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Xiamen Port bulk cargo collection and distribution systems optimization

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Xiamen Port Bulk Cargo Collection and Distribution Systems Optimization

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DECLARATION

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

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

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Supervised by

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ABSTRACT

Title of research paper: **Xiamen Port Bulk Cargo Collection and Distribution Systems Optimization**

Degree: **Master of Science in International Transport and Logistics**

The function of a port which realizes the corporation between port area and economic area is fulfilled through various modes of transport, that is to say, the connection between a port and a hinterland is realized through port collection and distribution system. The increasing total throughput is contributed by the development of the transport connection between port and hinterland, which enlarges the advantages of port transportation through the collection and distribution system optimization. Port collection and distribution system is the basic condition for port development, and is an important factor for a port to develop its functional hub, and enlarge the scale of the related hinterland. This will form the competitive advantages for ports via the perfect collection and distribution system. Port bulk cargo collection and distribution system optimization is an important step to increase the accessibility for the port area. A completed bulk cargo collection and distribution will decrease the probability of errors caused by man-made unreasonable cargo operations, thus it will reduce the operating cost like time, capital, labor, bulk cargos, and the fuels cost of transport. The aim of the optimization of port bulk cargo collection and distribution system is to construct the optimized bulk cargo transport system connecting port and hinterland logistics resources, aiming at increasing the efficiency for port bulk cargo transport and the reasonable transport routes arrangement through the systemic study, which will decrease the cost of resources utilization and human efforts in the whole procedure of bulk cargo collection and distribution transport. It is not only related to the economic development for a port, but also the bulk cargo transport efficiency for a city.

Key words:

bulk cargo; collection; distribution; system; transport; optimization

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1. Introduction of the thesis

1.1 Background of the thesis

Xiamen is a port city with its highly Export-Oriented Economy, facing the challenges of its economic growth mode, and the economic developing space. These challenges are brought along by the economic development of global market. Thus, Xiamen needs an evolution of economy that donates to the import and export trade business. Meanwhile, the government of Xiamen has decided to declare the Xiamen Free Trade Zone project to central government, which will promote the advanced economic evolution of Xiamen.

The setting of Shanghai Free Trade Zone is the trend of responding to the development of global economy. This is a chance for a city to grasp the opportunity to perform its competitive advantages in global import and export trade. It is well known that free trade zone will contribute to attract more global trades, which brings about more business opportunities for enterprises, and will drive the economic development of a city. After Shanghai has been the pilot free trade zone, the benefits that the new policy shows have attracted the attentions of many governments in different cities of China, like Tianjin, Chongqin, Zhoushan, Qianhai (Guangdong Province), Hengqin, and also Xiamen, etc.

It can be seen from the previous data in 2013 that the degree of Foreign-Trade Dependence of Xiamen was 176%, and in the same year from January to November, the import and export trade amount of Xiamen reached 78.6 billion USD, occupying 50% of the foreign trade amount of Fujian Province. It is also important for Xiamen's economic development indicators that 75% of Xiamen container throughput is from foreign trade containers.

In order to grasp the opportunities that free trade zone provides in the future, a series of policies have been applied in the city construction and the port construction and optimization. One of the great projects is the establishment of Xiamen Container Terminal Group Ltd. Company, with the total investment amount of 1.14167 billion USD. The container terminal group consists 7 main Port and Trading Companies of Xiamen, which means a great horizontal integration of Xiamen Container Port Enterprises, and improves the competitive advantages of Xiamen container port in the southeast China.

However, not only the container business, but also the bulk cargo trade should be contained in the city development plan. It is because the total throughput of Xiamen port is not simply donated by the container business development, the bulk cargo import and export trade is also an important factor affects the throughput amount and the trading efficiency. One of the important approaches to increase the bulk cargo trading efficiency is to improve the transport mode, which will be reflected in the collection and distribution system optimization for bulk cargos.

Bulk cargo collection and distribution system is an important step within the port development in both foreign countries and China. The ability of bulk cargo collection and distribution system will affect the development of port throughput directly, but there still exist some basic transport planning problems like the lack of structural diversity of transport network, the low utilization rate of highway transport, etc. Thus it is necessary to optimize the collection and distribution system for bulk cargo transport of Xiamen port.

1.2 Research purpose

It lasts for several years that the problem of structural diversity shortage for Xiamen port bulk cargo transport, and the problem of low development level of collection and distribution system within the hinterland has caused a series of influences like the loss of source of goods. Moreover, the limitation of the scale of hinterland has imposed restrictions on the further development of Xiamen port. Xiamen has been authorized as the International Shipping Centre of the Southeast China, which will brings along more import and export trade opportunities for Xiamen port. However the shortage of collection and distribution system in bulk cargo transport influences the whole operating efficiency for Xiamen shipping centre, thus it is important for Xiamen port to conduct a scientific approach in the strategic planning for port bulk cargo collection and distribution system.

In this thesis, the purpose of analyzing the Xiamen Port Bulk Cargo Collection and Distribution Systems is to study a modern systemic approach within the macro and micro logistics system design, which contains the logistics enterprises alliance, logistics resources integration, information technology, E-Commerce functional application, and the fourth-party logistics platform establishment. And all of these methodologies are based on a efficiency-oriented mechanism in logistics models. Logistics system modeling and the feasibility study of the comprehensive port logistics mode will be analyzed in detail under the current situation of the bulk cargo transport of Xiamen, and the optimization models for collection and distribution system will be presented in the thesis.

The optimization for Xiamen port bulk cargo collection and distribution system will solve the basic transport problems for collection and distribution system, make it possible for Xiamen to take full advantages of international shipping centre to attract

more shipping business, and form a basic bulk cargo inland transport structures for Xiamen island to enlarge its related hinterland. It will also contribute to the further comprehensive development of Xiamen port as an important hub in the southeast China.

1.3 Literature review

1.3.1 Research background

Xiamen is a coastal city located in the south China with its advantages of both geographic and economic status. Xiamen is facing a series of city development especially the port evolution, which will attract more investment and maritime business. The government is taking several effective approaches to optimize Xiamen port's logistics systems and the inland-connected transport network, such as the application of IT technology and other modern methods to make Xiamen port a modern transport centre of the southeast of China.

1.3.2 Existing problems in Xiamen port

When the container port is applied new policy to enforce the throughput capacity, the bulk cargo terminal of Xiamen island still existing some logistics problems waiting to be addressed in the future. For bulk cargos ,there are many restriction factors. For example, the hinterland of Xiamen is still not enough for some bulk cargos import trading, like the stone material, which has been attracted to Quanzhou Port of Fujian Province to conduct import business. Another example is the grain import trading amount is less than the demand of citizens of Xiamen with a net shortage of 75%. Although the biggest deep water bulk cargo terminal of Xiamen Bay has been started since December 27th, 2012, some logistics system problems involved in the bulk

cargo transport still exist. One of the problems is the logistics management problem, which is reflected in the un-integrating logistics resources, and the lack of planning for logistics enterprises cooperation. Another problem is showed in the un-integrating logistics networks, which needs an optimization with the application of multiple logistics system of information systems technologies.

As two of the most important logistics activities of bulk post, Collection and Distribution play the vital role that connecting the bulk cargo terminal and the inland with different logistics services, which means the efficiency of collection and distribution will affect the port logistics system operation directly. The systemic control of and the application of IT technology in collection and distribution will contribute to the port operation with logistics system optimization.

1.3.3 Recent research of port logistics system related areas

Both of the overseas and Chinese scholars have done a lot of research of logistics or logistics systems since logistics become one of the most important service industry. In the research of port collection and distribution system (or collecting and distributing system), the basic model is based on Chinese bulk port logistics system, thus the emphasis is put on Chinese port logistics situation on this aspect, especially the collection and distribution systems of Xiamen bulk cargo port status.

As it is cost control- and system efficiency-related for the thesis, the research not only considers the development of modern logistics mode and the port collection and distribution system evolution, but also considers the cost driving factors and the cost control methods under different logistics environment. Nevertheless, the emphasis is put on the port logistics efficiency optimization approach analysis, thus the research are all related to the port, logistic, collection, distribution, cost control,

environmental-friendly, supply chain efficiency, logistics system, and some new concept like E-Commerce platform and logistics information feedback system are also involved in the research.

First, the research on the traditional logistics development and the common logistics mode-Third Party Logistics (3PL) is abundant. Hee-sung BAE,(2012), JI Ming-Jun and CHU Yan-Ling (2012), WANG Chuan-xu (2008) and Zhang Weixi, Xi Tianyu andZhang Ruifeng (2011), demonstrate the efficiency of traditional logistics or port logistics network or systems through real cases or simulation. In Hokey Min and Hyun-Jeung Ko's article (2008), we can see that with the ongoing cost pressures in logistics industry, more and more third-party logistics providers (3PLs) have begun to find the approach to manage product returns in a more cost-efficient manner without extra expense. Another research about the cost-efficient study of Chiang Wang (2010), is emphasized on the applying Just-In-Time system into 3PL platform and supply chain management to increase the logistics frequency. In R. Rajesh, S. Pugazhendhi, K. Ganesh, Yves Ducq and S.C. Lenny Koh's article (2012), we can see that they demonstrate the functions or activities of 3PL services like warehousing, transporting, packaging , and also customer clearance, billing as the same as tracking and tracing, etc.

Second, the new development model for logistics is focusing on the Fourth Party Logistics (4PL). In order to reduce the logistics cost, Qiong Liu, Chaoyong Zhang, Keren Zhu, Yunqing Rao study the 4PL in their recent research (2014), and in their research they applied a "multi-objective scheduling model" to minimize the total operational costs, thus saving the finishing time and decrease the tardiness of all logistic tasks in 4PL. Also in the research of 4PL efficiency, Min Huangi, Yan Cu, Shengxiang Yang, Xingwei Wang demonstrated in their research (2013) that 4PL has the power to integrate the supply chain, which attracted attention in many fields

among logistics increasingly, and is an important role in modern logistics. Moreover, Gulcin Buyukozkan, OrhanFeyzioglu andMehmetSakir Ersoy evaluated the 4PL operating model in their research (2009), and concluded that 4PL network is important which manages the logistics operations with the original 3PL enterprises and the companies provide the logistics information technology.

Third, supply chain is a new concept derived from traditional logistics. In port logistics system, ports and terminals are an integral part of supply chain, which is demonstrated in the research (2009) of Jose Tongzon, Young-Tae Chang andSang-Yoon Lee. In the research (2011) of port connectivity in supply chain system, Jasmine Siu Lee Lam andWei Yim Yap presented that a port is a node in such system intersect hinterlands, and the performance of a port will impact the port economic development and the competitive advantages of its users directly. Jianfeng Li, WeiHang Li and Yan Lin conducted an analysis called Port Supply Chain Simulation Model under Interactive in 2011, and used simulation to prove that partial efficiency increasing in port logistics might not make the overall improvement for the dynamic supply chain. In the view of the research conducted by Gul DENKTAS-SAKAR and Cimen KARATAS-CETIN, they concluded that for port authorities it is better to undertake the collaborator and integrator role through the approach of developing platforms promoting collective action and controlling and managing the common benefit of different stakeholders regarding the port logistics issues.

Fourth, the concept of Green Logistics can be seen in Ceren ALTUNTAS·Okan TUNA, aiming at reducing environmental effects of logistics activities through developing a green industrial buying model for logistics centre. Also in the research called *Operation Research for Green Logistics* (2012) from Rommert Dekker, Jacqueline Bloemhof and Ioannis Mallidis, discusses the contribution of operation research to green logistics which includes the environmental aspect integration within

the logistics. In Rickard Bergqvist's and Niklas Egels-Zandén's research (2012), they focus on the port logistics from an environmental and social point, regarding the port logistics play a key role in transshipment hubs.

Fifth, the logistics cost control related researches can be find in the study of integration of cost control system and information technology (2012) of Adam S. Maiga, Anders Nilsson and Fred A. Jacobs, which aims at using modeling to show the IT technology's contribution in the cost-efficiency and the increasing in organizational financial performance. In the study of storage cost management of Shi Xiaodi (2013), the writer demonstrates the different cost control methodologies and the optimal approaches for storage logistics cost control. In Wu Jingtai and Yao Pengli's research (2013), they applied the factor analysis to study the logistics system cost control mechanism, using matrix to record particular logistics cost within the modeling analysis.

Sixth, the important part of the thesis is the port logistics with its cost-efficiency analysis, and the optimal design for modern port logistics mode. Writer JI Ming-Jun and CHU Yan-Ling have studied the optimization for port logistics network of dynamic hinterland in 2012, and in the same year, writer Chen Tao, and Yang Liu studied the cost control of port logistics enterprises with the approach of activity-based costing to analysis the relationship among different cost variables similar to the study of Lin Suyan who studied the activity-based costing approach in port logistics firms (2012). In the same research direction, the simulation and modeling of port logistics system from the assay written by Geng Wenqian, Zhang Ziliang, Bian Huiting and Li Wenpeng in 2012, and the port logistics development study for China can be seen in the research conducted by Jiang Shunjie and Fan Zhen, using the systemic analysis methodology. For port logistics efficiency development, relative research can be seen in Li Diansheng, Zhang Shengze and Yuan Lifen’s

research (2013) , Song Xiaozhong and Liu Xiangmin's research (2013) about port logistics status development, Ma Junwen's research (2013) about port logistics driving factor analysis, and other promotion-related countermeasure research like Wang Zhixin, Zhang Weifa and Wu Yang's analysis (2012) based on China port situation. Another research like the port logistics SWOT analysis of Ma Jinfeng(2013) is also suitable for the analyzing part in the thesis as a good example for SWOT methods.

Seventh, as it is the new direction for port logistics development, information technology and new E-Commerce mode would not be excluded from the logistics system optimization. In Chen Zhikun's researchin 2013, we can see the writer suggested a port logistics information system framework, using XML technology and network techniques to analysis the IT approach applied in the port logistics optimization. This can also be seen in Li Kexue's research (2013), about the application of data chain technology in smartport logistics system. Some e-Commerce related report can be found in the journals like Journal of Shipping Management, in which shows an assay about development Strategy of modern port logistics and e-Business (2011). Also in a government report, the article about Qingdao Port established modern logistics e-Business platform (2008) demonstrated the process of port logistics resource integration and the advantage of this integration by using e-Business had brought along. One of the PowerPoint resource online called the Application of Port e-Commerce(2012) uploading by Rmoyes discussed the concept of traditional logistics activities to port logistics and analysis the competitive advantages that the application of port e-Commerce created. Moreover, in Wang Jingmin's research (2011), the writer analyzed the informationalized port logistics development strategybased on the mode of e-Business.

Eighth, the main part of the thesis is the research on port collection and distribution

system. In the research of port distributing and collecting system, Zhang Shengxian (2008) analyzed the existing problem and structures of port distribution and collection system, and used a model of integration of port, cargo handling and transport routes to optimize the port collection and distribution system. Another research about port collection and distribution system (Huang Xiaomin, 2008) analyzed the overseas port collection and distribution system development and tendency. In Li Jufang (2013)'s research, the writer suggested the application of information technology for project management in port's collection and distribution system. In ZHANG Yu-qin，ZHOU Qiang and ZHANG Yan—wei's research, they applied the simulation for comprehensive port collection and distribution system to optimize the system efficiency.

1.4The framework and content of the thesis

The first part of the thesis is the introduction of the research of Xiamen port bulk cargo collection and distribution system with its study background, literature review, research purpose, and the problems exist in the collection and distribution system.

The second part will introduce the current macro situation of Xiamen port bulk cargo collection and distribution systems with its characteristics and status, and also will study the factors restrict the logistics development of bulk cargo transport in the city.

The third part is the efficiency analysis for macro port bulk cargo collection and distribution system, which will study the characteristics of the collection and distribution transport mode, and the modern factors affect the collection and distribution system.

The fourth part is the possible solutions for Xiamen port bulk cargo collection and

distribution system in both macro and micro methods, including two important resources integration and transport network optimization. In the macro and micro resources integration solution, it includes the horizontal integration and vertical integration, and a series of typical examples are showed and analyzed in the chapter.

The fifth part is the logistics integration optimization model design of bulk cargo collection and distribution system, including the combination of vertical, horizontal integration, the usage of IT technologies and the system combination. The optimization design is divided into four modules with detailed processes demonstration and interpretation for their different functions. Following with the modules analysis it the simulation of the whole bulk cargo collection and distribution transport process within the optimized modeling systems, which will present the theoretic optimal processes of bulk cargo collection and distribution transport business. At the end of this chapter is the feasibility study for the optimization of Xiamen port bulk cargo collection and distribution in four aspects-technology and system feasibility, operation feasibility, economic feasibility and resource feasibility.

The sixth part is the final conclusion for the whole dissertation.

2. Current situation of bulk cargo collection and distribution system of Xiamen Port

2.1 Characteristics of port cargo collection and distribution systems

Cargo collection and distribution system is a kind of transportation system, aiming at providing a service of collecting and distributing port cargos, which connecting the port, railway, inland road, and other related transportation hubs. Collection and

distribution system is an important channel for the linking of port and the economic hinterland for a city, playing an important role in the development of a port and the local economy.

The macro and micro characteristics of collection and distribution system varies from different ports, based on the condition of transportation direction, routes distribution, geographical location, economic factors of hint land, etc. It will be more complex for the distribution structures of collection and distribution system if there is more routes connecting the port with the hint land, and the long distance of transportation will also affect the pattern of the collection and distribution system.

2.2 Xiamen port bulk cargo collection and distribution system status

Xiamen port bulk cargo collection and distribution system is the dual-directional transport system from the inland cargo transport to port cargo loading and discharging operation, including the distribution of ashore cargo at port, and the whole transport system of cargos collection from hinterland to port. That is to say, the bulk cargo collection and distribution system is to transit the import cargo to the port, and stow the cargos at the dock or the nearby storage yard, this is called the function of collection; and the distribution is another function, which discharges the import cargos from vessels and stow at the storage yard or distribute through machines like conveyor belt or transport through cranes, pipes, etc.

The bulk cargo collection and distribution system can be classified as three parts-the external collection and distribution system, the collection and distribution connecting system, and the internal collection and distribution system. The external collection and distribution system is the transport system composed by different modes of

transport, like rode and railway, and highway. The collection and distribution connecting system is the system connecting the port area and the inland transport, including the railway entering the port, the rode way to the port, and other transport-connected facilities. The internal collection and distribution system refers to the internal fundamental facilities like the berth, handling technology, the collection and distribution routes, and the information management technology of collection and distribution system.

2.3 The structure of Xiamen bulk port collection and distribution systems

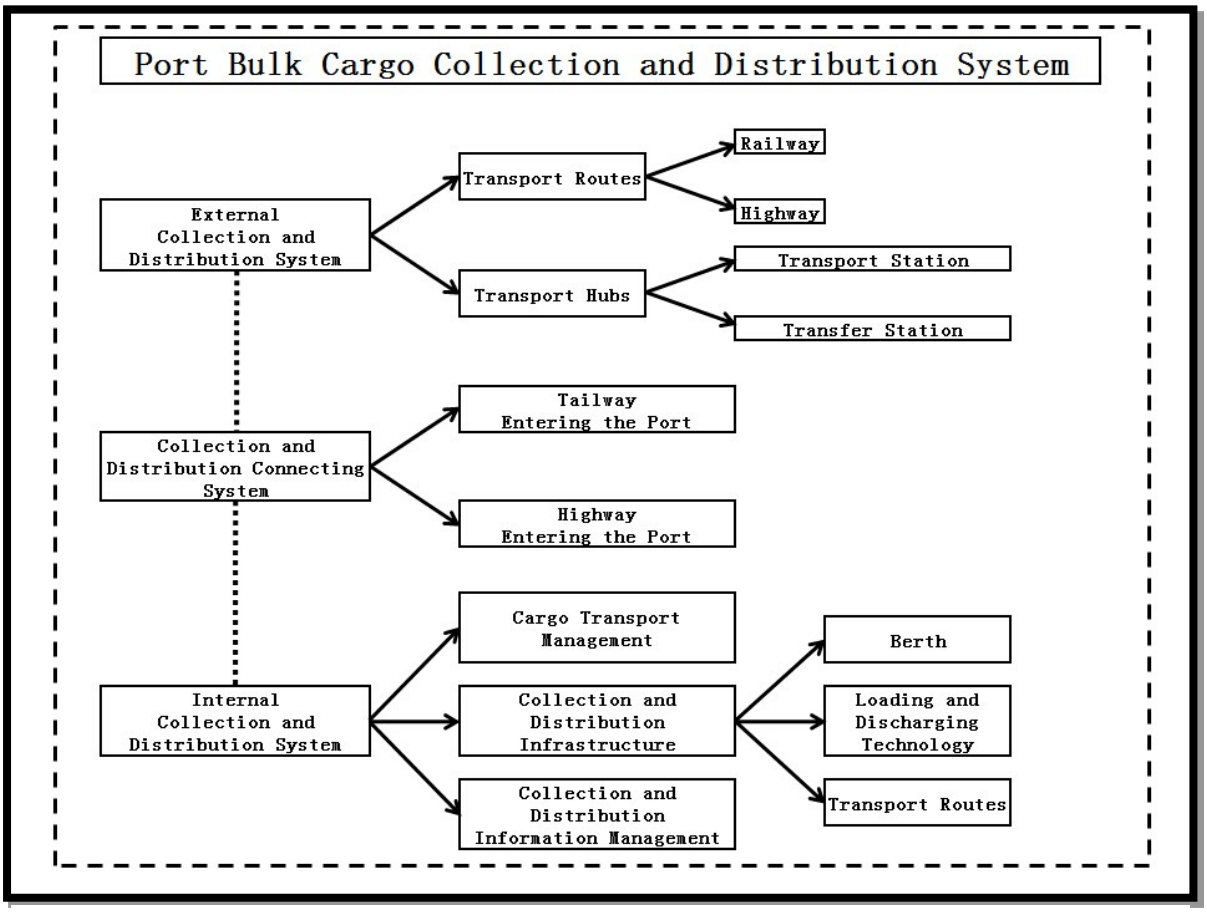

Figure 1 The macro structure of port bulk cargo collection and distribution system

The three parts of bulk cargo collection and distribution system fulfill the normal operation of the whole collection and distribution system. The external collection and distribution system focuses on the construction of transport network with inland transport. The internal collection and distribution system focuses on the port area operation management. And the connection system focuses on the connection between port area and the inland transport through the linking of time and space. The Figure 1 shows the macro port bulk cargo collection and distribution system.

2.3.1 External Collection and Distribution System of Xiamen Port

The external collection and distribution system network refers to the transport networks within the hinterland of the related port and city. It is in the hinterland that different kinds of transport modes consist the comprehensive transportation system with multiple routes and hubs, and completed technologies and infrastructure. With the development of transportation industry, the modes of transport are being gradually developed to a high coordinating level, which has formed a series of transport alliance among railway transport, highway transport, waterway transport and air transport. This will compose a consolidated transportation system for a city.

2.3.1.1 The transport routes of Xiamen port bulk cargo collection and distribution system

a. Railway transport

Because of the geographical factors that Xiamen is an half island with not enough area for the internal island, the direction of cargo transport for Xiamen port is to transport cargos to the external island to the other four districts of Xiamen-Tong An district, Hai Cang district, Ji Mei district, Xing Lin district and Xiang An district.

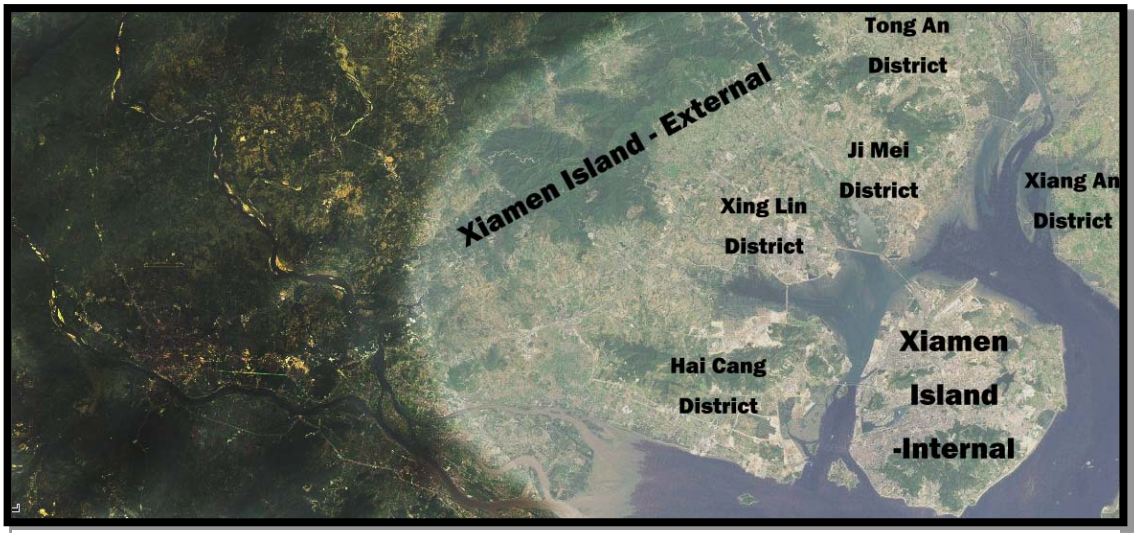

Figure 2 The geographical location of the internal and external island of Xiamen

The Figure 2 shows that the mainland of Xiamen is the internal island, and the external island of Xiamen consists of four district. Most of the industrial area are located in these 4 district, and among them, there is only on bulk cargo railway transport routs go through Xing Lin district.

Figure 3 Two bulk cargo railway transport routes of Xiamen

This figure 3 shows the main railway mode of Xiamen bulk cargo transport. The red line is the main railway across the external island of Xiamen, and the line ① and line ② is the branch of the main railway line, which transport bulk cargo from two port areas of Xiamen.

b. Highway transport

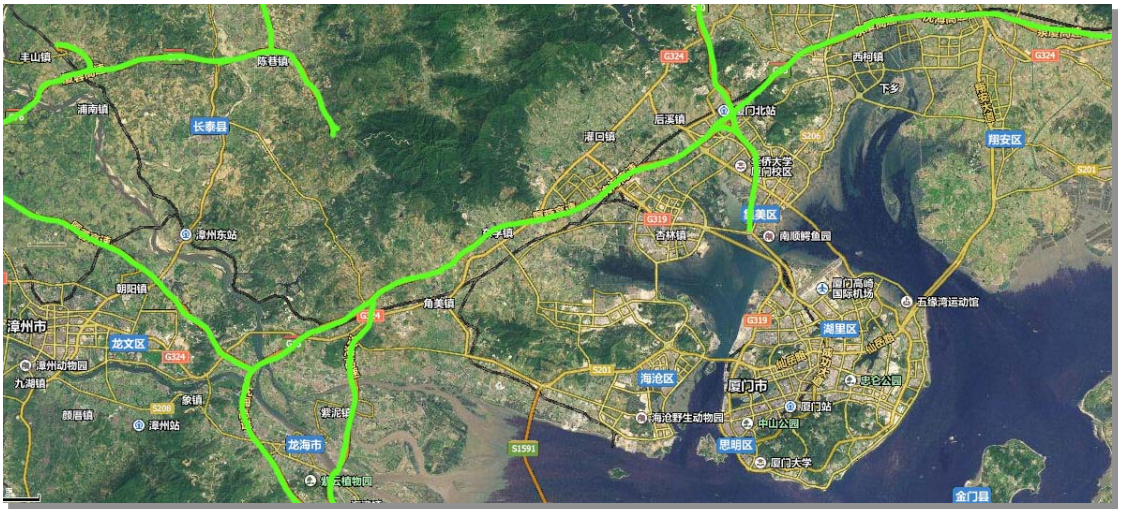

Figure 4. Highway transport routes across the external island of Xiamen

The green line represents the main highway transport across Xiamen. The figure 4shows the highway transport for Xiamen and the nearby city Zhangzhou. It is obvious that there is no highway transport network in the internal island of Xiamen. The main rode of the highway line is directly running across the four external district of Xiamen, and connect another city at the west of Xiamen island.

2.3.1.2 Transport hub of Xiamen

The transport hub is composed of more than two transport routes through their intersection and connection. A transport hub has several functions like organizing transport, transferring cargos, cargo handling, warehousing, providing transport information service and other comprehensive activities.

There are two concepts for the Transport hub of Xiamen bulk cargo transport. One is the geographical meaning that the hub is the intersection of several transport routes with the same of different transport modes. Another one is the meaning of service function which provides different services for freight transport, like the bulk cargo handling, transferring, and warehousing.

At present, there are many different types of transport hub in Xiamen, dealing with

the bulk cargo handling, transferring, warehousing and other related activities. Because of the geographical limitation in the internal island of Xiamen, the transport hubs for Xiamen are playing an important role in raising the transport efficiency for bulk cargo transport for the city. There hubs connect with the hubs located in the external island of Xiamen, which forms the completed transport hubs network for the internal and external island.

2.3.2 Collection and distribution connecting system

The function of bulk cargo collection and distribution connecting system is to realize the closed connection between the internal transportation and external transportation, aiming at decreasing the frequency of cargo handling during the whole process. Generally speaking, most of the bulk cargo ports have their own dedicated railway entering the port, which contributes to the sea-land combined transport. Also the highway entering the port is good for the connection between the port and the external transport, which forbids the additional handling procedures. Both of the two transport modes will realize the reduce of time and transport cost.

2.3.2.1 The railway entering Xiamen bulk cargo terminal

The port railway consists of the internal route and the external route. The external route includes the dedicated routes and the port railway station, and the internal route includes the train yards, connecting routes and cargo handling routes, etc. For two main bulk cargo terminals of Xiamen, the transport mode connecting with the external routes of Xiang Yu terminal is the railway transport, while the Hai Cang terminal enjoys the benefit that both of the railway and highway transport brings.

2.3.2.1 The roads entering Xiamen bulk cargo terminal

The roads of port can be classified as the external road and the internal road. The

external road is the road connecting the port area and the urban districts. It is the way to the port or terminal, with the function of bulk cargo distribution. On the contrary, the internal road is the main routes for the transport of cargos dealing in the port area.

For Xiamen port, both of Xiang Yu terminal and Hai Cang terminal have completed internal roads for bulk cargo handling in the port areas. However, when it is referring the external roads, Xiang Yu terminal relies on the urban roads of internal island of Xiamen city, which has been set a series of limitations for trucks transport. Unlike the restricted problems that Xiang Yu terminal faces, Hai Cang terminal does not have such limitation with external cargo distribution. Hai Cang terminal is located at the Hai Cang district of Xiamen's external island, of which the transportation planning is better than that in the internal island. Thus Hai Cang terminal owns more transport areas, and the external transport for this terminal will be more efficient than the operation of Xiang Yu terminal in the field of highway transport.

Figure 5. External road transport of Hai Cang terminal and Xiang Yu terminal

The Figure 5 shows the main routes of two bulk cargo terminals of Xiamen for their external cargo transport use. The blue line is the external roads of Hai Cang terminal, and the white line is the external roads of Xiang Yu terminal, and the red line is the

main highway transport routes across Xiamen city. Both of the blue and white line connect with the red line, namely, the external routes of Hai Cang terminal and Xiang Yu terminal is both from their own bulk cargo terminal to the highway routes.

However, the white routes of Xiang Yu terminal and the blue routes of Hai Cang routes are different due to the unique geographical location of the two terminals. Hai Cang terminal located at the place showed as 1 in the figure 6, to which the southeast direction is facing the Taiwan Strait directly. Because of the reason that Hai Cang terminal is located at the external island of Xiamen in the Hai Cang district, which connected another city called Zhangzhou, it is convenient for the bulk cargo collecting in the Hai Cang terminal to be distributed to Zhangzhou city located at the southwest of Hai Cang district. On the contrary, Xiang Yu terminal is located at the internal island of Xiamen city as the 2 showed in the figure 6.

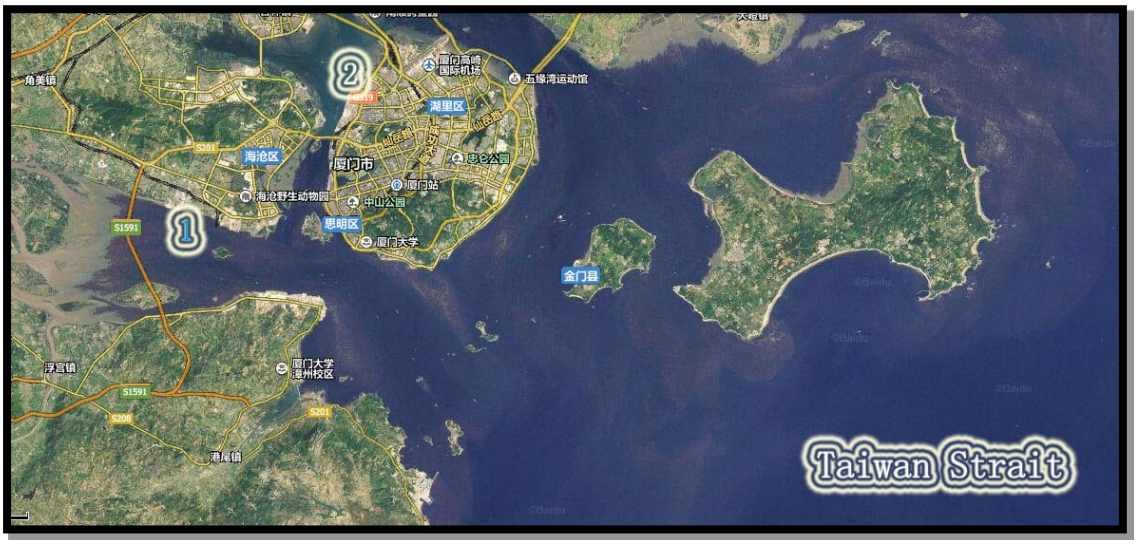

Figure 6. The geographical location of Hai Cang terminal and Xiang Yu terminal

Although the external road transport of Xiang Yu terminal has encountered a series of transit limitations, the transportation routes for the terminal is more than that of Hai Cang terminal. In figure 5, there are four branches for the white routes which start from the internal island of Xiamen, and extend to the external island, across the five external district of Xiamen-Hai Cang, Xing Lin, Ji Mei, Tong An and Xiang An. The

connection is realized by the routes through three great bridges-Hai Cang Bridge, Xing Lin Bridge, and Ji Mei Bridge, and one tunnel-Xiang An Tunnel. These routes is convenient for the bulk cargo handling from Xiang Yu terminal to distribute out of Xiamen internal island. Furthermore, all of these routes are linked with the main highway transport line, which is showed as the red line in the figure across the external island of Xiamen. Thus it is also an important bulk cargo collection and distribution geographical location for Xiang Yu terminal, and for Xiamen city.

2.3.3 Internal collection and distribution system

The internal collection and distribution refers to the bulk cargo transport happens within the port areas. The internal activities for bulk cargos include cargo loading and discharging, storage, and short-distance or in-port transport.

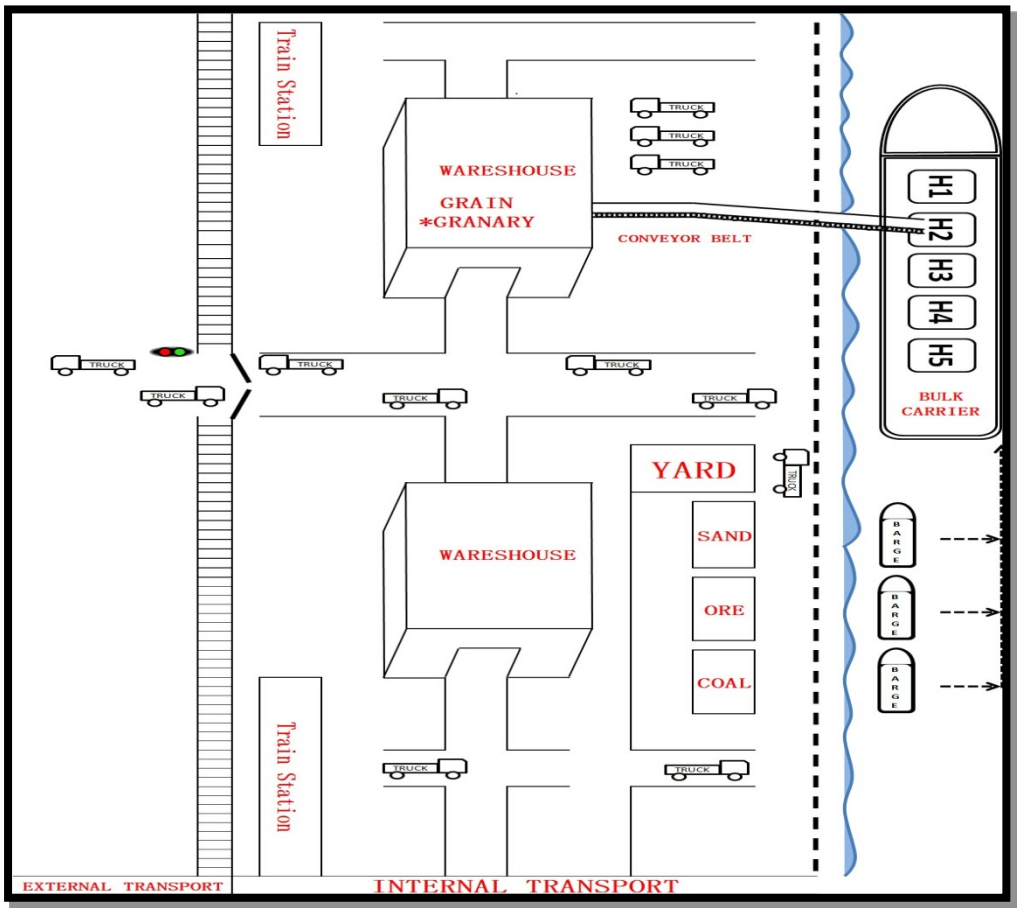

Figure 7. Internal bulk cargo collection and distribution transport routes

The figure shows the internal transport routes for bulk cargos in the port area. It can be classified as five main routes during the whole bulk cargo handling activities.

The first routes is from the external transportation - trucks and trains to the bulk cargo vessel or the reverse direction. It is the directly loading and discharging between transportation tools - trucks, trains and vessels.

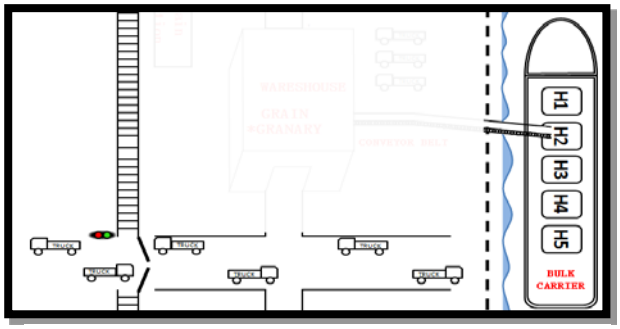

Figure 8. Truck/railway-to-warehouse route

The second route is from trucks or trains to the warehouse in the port. This activities is usually for the carriage of grain or other bulk cargos, which will be more likely influenced by bad weather.

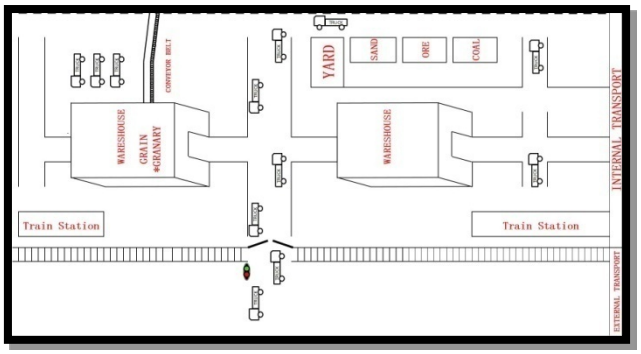

Figure 9. Truck/railway-to-vessel route

The third route is from the vessel to the warehouse or yard. Wheat and other bulk cargos which can be transported through conveyer belt that loaded on or discharged from the vessel, and other cargos like coal and ore can be discharged to the yard and wait for the truck to transport to the railway station.

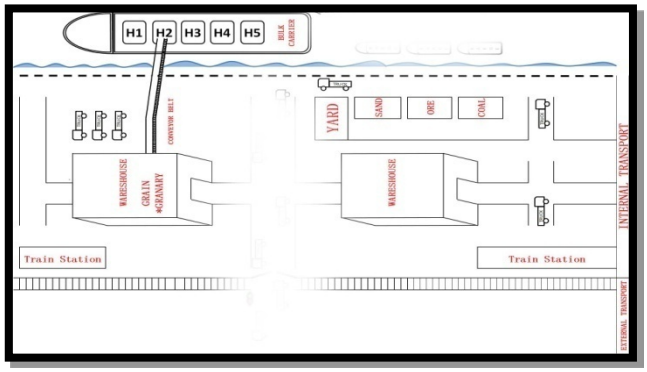

Figure 10. Vessel-to-warehouse/yard route

The fourth route is from barges to bulk cargo carrier. This will happen in the loading and discharging of coal, ore, stone and sand. It is because of that these bulk cargos are usually transported through railway, and placed at the yard first, then to be loaded directly or arrange barges to transport them to the bulk cargo vessel. The reverse direction is also established for route four. The barge transport is important in this process, and it is also a necessary step for vessels' bunkering. Barges will help transport marine diesel oil or other types of fuel to the vessel.

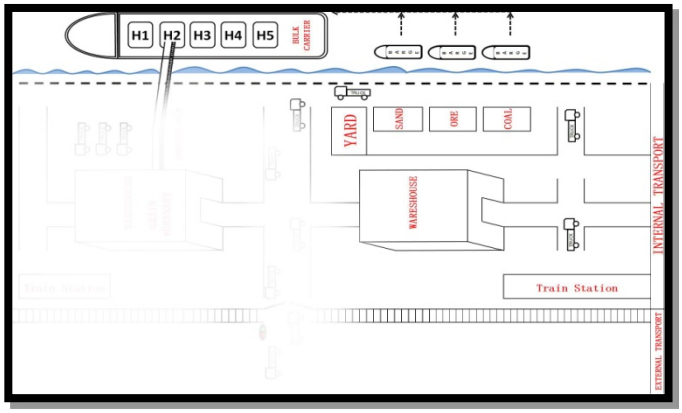

Figure 11. Barge-to-vessel route

The fifth route is from warehouse to warehouse, or yard to yard, aiming at realizing the reasonable space arrangement in the port area.

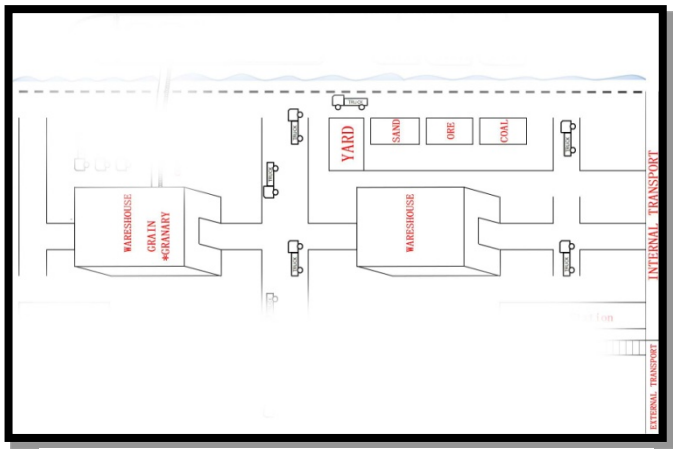

Figure 12. Warehouse/yard-to-warehouse/yard route

The process of bulk cargo transport activities is important for the total operating efficiency for macro collection and distribution system. Thus it is necessary for operators to keep the bulk cargo transport activities convenient in the port area. The efficiency of this process of bulk cargo collection and distribution is depended on the operating ability of in-port bulk cargo loading and discharging technologies,

warehousing process, transport routes connecting condition, the organizing efficiency of collection and distribution system, and the service level of information system platform.

a. The ability of berth and terminal of Xiamen port

Hai Cang bulk cargo terminal is the representative of Xiamen bulk cargo port. More precisely, the Shi Hu Shan terminal, which is belong to Hai Cang terminal, plays an important role in the bulk cargo handling activities. The main bulk cargos transported through Shi Hu Shan terminal are ore, coal and stones. It is the most important bulk cargo transit hub and the largest centre for bulk cargo collection and distribution for Fujian province.

Shi Hu Shan terminal not only owns the 7# and 8# berth of Hai Cang terminal, but also the 18# and 19# berth of Xiang Yu terminal. 18# and 19# berth is linked together, making the total shoreline reach 724 meters. Furthermore, the depth of sea water in front of the terminal is -15.3 meters, and -12 meters for the sea routes. It is the 50,000-ton berth, which is available for the largest panamax vessels. The overall length of the shoreline of 7# berth is 349 meters, and -17.5 meters for its front sea water depth, which is available for 150,000-ton ~ 200,000-ton bulk cargo vessels. Both of the Hai Cang port area and Xiang Yu port area can provide Shi Hu Shan terminal company the dedicated railway transport, realizing the different bulk cargo collection and distribution transport modes.

b. Bulk cargo collection and distribution handling technologies

Bulk cargo handling work refers to the port activities between trucks and vessels, trucks and yard, and vessels and yard. It will directly affect the efficiency between port transportations and the yards operation, and is an important process of port bulk cargo collection and distribution.

c. The arrangement of bulk cargo collection and distribution routes

A reasonable arrangement for the port area transport is an important process during the planning of bulk cargo collection and distribution system, which related to the collecting ability of terminals and the cargo distributing ability of port. The collection and distribution of port t-area bulk cargos is mainly depended on the railway and highway transport.

d. The organization form

The advantage-developed level for bulk cargo collection and distribution system is depended on a good organization form for the operation of port of terminal. A completed, high-efficiency, reasonable collection and distribution infrastructure will realize the low-cost transport for both time and space saved.

e. Information system platform

The informationalized level is an important symbol for the port developed to the level of modernization. It is the driving factor that port managers have increased the speed of informationalized construction for port development. The integration and openness of information system plays a vital role in the developing of port and the port operation management. A reasonable information system designed for port will level up the efficiency of port collection and distribution transport processes, and indeed raises the competitive advantages for the port area.

3. Factors analysis for bulk port collection and distribution system

3.1 The macro factors restrict the development of bulk cargo transport

The factors limit the development of bulk cargo collection and distribution transport can be classified as four sections-the factors existing in the external bulk cargo collection and distribution system, the factors existing in the bulk cargo collection and distribution connecting system, the factors existing in the internal bulk cargo collection and distribution system, and the economic factors existing in the import and export trade of Xiamen

3.1.1 The factors existing in the external bulk cargo collection and distribution system

a. Single railway transport

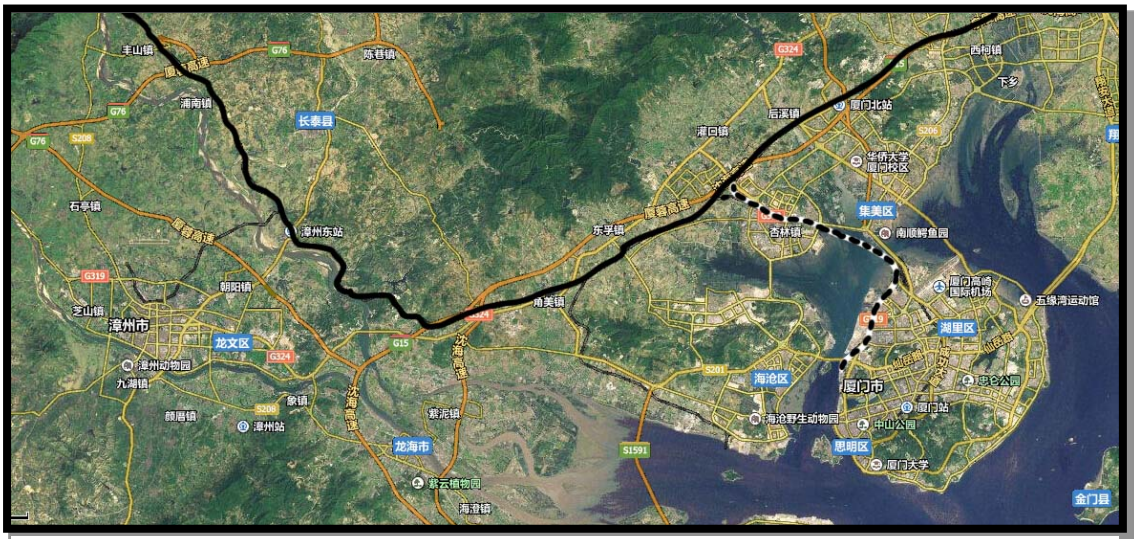

Figure 13. Railway transport for Xiang Yu terminal

There is an only one railway route in the internal island of Xiamen, which connected the whole Dong Du port area including Xiang Yu terminal. Thus it is an important restriction for the development of bulk cargo collection and distribution transport efficiency through railway routes. And this railway route has to run for a long distance, crossing Xing Lin Bridge and passing Xing Lin district, and then connect the main railway line. It is showed in the figure that the black and white line is the only bulk cargo railway transport routes from the internal island of Xiamen to the external island and districts. The black line is the main railway line through the whole Fujian province.

b. Highway transport limitations

The limitation for highway transport especially for Xiang Yu terminal is still exist that there is no highway roads in the internal island of Xiamen, thus it cannot realize the highway transport until when the trucks have gone to the external island and districts. In the internal island, trucks can only go on the normal roads with the normal waiting process for traffic lights, sharing the road condition with taxies, cars, motorcycles, bicycles, pedestrians, and other transportation tools. This leads to the traffic congestion everyday during the rush hours, which decreases the low level for bulk cargo collection and distribution transport.

c. Traffic control for trucks

The government of Xiamen has set a series of policies to limit the transit of trucks, aiming at stopping the traffic congestion caused by trucks. This certainly restricts the normal transportation for trucks, which decreases the transport efficiency for cargo distributing from internal island to External Island. Table is the restrict policy for the four great bridge and one tunnel of Xiamen city.

Transport Routes	Disallowed Period 1	Disallowed Period 2	Penalty
XIAMEN Great Bridge	7:00-9:00	17:00-19:00	200 CNY
Ji Mei Great Bridge	0:00-7:00	20:00-7:00	200 CNY
Xing Lin Great Bridge	None	None	200 CNY
Hai Cang Great Bridge	7:00-9:00	17:00-19:00	200 CNY
Xiang An Tunnel	0:00-7:00	20:00-7:00	200 CNY

Table 1 Truck Transport Restriction of Xiamen City- 1

Transport Routes	Speed Limitation	Odd-and-even License Plate Rule	Penalty
XIAMEN Great Bridge	As normal rules	None	200 CNY
Ji Mei Great Bridge	As normal rules	YES	200 CNY
Xing Lin Great Bridge	80 km/h	None	200 CNY
Hai Cang Great Bridge	As normal rules	None	200 CNY
Xiang An Tunnel	As normal rules	YES	200 CNY

Table 2 Truck Transport Restriction of Xiamen City- 2

Thus the construction problem exists in the bulk cargo transportation system, namely the completed planning for Xiamen bulk cargo collection and distribution structure do not actually fit the current diversified transport model. In the picture, it can been seen that the bulk cargo is usually transported by railway, other than the trucks, and because of the truck restrict policy set in for the bridges and tunnel of Xiamen, it limits the efficiency of cargo transport, and creates an extra waiting time for trains.

d. The geographical limitation

One of the important factors which restrict the bulk cargo transport development for Xiamen port is the geographical location of Xiamen city. Xiamen is a half island connected with three main districts around it. It can be seen from the picture 2 that the scale of the hint land of Xiamen is limited by the geographical location, which influences the further development of the cargo transport especially for the bulk cargo distributing system because of the restricted inland area.

3.1.2 The factors existing in the bulk cargo collection and distribution connecting system

The distributing routes for bulk cargo from Xiang Yu terminal is through the road along the sea, which is also the urban road for citizens' transportation. The increasing trade amount of bulk cargo will bring along the related pressure for urban roads to support the normal traffic for trucks during the rush hours.

3.1.3 The factors existing in the internal bulk cargo collection and distribution system

The main factors restrict the bulk cargo transport within the port area is the information system problems. The information system integrated in the whole process of bulk cargo collection and distribution should realize the electronic operation for in-port document processing, customs clearance, and other important procedures. The low level of the in-port bulk cargo collection and distribution information sharing will lead to the weak real-time efficiency, and create more extra needless cargo handling activities, and indeed decrease the handling ability of bulk cargo collection and distribution system.

The economic factors existing in the import and export trade of Xiamen

The trade factors affect the bulk cargo import and export amount, which is connected with the bulk cargo transportation level and ability. Less trade amount will cause less cargo transport activities at Xiamen port, which results in the low development level of bulk cargo collection and distribution system. Xiamen Island is an important problem leads to the low trade amount compared to the other port near the Taiwan Strait like Quanzhou port. The internal hinterland for Xiamen Island is limited to the whole internal island, which the external island still cannot become the main hinterland for Xiamen city.

3.2 Characteristics analysis of port bulk collection and distribution transport mode

The two important transport modes related in the macro system of port bulk cargo collection and distribution is highway or road transport and the railway transport.

a. Highway transport or road transport

The characteristics of highway transport are the transport between point and point, namely the door-to-door service. Among the all types of bulk cargo transport modes, only the highway transport or road transport can realize the terminal services, that is to say, the first process that receiving cargos from the shipper, and the last process that delivering cargos to the receiver. Road transport has the advantages of high cargo transit speed, high flexible working ability, low probability of the damage of cargos, and the door-to-door terminal service. However, the road transport has the shortage in the low transport amount, high transport cost, high fuel consumption, and the unfriendly to the environment. Thus the road transport or highway transport is normally playing the role of transport connecting or the supporting transportation for bulk cargo collection and distribution system.

b. Railway transport

Railway transport owns the advantages of large amount of bulk cargo transport, low transit cost, high running speed, long average transport distance, high quality of time assurance, good universality for different types of bulk cargos, and high security. Moreover, railway transport consumes less energy, and hardly ever be influenced by the weather. However, the investment for the construction of railway is comparatively high, and the constructing period need months to years.

3.3 Modern factors affect bulk port collection and distribution system

a. Environmental factors

The throughput amount of port shows a rising trend annually for Xiamen port with the increasing international trade amount, which has brought a series of challenges and opportunities for the port development. One of the challenges is the problem of the port transport exhaust gas emission during the bulk cargo collection and distribution process. One of the important contents of the environmental friendly infrastructure construction is to choose the low carbon dioxide emission transport modes for the bulk cargo collection and distribution activities.

b. Informational factors

The information technology management is one of the important component of port bulk cargo collection and distribution system. The integration and organization of information resources, and the effective utilization of the information technologies in the port bulk cargo collection and distribution system operation is the trend for port authority to create the own international competitive advantages for the port under the diversified and high competition age. IT technologies will promote the high efficient operation of port bulk cargo collection and distribution system is systemic approaches with its informationalized methods to optimize the micro aspects of the center systems.

4. Possible solutions for Xiamen port bulk cargo collection and distribution system

It can be seen from the demonstration in Chapter 2 and Chapter 3 that the macro problems for Xiamen port bulk cargo collection and distribution are various, and it is still the problems for local government to be addressed in the future. These solutions include the construction of urban transport roads for cargos, the traffic re-planning for urban transportation tool, and the expanding plan for the bridges connected with external island of Xiamen, etc. However, this macro methods might cause more time and efforts to be realized with large amount of capital cost.

The macro solutions for Xiamen urban transport roads may directly contribute to the port bulk cargo collection and distribution transport with more fast-transport routes and better road condition for transportation tools. Nevertheless, the aim of optimization of Xiamen port bulk cargo collection and distribution is better firstly to focus on the systemic approaches in both macro and micro views to solve the current low efficiency problem. Even though the transport road condition is not good enough for port bulk cargo collection and distribution activities, the systemic optimization will promote the collection and distribution system operation condition currently.

The systemic solutions are based on the conditions of port bulk cargo collection and distribution transport in both macro and micro aspects, which focuses on the optimization within the informationalized development for systems to promote the whole transport processes with systems and resources integration and combination. These approaches can be divided into macro methods and micro methods according to the different optimized direction-the optimization for logistics enterprises corporations and the optimization for bulk cargo collection and distribution information system. Or these approaches can be separated as two types-the horizontal

and vertical integration of logistics resources. It is more appropriate to use the horizontal and vertical integration to represent for the systemic approaches to solve the problems within the port bulk cargo collection and distribution system because the resources integration is composed by both macro and micro methods. Thus, the resources integration will be presented in the following parts of the dissertation, including the resources horizontal integration and the vertical integration among different logistics companies, terminal enterprises, logistics service platforms, and other important aspects related to bulk cargo collection and distribution system.

4.1 Resources Horizontal integration

Resources horizontal integration refers to the horizontal integration among the similar service provider and the similar collection and distribution systems. The resources horizontal integration will realize the resource sharing, system connection, and cost-benefit.

4.1.1 Macro transport system integration - Modern Logistics Park

Modern Logistics Park is the centre for transportation companies to share transport information together, wait for the instruction to receive arrangement for bulk cargo transport. This is the area to gather the whole port transport companies, aiming at forming a more completed and comprehensive transport service platform for port cargo collection and distribution activities. The integrated transport resources will donate in the high dispatching efficiency for trucks, and contribute to the time and space saved cost-control mechanism.

4.1.2 Macro approach for enterprise alliance - Corporation

Enterprise alliance is the future trend for the development of Xiamen port, especially for the bulk cargo terminals. The alliance will increase the total bulk cargo handing ability for Xiamen port with the information sharing of vessels, berths condition, and other important resources related to the common benefit. There is an outstanding example for the port enterprise alliance-Xiamen Container Terminal Group Ltd., has been set up with more than 7,000,000,000 CNY, and is the largest size for port property integration in China for recent years. The integrated container property resources for the belonging shoreline nearly include the whole 100,000-ton level container terminal berths of Xiamen. It helps Xiamen container terminal realize the ability of providing berths for the largest container vessels. The integrated container terminal group can provide the terminal facilities for vessels, with the in-port container handling, transfer, warehousing, logistics, etc. Thus the integration of bulk cargo terminal of Xiamen port can take the real experience that the container terminal group operates.

4.2 Resources Vertical integration

Resources vertical integration refers to the vertical corporation of the similar systems. For Xiamen bulk cargo terminals, this step refers to the construction of fourth party logistics platform based on the former third party logistics system. Meanwhile, the combination of different but related systems will be realized at this step of micro or systemic approaches.

4.2.1 Micro approach for transport mode evolution- Third Party Logistics

In modern logistics environment, 3PL service providers cooperate to form a multimodal transport in many countries, which consists the multimodal hub network,

connecting the maritime transport and inland transport together to improve the cargo or container transport efficiency. Some of the 3PL enterprises have tried to integrate the multimodal business into their own logistics operating model, which called the vertical integration, aiming at enhancing the competitive advantages in the logistics industry. This integration activity would consider the logistics company's operational ability and its financial condition, which might be high operational risk in doing two types of logistics transport business, thus some 3PL service provider would choose outsourcing or cooperate with other 3PL companies.

4.2.2 Micro approach for the construction of Fourth Party Logistics service platform

As a modern logistics service platform provider, port logistics activities connect the inland transport with the maritime transport through the multimodal transport, including the comprehensive logistics service like cargo loading, discharging, warehousing, and container yard service. Port has been regarded as a modern logistics centre of cargo dispatching and transport, relying on its special advantages both in geographical location and fundamental infrastructure construction, which has gradually formed a port logistics system with its unique characteristics and functional structure, and played an important role in the economy and trade, and the integrated transport system.

The fourth party logistics platform will realize the reasonable resources integration of third party logistics, and can provide a systemic service mode for customers with a detailed process without the extra effort to spend time to search for the trucks.

4.3 Systemic transport routes arrangement within the collection and distribution micro system

The two important routes for Xiamen port bulk cargo collection and distribution system - railway and highway transport, are both important for the efficiency of port cargo handling activities. While the reasonable arrangement for the two types of transport will increase the working ability of the whole in-port bulk cargo bulk cargo collection and distribution system.

The systemic transport routes arrangement including the reasonable arrangement for the time for trucks and trains to receive bulk cargos, or other related cargo transit activities. It also includes the real-time tracking system for trucks and trains to know their geographical location, aiming at monitoring the cargo transport processes.

Not only the optimization in the transport time arrangement and the processes monitoring, but also the transport routes for highway transport will be optimized through the application of arrangement systems from logistics enterprises. The railway routes is currently fixed without any further plans to change directions. Thus the highway transport, which has the advantages of operation flexibility, can be put into the routes optimization model to find the best transport routes for bulk cargo distribution.

4.4 The effect of IT technology to the port collection and distribution system

To achieve the goals of cost control set for port logistics activities when consider the information technologies, the most important thing for port logistics system is to find a way for applying IT technology in logistics network. These IT technologies include Computer-Aided Design (CAD), Geographic Information System (GIS), Global Position System (GPS), and Electronic Data Interchange, etc. The application of these

IT technologies in some of the port of China has been successfully operated, which has formed an original foundation of informationalized port transport. The challenge for port logistics enterprises currently, is to apply e-Commerce information service system into port logistics activities, which might be connected with the fourth-party logistics information service platform in the advanced improvement of port logistics system.

5. Optimization model design of bulk cargo collection and distribution system

The optimization model design for Xiamen port bulk cargo collection and distribution is aiming at maximizing the entire efficiency for the bulk cargo handling and transport during the completed transportation routes. The optimal designed objective for Xiamen port bulk cargo collection and distribution system includes three parts-the external bulk cargo collection and distribution system, the bulk cargo collection and distribution connecting system, and the internal bulk cargo collection and distribution system.

In the optimal design for the external bulk cargo collection and distribution system, it includes the design for the transport routes networks within the related hinterland, the space planning for the collection and distribution transportation modes

The optimal design for the bulk cargo collection and distribution connecting system is mainly refers to the design for the collection and distribution routes connecting with the port area and the inland transport.

The internal bulk cargo collection and distribution system optimal design is to rearrange the routes considering the ability of terminal berth, loading and discharging rates, and the infrastructures.

The three optimization objectives above is mainly for the design of the transport routes for bulk cargos, while the simple design for routes cannot solve the basic problems for Xiamen port bulk cargo transport limitations. Thus a further optimization for the whole collection and distribution system should be extended to a

high level with the resources integration in both horizontal and vertical integration.

The system integration of the construction of modern logistics part and the enterprise alliance of the corporation of enterprises will be connected with the fourth party logistics platform of vertical integration, and applied advance IT technologies in the two types of integration after the basic optimal design is completed.

5.1 Modeling of the new integration of bulk cargo collection and distribution systems

a. First step - horizontal integration - Modern Logistics Park

The first step for the modeling is to create the horizontal integration of modern logistics park model of bulk cargo collection and distribution system components.

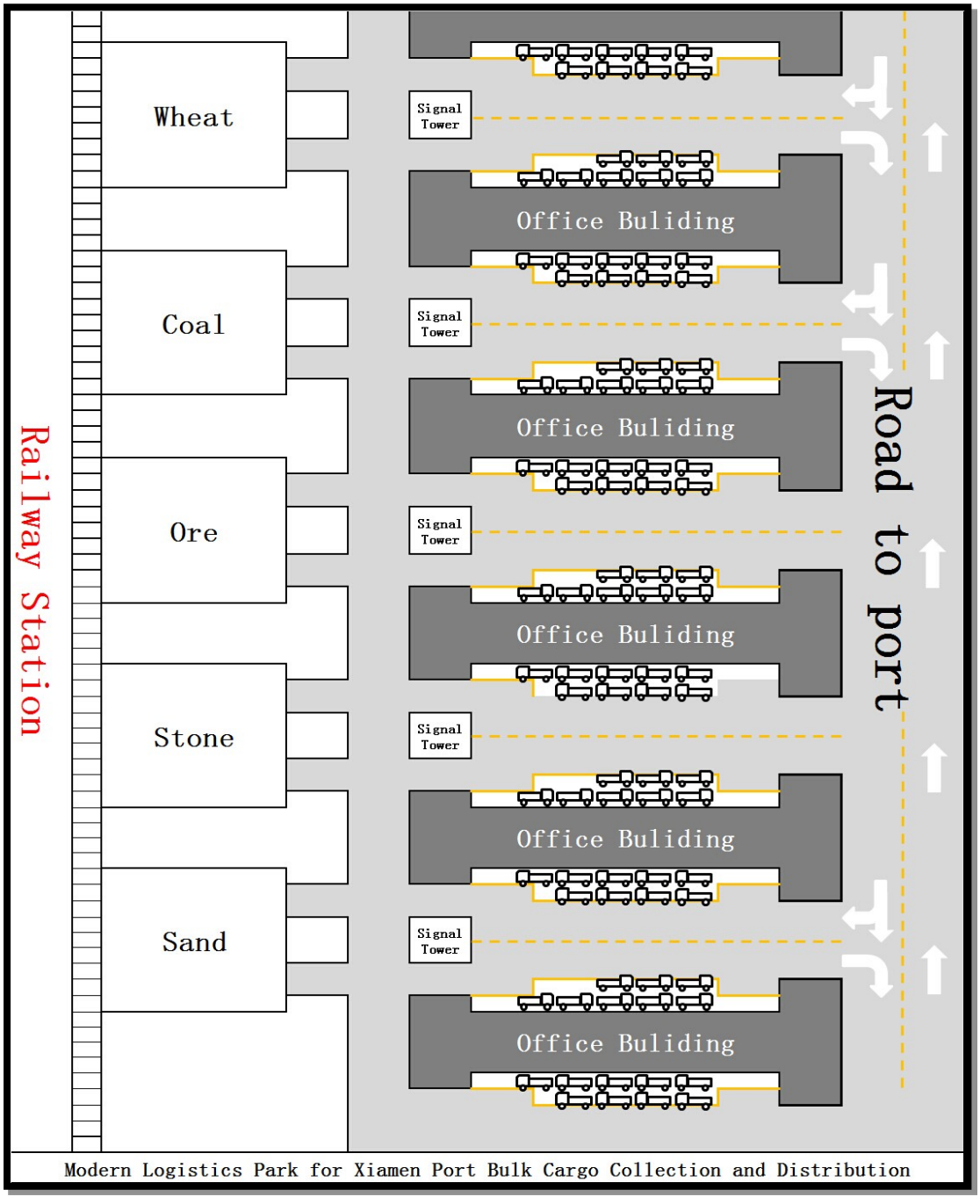

Figure 14. Modern logistics park of Xiamen port bulk cargo collection and distribution system

It is the comprehensive park for the distribution transport for port bulk cargos. The Modern Logistics Park is connected with the port via The Road to the Port as the figure 14 shows. Trucks will first collect bulk cargos from terminals, and then go through the internal road till the external road connected to the Modern Logistics Park.

The Modern Logistics Park is composed by several different transit stations, which are classified by the different types of bulk cargos, like wheat, coal, ore, stone and sand. These different types of stations play the role of transit centre for bulk cargos, and also have the function of temporary warehousing.

Bulk cargos will be transported to the transit stations, waiting for railway transportation for external distribution. Thus the Modern Logistics Park should be connected with the railway line for purpose of fast distribution for port bulk cargos.

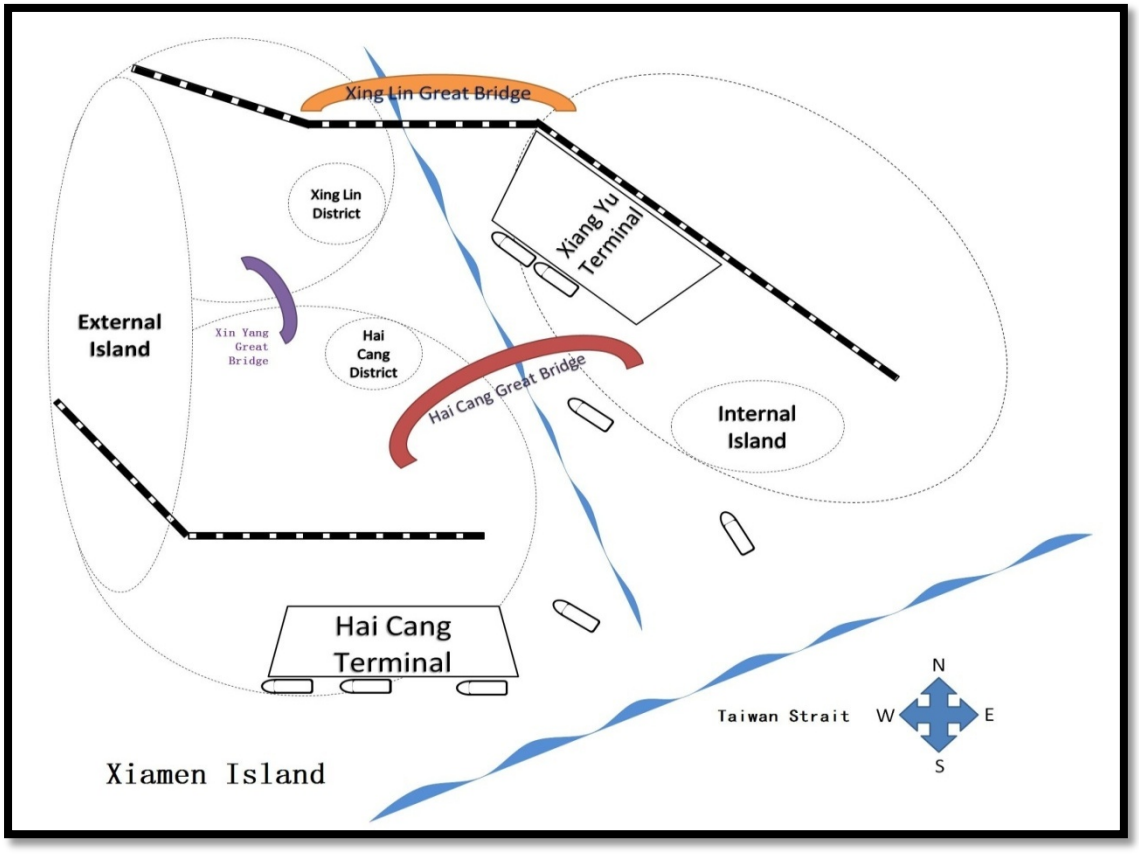

Figure 15. Hai Cang Terminal & Xiang Yu Terminal

It can be seen from Figure 15 that without the construction of Modern Logistics Park, logistics companies or port enterprises have to arranged the bulk cargo collection and distribution activities themselves. However, after the application of Modern Logistics Park that Figure 16 shows, logistics enterprises will be centralized and managed by Modern Logistics Park regularly. Because of the fact that the Modern Logistics Park connects the railway and highway with the road to the Hai Cang Terminal, it will be more convenient for bulk cargo collection and distribution transport in and out of port area.

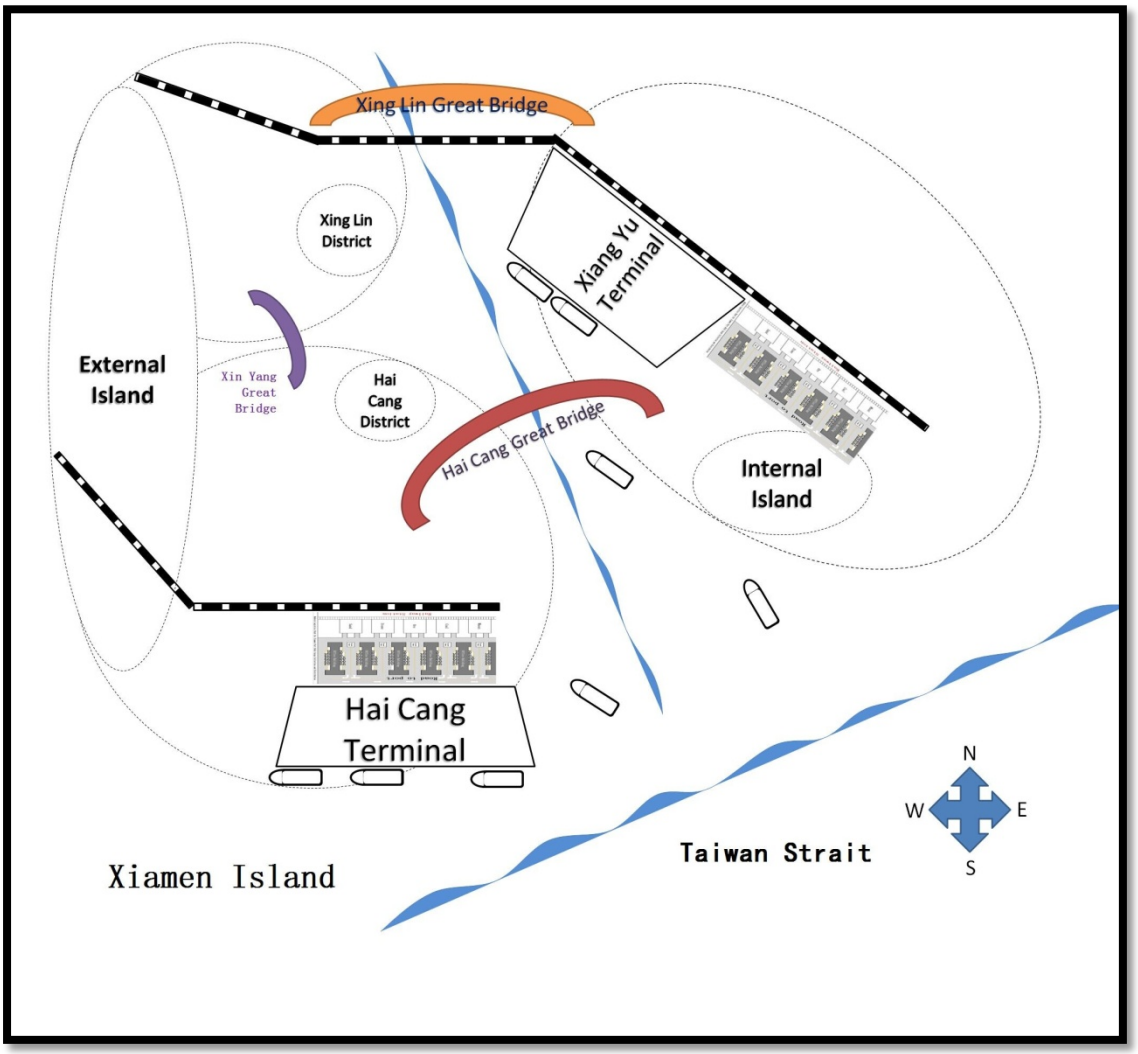

Figure 16 Hai Cang Terminal & Xiang Yu Terminal with the integration of Modern Logistics Parks

b. Second step - horizontal integration - Port Enterprises Corporation

The suitable corporation mode for terminals of Xiamen bulk cargo port is the corporation between Xiang Yu terminal and Hai Cang terminal. The corporation will bring along many advantages for the bulk cargo collection and distribution system.

After the corporation between the two terminals is fulfilled, they can have the ability to arrange the bulk cargo carriers arriving Xiamen together, providing the most suitable berths of Hai Cang terminal or Xiang Yu terminal, arranging the in-time bulk cargo loading and discharging processes, and then the centre monitoring system will have more power to select the suitable collection and distribution routes for the transport of different types of bulk cargos.

Thus the most important objective of terminal corporation is to make the final collection and distribution system more efficient, which can be realized through the corporation between Xiang Yu terminal and Hai Cang terminal, namely, the combination of the centre cargo handling information system.

It can be seen from Figure 15 that the two terminals of Xiamen – Hai Cang terminal and Xiang Yu terminal are closed, thus the corporation between them is reasonable and feasible. The bulk vessels come to Xiamen can be arranged flexible to either Xiang Yu terminal or Hai Cang terminal according to their special requirements.

c. Third step- vertical integration - fourth party logistics service platform - Module A

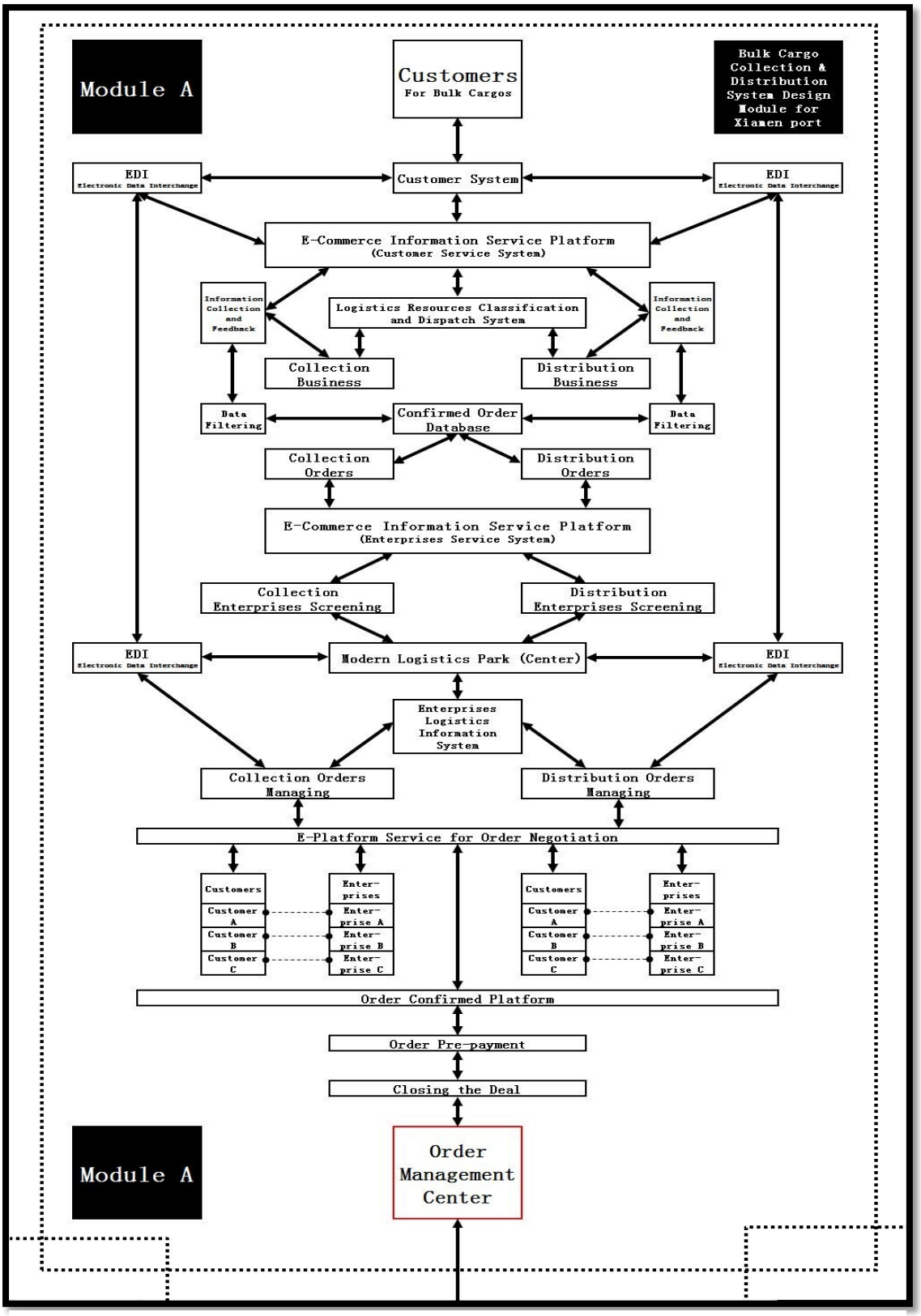

Figure 17 Vertical integration Module A - Fourth party service platform

The third step is the system construction of fourth party logistics service platform It is the platform based on IT technologies like EDI (Electronic Data Interchange) and e-commence service. The function of this system is to provide customers a forth party platform to order transportation for their bulk cargos for collecting and distributing. The customers might be consignees, freight forwarding companies or other related parties. Customers will not have to find third party logistics companies for their cargo transport through this kind of fourth party service platform.

Meanwhile, the fourth party logistics service platform is connected with the system of Modern Logistics Park, which provides the fourth party logistics platform the transportation resources like trucks and trains and other transport tools. Fourth party logistics platform is informationservice system, which connects customers and bulk cargo transport companies, acting like a bridge between the two parties. It is unlike the traditional third party logistics modes that customers have to contract the logistics companies themselves, which might cause a series unnecessary cost and time.

The process of Module A

A Customer will firstly log in the Customer System of the fourth party logistics service platform to order bulk cargo transport service. This information will flow from Customer System to E-Commerce Information Service Platform, which is the start of the whole ordering process. E-Commerce Information Service Platform is connected with Logistics Resources Classification and Dispatch System, which can classify different orders as Collection Business or Distribution Business from customers automatically. Logistics Resources Classification and Dispatch System also links to the information tunnel of Modern Logistics Park, which can submit the logistics dispatch information, and is good for transport dispatching arrangement for customers. This logistics information will be collected and provided to E-Commerce Information Service Platform, thus customers will know the actual information about the

transportation arrangement. Furthermore, this collection or distribution information will be filtered, and flow to Confirmed Order Database, which collect whole confirmed orders and permit customers to continue their collection or distribution transport orders continuously. Customers will first confirm their orders and then they can start searching and choosing the suitable collection and distribution transport service providers.

Their orders will be divided into Collection Orders and Distribution Orders after they have confirmed the orders without payment, and then this information will connect to E-Commerce Information Service Platform of Enterprises Service System, which collect the transport information of whole related logistics services providers from Modern Logistics Park. The screening of collection or distribution enterprises for suitable choices for customers will start after the ordered information come to this step, and this ordered information will be matched with the transport ability in Enterprises Logistics Information System. This system will manage the orders passing through it, and transit the orders to E-Platform (Electronic Platform) for further negotiation between customers and customer services of logistics enterprises. E-platform Service for Order Negotiation is a platform provided for customers and enterprises to negotiate their business of bulk cargo collection or distribution. It is the B to C (Business to Customer) model that usually be seen in the transaction of E-commerce. After the negotiation, if customers agree to order the bulk cargo collection or distribution business, they will enter Order Confirmed Platform to make an Order Advance Payment, and the deal will be closed. Finally, the order will come to Order Management Center for centre monitoring.

The Paid orders will be delivered to the corresponding logistics services providers, thus they can arrange transport modes for customers to carry their bulk cargos. Different orders will come to different information platform, like the platform for bulk

cargo collection and the platform for distribution, but one logistics enterprise may have diversified types of service. Thus it is more comprehensive in one order system of port bulk cargo collection and distribution system. However, the general framework for the collection and distribution system is permanent; it connects the bulk cargo order system (seen as Module A), bulk cargo terminal system (seen as Module D), bulk cargo collection and distribution transport routes & schedule arrangement system (seen as Module C), and bulk cargo collection and distribution operation system (seen as Module D). These four systems are connected by a system control centre with four different interfaces, and they together compose a port bulk cargo collection and distribution system. Thus the information flow in the system is fluent and shared.

d. Fourth step - vertical integration - informationalized bulk cargo terminal system - Module B

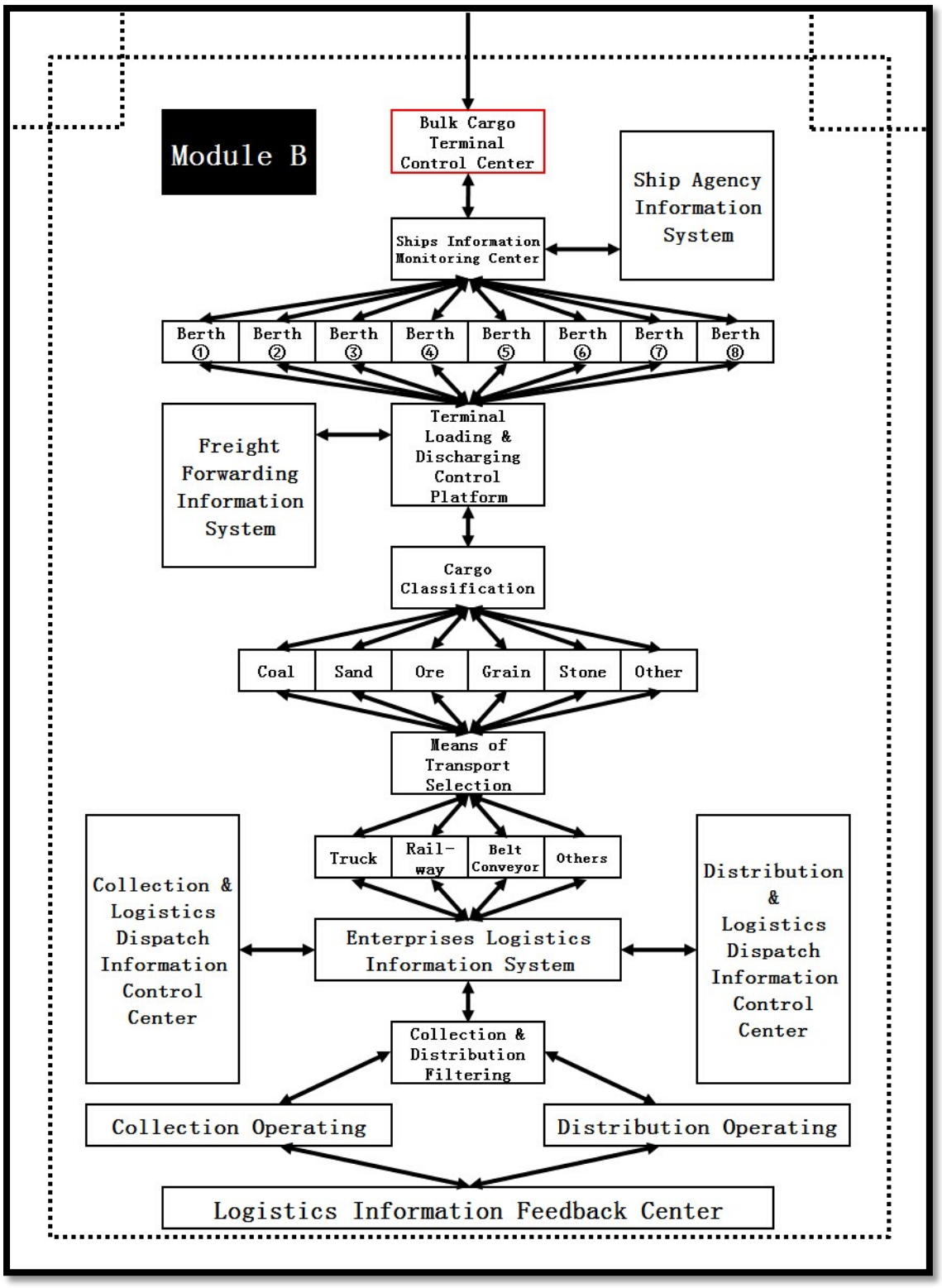

Figure 18 Vertical integration - Module C - informationalized bulk cargo terminal system

The order information is based on the bulk cargo loading and discharging information at the terminal, which affects the order delivery time and transport arrangement schedule for logistics service providers. Thus in Module B, the terminal information system is also an important component of port bulk cargo collection and distribution system.

The process of Module B

After bulk cargo carriers arrived at Xiamen port, Bulk Cargo Control Centre will start to collect the related information of the ships. Ships Information Monitoring Centre will manage the information from different berths like berth ① to berth ⑧. Ship Agency Information System will also connect with Ships Information Monitoring Center to keep track of the vessels information at the terminal. Terminal Loading & Discharging Control Platform will monitor the bulk cargo handling at the terminal, and Freight Forwarding Information System will link to this Platform to keep track of the cargo handling information. Freight forwarding companies will get this information in time, and thus they can arrange to order cargo collection business if they need to transport bulk cargos to terminals for cargos preparing, and to order cargo distribution business if they need to distribute bulk cargo out. Even if vessels still not berth at the terminal, the berthing plan and other related information provided by Bulk Cargo Terminal Control Center will help freight forwarding companies to make a pre-order for further bulk cargo collection or distribution. It is better than not order services until vessel arrived. Pre-order method will also help logistics service providers to arrange transport routes and modes within a plenty time. Thus the connection between Freight Forwarding Information System and Terminal Loading & Discharging Control Platform plays an important role in the pre-order process.

Terminal Loading & Discharging Control Platform will classify bulk cargos before they are loaded or discharged. The classification will be Coal, Sand, Ore, Grain, Stone,

and other bulk cargos, and this classification information will be transferred to Enterprises Logistics Information System for logistics service providers to decide the Means of Transport like Truck, Railway, Belt Conveyor or other tools. Of course, this bulk cargo information will be allowed to be transferred to logistics companies only if the collection or distribution orders are confirmed and pre-paid. Thus logistics companies will have an access to Bulk Cargo Terminal Control Centre to get the information from Terminal Loading & Discharging Control Platform for the bulk cargos specified in the orders. After they get the information, they will send this cargo information to their Logistics Dispatch Information Control Centre of Collection or Distribution to arrange the transport approaches. Meanwhile, bulk cargo information will be filtered for collection or distribution purpose, and logistics companies will turn to operate the collection or distribution process for bulk cargos specified in orders. And the whole Logistics Information will be collected and fed back to customers and logistics companies during transport processes.

Thus there are three main components of Module B –Terminal Loading & Discharging Control Platform within Bulk Cargo Terminal Control Center, Enterprises Logistics Information System connected with their Collection/Distribution & Logistics Dispatch Information Control Centre, and Freight Forwarding Information System. Terminal Loading & Discharging Control Platform will provide customers – freight forwarding companies the information of their bulk cargos, and freight forwarding companies will order logistics services through the E-platform showed as Module A to logistics service providers. After the orders are confirmed and pre-paid, the logistics service providers will have the access to the bulk cargo and terminal or berths information provided by port terminal authority. Thus logistics service providers can start to arrange bulk cargo transport routes, approaches and schedules.

Bulk cargo transport is divided into two parts – collection process and distribution

process, which act as third party logistics modes as the traditional logistics mode. But after the E-platform is constructed, the whole logistics processes compose a fourth party logistics mode, which is the trend in the future logistics development.

e. Fifth step - vertical integration - reasonable arrangement for bulk cargo collection and distribution transport routes and schedule- Module C

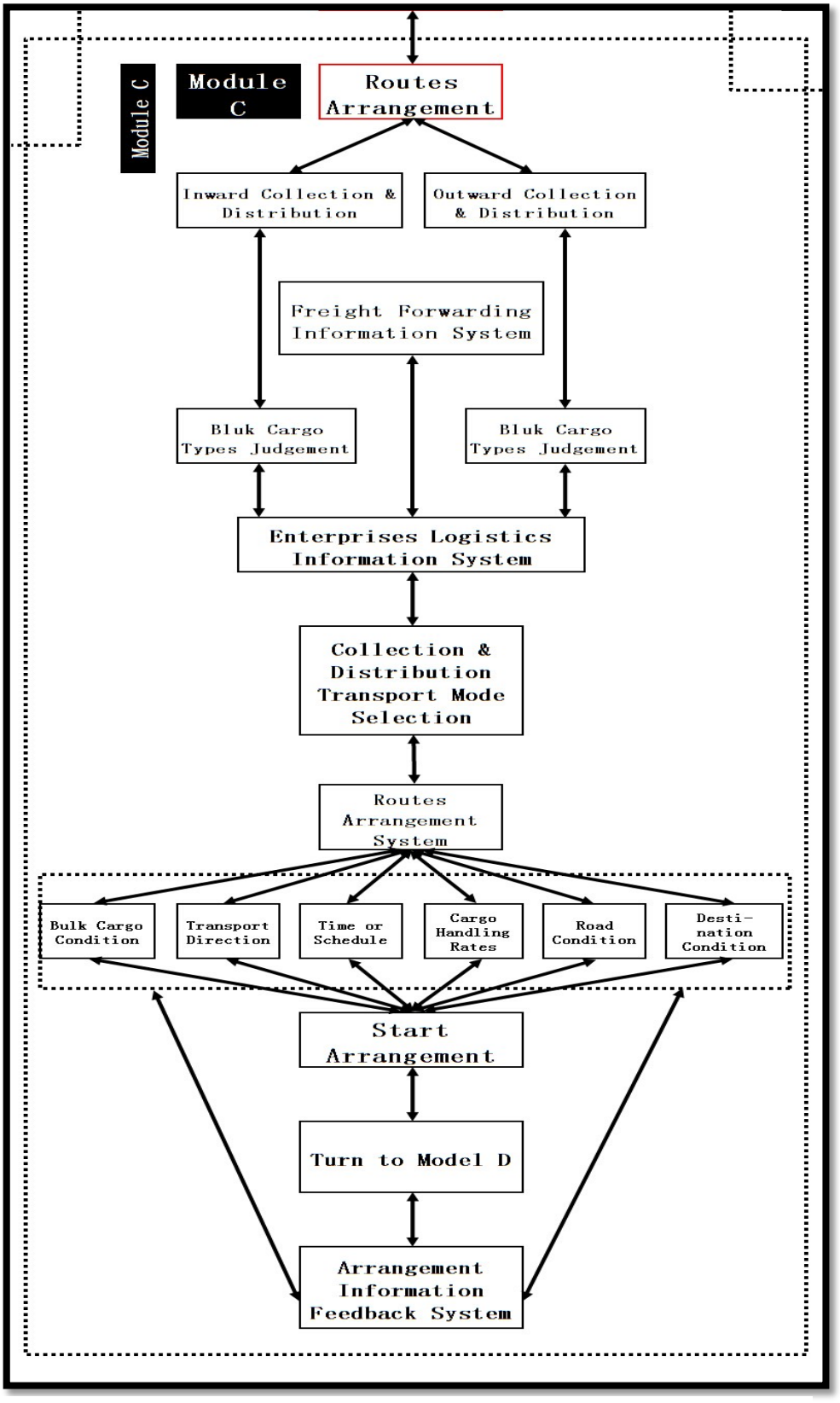

Figure 19 Module C - Reasonable arrangement system for bulk cargo transport

Module C shows a system of bulk cargo collection and distribution transport routes and schedule of one logistics service provider. After an order information has been delivered from Module B to Module C, the arrangement for bull cargo collection and distribution transport routes and schedule will be started. The data flow in Module C is from the right side to the left side seen as Figure 18 shows.

The process of Module C

Orders information come to this step will be divided again into two types of business according to their transport routes-Inward Collection or Distribution Transport and Outward Collection or Distribution Transport. It is because the classification of different transport routes will be good for the further transport arrangement without man-made confusion. Then both of the two types of transport direction information will flow to a system to be analyzed for the types of bulk cargos, which will classify different kinds of bulk cargos and provide the classification information to Enterprises Logistics Information System. This is a filtering step for orders with their recorded bulk cargo business. And Freight Forwarding Information System will also link to Enterprises Logistics Information System to keep track of the order information flow and the routes & schedule arrangement for their bulk cargos.

When the classified orders information come to the step of Collection and Distribution Transport Mode selection, the bulk cargos specified in the related orders will be analyzed and decided the suitable transport modes. These modes include truck, railway, belt conveyor, or other transport approaches. After the most suitable transport mode for the specified bulk cargo recorded in an order, system will start to arrange the reasonable routes for the transportation. There are several influence factors which will affect the plan of routes arrangement, such as Bulk Cargo Condition, Transport Direction, Time or schedule, Cargo Handling Rates, Road Condition, and Destination Condition.

The influence factors demonstrated above is an important point for the collection and distribution system in its transport process. Bulk cargo condition will decide whether the cargo is suitable for belt conveyor transport or truck transport, or transport through trains. Transport direction will decide the transportation path whether the geographical orientation it will go. Time or schedule will affect the start point and the transport effectiveness during the collection or distribution process. Cargo handling rates will also affect the effectiveness of the whole process, but it refers to the rates of bulk cargo loading or discharging from vessels, which influences the corporation efficiency between vessels and road transport arrangement. Road condition will decide the final transport routes within or out of a city, which considers the different road transportation information at different time point during a whole day. And the destination condition will affect the transport mode at the final stage before consignees receive their bulk cargos. It is because one collection or distribution transport process might composed by more than one transport modes, for instance, coals are transported by trucks after they are discharged from the vessel. Then the trucks collect the coal and distribute them to Modern Logistics Park for further distribution as the destination specified in the order is far from the terminals. Thus the destination condition might lead to the corporation between different collection or distribution tools.

If the reasonable routes arrangement is completed under the help of systemic factors analysis of Reasonable Routes Arrangement System, the information will be delivered to Model D for the transport step. Meanwhile the arrangement information will be fed back to customers (like freight forwarding companies) and the centre system (Enterprises Logistics Information System) through the feedback system.

f. Sixth step - vertical integration - bulk cargo collection and distribution processes - Module D

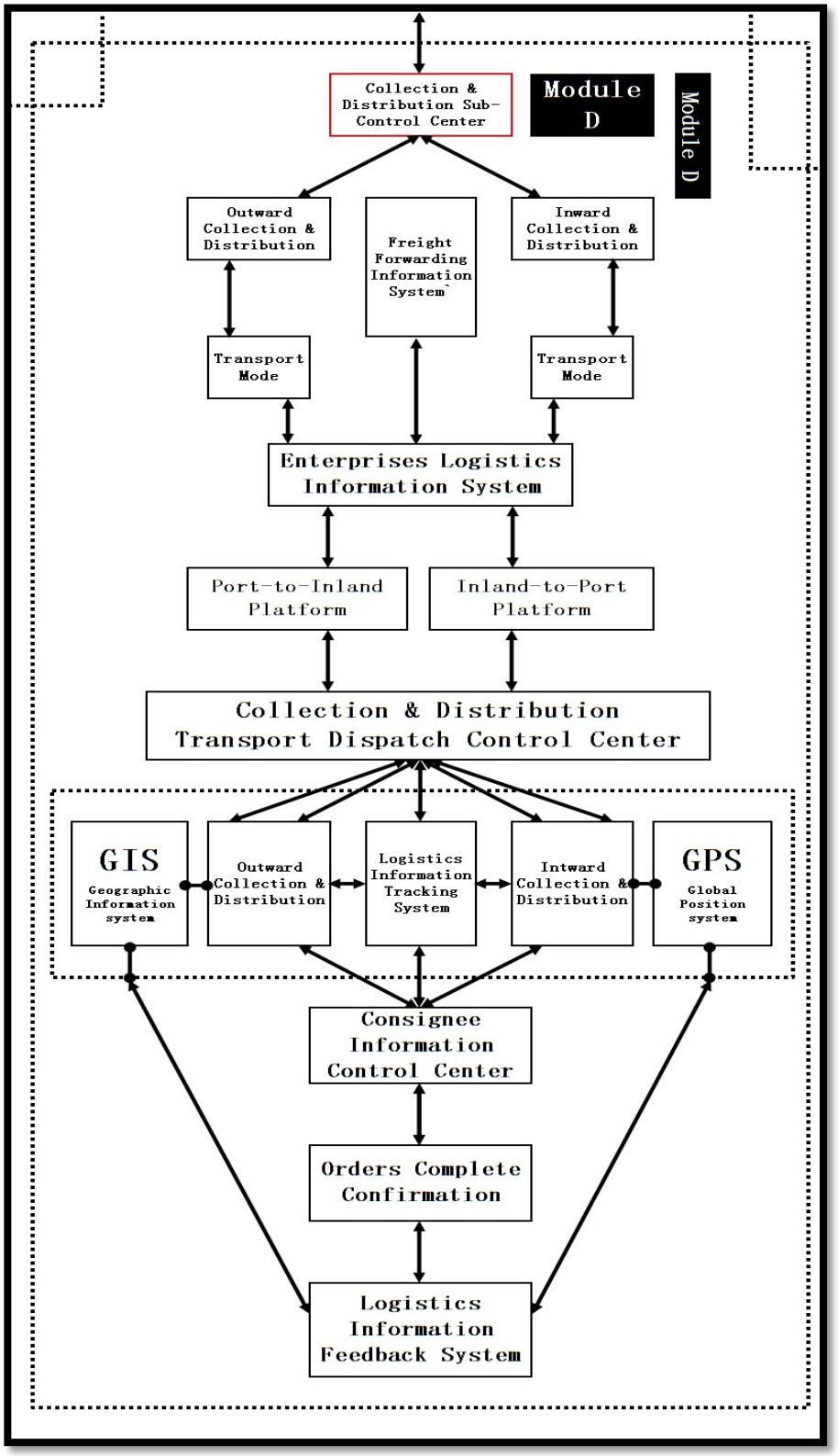

Figure 20 Module D - Bulk Cargo Collection and Distribution Process

The final step of port bulk cargo collection and distribution is to transport cargos under the instruction sent by operating systems. The systems embedded in Module D play a role of collection or distribution transport decision and transportation information tracking and tracing for bulk cargos.

The process of Module D

The transport arrangement information will be sent from Module C to Module D for further decision for the conduction of re-paid orders. In Module D, Collection & Distribution Sub-control Center will receive the arrangement information from Enterprises Logistics Information System connected in Module C, and the same as in Module C, the different transport direction of the ordered business will be addressed respectively as Inward Collection & Distribution and Outward Collection and Distribution. The system at this step will arrange the real transport for the orders according to the specified Transport Mode like Truck, Belt Conveyor or Railway Transport. This information and decision will under the instruction sent from the center system of logistics companies-Enterprises LogisticsInformation System. Meanwhile, Freight Forwarding Information System is also linked to the center system to keep track of the information of cargo transport. Because of the fact that inward direction is from the terminal to inland city, and outward direction is from inland city to terminal, the information of Inward Collection and Distribution will be collected by Inland-to-Terminal Platform, and the information of Outward Collection and Distribution will be collected by Terminal-to-Inland platform. At the same, these two platforms with the order information and transport decision will be controlled by Collection and Distribution Transport Dispatch Control Center, which connected with Bulk Cargo Terminal Control Center in Module B to receive the bulk cargo loading or discharging arrangement information.

Collection and Distribution Transport Dispatch Control Center will conduct and monitor the whole transport process of bulk cargo collection or distribution stages for both inward and outward direction. In addition, the control will under the application of Global Position System (GPS) to provide the precise position of transported cargos and transportation tools, and the exact transport speed measure measurement with time calculation to count the transport efficiency for cargo delivery and handling. The other application is Geographical Information System (GIS), which will provide its map resources database for users like the drivers to get the help from the function of routes navigation and location based service. And the combination of the usage of both GPS and GIS will maximum the function applied in the collection and distribution processes. The other important application at this stage is Logistics Information Tracking System, which will collect the collection or distribution information fed back from transportation tools and consignees.

After a consignee (for example, freight forwarding company or other final customers) has received his bulk cargos specified in the order, the cargo receiving information will be collected in Consignee Information Control Center to judge whether the transport process is completed or still need extra days to finish it. If the consignee refuses to receive his cargos because of some problems like cargo loss or damage, information will be delivered to Enterprises Logistics Information System to conduct an inspection for the whole transport links to find the reasons for the loss or damage of cargos. If the problem is from the import or export traders, the responsibility will not be attributed to logistics companies, but if it is the mistake create during the transport, logistics companies will have to undertake the due obligations. They might have to pay back some amount of freight to consignees, and this amount of money will be directly deducted from the pre-payment of consignees. If there is not argument for the transport service, one consignee will need to confirm the pre-payment for the order, and the pre-payment will be transformed to actual payment. If a consignee

refuses to receive the bulk cargos, Orders Complete Confirmation stage will not be finished within several days (for instance, seven bank working days). These days are provided for customers and logistics service providers to argue the reason that customers refuse to receive the cargo or confirm the payment. If the reason is established and agreed by both parties, the order might be canceled, and if the argument exceeds the allowed days, the pre-payment will be transformed to actual payment automatically. However, this is the worst condition that both customers and logistics services providers do not want to see.

Thus, Logistics Information Feedback System plays an important role in the information deliver between logistics service providers and customers. Keep the collection and distribution transport information fluently flowing within the whole systems connected with different transport process is the function and responsibility of feedback system. The real-time information will help logistics companies to know whether their transport modes are going on the right routes, and whether the transport schedule is carried out step by step. After the whole information with order payment confirmation is fed back, Enterprises Logistics Information System will store the information in its database, and the transport business is finished.

g. Seventh step - integration among the four modules

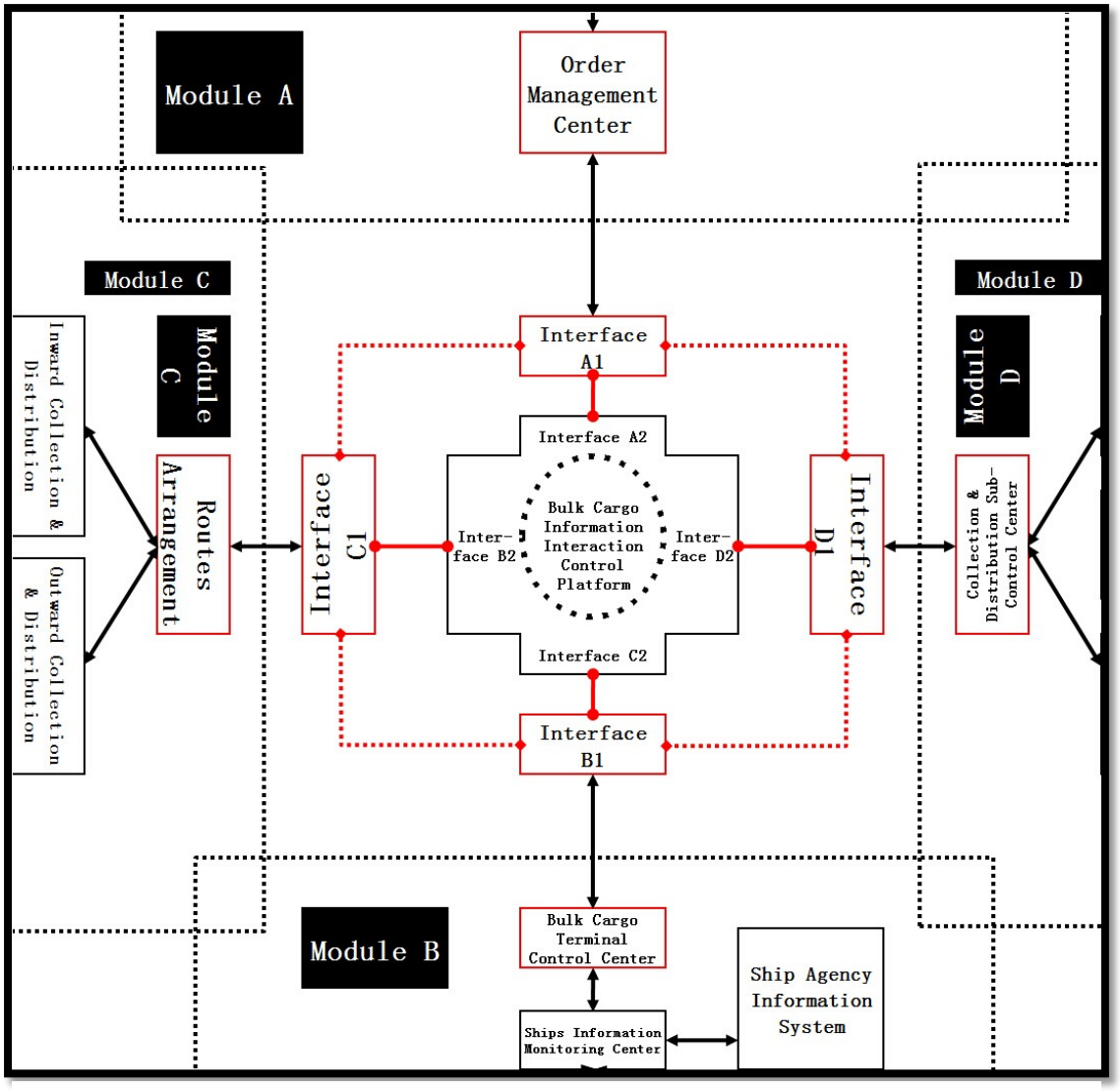

Figure 21 Bulk cargo information interaction control platform

Figure 20 shows the Bulk Cargo Information Interaction Control Platform, which provides the interfaces for Module A, Module B, Module C and Module D to deliver and share the bulk cargo orders information, bulk cargo loading and discharging condition at the terminal, collection and distribution transport arrangement details and the tracking and tracing information from transportation processes.

The interaction control platform acts as the connection system for the four modules to guarantee the information flow and data flow exchanged with the bulk cargo collection and distribution system.

h. Eight step - the overall view of the optimal port bulk cargo collection and distribution system

Figure 21 shows the overall view of the optimal port bulk cargo collection and distribution system for Xiamen port. It is composed by five part - Module A at the north side, Module B at the south side, Module C at the west side, Module D at the east side, and the interaction control platform at the center of the optimal system modeling.

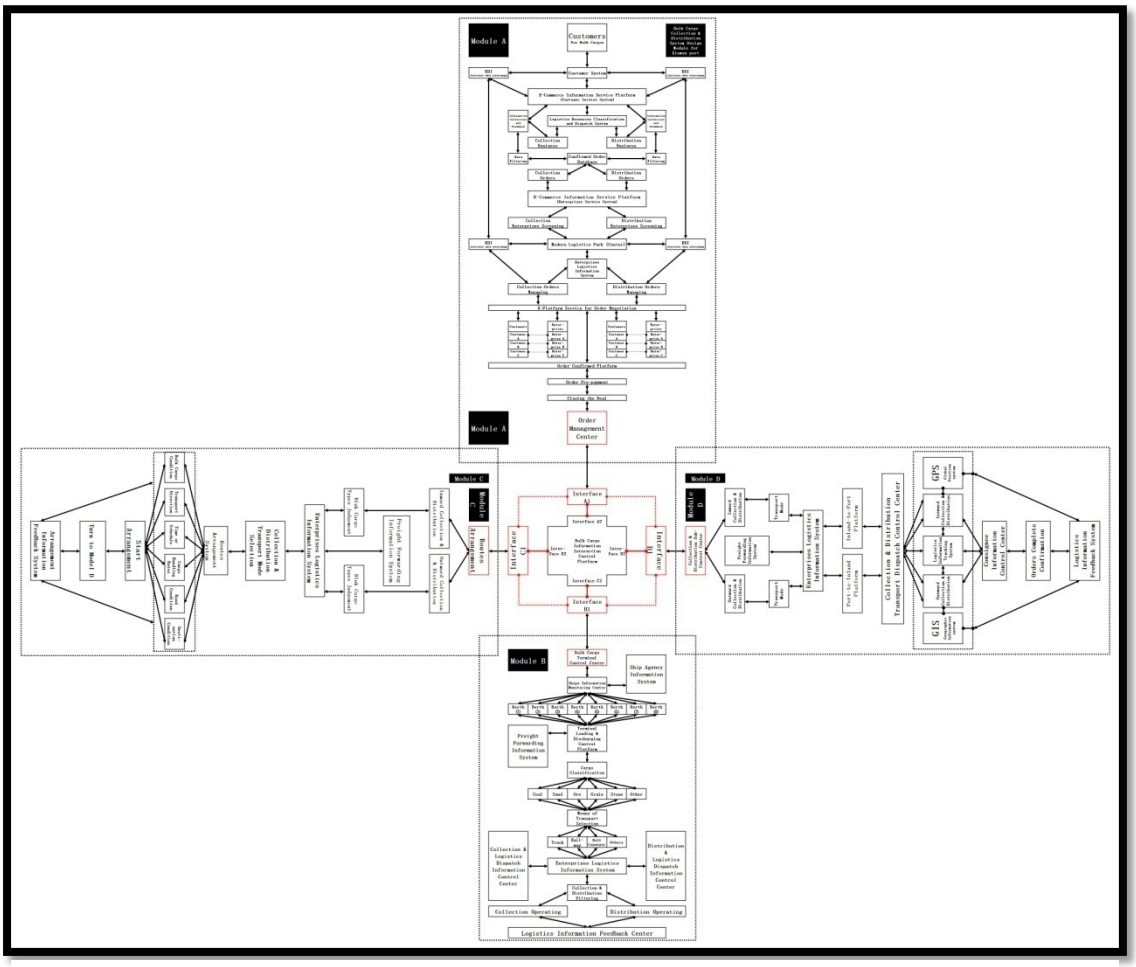

Figure 22 Overall view of the Optimal Port Bulk Cargo Collection and Distribution System

5.2 The application of the optimal bulk cargo collection and distribution systems

After the modeling for the port bulk cargo collection and distribution system through both macro and micro approaches, the system will be optimized at the aspect of operational efficiency and information exchange. Moreover, a further application for the optimized system should be simulated for the whole processes of one business.

Simulation

BULK CARGO SYPES: AUSTRALIAN PCI COAL

CARGOS AMOUNT: 85,000 MT 10% MOLOO

ACTUAL AMOUNT OF CARGOS: 91,210 MT

VESSLE: MV.W-ACE

DWT: 93,014.7 T

SHIPOWNER: REFINED SUCCESS LTD

INTERNATIONAL TRADER: FUJIAN SANSTEEL INTERNATIONAL TRADE CO., LTD (ABBREVIATION - SANSTEEL)

CUSTOMER/CONSIGNEE: HOUSHI ELECTRICITY GENERATING STATION, ZHANG ZHOU CITY, FUJIAN PROVINCE ,CHINA

LOADING PORT: DALRYMPLE BAY COAL TERMIAN, AUSTRALIA (ABBREVIATION - DBCT)

DISCHARGING PORT: XIAMEN PORT, CHINA

LAYTIME: JUNE 5 - 15, 2014

ARRIVING DATE AT DISCHARDING PORT: JUNE 29, 2014

DISCHARGING TERMINAL: HAI CANG TERMINAL OR XIANG YU TERMINAL

SHIP AGENCY: XIAMEN UNITED INTERNATIONAL SHIPPING CO., LTD (ABBREVIATION - UNISCO)

FREIGHT FORWARDING COMPANY: XIAMEN PENAVICO INTRENATIONAL FREIGHT & FORWARDER CO., LTD (ABBREVIATION - PENAVICO)

LOGISTICS SERVICE PROVIDER: XIAMEN ITG TIDAK LOGISTICS CO., LTD (ABBREVIATION - TIDAK LOGISTICS)

In the simulation, the business is between the international trader-FUJIAN SANSTEEL INTERNATIONAL TRADE CO., LTD (SANSTEEL) and the customer - HOUSHI ELECTRICITY GENERATING STATION, ZHANG ZHOU CITY, FUJIAN PROVINCE ,CHINA. SANSTEEL (for abbreviation) has signed a contract of maritime transport with the ship-owner, REFINED SUCCESS LTD to carry the cargos-AUSTRALIAN PCI COAL from DBCT (DALRYMPLE BAY COAL TERMIAN) , AUSTRALIA to XIAMEN PORT, CHINA. The agreed amount of cargos is 85,000 MT 10% MOLOO (MORE OR LESS IN OWNER'S OPTION), and the actual transport amount is 91,210 MT which is within the allowed DWT of MV.W-ACE of 93,014.7 T.

Before MV.W-ACE arrives at Xiamen port, the port authority will judge which bulk cargo terminals is suitable for MV.W-ACE. This judgment will depend on the information from the freight forwarder-XIAMEN PENAVICO INTRENATIONAL FREIGHT & FORWARDER CO., LTD and the customer (or consignee)-HOUSHI ELECTRICITY GENERATING STATION, ZHANG ZHOU CITY, FUJIAN PROVINCE ,CHINA. Xiang Yu Terminal is located in the western area of internal island of Xiamen city, and Hai Cang Terminal is located at the external island of Xiamen city. It can be seen from the Figure 15 that Hai Cang Terminal is more closed to the open seas, which directly faces the Taiwan Strait. Moreover, the depth condition of the berths of Hai Cang Terminal is better than that of Xiang Yu Terminal, and MV.W-ACE is suitable to berth at Hai Cang Terminal as its draft is not exceed the

safety draft of 16.3 M of the No.7 Berth of Hai Cang Terminal. The No.7 Berth of Hai Cang Terminal is the largest berth of Xiamen city, which allows vessels of cape size to berth at the terminal. Thus the cape size bulk carrier - MV.W-ACE is better to berth at Hai Cang Terminal, and the information will be delivered to the related parties.

The berthing plan will be announced by the captain of MV.W-ACE to port authority and the operators of ship-owner and ship agency-XIAMEN UNITED INTERNATIONAL SHIPPING CO., LTD (UNISCO). Then the operator of UNISCO will inform the charterer or trader-SANSTEEL the berthing information, and SANSTEEL will contract the freight forwarder-PENAVICO and consignee - HOUSHI ELECTRICITY GENERATING STATION to arrange cargo receiving. This is the start of the bulk cargo collection and distribution system process.

The processes are classified as four modules.

Module A step

The customer-HOUSHI ELECTRICITY GENERATING STATION may entrust the freight forwarding company- PENAVICO to transport the cargos-PCI COAL. After the PENAVICO has got the authorization ,one of their operators will receive the instruction to order logistics business through the bulk cargo collection and distribution service ordering platform of Module A system.

First, the operator Sam of PENAVICO will enter the Customer System to connect to E-Commerce Information Service System using his account name with the password. Then, he will choose the required service type of bulk cargo collection or distribution transport. His choice information will be delivered to Logistics Resources Classification and Dispatch System for further resources and dispatch information collection feedback from logistics companies. The feedback information will help operator Sam to make further information filtering to choose the most suitable service.

This information for filtering might be the transport direction, routes, transportation tools, schedule arrangement, freight, fuel surcharge, whether, insurance, or other related aspects during the bulk cargo collection and distribution processes. There different aspects will be divided into several choices as following figure shows.

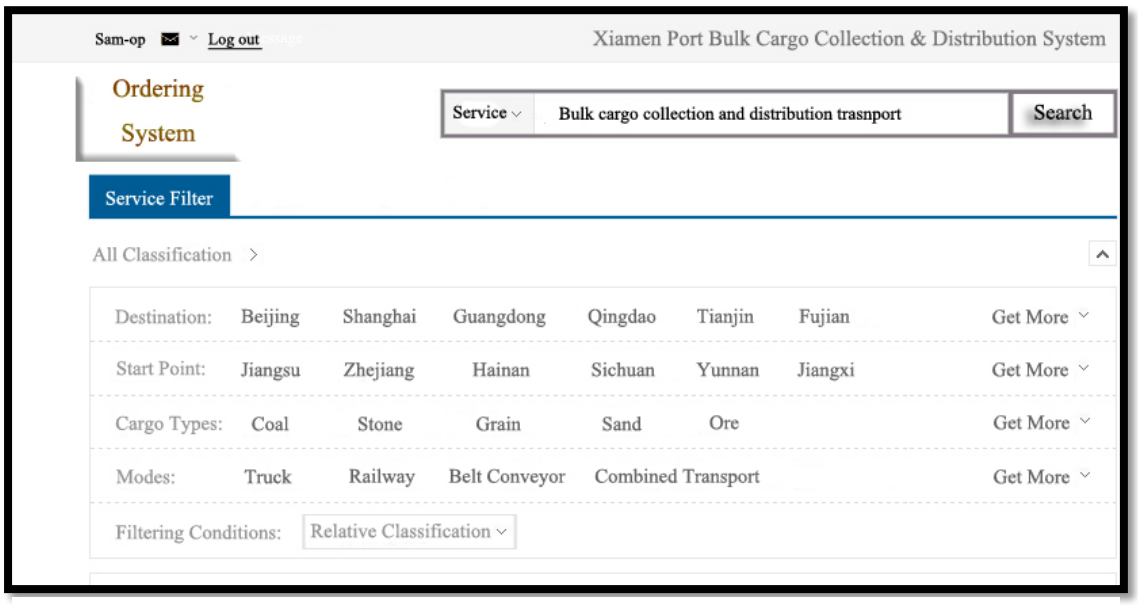

Figure 23 Ordering System Model of Bulk Cargo Collection and Distribution Transport

At this step, if Sam choose the Destination-Zhangzhou, Start Point-Xiamen, Cargo Type-Coal, Mode-Combined Transport (Truck + Railway), he will have the decision to make a pre-confirmation for the order. Then, the pre-confirmed information will be delivered to E-Commerce Information Service Platform of Enterprises Service System for Collection or Distribution Enterprises Screening to filter the results by the condition according with the choices made by Sam. The information of logistics enterprises is provided by Modern Logistics Park, which manages the whole data and transport processes of bulk cargo collection and distribution business intensively with its unique Enterprises Logistics information System.

After the filtering is finished, the satisfactory logistics service providers information will be delivered to Sam, and then, Sam will have the access to E-Platform Service for

Order Negotiation through the on-line communication platform with the operators from different logistics enterprises. These satisfactory service providers might be various, but Sam chooses the most suitable logistics enterprises-XIAMEN ITG TIDAK LOGISTICS CO., LTD, which is the local company with more transport experience and better service records. Thus, after the negotiation with TIDAK LOGISTICS, Sam delivers his order information with detailed requirements to the operator, and prepares to confirm the order. The example of the confirmed order is showed as follows.

ORDER INFORMATION		
Logistics No. Signed Date:	14628TK02 JUNE 28TH 2014	
DETAIL	DESCRIPTION	REMARKS
CARGO TYPE	AUSTRALIAN PCI COAL	91,210 MT
TRANSPORT MODE	TRUCK & RAILWAY	COMBINED TRANSPORT
TRANSPORT PURPOSE	DISTRIBUTION TRANSPORT	TERMINAL TO INLAND
RELATED VESSEL	MV.W-ACE	93,014.7 DWT CAPE
START POINT	13# BERTH, HAI CANG TERMINAL, XIAMEN, FUJIAN, CHINA	TERMINAL - TRUCK - MODERN LOGISTICS PARK
DESTINATION	HOUSHI ELECTRICITY GENERATING STATION, ZHANG ZHOU CITY, FUJIAN PROVINCE ,CHINA	MODERN LOGISTICS PARK - RAILWAY - HOUSHI
REQUIREMENT	DESCRIPTION	REMARKS
WEATHER	DRY	
PERIOD	WITHIN 10 WORKING DAYS	
OTHERS		
PARTIES	COMPANIES	REMARKS
CUSTOMER	XIAMEN PENAVICO INTRENATIONAL FREIGHT & FORWARDER CO., LTD	OPERATOR-MR.SAM
LOGISTICS CO.	XIAMEN ITG TIDAK LOGISTICS CO., LTD	
CONSIGNEE	HOUSHI ELECTRICITY GENERATING STATION	

Table 3 Order information model for bulk cargo collection and distribution system

The final step in Module A process is the pre-payment for the order, TIDAK LOGISTICS will not receive the cargo freight until Sam confirms the actual payment in the final step of Module D to finish this whole transport processes. Then, the ordered business information will be transferred to Bulk Cargo Information Interaction Control Platform, which connects the four Modules, aiming at guaranteeing the order information being interacted and shared fluently in the Modules.

Module B step

In Module B, the vessels information is monitored and controlled before the confirmed an pre-paid order is delivered to Bulk Cargo Terminal Control Center. After the center has received the information from Module A, it will allow the related logistics company- TIDAK LOGISTICS and customer- Sam, freight forwarder of PENAVICO CO., LTD to enter the system of Terminal Loading & Discharging Control Platform to keep track of the discharging arrangement information of the AUSTRALIAN PCI COAL. Before the discharging, if Terminal Loading & Discharging Control Platform announces that MV.W-ACE will berth at 13# berth of Hai Cang Terminal, operator Sam will start to prepare for the cargo receiving process, and TIDAK LOGISTICS will start to arrange distribution transport for the cargos. The information of PCI COAL will be delivered to Cargo Classification system of port authority, and they will select the transport method according to the confirmed order. Finally, the PCI COAL information will be transferred to Enterprises logistics Information system of TIDAK LOGISTICS, and then comes to Distribution & Logistics Dispatch Information Control Center for data collecting. Meanwhile, the information will be delivered to the filtering process of Collection & Distribution Filtering to classify the ordered business for TIDAK LOGISTICS, and then they will begin to conduct the Distribution Operating for the cargos. Operator Sam will also keep track of the operators of TIDAK LOGISTICS in the process of Module B to

know the actual arrangement decision and cargo information in detail.

Module C step

When TIDAK LOGISTICS decides to start the distribution business for the orders, the order information with the feedback of PCI COAL information will be delivered to Module C for distribution routes arrangement. According to the information specified in the order, the distribution route is Outward Distribution, and after Bulk Cargo Types Judgment-COAL, Enterprises Logistics Information System will deliver the order to the system of Collection & Distribution Transport Mode Selection to conduct the final transport mode selecting for the PCI COAL. If the selection is not matched with the transport modes specified in the order, the operator of TIDAK LOGISTICS will contract Sam to negotiate the change of modes, and Sam can also know the condition of his order in-time as the Freight Forwarding Information System is linked to the Enterprises Logistics Information System in Module C. After the transport mode is confirmed, it will come to the step of Reasonable Routes Arrangement, and the factors considered at this step is various like Bulk Cargo Condition-91,210MT PCI COAL at 13# berth of Hai Cang Terminal, Transport Direction-outward distribution from Xiamen to Zhangzhou, Time or Schedule-within 10 days, Cargo Handling Rates-20,000 MT PER WWD SHINC 24 CONSEC HOURS WITH 12HRS TT (provided by Terminal Loading & Discharging Control Platform), Road Condition-according to the transport restriction of Xiamen city, and Destination Condition of HOUSHI ELECTRICITY GENERATING STATION. The factor Road Condition might has more influence to the whole routes arrangement in Xiamen city as it exists a serious restrictions for city road transport, which can be seen from table 1 and table 2. Thus the distribution transport should avoid the period not allowed for truck transport. However, if the Modern Logistics Park is constructed near Hai Cang Terminal, truck transport will be directly connected to railway transport, just like the Figure 16 shows. If the whole related factors are considered and decided, the

arrangement will start and the information will be transferred to Module D for the real distribution operation.

Module D step

When it comes to the final step of bulk cargo collection and distribution system processes, the order of PCI COAL will be conducted after the cargo has been discharged from MV.W-ACE. The order will be checked once for distribution direction-outward, transport mode-truck & railway, and according to the transport direction ,the order will be delivered to the Port-to-Inland Platform from Enterprises Logistics Information System of TIDAK LOGISTICS to make further business operation. The order will be finally received by Collection & Distribution Transport Dispatch Control Center of Modern Logistics Park to decide and manage the conduction of the transport business. And Bulk Cargo Terminal Control Center here is linked to the control center to keep track of the information of PCI COAL, which will be fed back to ship-owners and traders.

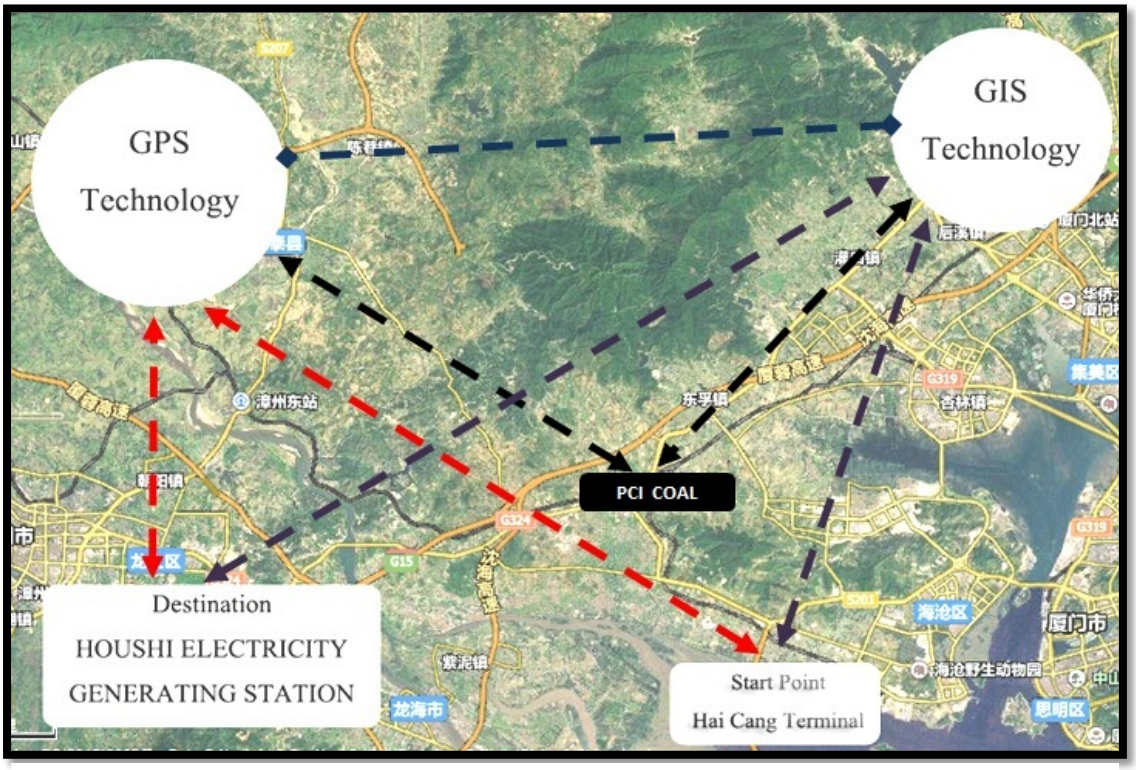

Figure 24 Application of GIS and GPS technologies

During the transport of the AUSTRALIAN PCI COAL, the control center of Modern Logistics Park will use the advanced tracking and tracing technologies to operate the distribution processes, like Global Position System (GPS) and Geographical Information System (GIS), from which the real-time feedback is actual and helpful. The application can be seen from Figure 24 that with the help of GPS and GIS technologies, both the control center at Hai Cang Terminal and the customer-HOUSHI ELECTRICITY GENERATING STATION can get the distribution information back from the GPS services, and the transport tool which carried the PCI COAL will get the navigation instruction from GIS service.

Any distribution transport information will be collected and delivered to center system in tome, and fed back to the customer-Sam, and the consignee-HOUSHI ELECTRICITY GENERATING STATION. After the PCI COAL has arrived at the destination safely, the consignee-OUSHI ELECTRICITY GENERATING STATION might ask some inspectors to check whether their cargos are in good condition. Finally, they will confirm to receive the PCI COAL with agreement, and confirm the orders again to transform the pre-payment into actual payment. Thus the logistics service provider- TIDAK LOGISTICS will get the freight, and the freight forwarder-Mr. Sam may finish this business with the consignee. Then, the order will be closed and stored in the database of both Enterprises Logistics System and Bulk Cargo Collection and Distribution system.

5.3 Feasibility Study

The feasibility study to the model of Xiamen port bulk cargo collection and distribution is to analysis the four important feasibilities - technology and system feasibility, operation feasibility, economic feasibility and resource feasibility.

5.3.1 Technology and system feasibility

The construction of the bulk cargo collection and distribution is based on information technologies, which needs a certain period of system development lifecycle, because the integration of information system will consider the compatibility for the whole system connected together through the comprehensive interface platform.

Technology and system feasibility for Module A

In Module A, the ordering system is based on the application of E-Commerce B-to-C platform to help customers classify and choose the satisfactory service type, and the negotiation platform between customers and logistics service providers is also an usual technology used in nowadays on-line purchasing. Thus apply the E-Commerce B-to-C technology in the ordering system of bulk cargo collection and distribution system with the interaction of logistics companies from Modern Logistics Park will transform the system into a Fourth Party Logistics service platform, which is the trend for the future development of port collection and distribution system. Therefore, the technology and system feasibility for Module A is reasonable.

Technology and system feasibility for Module B

In Module B, the connection technology is applied to combine the Terminal Loading & Discharging Control Platform with the Enterprises Logistics Information System, aiming at guaranteeing the fluent information flow within both terminal systems and logistics systems. It will help freight forwarding companies and logistics enterprises get the real-time information about the cargos specified in the confirmed and pre-paid orders. Thus the systemic application in Module is the combination of two important system without extra system development, and the technology for the combination is the systemic interaction application. Therefore, the technology and system feasibility for Module B is reasonable.

Technology and system feasibility for Module C

In Module C, the technology applied here is the filtering and classifying approaches for the arranged bulk cargos. These will not be complex under the usage of cargo identification technology. Of course, operators can directly identify the types of cargos with their experiences, but it will be a waste of time if the orders is of large amount. Another application is the systemic factors analysis for Reasonable Routes Arrangement, which depends on several factors including Bulk Cargo Condition, Transport Direction, Time or Schedule, Cargo Handling Rates, Road Condition, Destination Condition and so on. These factors will affect the choice of logistics enterprises in the routes decision-making. Thus the systemic factors analysis applied in this step will help operators find the most suitable collection and distribution plan for the specified bulk cargos. Moreover, some human factors might be considered in the decision, and the final routes may come out with both the recommendations from the system, and the thoughts from operators. Therefore, the realization of the systemic factors analysis for collection and distribution routes will not be difficult, and it is reasonable for the technology and system feasibility for Module C.

Technology and system feasibility for Module D

In Module D, the applied technologies are various. The first is the Collection & Distribution Transport Dispatch Control Center, which monitors and controls the collection or distribution business processes. It is important during the transportation of bulk cargos because it acts as a bridge to connect the transport processes information with actual transport condition, and links to the Enterprises Logistics Information System for receiving instructions. This is realized through the application of the two vital Information Communication Technologies (ICT) - Global Position System (GPS) and Geographical Information System (GIS). These two technologies are applied in various fields especially for the transportation processes. Thus it is normally that keep tracking and tracing for bulk cargos transport information with

real-time feedback mechanism via GPS and GIS technologies in Module D, and the technology and system feasibility for here is reasonable.

Conclusion of technology and system feasibility

It is reasonable to optimize the bulk cargo collection and distribution system through the systemic construction as demonstrated in Module A, Module B, Module C and Module D with the application of advanced and useful information technologies. Thus, the systems used in the modules will not need a long development lifecycle to realize the functions for Xiamen port bulk cargo collection and distribution transport, and most of the systems are existing and applied in different areas. The role of the four combined modules is to connect these systems together to take full advantage of the synergistic effect that the application of these systems brings along, aiming at optimizing the operational efficiency of bulk cargo collection and distribution system.

5.3.2 Operation feasibility

After a series of resources horizontal and vertical integration, port authority will face a challenge of operating the port bulk cargo collection and distribution system. Moreover, the terminal enterprises alliance will bring along a series pressure at first for port authority to manage the whole transport process well. But the operation for the new collection and distribution. The systems interacted with the Bulk Cargo Terminal Control Center are various, and they belongs to the parties from logistics enterprises, freight forwarding companies, ship agency companies, port authorities, and other related system-owners. Thus, in order to manage the system well, port authority will need to set a series of measurement for these parties to guarantee the normal and efficient operation of the port bulk cargo collection and distribution system. Because of the fact that the port authority is under the control of local government of Xiamen city, the parties related in the operation of port bulk cargo

collection and distribution system will also follow the instruction from government. Thus the operation feasibility is reasonable for the optimization of port bulk cargo collection and distribution system under the regular management of government.

5.3.3 Economic feasibility

The integration of resources will bring along the opportunity of the increasing trading amount for import and export bulk cargo transport. This will donate to the development for the economies of scale of bulk cargo collection and distribution system for Xiamen city. Before the optimized system start to run, there still need a period of time and effort to realize its new functions. It will certainly cost a short period of system development lifecycle for the integration of the four modules with the combination among different functional sub-systems. Meanwhile, the development and optimization also need the financial support from government, which is the manager of the port authority and the port bulk cargo collection and distribution system, but the theoretical efficiency and the system innovation might be attractive for the government to make decisions for the investment. Moreover, the optimization for the system is environmental friendly as it is the horizontal integration among different logistics companies, and the vertical integration from terminals to the final consignees service, which will reduce the needless intermediate processes and time for extra collection and distribution activities. This will also decrease the cost of logistics during the transport with efficient utilization of fuel and human effort through the construction and management of Modern Logistics Park , and logistics enterprises will have more space and time to arrange the most suitable development for the further transport business service to attract customers. Similarly, The integrated systems will contribute to the information transferring and sharing among different sub-systems integrated in the functional modules, which will enlarge the economic effect within the port bulk cargo collection and distribution system under

this so called BIG DATA age, which is a revolution that will transform how we live, work, and think (Viktor Mayer-Schonberger, Kenneth Cukier, 2013, BIG DATA). Thus the micro informationalized approaches for the optimization of Xiamen port bulk cargo collection and distribution system is required, which will promote the macro system operation of collection and distribution transport processes at the same time. Therefore, it is economic feasibility for the optimization of the bulk cargo collection and distribution system of Xiamen port.

5.3.4 Resource feasibility

The resources for the two bulk cargo terminals of Xiamen - Hai Cang terminal and Xiang Yu terminal are abundant in both the area of infrastructure construction and the bulk cargo transport amount. Through the integration with the inland logistics transport resources, the macro and micro scale of Xiamen port bulk cargo collection and distribution system will be enlarged, which combines the transport activities within port areas and the logistics processes out of port areas together, aiming at realizing the reasonable collection and distribution utilization and arrangement. The resources horizontal integration of Modern Logistics Pork will contribute to the logistics resources consolidation, and the enterprises corporation among terminals like Xiang Yu terminal and Hai Cang terminal will bring along a series advantages for Xiamen port to make reasonable berthing arrangement for different types of vessels and bulk cargos, which will make the port bulk cargo collection and distribution more flexible in the decision-making for cargo transport modes and routes according to different order requirements and urban road conditions. Meanwhile, the systemic horizontal resources integration of the construction of fourth party logistics service platform with the application of advanced IT technologies to bulk cargo collection and distribution will lead to a new mode of bulk cargo transport business, which includes the functions of third party logistics service, the ordering approaches of

E-Commence platform, and the advanced tracking and tracing advantages that IT technologies bring along. Thus, it is reasonable for the resources feasibility of the optimization for Xiamen port bulk cargo collection and distribution system.

5.4 Conclusion of feasibility study

It is theoretically feasible for the optimization of Xiamen port bulk cargo collection and distribution system through the analysis of technology & system feasibility, operation feasibility, economic feasibility and resource feasibility. According to the advantages that the optimization will bring about, the application of the optimizing program will be an innovation for current port collection and distribution operation. Even though the optimization need a certain period and effort for system interaction and resources horizontal and vertical integration with the investment from local government and other related authorities, the functions that the optimized system will bring alone is diversified, and the logistics resources utilization within the arrangement of the new system structure will be high efficient. Thus the result of the feasibility study for the optimized port bulk cargo collection and distribution system of Xiamen city is reasonable.

6.Summary and conclusion

6.1 Conclusion

The thesis is based on the current port collection and distribution system studies both overseas and in China, and a new concept for Xiamen port bulk cargo collection and distribution system optimization is presented in the thesis. The concept is not only includes the micro view of logistics system optimization for the systemic smoothly operation, but also the macro view for the whole bulk cargo port cargo handling infrastructures system optimization.

The main effort for the thesis is the horizontal and vertical resources integration with the utilization of advanced IT technologies to manage and conduct the whole bulk cargo collection and distribution system. In the thesis, a series figures of the railway and highway or the urban roads of Xiamen are showed for the macro view of port bulk cargo collection and distribution, and the processes of cargo handlings happen in the port area are also presented. The dissertation is focused on the systemic modeling for micro Modules within the port bulk cargo collection and distribution system, aiming at optimizing the system with informationalized approaches according to the functions that bulk cargo collection and distribution system will bring about.

Meanwhile, A simulation is conducted after the construction of four systemic modules, and the main contribution for the modeling in the dissertation are demonstrated as follow:

a. The theoretic structure for Modern Logistics Park for port bulk cargo collection and distribution transport is created with the demonstration of its different functions and the roads connection with port area and railway station. And the application of

Modern Logistics Park in the port areas of both Hai Cang port and Xiang Yu port is the optimal purpose of logistics resources integration.

b. The creation for Module A which presents the ordering system for customers and logistics service providers with the application of EDI technologies and E-Commerce service platform. Thus Module A will realize the systemic ordering function of port bulk cargo collection and distribution system.

c. The creation for Module B which presents the systemic combination between Terminal Loading & Discharging Control Platform and Enterprises Logistics Information System. The combination between the two system will realize the real-time bulk cargo information transferring within the two systems. Thus customers and logistics companies will have more time and space to arrange the receiving for bulk cargos, and logistics companies will be able to deliver the information to its bulk cargo transport arrangement system to make transport routes selection.

d. The creation for Module C which presents the systemic routes arrangement function for logistics companies with the application of systemic factors analysis for routes arrangement considering different transport conditions like bulk cargo condition, transport direction ,time or schedule requirement, cargo handling rates, road condition, and destination condition. The system will select the suitable routes choices for logistics service providers with recommendations.

e. The creation for Module D which presents the systemic collection and distribution control center for logistics enterprises with the application of IT technologies-GPS and GIS to keep tracking and tracing for the transported bulk cargos. And it is the final step for the whole bulk cargo collection and distribution business that consignees will transform the pre-payment into actual payment if they are satisfied with the

logistics service.

f. The simulation presented in Chapter 5 simulate a process of bulk cargo distribution business from the start to the end of the whole procedure of port bulk cargo collection and distribution activities. It will be more intuitive for readers to know the processes among the optimal system.

6.2 Further study

It is the theoretical optimization model for Xiamen port bulk cargo collection and distribution system, thus a further study for the virtual utilization and optimization need more effort to be explored. The study in the future will need the practical test for the application feasibility of the optimized bulk cargo collection and distribution in both macro and micro areas according to more factors which influence the optimization for the system.

Another study that needed to be conduct might be the macro analysis of the real bulk cargo transport routes and schedule arrangement within both the internal and external island of Xiamen city, which will need more mathematic models to simulate and calculate the most suitable transport routes according to every transport influence factors like the transport limitations set by government. Thus it is the optimization through the macro view of Xiamen port bulk cargo collection and distribution system, which will realize the macro optimization for the transport.

Reference

[1] Adam S. Maiga, Anders Nilsson, Fred A. Jacobs, (2013), Assessing the interaction effect of cost control systems and information technology integration on manufacturing plant financial performance, *The British Accounting Review xxx (2013) 1–14*

[2] Chen Tao, Yang Liu, (2012), Study on Cost Control of Port Logistics Enterprises, T*ECHNOLOGY AND APPROACH, September 2012*

陈涛，杨柳，（2012），港口物流企业成本控制研究，*技术与方法，2012.9*

[3] Chen Zhikun, (2013), Research on Establishment of Port Logistic Information System based on Supply Chain, *RAILWAY TRANSPORT AND ECONOMY, Vol.35 No.5, 2013*

陈志坤，（2013），基于供应链的港口物流信息系统构建研究，*铁路运输与经济，Vol.35 No.5, 2013*

[4] Chiang Wang, (2010), The application of third party logistics to implement the Just-In-Time system with minimum cost under a global environment, *Expert Systems with Applications 37 (2010) 2117–2123*

[5] Chiung-Lin Liu, Andrew C. Lyons, (2011), An analysis of third-party logistics performance and service provision, *Transportation Research Part E 47 (2011) 547–570*

[6] Ceren ALTUNTAS·Okan TUNA, (2013), Greening Logistics Centers : The Evolution of Industrial Buying Criteria Towards Green**,** *The Asian Journal of Shipping And Logistics ·Volume 29 Number 1 December 2013 pp.059-080*

[7] Rickard Bergqvist, Niklas Egels-Zandén, (2012), Green port dues — The case of hinterland transport, *Research in Transportation Business & Management 5 (2012) 85–91*

[8] Geng Wenqian, Zhang Ziliang, Bian Huiting, Li Wenpeng, (2012), Large Port Logistics System Modeling and Simulation, *DA GUAN WEEKLY, Vol. 576 No.16,*

2012

耿文倩，张子良，边会婷，李文鹏，（2012）大型港口物流系统的建模与仿真，*大观周刊，Vol. 576 No.16, 2012*

[9] Gulcin Buyukozkan, OrhanFeyzioglu, MehmetSakir Ersoy, (2009), Evaluation of 4PL operating models: A decision making approach based on 2-additive Choquet integral, *Int. J. Production Economics 121 (2009) 112–120*

[10] Gul DENKTAS-SAKAR, Cimen KARATAS-CETIN, (2012), Port Sustainability and Stakeholder Management in Supply Chains: A Framework on Resource Dependence

[11] Hokey Min, Hyun-Jeung Ko, (2008), The dynamic design of a reverse logistics network from the perspective of third-party logistics service providers, *Int. J. Production Economics 113 (2008) 176–192*

[12] Hosang Jung, F. Frank Chen, Bongju Jeong, (2008), Decentralized supply chain planning framework for third party logistics partnership, *Computers & Industrial Engineering 55 (2008) 348–364*

[13] Hong, J.J., Chin, A.T.H., Liu, B.L., 2004. Logistics outsourcing by manufacturers in China: *a survey of the industry. Transportation Journal 43 (1), 17–25.*

[14] Hee-sung BAE, (2012), The Effect of Market Orientation on Relationship Commitment and Relationship Effectiveness of Port Logistics Firms, *The Asian Journal of Shipping And Logistics ·Volume 28 Number 1 April 2012 pp.105-134*

Huang Xiaomin, (2008), The Development of Overseas Port Collection and Distribution System, *Maritime Management Vol.30 No.6*

[15] JI Ming-Jun, CHU Yan-Ling, (2012), Optimization for Hub-and-Spoke Port Logistics Network of Dynamic Hinterland, 2012 International Conference on Medical Physics and Biomedical Engineering, *Physics Procedia 33 (2012) 827 – 832*

[16] Jiang Chang, (2010), Port Logistics Features and Correlation Analysis, *PORT HANDLING Vol.192 No.4. 2010*

蒋昌，（2010），港口物流的特征及相关性，*港口装卸 Vol.192 No.4. 2010*

[17] Jiang Shunjie, Fan Zhen, Systematic Analysis and Evaluation Research of China Port Logistics Development

姜顺婕，范震，我国港口物流发展的系统分析与评价研究，*理论研究*

[18] Jayanth Jayaram, Keah-Choon Tan, (2010), Supply chain integration with third-party logistics providers, *Int. J. Production Economics 125 (2010) 262–271*

[19] Jianming Yao, (2010), Decision optimization analysis on supply chain resource integration in fourthparty logistics, *Journal of Manufacturing Systems 29 (2010) 121–129*

[20] Jasmine Siu Lee Lam, Wei Yim Yap, (2011), Dynamics of liner shipping network and port connectivity in supply chainsystems: analysis on East Asia, *Journal of Transport Geography 19 (2011) 1272–1281*

[21] Jianfeng Li, WeiHang Li, Yan Lin, (2011), Port Supply Chain Simulation Model under Interactive

[22] Analysis, Procedia Engineering 15 (2011) 2082 – 2086

[23] Jose Tongzon, Young-Tae Chang, Sang-Yoon Lee, (2009), How supply chain oriented in the port sector?, *Int. J. Production Economics 122 (2009) 21–34*

[24] Jiang Nengtao, (2013), Application of Information Technology in Port Logistics Management: Taking X Wharf Company as an Example, *VALUE ENGINEERING, No.33, 2013*

Website: *http://www.sciencedirect.com*

姜能涛，（2013），浅谈信息技术在港口物流管理中的应用-以 X 码头公司为例，*价值工程，No.33, 2013*

[25] Khalid Bichou, (2007), REVIEW OF PORT PERFORMANCEAPPROACHES AND A SUPPLYCHAINFRAMEWORK TO PORTPERFORMANCE BENCHMARKING, *Devolution, Port Governance and Port Performance Research in Transportation Economics, Volume 17, 567–598 Chapter 24*

[26] Journal of Shipping Management, (2011), Development Strategy of Modern Port Logistics and e-Business, *China e-Business Research Centre, July 19th 2011*

Website: http://b2b.toocle.com/detail--5850855.html

[27] Li Kexue, (2013), Application ofData Chain Technology in Smart Port Logistics System, *LOGISTICS TECHNOLOGY, Vol.32 No.8, 2013*

[28] Lieb, R., Bentz, B.A., 2005a. The North American third party logistics industry in 2004: the provider CEO perspective. *International Journal of Physical*

[29] Lieb, R.C., Bentz, B.A., 2005b. The use of third-party logistics services by large American manufacturers: the 2004 survey. *Transportation Journal 44 (2), 5–15.*

[30] Li Naibin, (2008), Qingdao Port Established Modern Logistics e-Business Platform, *China Transportation Report, Jun 27th 2008*

Website:http://www.moc.gov.cn/zhuzhan/jiaotongxinwen/difangxinwen/200806/t20080627_502205.html

[31] Li Diansheng, Zhang Shengze, Yuan Lifen, (2013), Research on Measurement of Comprehensive Efficiency for Port Logistics, *Journal of Transportation Systems Engineering and Information Technology, Vo1.13 No.5, October 2013*

李电生，张圣泽，员丽芬，（2013），港口物流综合效率测度研究，*交通运输系统工程信息，Vo1.13 No.5, October 2013*

[32] Li Yubao, (2013), Port Logistics Supply Chain and Operation Mechanism Research, *LOGISTICS TECHNOLOGY, No.9, 2013*

李玉保，（2013），港口物流供应链及其运作机制研究，*技术与应用，No.9, 2013*

[33] Li Jufang,(2013),Application of Information Technology in Project Management for Port’s Major Pieces' Collection and Distribution, *Port & Waterway Engineering No. 6 Serial No. 480*

李菊芳，（2013），港口工程重大件集疏运项目管理中的信息技术应用，*水运工程，No. 6 Serial No. 480*

[34] Lin Suyan, (2012), Application of Activity-Based Costing Approach in Port Logistics Enterprises, *Economic Forum, Gen. 502 No.05, May 2012*

林素燕，（2012），作业成本法在港口物流企业的应用

[35] Liu Caifang, (2004), Establish Port Logistics Alliance, *Introducing and*

Consulting, No.10, 2004

刘彩芳，（2004），构建港口物流联盟，*引进与咨询，No.10, 2004*

[36] Ma Jinfeng, (2013), Yangtze River Delta Region Port Logistics SWOT Analysis, *Modern Business Trade Industry, No.22, 2013*

马金凤，（2013），长三角港口物流 SWOT 分析，*现代商贸工业，No.22, 2013*

[37] Ma Junwen, (2013), Port Development Driving Factor Analysis, *China Water Transport, Vol. 13 No. 12, December 2013*

马珺文，（2013），港口发展的驱动因素分析，*中国水运，Vol. 13 No. 12, December 2013*

[38] Min Huangi, Yan Cu, Shengxiang Yang, Xingwei Wang, (2013), Fourth party logistics routing problem model with fuzzy duration time, *Int. J.ProductionEconomics145(2013)107–116*

[39] Qiong Liu, Chaoyong Zhang, Keren Zhu, Yunqing Rao, (2014), Novel multi-Objective resource allocation and activity scheduling for fourth party logistics, *Computers &OperationsResearch44(2014)42–51*

[40] Rommert Dekker, Jacqueline Bloemhof, Ioannis Mallidis, (2012), Operations Research for green logistics – An overview of aspects, issues, contributions and challenges, *European Journal of Operational Research 219 (2012) 671–679*

[41] R. Rajesh, S. Pugazhendhi, K. Ganesh, Yves Ducq, S.C. Lenny Koh, (2012), Generic balanced scorecard framework for third party logistics service provider, *Int. J. Production Economics 140 (2012) 269–282*

[42] S. Ubeda, F.J. Arcelus, J. Faulin, (2011), Green logistics at Eroski: A case study, *Int. J. Production Economics 131 (2011) 44–51*

[43] Shi Xiaodi, (2013), Storage Cost Management and Control of Logistics Enterprise, *Business, Logistics Trading, 2013*

[44] Song Xiaozhong, Liu Xiangmin, (2013), Port Logistics System Status and Development Research, *CHINESE COLLECTIVIZATIONAL ECONOMY, No.09, March 2013*

宋效中，刘向民，（2013），港口物流系统现状与发展研究，商贸流通，*No.09, March 2013*

[45] UNCTAD Secretariat. Technical note: Fourth-generation port [J]. *Ports Newsletter, (11) 1999* .

[46] Viktor Mayer-Schonberger, Kenneth Cukier, 2013, BIG DATA

[47] Wayne K. Talley, (2013), Maritime transport chains: carrier, port and shipper choice effects, *Int. J. Production Economics*

[48] Theory, *The Asian Journal of Shipping And Logistics ·Volume 28 Number 3 December 2012 pp.301-320*

[49] Wu Jingtai, Yao Pengli, (2013), Based on Factor Analysis of the Logistics System Cost Control Research, *Logistics Sci-Tech, No.11, 2013*

吴景泰，姚鹏丽，（2013），基于因子分析的物流系统成本控制研究，*Logistics Sci-Tech, No.11, 2013*

[50] Rmoyes, (2012), The Application of Port e-Commerce,

Website: http://doc.mbalib.com/view/b72a481d5a3b55c7f86aebb45b1c50af.html

[51] Wang Jingmin, (2011), Port Logistics Informationalized Development Strategic Research in the Mode of e-Business, *China e-Business Research Centre, January 11th 2011*

Website: http://www.cnki.com.cn/Article/CJFDTotal-GLXZ201006037.htm

王景敏，（2011），电子商务模式下港口物流信息化发展策略研究，*中国管理信息化，January 11th 2011*

[52] Wu Yan, (2010), China e-Commerce Development Status and Trend Analysis, *Netease Business News, July 27th 2010*

Website:http://money.163.com/10/0727/10/6CJESV3600253G87.html

吴彦，（2010），我国电子商务发展现状与趋势分析，*网易财经，July 27th 2010*

[53] WANG Chuan-xu, (2008), Optimization of Hub-and-Spoke Two-stage Logistics Network in Regional Port Cluster, Systems Engineering — *Theory & Practice, Volume 28, Issue 9, September 2008, Online English edition of the Chinese language*

journal, Cite this article as: SETP, 2008, 28(9): 152–158

[54] Wang Zhixin, Zhang Weifa, China Port Logistics Development Countermeasure, Website: *http://www.sciencedirect.com*

[55] Wu Yang, (2013), Domestic Port Logistics Development Situation and Countermeasure, *Modern Enterprise Culture, February 2013*

吴杨，（2013），国内港口物流发展态势及对策，*Modern Enterprise Culture, February 2013*

[56] Xiang Jiying, (2013), Relation of Port Logistic Industry and Local Economy: A Case Study of Yantian Port, *No.6, 2013*

Website: http://xb.szpt.edu.cn

向吉英，（2013），论港口物流企业与地方经济的关系-以盐田港为例，*No.6, 2013*

[57] Xue Gendi, (2010), Evoluation System Research of Modern Port Logistics, *NATIONAL BUSINESS (Theoretical Research), No.07, 2010*

[58] Xinyan, Renyan, Liu Huina, (2013), Comparative Cost Analysis of B2C e-Commerce Enterprise Self-support Logistics, *JOURNAL OF DALIAN UNIVERSITY ,Volume 34 Number 5 October 2013*

辛晏，任妍，刘慧娜，（2013），B2C 电商企业自营物流成本比较分析，*大连大学学报，Volume 34 Number 5 October 2013*

[59] Yan Cui, Min Huang, Shengxiang Yang, Loo Hay Lee, Xingwei Wang, (2013), Fourth party logistics routing problem model with fuzzy duration timeand cost discount, *Knowledge-Based Systems 50 (2013) 14–24*

[60] Yang Hua, (2013), Port Informationalized Development Orientation Analysis, *TELECOM WORLD- Technology and Innovation, July 2013*

杨桦，（2013），关于港口信息化发展方向的分析，*科技与创新，*

[61] Yuan Ye, (2013), Ningbo-Zhoushan Port Logistics Development Strategy Research, *China Water Transport, Vol.13 No.12, December 2013*

袁野，（2013），宁波-舟山港港口物流发展策略探讨，中国水运，*Vol.13 No.12,*

December 2013

[62] Yi-Chih Yang, Wei-Min Chang, (2013), Impacts of electric rubber-tired gantries on green port performance, *Research in Transportation Business & Management 8 (2013) 67–76*

[63] Zhang Weixi, Xi Tianyu, Zhang Ruifeng, (2011), A Case Research on Vulnerability of logistics system in the Tianjin port, IACEED2010, *Energy Procedia 5 (2011) 2059–2064*

[64] ZHANG Yu-qin，ZHOU Qiang，ZHANG Yan—wei,(2011), Simulation and Analysis of Road Network Structure for Comprehensive Port Collection and Distribution system, *Port＆Waterway Engineering No．12 Serial No．46l*

[65] Zhang Ying, Zhang Lei, (2013), Cost Control Analysis of e-Commerce Enterprise Logistics, *Market Marketing ,Volume 435 Number 9, 2013*

张颖，张磊，（2013），电子商务企业物流成本控制探讨，*市场营销，Volume 435 Number 9, 2013*

Website:

http://www.sciencedirect.com

http://www.elsevier.com

http://www.cnki.com.cn

http://doc.mbalib.com

http://b2b.toocle.com

http://www.moc.gov.cn

http://money.163.com

http://xb.szpt.edu.cn