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Research on the connection of contrainer transport between the waterway and the railway along the downstream area of Yangtze River

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Research on the Connection of Container Transport between the Waterway and the Railway along the Downstream Area of Yangtze River

By

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Declaration

I certify that all the material in this dissertation 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 dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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Abstract

Transportation plays an important role in facilitating the development of economy, as it delivers goods for trade between different origins and destinations. Along with the rapid economic development in China, there are increasing demands for the improvement in the transportation system in the country, such as railway, roads or highway, and waterway. In particular, the economic development moving from the coastal area in the East to the interior area in the West further requires the transportation along the Yangtze River, which is the largest waterway in China and third largest in the world. Specifically, container transportation, as a transportation mode, has been playing an more and more important part in the transportation system; but the rapid development and increasing demands for transportation also requires for more flexible and efficient transportation mode, which is the intermodal transport, such as combined container transport, between railway and railway, or railway and waterway, or others. As in this paper, it discusses the connection of container transport between the waterway and the railway along the downstream area of the Yangtze River. First, the present situation of container transport along the Yangtze River is analyzed, involving the entire transport system and the container transportation within the area, as well as the central ports along the Yangtze River, in addition to the current situation of the waterway and railway container transports. Second, it then analyses the problems related to the connection of container transport between the waterway and the railway along the Yangtze River, which mainly focus on the railway transport, the ports and the customs. Afterwards, solutions are proposed for dealing with the existing problems. To be specific, there are four approaches recommended for promoting the connection of the container transport between the Waterway and the Railway along the Yangtze River, which are: 1) understanding advantages of Water-Rail combined container transport; 2) upgrading hardware and software standards; 3) speeding up the legislation for creating a favorable legal environment; and 4) preventing the pollution along the Yangtze River. Moreover there are another

six counter-measures for resolving the existing problems: i) to develop double stack container transport; ii) to establish and improve the harbor stations; iii) to establish and improve the railway inland port; iv) to set rehanding locations for carriers in railway container terminals; v) to develop the information system of water-rail combined transport; and vi) to set up an overall coordinating department.

Key words: Yangtze River, transportation, container transport, combined container transport, railway and waterway.

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Chapter 1 Introduction

1.1 Background

From the sub-prime credit crisis triggering to the global financial crisis, then the economic crisis, the disaster has been going on for two years varying from recessive to dominant. In accordance with its evolutionary process, the global economy will face up with the greatest economic crisis since World War II; until now we still have not seen any evidences that this disaster will be over. The shipping market is at the low end of the production line for the global economy. Under the bullwhip effect, the financial crisis triggered by the U.S. led to only ten percent of the world economy transmitting to the shipping economy. In the global economic system, the shipping market is affected even in a more disastrous degree which in particular involved with the international dry bulk cargo market and container transport market. Because the financial crisis has resulted in a slump of the global maritime industry which caused that the demand for consumption in Europe and in the United States dropped and the raw materials needs declined, the demand for seaborne transport also plummeted. The growth rate of the global shipping market faced up with at least 15.5% slowdown in 2009. The shipping industry turned into a crisis management system when the freight and tonnage were continuously declining, almost all the major shipping companies had to adjust the structure in response to the financial crises. However, at the same time, the financial turmoil has also put the transport in a station of seeking a new developmental model.

Inland water transport was a basic industry of the national economy which is also an important component of the comprehensive transportation system. In the early nineties of the last century, due to the rapid development and intensive competition of the roads, railways and other modes of transport, the advance of the inland water transportation lagged. Then as the implementation of building a resource saving and

environment-friendly society and carrying out regional economy to coordinate development strategy, the inland harbors, fairways and shipping were required to coordinated development and to accelerate modern process which gradually started to show a good trend of rapid development, the importance of inland water transport and its comparative advantage were obvious increasingly. During the period of Eleventh Five-Year period, the central government raised at least 400 billion RMB with emphasis on the construction of the inland and coastal fairway, water support system and other projects. Meanwhile, in the November of 2008, the Government made clear that it would invest 4 trillion RMB on stimulating the state economy, while the Ministry of Communications was also planning a new investment project for the construction of roads, waterways, ports and terminals.

With the abundant water, the Yangtze River crosses over from east to west while its tributaries link up the north-south, there are many excellent natural conditions that Yangtze River has the navigable mileages and traffic volumes which respectively account for 53% and 80% of the country where the inland water transport is most developed, largest and busiest. The channel under Nanjing of the Yangtze River could be open to the navigation of 3-5 ton ships, From Nanjing to Wuhan navigable to the 5000-ton ships. Today, the connection of container transport between the waterway and the railway along the downstream area of Yangtze River has shortcomings both in the mode of operation and the managing standard which has hindered its development.

1.2 Aim and Objectives of the Research

The first objective of the research is to specify the present situation of the container transport between the waterway and the railway along the downstream area of Yangtze River, as well as the gap of transport in China compared with in the developed countries. The second objective is to make clear our current problems of the connection of the container transport between the waterway and the railway along

the downstream area of Yangtze River that although with the rapid development of transport facilities in China, the construction of inland waterways is relatively slow which has become a comparatively weak link of the transportation system. The ultimate goal is to make suggestions and forecasts in response to these problems in inland water transportation system so as to enhance the inland navigating capabilities and to build an integrated transport system with the formation of railways and waterways interrelated and the complementary advantages that could effectively lower the cost of integrated logistics and provide strong support for expanding and upgrading the inland shipping market, and actively cope with the transportation impact caused by the international financial crisis to maximize the overall efficiency of water resources.

1.3 Literature Review

1.3.1 Foreign Experiences, Advance Technologies and Policies of Inland Water Transport

Hellmuth St. Seidenfus (1994) explored the future problems of the inland waterway transport in the Federal Republic of Germany, on the one hand, will arise from fundamental market and relating changes inland waterway transport has to adapt to within the scope of transport chain optimisation. On the other hand, the abolishment of fare regulation and the commercialisation of the railway companies will change the internal and external competitive conditions. An additional problem arises from future competition of inland vessels from Eastern European countries.

Li Chen and Zhou Zuofu (2004) made a brief introduction of a series of measures to develop the container transportation adopted by the German government, considering with the development of the China's current situation, they proposed that for developing inland water transport in China, we should seize the historical opportunity according to the local conditions to speed up development so that China's inland Shipping could achieve the goal of a developmental virtuous cycle path of high-speed,

efficiency, coordination and health.

Ten Broeke et al (2002) show the use of ECDIS (Electronic Chart and Display Information System) for inland transportation, the possibilities to enhance the ECDIS with the position of your own ship in the ECDIS and the positions of all other vessels in your vicinity, including those that cannot be seen by radar due to land conditions. It has shown systems with which you can improve voyage planning and terminal planning and how to optimize the use of existing infrastructure like locks. The research project was started under the umbrella of the European Commission to develop and demonstrate standards for data and communication in Inland Waterways to enable and improve traffic management and to combine traffic management with transport management. These enable us to find a high degree of progressiveness of the European inland transportation information system.

N. Douben. et al (2007) elaborated a methodology for assessing and comparing alternative river management strategies for the Dutch branches of the river Rhine. The three objectives considered in the analysis are: safety against flooding which is a necessary condition to maintain and enhance economic development of a major part of the Netherlands, improving inland transportation conditions along the river (the Rhine is a major transport route between the port of Rotterdam and Germany), and increasing the ecological values of the river system. This paper describes the methodology and models that are used to assess alternative ways of meeting these objectives. The analysis shows the trade-offs for various strategies and looks for possibilities to create win-win situations. It also produces scorecards for various strategies, which show their impacts on the functions of the river and their financial consequences.

Chen Hong (2002) analyzed the reasons for the vigorous development of inland water transport in the European countries and made a general description of the effective measures to develop the inland water transport in the EU countries. 1) Establishing an

inland water transport network of the EU, unifying the grades and standards of the channels and formulating developmental goals. 2) Developing the EU's inland infrastructure. 3) Advancing on the improvements of the multimodal transport in the EU countries. 4) The EU has enhanced the construction of the information system of the inland river management. 5) The European Union Government formulated a series of policies promoting the advancement of the inland river transport. The article concluded some measures which could be learned from and used in our Chinese country. 1) The development of China's inland infrastructure. 2) The improvement of China's inland container transportation.

1.3.2 Deficiencies and Countermeasures of the Chinese Inland Water Transport

Mao Jian (2005) Interpreted the important position of the inland waterway shipping in integrated water resources development in United States, as well as the close relationship between inland waterways shipping and water resources development, and studied various stages of the development and its characteristics, and analyzed the premise, role and advantages of the development of inland waterway shipping in United States. Meanwhile, he compared the development of inland waterway shipping in United States with the situation in China and proposed that the two stages of the United States inland waterway large-scale construction and modernization development could be merged into one for the modernization of the China's inland waterway.

Su Xiaolei and Fang Fang (2006) believed that United States and Germany have a great power of inland transportation. They elaborated the development of inland transportation in United States and Germany from the view of legislative protection, regulatory agencies, policy planning, waterway construction and financing investment to emphasize that inland river shipping in China should seize the opportunity to implement the leapfrog development strategy.

1.3.3 The Research on the Container Transport in Yangtze River

Luo Shigang(2000) proposed that the regulations and the administrations of the Yangtze River transport must be unified which is meant to adhere to increasing the power of the Yangtze River Shipping Administration in order to make the industry of the Yangtze River navigation competitive in good order and healthy in development.

Zhangqi (2009) had a brief analysis on the current situation and the state of competition of the container feeder transporting market of the Yangtze River, made an estimate of its throughput in the future, brought forward some existed issues in its competitive market and made relevant recommendations and measures on how to develop Yangtze River feeder container transporting market.

Ye Weilong (2009) summarized the uncertain factors of container transportation in Yangtze River and had an overview of the development of the road and rail along the river, the formulation of the edge river harbor and the construction of EDI's status quo.

1.3.4 Advancing the Science of the Facilities and Theories

Hans H. Heuser (1991) insisted on the evaluation of transport relations to be implemented, the environment protective impact would get a significant higher order in the near future than at present. This could be expressed in an environment correlated figure, which would indicate the exhaust gas quantity per ton kilometre. Therefore he is convinced that the progress in the design of inland cargo vessels had fully taken this development into account, same as with a further increase in economic efficiency.

Chen Fei-er and Zhang Renyi (2006) made a research on Shanghai's Inland-River transportation network was comprehensively made and analyzed. Firstly, the Shanghai's Inland-River shipping system is simplified to be a structure network，in

which the nodes represent the key intersections of Inland-Rivers and are assigned corresponding container volumes. Secondly, the network transportation capacity is analyzed according to the actual conditions and the Program of One Surround & Ten Rays. Finally, the Dijkstra algorithm is used to find out the shortest routes. With comparison of the above routes and the actual capacity，different suggestions were provided accordingly to conclude an ideal Inland-River transportation network plan.

1.3.5 Existing Problems

The existing research is relatively more general overview of or blindly speaking of the theory, which is lack of systematic data and factual basis.

Wei Lei (2007) stated the problems of inland water transport at the present stage in China; however, he just made an overview of overcapacity, industry losses, high charges, and the problem of low level of the management, without using a lot of data and information to support his point of view.

When Huang Qiang (2009) pondered how to solve the problems of modern development of the Yangtze River shipping industry, with a scientific development perspective, he analyzed the current situation of the Yangtze River transport. However, it involved with too many theories without the support of data.

The current paper that talks about the development of Yangtze River transport is not closely connected with the new situation of this year. At the same time, there have fewer researches on the connection of container transport between the waterway and the railway along the downstream area of Yangtze River

It was Tu Wenling (2007) who ignored the concept of sustainable development suggested that we should learn from the West to build infrastructure and information systems for the inland water transport developed in China.

In a word, there is still enough space for research and development. Since the economic crisis, inland shipping which is in the original relatively weak position will be changed that the focus of the transport industry will transfer from overseas transport to inland transport. When the Ministry of Transport has issued the documents of increasing the investment on expanding the domestic demand and accelerating the construction of the infrastructure (2008), China's National Development and Reform Commission Chairman Ma Kai (2007) advanced that controlling the greenhouse-gas emissions should be brought into the overall sustainable economic developmental planning. All these factors have a significant impact on our country's inland water transport even the entire transportation industry.

Chapter 2 Analysis of the Present Situation of Container Transport along Yangtze River

2.1 Transport System within the Yangtze River

In order to reduce the costs on production processes and achieve cost advantage, more and more companies in China have begun to move from the coastal areas in the east to the interior area of the country. The waterway of the Yangtze River has been one of the most heavily used in the world, which provides the most common access to the core area of China. Along with these changes, there are the needs and demands for increasing container transport and liberalizing the third party logistics industry. Due to the importance of foreign direct investment and trade, the coastal area of China such as Shanghai has played a great part in the development of China, since its opening up to the outside world. Inland industrial centers of China were firstly promoted mainly in the Northeast and Southwest in the first decades since 1950s; but later, were supplanted by the Pearl River Delta and the Yangtze River Delta. Economic activities such as foreign direct investment and trade often happen in which there are strong

connections with the international economy of the outside world. The export driven economy of China since its opening up to the outside world has mainly emerged in the richer coastal area, which also has led to the large migrations to this area due to the movement of labor population, searching for employment in the area. However, the requirement for sustainable development in China's economy has been raised, due to the disparity in income. Specifically, there are 60% of the Chinese populations living in the interior area, while the income of this population is only 40% of that in the coastal area. In this case, the Chinese government has been aware of the need to close the income disparities between different areas in the country, so as to achieve continued growth and stable development. It is necessary to bring jobs to the labors, where it requires for a change to reassess the issue of access or transport in the country. As for the foreign investors, it is evident to figure out the internal strains in the coastal area of China, such as the increasing costs on land, the wage inflation, the erratic power availability, and the labor shortages. However, as for the companies that are willing to turn to the interior areas of China, there are still strong competitive advantages in the country. Wages for manufacturing or labors in the interior areas of China are much lower than the coastal areas like Shanghai; moreover, real estate or land for industrial use is also more available in the interior areas, which are also costing much less than the coastal areas. In addition, the under-served consumer markets with fast growth have also been attractive with great market potentials. In this situation, there exists ever-increasing potential along the Yangtze River. About 25% of the total population in China lives along the 1,500 miles basin stretching from Shanghai to Chongqing, crossing seven princes along the banks of the Yangtze River, but which account for over 40% of the gross domestic product in this country. In order to promote the utilization of the Yangtze River, the Chinese government has input billions of dollars, on developing railway lines and roads. Concerning this input on transportation, much of the part has been concentrated on the containerization for the inland economic development. To be specific, it is to encourage the use of container transportation for transporting goods, no matter by railway, road, or waterway. In this case, as for those foreign investors that are seeking for new opportunities in sourcing,

manufacturing and marketing or selling in the Chinese market, the multimodal transport along the Yangtze River, such as the combined container transport between railway and waterway, is of great significance in China.

There are two developments are closely associated with the access along the Yangtze River. The first is about the increasing container-on-barge service along the area of the Yangtze River, which has been facilitated by the opening of the new Yangshan Port Complex due to the establishment of the Three Gorges Dam complex. The second development is related to the logistics sector in China, which has been fully opened up for market competition. The first has promoted the hardware conditions for the intermodal transport along the Yangtze River, while the second has then enhanced the software conditions for the development of intermodal transport along the Yangtze River area.

Through the construction in recent years, the transportation system including its distribution and management like railway, roads or highway, as well as waterway have obtained great improvement in China. Besides the great improvement in the management level and throughputs of the major harbors along the coastal areas that have been playing an important part in the international container transportation, there is also great development existed in the railway, road, and waterway transportation as well as the formation of container transportation networks along the hinterlands of the harbors along the Yangtze River.

There are different types of products or goods, containers, as well as amount of goods and containers, origins and destinations, and directions of transportation; in addition, there exist different demands with great potential in the container transportation markets. Due to these reasons, there are multiple choices for the transportation modes between the harbors and their hinterlands. In the meantime, due to the existence of different ways to deal with trade such as CFR (Cost and Freight), CIF (Cost Insurance and Freight), and FOB (Free on Board), all harbors have been the delivery places that

are commonly agreed by both parties. When the containers imported or exported are transported and achieve the harbors, then the party that is in charge of the containers is to arrange the following transportation. In this case, there are various route schemes for transportation available for transporting the containers between the harbors and the hinterlands. Further, how to select an optimal scheme for the following transportation between the origins and destinations is an important issue, while intermodal transportation is a good choice.

2.2 Container Transportation along the Yangtze River

Yangtze River, the third longest river in the world, has been one of the busiest waterways in the world for a long time. But just before 2000, bulk cargo was the main transportation form along inland stretches of the river. The government understands that the private sector pays attention to the longer lead times and it will be impossible for it to commit to the interior if there is no safety supplied by sealed containers. Since China is a large country, it seems that the best solution is rail service comparing with the shipping containers over long distance. China has the second longest rail line in the world, but most of the lines engage in supplying coal and other raw materials to areas lack of energy. China is building the infrastructure to realize a network of high-speed, double-stack intermodal trains along segregated routes, but it will take at least five years to complete. Meanwhile, a large amount of large and more efficient trucks have been used on China's fast developed new expressways for ninety percent of which charge tolls. Nowadays long-distance trucking is possible in China, but this kind of traffic is seldom carried on through container. Compared with shipping through barge along a comparable river route, it is much more expensive per TEU (20-foot equivalent unit).

Generally speaking, nowadays the safest and most relatively inexpensive way of shipping boxes over long distances in China shall be barge service. Expanding container capacity on the Yangtze River will for a short time make up for a deficiency

in the existing road and rail network and connect huge areas of central and southwest China to the coast with low cost. In the long run, viable container-on-barge service will become a useful check for costs throughout the region's intermodal system. Therefore, the government has taken measures timely to improve conditions on river, like reef demolition, dredging, navigational improvements and underwater reef demolition which are related to the Three Gorges Dam project. More than two dozen inland container ports have also been caused by it into existence reaching 1,500 miles upriver. The result is that the river has become a crux for extending intermodal trade inland. Most of international trade between large upriver centers has already being carried on through barge. More than thirty companies now offer container services, together shipping more than 2.6 million TEUs in 2005, increasing by 44 percent in 2004. Figures in 2006 have exceeded 3 million TEUs, along with 4.5 million TEUs predicted in 2010 and 15 million TEUs in 2030.Nothing in the United States is remotely comparable. Only the container-on-barge service on the Rhine transcends the performance of China.

The completion of the Three Gorges Dam project and the opening of the Yangshan Port Complex off Shanghai in December 2005 are two major developments along the river serving as major catalysts for containerization of Yangtze River. The Three Gorges Dam, which locates 625 miles west of Shanghai, has been now the largest hydroelectric facility in the history since its fully operation. The dam will have a far-reaching influence on the development of waterborne traffic on the river besides electricity generation and flood control. A two-way, five-stage shiplock opened in July 2004, permitting loaded barges for 10,000 deadweight tons (DWT) to pass within three hours. A smaller shiplift designed to raise 3,000-DWT vessels in 45 minutes had already been opened in 2009. Barges moving inland through the famously treacherous gorges will now start from a deep, placid reservoir extending more than 400 miles from Yichang in Hubei to the docks in Chongqing. A new container port at midway across the reservoir and with a designed capacity of 400,000 TEUs has already been built in Wanzhou. The reservoir is more than .62 miles wide and more than 11.5 feet

deep, with a navigation channel considerably wider than any place of Mississippi north of Baton Rouge. Deeper, wider, more regulated flows of water will alternately allow the introduction of much larger container barges on the upper Yangtze River. Barges which are capable of moving 250 TEUs will reach much more miles inland to Chongqing. Along with the improvements of river conditions, barges which could move 00-400 TEUs will finally be brought in. The major present challenge shall be to manage the congestion around the Three Gorges locks and the potential bottlenecks which connects with the new container ports of the river.

The second biggest event for the long-term development of Yangtze River shipping is the significant expansion of container berths in Shanghai. After opening phase I of Shanghai's new Yangshan deepwater container complex, 2.2 million TEUs of additional capacity has been added to the third largest container port of the world. Located 21 miles off the southeast coast of Shanghai, this new port would add between from 15-20 million TEUs to the total handling capacity of Shanghai, which is more than the overall throughput of the top three U.S. container ports in 2005. But the sole surface connected to the port at this stage is just a six-lane causeway which owns a designed capacity of 5 million TEUs for each year. China indeed plans to extend rail service to the complex, but it will take a long time and will be completed earliest in 2010 or even later. Similar to the situation along the Yangtze River, obviously barge service shall be increased to make up. Port planners are expecting to increase barges by over 30 percent of the capacity in Yangshan by 2020, with the result that barge companies alongside the Yangtze River are upgrading their fleets. Many of them have tried the sea-going barges. Among them, in 2005, the first barge started to serve Yangshan directly from Nanjing. Such more powerful ships could move 250-300 TEUs for each time, could cut transit times on the entire river greatly and realize direct container-barge service from deep up the Yangtze River to ports even in South Korea and Japan. According to the estimates of the government and industry, the expenses on shipping container by barge could be reduced by as much as 40% percent in the following years due to these changes and navigational progress related to the

Three Gorges Dam project.

2.2.1 The Situation of Water Transport of Container

When we make a comparison, we discover that China is a country, possessing a well-developed inland waterway transport with an inland waterway system which is composed by over 5,600 navigable rivers and in total, a navigable length of 116,500 km. It is found that 210 inland rivers of all navigable rivers (3.75% of the total) lie near and around Shanghai. In China, the majority navigable waterways belong to the courses of such main rivers as the Yangtze River (total length is 73,000 kilometers), the Pearl River (total length is 13,000 kilometers), Huhe River and the Heilongjiang River (total length is 4,700 kilometers).

Container transport from Shanghai Port relies mainly on the waterway of Yangtze River. With 57,447 kilometers of navigable length, Yangtze River occupies 52.6% of all inland rivers in China. In 1981, container transport emerged in the Yangtze River area. And then, ports and water works along the Yangtze River and other inland waterways started to develop. Most navigation channels are gathering in the middle and lower reaches of the river. If we put all navigable kilometers together, the total navigable kilometers of the provinces of the Yangtze River area occupy 77.2% of that of the Yangtze River. It is obvious that Downstream of Nanjing the density of the navigation channel network is higher than upstream.

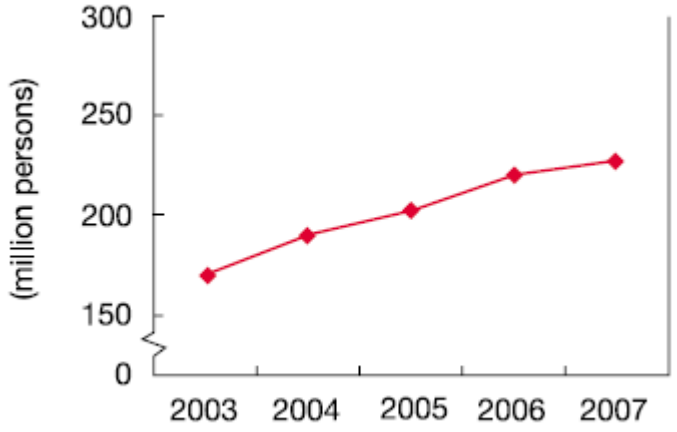
Apart from the Yangtze River, this area also covers such inland rivers and navigational channels as the Han River, Gan River, Hefei and Yuxikou channel, the Huai River and the Grand Canal. The Grand Canal is 1,044 kilometer long, running from north to south and playing an important role in connecting the Yangtze River valley, the Yellow River valley and secondary river systems. Nowadays, there are about 200 inland ports with 85 leading ports included lying on the sides of these waterways. The waterway network consists of 900 navigational structures like

ship-locks and ship-lifts among which the largest fivestep ship-lock in the world sits at the Three Gorges Dam near Jiujiang, covering an area of 280x34x5 meters.

It is necessary for us to first consider the transport development of the Yangtze River area since Yangtze River plays such an important role in pushing the Chinese economy from the coastal area to the hinterland. The Go-West policy proposed by Chinese government is a great support for this. Transport network of the Yangtze River area is of a higher lever that that of the average national one. The Yangtze River area only occupies 6% of China but it possesses 13% of the highway network, 14% of the railway network and almost 53% of the waterway network. The reason lies in that this area is the economic center of China.

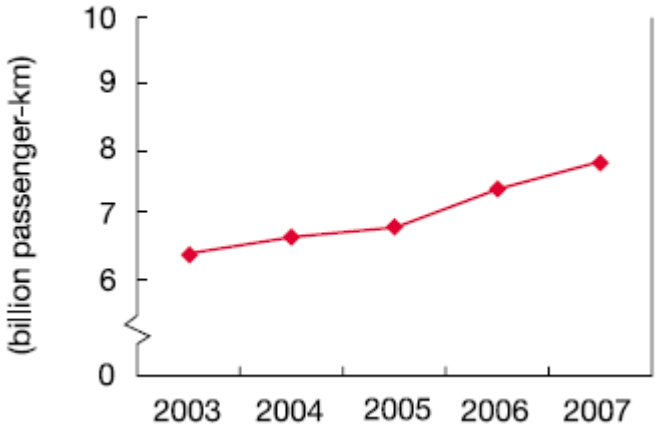
China's National Bureau of Statistics (NBS) reported that in 2007, the total waterway passenger traffic in China reached to 228.4 million persons, increasing by 3.6% from last year. The total waterway passenger kilometers reached to 7.8 billion passenger-km, increasing by 5.7 % from the last year. We can have a basic understanding about the total waterway passenger traffic and the total waterway passenger-kilometers during past five years from figure 1 & figure 2. It can be seen that there is a steady growth in waterway passenger traffic and passenger-kilometers

Figure 1: Total Waterway Passenger Traffic, 2003-2007



Source: National Bureau of Statistics

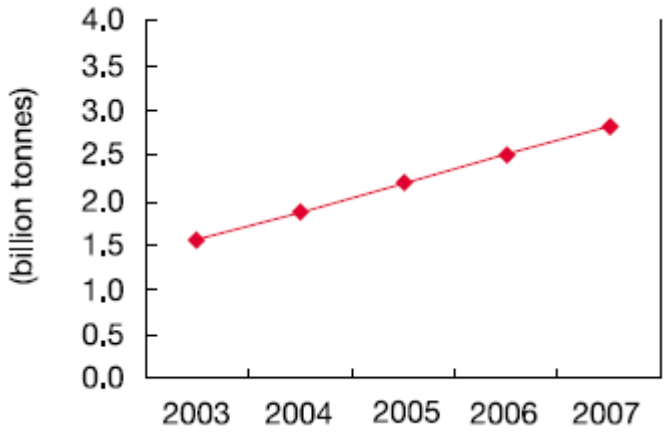
Figure 2: Total Waterway Passenger-kilometers, 2003-2007



Source: National Bureau of Statistics

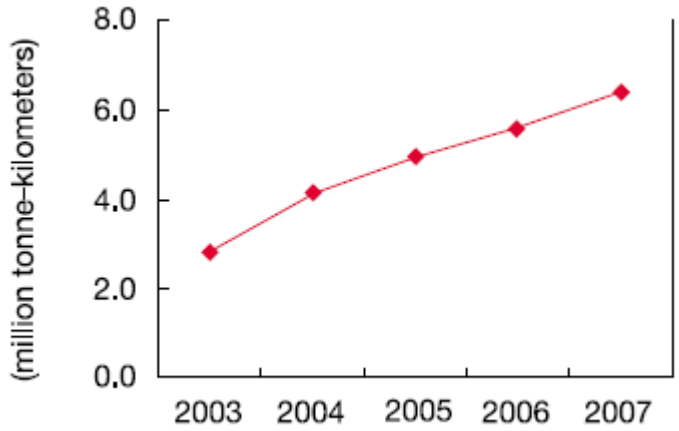
As in 2007, the total freight traffic through waterway was about 2.8 billion tonne, which had increased by about 13% comparing to the prior year. In the same year, the total freight tonne-kilometers through waterway was increased by about 16%, up to 6.4 trillion tonne-kilometers, comparing to the prior year. Specifically, the total freight traffic and the total freight tonne-kilometers along waterway from 2003 to 2007 are presented in Figure 3 and Figure 4. Concerning the types of goods that were transported through waterway, about 60% of the total freight was attributed to coal, metal ores, natural gas, petroleum, as well as their related products, in addition to mineral ores, steels and iron, as well as other materials for building.

Figure 3: Total Waterway Freight Traffic, 2003-2007



Source: National Bureau of Statistics

Figure 4: Total Waterway Freight tonne-kilometers, 2003-2007



Source: National Bureau of Statistics

In addition, the container throughput by transportation along the waterway has been developing steadily. As the total, throughput was increased by about 22%, reaching about 114 million TEUs in 2007. To be specific, for five consecutive years, China has been the one country that handled the largest container throughput in a global range. As presented in Figure 5, ports located in the Chinese Mainland have been handling the largest container throughput in the world in 2008, which also indicates the ever-increasing importance of China in the development of waterway transportation at a world class. As stated by the Ministry of Transport (MOT), concerning the total container throughput handled by the ports in China, there are over 100 million TEUs were handled by the ports along the coastal areas, while only about 10 million TEUs were handled by the inland ports. However, both were increased compared to the prior year, by about 22% and 25% respectively.

Figure 5: Top 20 ports handling the largest container throughput in the world, 2008

2008	2007	Container Port	10 000 TEU in 2008
1	1	Singapore	2997
2	3	Shanghai*	2798
3	2	Hong Kong	2449
4	4	Shenzhen*	2140
5	5	Busan	1345
6	7	Dubai	1180
7	12	Guangzhou*	1100
8	11	Ningbo*	1080
9	6	Rotterdam	1078
10	10	Qingdao*	1032
11	9	Hamburg	970
12	8	Kaohsiung	968
13	14	Antwerp	866
14	17	Tianjin*	850
15	13	Los Angeles	785
16	16	Pakistan Port	780
17	15	Long Beach	649
18	18	Tanjung Pelepas	560
19	20	Bremen	550
20	19	New York	548

Source: China Ports & Harbors Association

2.2.2 The Situation of Rail Transport of Container

Rail transportation in the country size like China is the natural alternative, however, unlike trucking, rail transportation is known for slow and unpredictable service. A few years ago, this reputation has changed, but the reality is not so bright because from China's main north-south corridors and for shippers can use the volume system fully. China's 75,000 km (47,000 mile) rail system takes one sixth of the global length, which have already content quarter of the world's total transport volume. Therefore, for 20 years running the required freight has been exceeded the supply on virtually every major route. For a foreseeable future, the priority movement of China's single track lines which takes percent of the total network will continue to go to passengers and bulk cargo, coal is the top one. In 2005, containerized freight took only three percent of total freight volume and most of them were still shipped by local containers which are smaller than international standards. These trains have to traverse some of the world's most challenging geography. It is common that bridges and tunnels to compose more than half the length of entire routes in China's mountainous interior.

With modern standards and electrification, the clearance of China's 5,400 rail tunnels is low, while especially in rough terrain is achieved by low-hanging catenaries wires rather than third rails. Although China's Ministry of Railways (MOR) is take efforts on remedying the situation of these factors which have complicated the introduction of double-stack container trains that is common for cost-saver on European and especially U.S. rail routes.

MOR made a dedicated subsidiary, the China Railway Container Transport Company (CRCTC) come into being in late 2003 so as to speed up containerization of the rail system. This organization serving as the country's sole intermodal rail operator began to take a lot of initiatives which aimed to improve intermodal transport of the country. Fleet of container-ready flat cars and many containers are assembled by CRCTC, including reefers, specialized tankers and the standard 20 and 40 ft. marine variety. It also brought about en route tracking for intermodal shipments. Though this system is short of external visibility, it is a big progress toward greater reliability. However, becoming the foundation of first dedicated container-handling rail stations in China consists CRCTC's most important legacy. In Dec, 2005 Shanghai, the first nationwide system of 18 major intermodal rail hubs and 40 mid-size stations in China was launched by the company, which are located at ports and inland economic centers. The purpose of building this network is to make container traffic at the over 600 mixed-use facilities used by the CRCTC reasonable. In 2006, there will be a second hub in the southwestern city of Kunming. What is more, Chongqing and Wuhan also planed to open major hubs along the Yangtze. Each of them will cover between 6-12 sq. Km (1,500-3,000 acres), thus becoming one of the largest rail freight stations in Asia with the ability to deal with 200,000- 300,000 containers a year. All major hubs will be connected by Double stack container service. MOR's plans are helpful for the system to divorce passenger rail routes from freight lines. This network which will be built and managed mostly by the CRCTC and also by Hong-Kong based NWS Holdings, will take intermodal rail into the remote areas of western China, to Central Asia and even to Europe. MOR will invest US$240 billion (including private capital)

to upgrade and expand the entire rail system to 100,000 km (62,000 miles) by 2020, which is one of MOR's ambious plans. Not until 2010 can most of these improvements be achieved. Intermodal customers only find that they have to make a compromise with the demands of a modern global supply chain within an immature system.

Figure 6: Length of China's Railway (km), 1985-2004

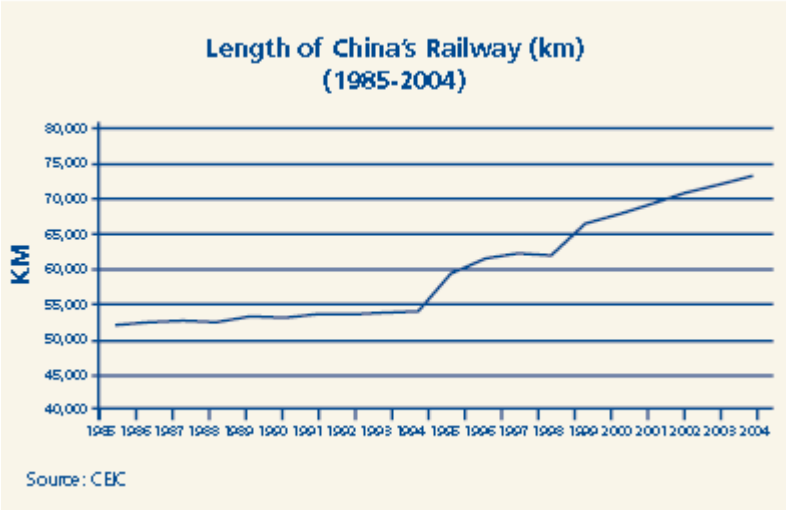
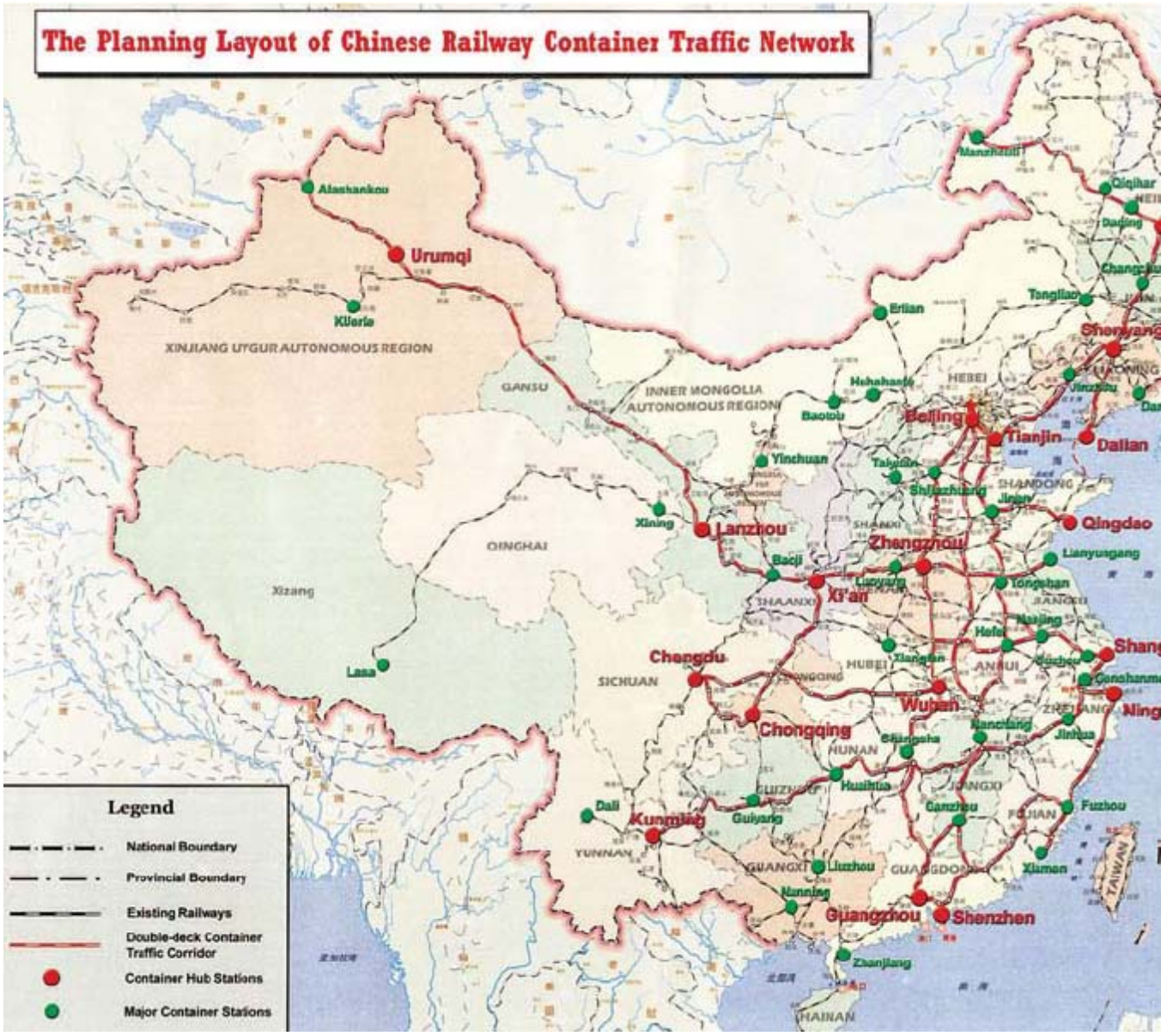


Figure 7: The Planning Layout of Chinese Railway Container Traffic Network



Source: China Railway Container Transport Company

2.3 Central Ports along the Yangtze River

There are ports of different sizes and scales along the Yangtze River. As in Wuhan, there are 16 major ports, while six of which are of great importance in the area. Concerning these six major ports, they are the destinations for most of the containers that are transported from between Shanghai and other areas along the Yangtze River. More specifically, these ports have also been granted as the central ports along the

area of the Yangtze River in Masterplan[1]. These six ports include:

- Nantong
- Zhangjiagang
- Nanjing
- Wuhu
- Jiujiang
- Wuhan

These six ports have made greatest contribution to the container transportation along the Yangtze River with highest throughputs, compared to other ports along the area. As shown in Figure 8, the expected contribution to the total container throughputs along the Yangtze River in 2001 and 2010 has been given, indicated by the Masterplan.

Figure 8: Share of Ports to the Total Throughput along the Yangtze River

Port	2000 (%)	2010 (%)
Nantong	18.6	13.1
Zhangjiagang	19.7	14.8
Nanjing	27.3	32.3
Wuhu	8.1	10.4
Jiujiang	2.0	0.7
Wuhan	8.1	10.9
Other Ports	16.2	17.8
Total	100	100

[1] State Planning Commission China and Ministry of transport, Public works and Water Management (1998), *Masterplan Study Report, Sino-Dutch joint research on the Yangtze River Basin inter-modal transport project*, Nijkerk

According to the figures shown in Figure 8, it can be seen that it leads to an increasing contribution to the total transportation throughputs along the Yangtze River in Wuhan, Wuhu and Nanjing, while there is a decrease in the contribution of the ports of Nantong, Zhejiang and Shanghai. However, the fact is the expected increase in the actual throughputs in these ports. The volume of containers transported through the Jiujiang port along waterway is constant but the total throughput is to be reduced due to this.

As shown in Figure 8, it can also figure out the importance of the six major ports, as they account for over 80% of the total throughputs along waterway of the Yangtze River.

2.4 Container Traffic Development over the Yangtze River and its Opportunities

2.4.1 Development of Container Traffic

The efforts to expand container-on-barge service which along the Yangtze River became the sharper focus with challenges before the long-haul trucking industry and rail did not meet growing demand. In fact, the shipping containers' advantages are remarkable since Yangtze barge has transported its first container in 1986.Over centuries the most reliable and cost effective ways of moving commodities along the rivers were barges and it is estimates by government that 80 percent of iron ore, 72 percent of crude oil and 83 percent of coal, which delivered to manufacturing enterprises along the Yangtze, delivered by barge. In 1990s，when the first foreign investor headed west and with the growing interest of inland manufacturers to foreign markets, the barge capacity was shifted to containers dramatically. Planner of government who have understood that to expand the river's capacity should be completed in a lower cost far more than the likely upgrades to rail or road networks. Fertile land did not need to be taken away from its usage and without the Three Gorges project, few Chinese residents were moved. A series of low cost, high impact

measures have been taken to improve navigation to greatly effect in the past five years. Including underwater reef demolition, dredging and the construction of riverbank navigational aids, all river barges required use Global Positioning Systems (GPS) as well. The central government has reported that only 15 percent of total capacity of the Yangtze River is being utilized at present. This capacity is estimated equal of six rail lines of same length.

About 35 major barge companies provided container service for two dozen Yangtze ports, which extended 2,400 km (1,500 miles) upstream from Shanghai at the beginning of 2006. The top five among them have controlled approximately 50 percent of capacity. Just like the US, Japan and other countries, China did not allow foreign-owned vessels to move freight in inland; however, more than twenty international shipping companies have cooperated with the major operators of China and provided a series of services to international container transport. Many companies have set dedicated barges service for international customers since 2001. Some barge operators have become dominate their container traffic along special parts of the river in privately, that have holden China Minsheng to move 65 percent containers to and from upstream areas of Chongqing, COSCO’s 90+ which is state-owned is good in the river’s middle reaches, especially between Wuhan and the ports of Anhui Province; Both of Nanjingtonghai and Jihai Shipping claimed one third container traffic beside the busy Nanjing-Shanghai section. (Wuhan-based Changjiang National Shipping is the largest barge company of the Yangtze, which have done business every though its dominance operations is more strongly in bulk shipping). In the past, the raw division in labor has sparked speculation in cartel behavior, however since 2002, the prices were unstable, companies began competing fiercely for greater market share among rivals, specially for the growing foreign trade of river’s. For example COSCO in recent years has pushed upstream steadily and many coastal shipping companies such as Shandong-based SITC Maritime Group and Yantai Int'l Marine Shipping were also entered the fray. When moving containers’ cost increased to 50 percent less than rail or road on many coastal sea routes, the Yangtze shipping integrated with Green Water

service, and the China's seaboard length is fast to become a reality.

Barge companies have taken advantage of improved navigation of the river and keep to shift capacity from bulk to container, the governments in central and local have set great investments for construct or upgrade container ports on the river. Five years ago, the facilities did not upriver from the major transshipment port of Nanjing which ranged from large but capital-starved companies at Wuhan and Chongqing to little more than seasonal truck landings. Yet at high advanced middle and upstream terminals, harbor cranes, yard tractors and other standard container-handling equipment never show before 2000. As information-intensive of a modern port complex, for an operation, lack modern T systems will make a serious handicap on the way. This picture has been significantly changed by new investment, but for over two dozen viable container ports now operate to as far as Sichuan, and since 2000, the container capacity has quadruped. On the one hand, on the shorter, the expanding capacity of the Yangtze's container will meet the key gaps which between road and rail network and could link large central and southwest China area to the coast in relatively low cost. While in the long term, viable container-on-barge service will play a role throughout the region's intermodal system as a useful cost check.

2.4.2 The Opportunity

Opportunity for the Transportation Equipment Sector

Enhanced inter model channel will bring benefits to most industries along the Yangtze River. But, firstly, the areas desired transportation equipment sector. The basin between Shanghai and Chongqing along the Yangtze River has shaped the most vigorous manufacturing center worldwide for passenger cars, trucks, buses and motorcycles in particular.

Wuhan and Chongqing has become Chinese third and fourth largest vehicle manufacturing bases in sequence due to the annual output. In early 2006, the two

cities claimed their aspiring plans that they would double their vehicles production to 1.3 million respectively by 2010. Global OEMs and part suppliers, for example, Ford, PSA Peugeot-Citroën, Suzuki, Isuzu, Renault, Cummins, Lear, Tenneco, Visteon and Johnson Controls have made each or both of the two cities as their important centers of operations since the early 1990s. Dongfeng Motors which based in Wuhan was listed in Hong Kong in 2005, and has producing joint venture for more than six global auto companies, top the producers in China. In west of Wuhan, Chongqing-based producers output over 650,000 vehicles in 2005 and the city's 5.6 million motorcycles production bring it to the first place in China. China's fourth largest car-producer, Chang'an Automotive located in Chongqing which is Chinese leading producer of mini-cars and vans where the fastest growing market sector in China and a leading driver of transport equipment exports. A trio of Chongqing-based private motorcycle-producers, involving China’s largest, the Lifan Group, has increase quickly into overseas markets and holds a one-fourth of global motorcycle output presently. Now, Lifan is also entering into the automotive market, sending its first cars bound for overseas markets down the Yangtze in January 2006. At the same time, mini-cars, motorcycles and auto parts hold 70% of all export containers from Chongqing and imported parts and equipment come into being the largest sector of import traffic.

On the upper Yangtze, Chang'an Minsheng Logistics (CMAL) played a key role in forming the sector’s expansion of joint venture between Chang'an, Ford, APL Logistics and China Minsheng. The company has grown as the largest container barge operator west of Wuhan, although it is established only in 1999. Besides a fleet of 1,500 car-moving trucks, the company operates 37 barges with 84 TEU-capacity and 17 roll-on/roll-off (Ro-Ro) car barges, each can load 400 vehicles. In 2005, CMAL transported 20,000 containers of transportation facility and parts upriver from 12 countries and transported 4,000 downriver for export. This involves Ford's 20 containers around a week for joint venture of Chang'an. CMAL also transported 160,000 cars by river down to Wuhan, usually the most cost effective methods of

entering markets as far away as Beijing. The company plans to promote its fleet with Ro-Ro ships capable of transporting 600 cars once and container barges with a capacity of 120-250 TEUs due to demand increases and conditions on the river continue to promote. Actually, every vehicle and parts maker in China now desire to sell its products overseas, the continued development of the Yangtze as an export channel is the best choice for them..

Opportunity for the Light Industry

It starts to change that heavy industry dominated production along the middle and upper Yangtze. In order to attract the crowd of overplus rural labor to along-river economic hubs, Chinese government has keen to inspired labor-intensive industries to enter in further inland as the consequence of around 40 million people moved between 2001 and 2005 alone. Although Chongqing and Wuhan are the two state-level investment zones respectively, an increasing number of specialized industry parks have come out quickly to make use of better transport channel to connect the interior with China's prosperous export economy. In Chongqing and to a little extent, Wuhan, most Western and Japanese still invest in the automotive, petrochemical and other heavy industries. However, Taiwan and Hong Kong's investors, usually called pioneers are turning quickly to various local economies. Although a actual portion of these funds is probably “round-trip” investments made by domestic Chinese to grasp incentives meant for foreign investors, Hong Kong still hold around 40 percent of FDI in both cities. Actually, in the last two years some of the most attractive investments have been made by major domestic manufacturers. From 2000 to 2005, Wuhan witness more than US$7 billion investments from other areas of the Mainland, the majority are from Beijing, Guangdong and the Yangtze River Delta. During the first half of 2005, Chongqing Domestic investment boosted 53 percent to US$463 million, much of it in labor intensive industries. Zhejiang-based Aokang Group is the largest shoe producer in China. It will open a US$120 million industrial park in Chongqing in 2006 which aims at doubling the region’s annual shoe production to 200 million on pair. The Ruyi Group of Shandong which has joined the

Zhejiang garment producer Youngor Group will begin deals at a US$181 million spinning and weaving equipment in 2006. As for the white commodity sector, the producer Qingdao Haier which based in Shandong will open a US$338 million industrial park for producing facilities in 2006 - the first of its 11 industrial parks to be located in China's domestically. Air conditioner-producer Midea broke ground on a US$150 million facility alike in Chongqing last year which is the first producing base outside Guangdong. The company calculates the production costs will lower by RMB100 (US$12.50) per unit if it open industrial in Chongqing.

As light industry grows, cities along the Yangtze River are beginning to manufacture exactly such goods that is to fill about 10,000 TEUs which is brought through the North American ports every week by Wal-Mart As the transport costs become lower along the Yangtze River, so it becomes more accessible to transport along the waterway along the Yangtze River. In this case, the further for sourcing more effectively at lower costs is very promising for global retailing sector. Wal-Mart, Carrefour, the Thai hypermarket chain, Lotus have all already established buying centers in both Wuhan and Chongqing. In mid-2006, British B&Q tended to open a similar facility in Chongqing. At the same time, Chongqing, Wuhan and other inland cities along the Yangtze River are listed as fastest growing consumer markets in China, which have also been discovered by the foreign retailers. As in 2000, the retail sales in Chongqing were only achieving 1.1 billion US dollars; while it has increased by over 14% in 2004, achieving 11.5 billion US dollars. Further, the per capital monthly income of the urban population got to about 118 US dollars in 2005, which was the highest in the western provinces in China; while it was only slightly higher in Wuhan, with a population of 7.5 million. In both cities of Chongqing and Wuhan along the Yangtze River, there have been various locations in the downtown areas established by the global retailers like Wal-Mart, Lotus, Metro, Carrefour and others. Due to the increasing incomes and the market potentials in these cities, they become more attractive to the business companies for launching their new products, as well as part of their strategies for expansion in the Chinese market with great potential. As for the

global retailers, this is to form a virtuous circle, as supplying the global markets makes the local Chinese become richer, which then again facilitates these local Chinese to become more attractive customers to the retailers.

2.5 Waterway and Railway Container Transport along the Yangtze River

2.5.1 Current Situation of the Waterway Container Transport

Concerning the Port of Shanghai, 65% of its exported goods are from the area of Yangtze River. For a long time, containers in this area are transported to the Port of Shanghai through road transportation. With the increase of containers in this area, the collection and transmission system centered on road transport has occurred enlarging burden, with eager demands of transferring to waterway and railway transportation. The waterway container transport along the area to the Port of Shanghai is mainly from Nanjing, accounting for 60% of the total containers in Nanjing. The waterway container transport from Suzhou and Nantong to the Port of Shanghai account for a great proportion of the total containers in the two locations, but the total amount is not large. In the meanwhile, limited by the container transport conditions of the Shanghai inland rivers between Shanghai and Zhejiang, the waterway collection and transmission amount is also very limited. Accordingly, the waterway container transport along the Yangtze River area and the Port of Shanghai is very small, accounting for a very limited proportion of the total waterway container transport.

From this perspective, the inland river container transport along the Yangtze area has not been developed largely yet, and there are several reasons. First, the grade of waterway is low, and there are no regular inland river container terminals and specific facilities along the area, so the conditions for container transport are limited. Second, the container transport scale is very small with insufficient scale benefit to attract the owners of goods. Third, there are main problems within the fleet of vessels and the transport organizations, since there are many sectors, industries and locations involved in the transport along the Yangtze area. It lacks of an effective department to

organize and coordinate the development of the waterway container transport along the area. Fourth, the vessels are not standardized for the container transport. Currently, there are not many vessels for transporting the containers, which limit the development of the waterway container transport.

Currently, in order to facilitate the waterway container transport along the area of Yangtze River, there are several approaches. First, develop the inland river transportation. Comparing road and railway, inland river transport has the advantages like large loading capacity, low energy consumption, less land use and less environmental pollution, which is a type of sustainable transport mode. However, its current grade of waterway is low, lacking of navigation capacity. In this case, to expand the waterway container transport requires the coordination and management of the inland river transport conditions. Second, facilitate the development of river-sea combined transport, since the Yangtze River area is closely related to the sea. Furthermore, besides the sea transport, other water and water combined transport can also be developed, since there are many waterways involved in the area of the Yangtze River. Promoting the connection between the waterway transports will be then beneficial to the waterway container transport. In addition, the connection of waterway transport and railway transport can also facilitate the waterway container transport, as land transportation currently is more accepted than the waterway transport.

2.5.2 Current Situation of the Railway Container Transport

The railway transport has been developed greatly in the area of the Yangtze River; however, the container transport still occupies a small proportion, taking the Port of Shanghai as example. Looking into the reasons, it is because the railway container transport lacking of sufficient conditions for its development, which is limited by the railway capacity and the operational mechanism. Due to the limitations, the railway container transport cannot meet the customers' demands on transport quality and

price.

Generally, there are both hardware and software reasons that cause the backward railway container transport. Concerning the aspect of hardware, first, the container types and sizes are not unified, without a unified standard, which has then limit the development of the railway container transport as well as the water-rail combined transport; second, there lacks of railway carriages for containers as well as other relevant facilities, which lead to high costs of railway container transport, then limiting its development; third, the infrastructure is weak, as the ports and major railway lines are not connected, which increases the transport expenses and time of the containers. On the other hand, the insufficient software conditions also limit the development of the railway container transport. First, the management system is not effective enough to direct the railway container transport to respond to the market demands. For example, the railway department often alternates the transport plans regardless of the interest of the owners of goods, so these owners become less possible to choose the railway container transport. In addition, there are barriers existed between the railway department and other departments, lacking of coordination, which then also affects the overall service quality of the railway container transport.

Comparing to road transport, the railway transport is more economic and reasonable, with less pollution to the environment. In this case, to facilitate the development of the railway container transport is of great importance to the construction of effective transport system along the area of the Yangtze River. Accordingly, there are also several approaches to the improvement of the railway container transport. First, construct railways along the Yangtze River, in order to establish a railway corridor that connects railway centers or terminals. In this case, it will be able to build a railway container transport network with great capacity, which will also develop the potential of the water and rail combined transport, as well as other combined transport modes. Second, construct the railways between popular ports and locations, as well as

develop the sea and rail combined transport in the Yangshan Port. When these railways are constructed, it will increase the railway channels along the area of the Yangtze River, and provide more transport conditions for the container transport, and even the sea and rail combined container transport. Third, as indicated, it lacks of effective management system of the railway transport; thus, to develop the railway container transport will requires for the revolution and changes of the management system; in addition to the strengthening of the coordination between relevant departments.

At last, in order to facilitate the railway and the waterway container transport, combined transport is of great significance, such as the water and water combined transport; the rail and water combined transport, as well as the sea and rail combined transport. Generally speaking, combined transport as part of the multi-modal transport network and system is playing an important role in facilitating the development of the container transport.

Chapter 3 Analysis of the Problems of the Connection of Container Transport between the Waterway and the Railway along the Yangtze River

3.1 Combined Transport over the Yangtze River

3.1.1 Concept of Combined Transport

Concerning road transport and rail transport, there are both advantages (strengths) and disadvantages (weaknesses) within them. These strengths and advantages of the different kinds of transportation modes can be integrated in an efficient way, so as to form new transportation mode that is more optimal. Further, the costs of this kind of transportation mode from one transport to another transport type should be kept to a

minimal limit. Specifically, there are two basic modes of combined transport, which are: 1) piggyback transport, which is a means of transport transporting another means of transport; and 2) container transport, which is a means of transport transporting a container(s).

Combined transport is aiming to make most use of various methods of transport and reduce the procedures of loading goods that are to be transported. Using this method, large quantities are transported in a fast, environmental protection way using far distance transport in the main overland transportation or by sea. Before transporting to the port, the freight can be quickly transported by vehicles. The combined transport needs transfer shipped goods from one method of transport to another efficiently, and reduce the transport work as much as possible. The consequence of this requirement is the establishment of centers which can cut the times of transportation. The centers are the place of ships-transmission which has huge capability, for example, high-altitude mobile crane, which is used for transmitting cargoes faster. They can be found in the hubs which need to deal with high cargo. They are also linked with other centers which themselves are part of the transport.

3.1.2 Water and Rail Combined Transport over the Yangtze River

Water and rail transport have their own strengths in the transport sector, while developing water-rail combined transport will provide more rapid, economic, safe and reliable transport services for the customers, which is beneficial to the improvement of transport system as well as the transport service quality. Generally, water-rail combined transport is an objective demand of the social and economic development.

First, the social economic development along the Yangtze River needs the support of more perfect multi-modal transport system. With the rapid development of the social economic development along the area of Yangtze River, there exists great demand for a large amount of lower cost freightage in the area so as to maintain the development,

which then needs great capacity of multi-modal transport system. This great capacity is just one of the strengths of water transport and rail transport. In the meantime, with the adjustment of industry structure along the Yangtze River area, the freightage of high technology and high value added products will counts for increasingly proportion, especially those products that are suitable for container transport. In this situation, whether a more perfect and convenient multi-modal transport system will directly influence the economic development along the Yangtze River.

Second, water and rail combined transport is of great importance to the implementation of sustainable social economic development. Large population and lack of land resources especially agricultural land are the fundamental realities of China, so to save land resources is a basic policy developed by China. Further, concerning the energy structure of China, there is much goal but less oil, so to promote the energy utilization effectiveness of the transport industry and reduce oil consumption is also a basic policy developed by China to realize the sustainable development of energy. With the rapid develop of China's economy, environmental issues become more and more attention taking, with increasing demands for environmental protection. In relation to these issues, water transport and rail transport both have land and energy saving and environmental friendly characteristics. Taking railway transport as example, first, it uses less land resource, while road transport occupies several times more than railway; second, it saves energy, as road transport consumes twenty times more energy than railway; third, it is environmentally friendly, as trains discharge much less harmful gas than trucks. Waterway transports also have such advantages. Accordingly, developing waterway and railway combined transport is beneficial to land saving, energy consumption reduction and environmental protection, which then reduces the total costs and facilitates sustainable development.

Third, developing water and rail combined transport will promote the transport service quality. Water transport and rail transport both have their strengths in the transport industry. Water transport is of great capacity and lower cost, and much safe,

but it is also very slow, with less reachability; on the other hand, railway transport also has great capacity, with fast speed, lower cost, as well as high reliability and reachability. In this case, developing water and rail combined transport will then provide the customers with more rapid, economic and reliable transport services, and promote the multi-modal transport system.

Developing Water and Rail Combined Transport over the Yangtze River

According to China's Medium and Long-term Railway Development Plan and Railway Eleventh Five-Year Plan, China railway will speed up the construction of main corridor. Concerning the north-south area of the middle and lower reaches of Yangtze River, the construction of Beijing-Shanghai High Speed Railway and Beijing-Shenzhen Passenger Special Line, as well as the electrification of Jingjiu railway, Jiaoliu railway and Huainan railway line, are planned. With the great promotion of the freight capacity of Jinghu railway and Jingguang railway in addition to the capacity expansion of Jingjiu and Jiaoliu railways, the crossing river freight capacity at south-north railway line will be to a great extent enhanced, providing powerful supports to the Yangtze River port collection and transmission system.

The rapid economic developing along the area of Yangtze River needs more convenient transportation modes to realize rapid transport of people and goods. Facilitating the construction of railway and building perfect multi-modal transport system along Yangtze River will facilitate the complementation of the advantages of water transport and rail transport. Because of this, in order to promote the railway system along the Yangtze River, the Hu Han Rong corridor is planed and constructed; in the meantime, the construction and transformation of other relevant railway lines are also facilitated, trying to form a railway corridor along the Yangtze River, centered on passengers and goods.

To promote the connection of waterway and railway transport and realize the combined transport, it is important to transfer the perception and form the

consciousness of the benefit and advantages of water-rail combined transport. Further, it also needs overall planning, to facilitate the development of facilities for combined transport, as the basis for water and rail combined transport. For example, in order to facilitate the development of the Nanjing Port, the Longtan container center is planed and constructed, as a port-railway special line for bulk freightage. In addition, organization and coordination of transport is also important for the development of water and rail combined transport, for example, the improvement of the system of combined transport.

3.2 Problems Existed in Water-Rail Combined Transport along Yangtze River

3.2.1 Problems in Railway Transport

Backward in Management System

China adopts highly centralized railway operation and management system, with united command, which then has great inelasticity to effective management. This is represented in several aspects: first, the mechanism is inflexible, depending on plans, while the concept of marketing is not established yet; second, the development of railway freight forwarding industry is slow, which cannot make effective response to the market; third, it is lacking of resource sharing and information communication; fourth, too many barriers lead to ineffective coordination, without unified and effective container transportation. All of these problems cause the bad transport service quality of the railway container transport.

Inflexible in Freight Rate Adjustment and Irrational Freight Rate Structure

The railway freight rates in China is administrated by the State Council, and the rates of container transport is managed by the Ministry of Railways; while the China Railway Container Transport Corp. ,Ltd. as the major operating part in the market has no right to adjust the freight rates. The railway freight rate adjustment scheme has to be submitted to many levels, so it cannot make effective changes according to the

market situation. This inflexible adjustment system then cause great problem for the railway transport. Comparatively, the road and water freight rate mechanisms are much more flexible.

In addition, the railway freight rate structure is irrational. Container transport has many advantages, such as its safety, lower packaging costs, convenience for loading and unloading, which is a development direction for future freightage. In this case, it should be greatly promoted. However, the current railway freight rate structure makes container transport even more expensive than transportation of truck-load, so some owners of goods use transportation of truck-load to transport the export goods to the ports. This has to a great extent affected the development of railway container transport.

Scarce Capacity of Transport Channels

Container goods owners demand the transport to be fast and on time, which then needs the support of large capacity of the railways. The container traffic is fluctuating time from time, and the amount of goods is also imbalanced, which requires sufficient transport capacity to support the demands of container transport and allocation of empty container. From the distribution, flow and flow direction of the railway container transport amount in China, it can be seen that the railway container transport mainly canters on the railway lines in Shanghai, Beijing, Guangzhou, Shenyang and Zhenzhou, accounting for 70% of the total amount in China. In addition, the transport channels also focus on the main lines of Jingguang, Jingjiu, Jinghu, Jingha, Zhegan, and Longhai railways, while the utilization of these lines is about to reach saturation, at restricted transport status, so there exists great contradiction between container transport and other transport modes in these railway lines.

Besides, railways in China belong to infrastructure facilities for public benefit. On one hand, the utilization intensity of China railways tops in the world, always at a excessive saturation status, while the transport capacity cannot meet the demands of

the market; on the other hand, for public benefit, the economic benefit of railways has then been neglected, which then lead to the ineffective use of the railway lines.

Lacking of Inventory of Railway Containers

Due to the late development of container transport and the adoption of international standardized containers, it lacks of the inventory of railway containers in China. Moreover, the containers are in bad condition, while the types of containers are also lacking. In addition to the backward railway container management and the long turnaround time, there is increasing transport demand conflict in the amount and type of railway containers.

3.2.2 Problems in the Ports

Insufficient Focus on Railways in Port Collection and Transmission System

Traffic of port or port capacity, also known as throughout, refers to the amount of total goods exported and imported through the port by waterway, meanwhile loaded and unloaded in the port. When the goods is transferred to land transportation from water transport, or from water transport to land transport, a ton of handing volume is then measured as a ton of throughout; when the goods is transferred to water transport from water transport (water-water combined transport), a ton of handing volume is measured as 2 ton of throughout. This port throughout is a significant index to measure the size and scale of a port. In this case, some port offices seeking for large throughout are more likely to support water-water combined transport, regardless of the advantages of rail-water combined transport.

Imperfect Service of Rail-Water Combined Transport in the Port

Currently, there is no direct connection between the railways and most of the ports. Taking the Port of Shanghai as example, the railway facilities are rather weak, and there are only several container terminals in the port has the access to railway lines. In 2005, an important matching construction for the Yangshan Port - Luchaogang

Railway Container Terminal has been started and used. However, for many reasons, the railway lines have not been accessed to the Yangshan Port, while the water-rail combined container transport has to transfer to truck transport, and then reach the Yangshan Port, which not only increases the container load and unload times, but also increase the costs of water-rail combined transport and reduce the timeliness and safety.

Ineffectiveness of Harbor Station

Harbor stations are railway container terminals established in the port, which are jointly organized and managed by various departments including the railway department and harbor service department; in addition, these harbor stations have obtained license from the railway transport administrative department to deal with container transport services. Generally, there are two harbor stations in the Port of Shanghai, which are Yangpu Harbor Station and Jungong Rd. Harbor Station; however, they are actually separated, and no trains directly enter into the port. The containers still need transport between these stations and harbors, increasing time and costs of the container transport.

3.2.3 Problems in Customs

Inland customs cannot obtain trust from the port customs, which has impacted the transport of goods between the railway and the waterway. Actually, different customs have already adopted unified system; thus, theoretically, remote customs declaration and customs transmit are enabled. However, in practical operation, these can only be allowed at the inland customers that have signed agreements with the port customs. To some extent, this also limits the development of rail and water combined transport, with negative impact on the connection of container transport between the waterway and the railway.

Chapter 4 Proposed Solutions to the Existing Problems

4.1 Approaches to Promoting Water-Rail Combined Container Transport

4.1.1 Understanding Advantages of Water-Rail Combined Container Transport

Container transport as a future direction for the development of the transport industry should be put an emphasis on. To be specific, understanding the advantages of container transport along the area of the Yangtze River will be able to broaden the investment idea and attract more investment, for example, the owners of goods using the transport will be more likely to use the transport services again if the service quality is promoted. From this perspective, the advantages of water-rail combined container transport should be fully understood, while there are several aspects to be focused on. First, the thinking of preferring the land transportation to water transportation should be changed, as there exist great advantages of water transport, especially along the area of Yangtze River. Second, the fund should be increased for the construction of infrastructure for water and rail combined transport. Third, in order to promote the effectiveness of the combined container transport, talents and professionals are in great need, so there should be an emphasis put on training of these talents.

4.1.2 Upgrading Hardware and Software Standards

In order to facilitate the development of the rail and water combined container transport, a high standard major channel for container transport should be constructed, with large capacity as well as economic and environmental benefits. Furthermore, the connection of container transport between the waterway and the railway should also be coordinated, with higher standards established. With the promotion of the standardization of the vessels, the transportation facilities such as the utilization rate of the waterways and the railways will be also improved, so as to facilitate the development of a well-established combined transport between the waterway and the

railway. Concerning the software standard, it mainly refers to the development of a information system so as to realize the informatization and digitization within the combined transport system. With the use of such high technology, the connection of container transport between the railway and waterway will be largely improved.

4.1.3 Speeding up the Legislation for Creating a Favorable Legal Environment

A favorable legal environment will greatly facilitate the development of transport system, including the connection of container transport between the railway and the waterway. In order to create a favorable legal environment, the government departments should speed up the legislation for the transport system, for example, to help it get rid of the local blockade and then establish a unified inland shipping market. Moreover, with the legislation development, the transport system will be more standardized, with simplified procedures for container transport management, through reducing examination, inspection and approval procedures. In addition, the improvement of legislation will also strengthen the safety supervision on the operations related to container transport, so as to ensure the effective connection of container transport between the railway and the waterway.

4.1.4 Preventing the Pollution along the Yangtze River

In order to establish an effective and sustainable water and rail combined transport system, it is important to prevent the pollution along the Yangtze River. A green approach of combined transport will enable the relevant stakeholders to put more focus on promoting their working effectiveness, which will also promote the connection of the container transport between the railway and the waterway. In this case, the environmentally friendly fuels can be used instead of the diesel oil, so as to achieve the goal of energy saving and emission reduction. Furthermore, the adoption of newly developed environmentally friendly technologies can also be used to prevent and deal with pollutions. More importantly, laws and regulations for preventing pollutions can be developed so as to have a control on this issue through strengthening

the supervision and management of the combined transport system.

4.2 Counter-Measures for Resolving the Existed Problems

4.2.1 To Develop Double Stack Container Transport

Double stack container transport is a new product and service that is with faster transport speed and lower costs. In the 1970s, the United States seeking to mitigate the traffic congestion in the port and promote the speed of port collection and transmission has then developed the double stack container transport. Currently, this transport mode has been widely used in many countries such as Canada, Australia and Mexico. As in China, the first double stack container train has been operated in 2004 at the Beijing-Shanghai railway line. This train has adopted direct connection and implement passenger train management, while the terminals, schedules and lines are all settled, forming a bulk logistic channel between Beijing and Shanghai. In this situation, developing double stack container transport in the railway sector will be able to mitigate the capacity tension at different railway lines, and also promote the transport efficiency and economic benefits, strengthen the competitiveness of railway in the market and increase the proportion of railway in the water and rail combined transport.

4.2.2 To Establish and Improve the Harbor Stations

To establish harbor stations, the railway containers can arrive at port directly when exporting goods, so as to avoid the trucking expenses and container handing expenses caused by increased transport, and then reduce the operational links in the rail and water combined container transport; while importing goods, the containers can also be unloaded to the railway special line in the harbor stations, so as to reduce the rehanding and carrying between different transport models. In addition, the combination of water and rail transports will simplify the procedures for container transport, as the owners of goods or freight forwarders can manage the consign for

shipment at the harbor stations near the port, but avoid going to the railway container terminals. From this perspective, the development of harbor stations is an inevitable way for the water and rail combined container transport. In this case, China should constantly improve the development of harbor stations and realize seamless connection between the railway and the waterway transport.

4.2.3 To Establish and Improve the Railway Inland Port

Railway inland ports are railway international container terminals established in the inland area, implementing the function of one customs, with commercial/commodity inspection, quarantine inspection and quarantine of animals and plants. The major function of railway inland port is to enable the import and export goods to cross the customs through the railway inland ports directly at appropriate locations, so as to reduce the burden of the port and speed up the customers' clearance of containers, and then increase the speed of container transport in the port. The establishment of inland ports will extend the border port function to the inland area, so as to realize the convenient customs declaration for the owners of goods, and then facilitate the connection of container transport between the railway and the waterway.

4.2.4 To Set Rehanding Locations for Carriers in Railway Container Terminals

Currently, the major functions of railway container terminals in China involve stocking, loading and unloading, packaging and unstuffy, cleaning the containers, as well as the management of container services like consignment of shipment. However, there are no container stocking locations for the carriers or shipping companies. In this case, if there are rehanding locations for carriers set up in the container terminals, the owners of goods can then return the empty containers to the container terminals when the goods are transported to the inland area; while as for the exported container goods, the owners can directly use the empty containers in the container terminals. This operational model will largely reduce the operational links in the container transport, making the transport even more effectiveness, so as to promote the

connection of container transport between the waterway and the railway.

4.2.5 To Develop the Information System of Water-Rail Combined Transport

In the water and rail combined transport system, information sharing and exchanging between different transport departments is of great importance to the reduction of transport time and costs as well as the promotion of transport service quality. In this case, during the process of developing rail and water combined container transport, in order to facilitate effective connection between the railway and the waterway, the information exchange capability between the ports and container terminals, customers and other organizations should be strengthened, so as to further reduce the transport costs, promote the working efficiency and competitiveness, facilitating even more rational operation within the water and rail combined container transport system.

4.2.6 To Set Up an Overall Coordinating Department

Water and rail combined transport is a multi-modal and synthetic system, involving many different sectors and departments such as customs, inspections, agency, storage yard and EDI network management besides the ports and the railways, which is in sore need of an authorized government department to organize and coordinate the container transport between the railway and the waterway. In addition, it also needs a governmental department that is responsible for conducting special research and investigation, launching relevant policies, encouraging and supporting the development of the water and rail combined transport, so as to promote the connection of container transport between the waterway and the railway.

Chapter 5 Conclusion

Through the research on the connection of container transport between the waterway and the railway along the downstream area of Yangtze River, it is found that not only the issue within the container transport industry but also the state's policy orientation,

the legal system's construction and other aspects are involved. In this grim economic situation, in order to develop a resource-saving and environment-friendly inland water transport in China, the community should pay attention; the Government should be responsible; the companies should be consciousness, so that we can create a good market environment and protect the common interests of state, enterprises and individuals.

This paper has focused on the connection of container transport between the waterway and the railway along the downstream area of the Yangtze River. The present situation of container transport along the Yangtze River has been analyzed, involving the entire transport system and the container transportation within the area, as well as the central ports along the Yangtze River, in addition to the current situation of the waterway and railway container transports. In addition, the problems related to the connection of container transport between the waterway and the railway along the Yangtze River have also been stated, which mainly focus on the railway transport, the ports and the customs. Accordingly, solutions have been proposed for dealing with the existing problems. To be specific, there are four approaches recommended for promoting the connection of the container transport between the Waterway and the Railway along the Yangtze River, which are: 1) understanding advantages of Water-Rail combined container transport; 2) upgrading hardware and software standards; 3) speeding up the legislation for creating a favorable legal environment; and 4) preventing the pollution along the Yangtze River. Moreover there are another six counter-measures for resolving the existing problems: i) to develop double stack container transport; ii) to establish and improve the harbor stations; iii) to establish and improve the railway inland port; iv) to set rehanding locations for carriers in railway container terminals; v) to develop the information system of water-rail combined transport; and vi) to set up an overall coordinating department.

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