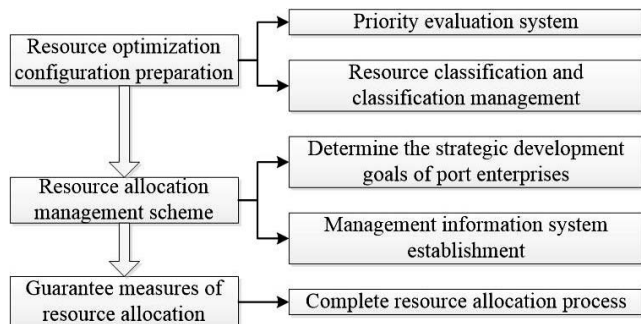


Figure 7. Resource configuration management architecture.

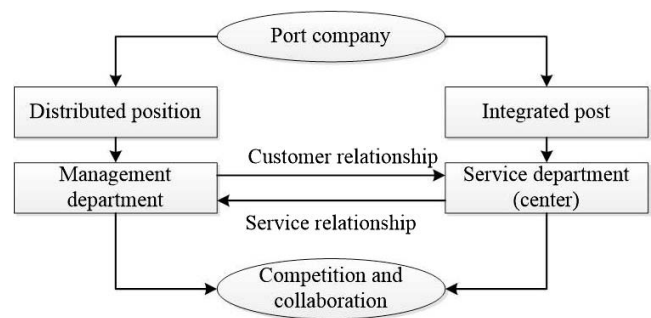


Figure 8. Post division status.

zation of post deployment is also an important measure to improve the efficiency of port industries.

### CONCLUSION

This paper describes the allocation and utilization of management resources of port industries and authorities. Some reasonable measures are developed to optimize the allocation of management resources in order to reduce operating costs. Here come specific conclusions:

The optimal allocation of facility resources, if available, can greatly improve the efficiency of port industries. The technical efficiency level of Qingdao port industries is on the rise year by year, and the technical efficiency level of Qingdao Yuangang International Container Terminal Co., Ltd. is higher than that of Qingdao Gangqianwan Container Terminal Co., Ltd.

There is a big gap in the average technical efficiency between China and foreign developed countries. Port industries and port-shore authorities are cooperative with each other. They have different bodies for management resource allocation. Advanced equipment and convenient working conditions have facilitated the innovation of customs clearance models to improve inspection efficiency.

Resource optimization allocation strives for efficiency, fairness and stability. It aims to integrate and utilize the management resources, improve port customs clearance operation efficiency, reduce human and financial consumption, and achieve the allocation of high-quality resources.

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