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Research on the route optimization of Huzhou port's outbound container

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FORMAT OF THE DECLARATION

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

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(Date): 2018.07.06

Abstract

Huzhou port located in the water network of Hangjiahu plain in the north of Zhejiang province, is an important port of Jiangnan water transport network, is one of the inland main ports in China. It is an important support for the development of the economic and social of Huzhou city and the development of mineral resources. It is also an important hub of the integrated transportation system in Huzhou and Yangtze river delta. It is also the main supply port for building materials for some cities in the surrounding area.

Huzhou ports are located on the "Yangtze river delta economic zone", "ring Taihu lake economic circle", "near Hangzhou belt", on the important node of "Hangzhou Huzhou Ningbo city belt", has obvious location advantage and important strategic position.

This paper firstly studies the container transport of inland river, expounds its own characteristics, and introduces the development status of inland waterway container transportation. Secondly, the paper analyzes the status of inland waterway, port and shipping in Huzhou, combining with the characteristics of Huzhou water transportation and economic development situation, Huzhou waterway container transportation for the scientific forecast, and put forward to some issues need to improve to meet the demand of Huzhou city transportation. Finally to Huzhou container based on planning and design of water transport, this article puts forward the idea of Huzhou container water transport network, and the various components of the detailed planning and function. According to the owner enterprise transport demand and transport site is different, the container water transport model was proposed through the planning of inland water transportation route optimization problem, route optimization model is established. And then according to the division of inland waterway optimization model, optimized for transportation lines.

The results show that the research methods of this paper are able to describe Huzhou inland container transport network planning and management, to provide the reference. At the same time, this research also provides a new way of thinking for the later more scientific and reasonable planning of Huzhou inland container transport network.

Keywords: Huzhou; Container; Inland water transport; Route optimization

Contents

1. Introduction

1.1 Backgrounds of this dissertation

China's "13th Five-Year" plan, the much starker choices and graver consequences-in planning outline clearly put forward with an emphasis on energy conservation and emissions reduction, actively develop low carbon environmental protection projects. Container transportation is a kind of low energy consumption, high efficiency of the new mode of transportation, at present in all countries in the world has got swift and violent development. Establishment of container multimodal transport projects, is relying on choosing transportation into this relatively low, the energy consumption is relatively less container transport model. Improve the transport organization structure, achieve energy conservation and emissions reduction, and built to promote low-carbon transport system.

At present, according to the development of the industrial economy, Huzhou container transport mainly relies on land transport and inland container transport. According to statistics, in recent years, Huzhou has finished inland container throughput of 86500 TEU, completed highway around 50000 TEU container volume estimation (market), foreign trade outbound containers within the source is controlled in 600000 TEU. Most points by the road transportation to other provinces and cities in and out of the forwarder company.

At present, the main bottleneck restricting the development of container transportation in Huzhou is the problem of waterway infrastructure construction. First, the channel structure is not reasonable. Level five, six and seven channels are 402.3 kilometers in Huzhou, accounting for 58.6 percent of the total mileage. Level 4 and above the high channel than the smaller, the grand canal "four to three" project has yet to start, Changxing-Huzhou line (Zhejiang)" four to three "project is implemented, and Changxing-Huzhou line (Suzhou) has not yet commenced renovation. They will restrict development of inland container transportation in the future. The second is the lack of bridge clearance. At present, as the main passageway of the Huzhou container ship, the Changxing-Huzhou-Shanghai line and the Wuyi bridge on Meihu line, the height of Changxing port bridge are obviously insufficient. This not only causes a certain effect

on the navigation of the ship during the flood season, but also makes the container ships that are in operation only have two layers, and the economic benefit of ship transportation is reduced by 1/3. Third, some passage curves and widths limit the navigation of large inland container ships. The turning radius is only 120 meters (lower than the standard of the five levels). Anji Jingui shipyard, Shiquan bay Wushan ferry pier and other channels are narrow, the ship intersection and full load operation so difficult.

1.2 Literature Review

The connotation of logistics refers to the physical distribution, which is the transportation, storage, packing and other activities of enterprises and sellers themselves. From the beginning of the 20th century to the present, after a century of development, the United States, Japan, Europe and other developed countries have formed a relatively perfect logistics theory system. However, China's logistics started late, and by the 1990s, logistics really attracted the attention of the society and popularized it. Although with the development of the past ten years, China's logistics has made great progress, but the late start and low level are still the main characteristics of China's logistics industry. Fortunately, domestic enterprises and scholars have gradually noticed that logistics is the third largest source of profit. It has become an effective way for enterprises to obtain competitive power by carrying out logistics planning and compressing the operating cost of enterprises.

Contact with the global economy more and more close, and demand more and more personalized, also to the requirement of port services to achieve to meet customer demand as the starting point, from start to finish of process inventory of raw materials, intermediate products, final products and related services in the whole process of the effective flow and storage of information. Traditional port operation mode has been unable to meet the needs of modernization. As a result, introducing advanced concept of logistics operation and management of ports, applies the method of system planning for the construction of modern port logistics mode has become the integration of port logistics resources. Improve the port operation efficiency, reduce operating costs, promote the development of port and drive the development of port cities and hinterland economy are urgently needed.

Recent research of outbound containers of inland river ports

Both scientists in China and abroad have done quite a lot of research on container transport plan for inland river ports.

First, In the article "Spatial and institutional characteristics of inland port development in China" (2013) [1]: Traditional port logistics mainly provides handling, warehousing and transport services. With the development of modern logistics, the connotation and extension of port logistics are undergoing profound changes, and port logistics has become an important part of the whole logistics system. Modern port logistics is refers to the port city of using their own port advantage, which is based on the advanced software and hardware environment, strengthening the logistics activity in areas surrounding the radiation ability, give full play to its collection of goods, inventory, distribution and other advantages, on the basis of port-vicinity industry, supported by information technology, to optimize the port resource integration as the goal, to transportation, storage, loading and unloading handling, distribution, packaging, circulation processing, information processing, logistics links such as organic combination, forming a complete supply chain, to provide users with multi-function, integration, integrated logistics services, logistics industry chain development will cover all links the characteristics of the port comprehensive service system. "Functions and actors of inland ports: European and North American dynamics" (2010) [2] aims at that Inland ports are mainly located in areas with large inland freight volumes. Building an inland port should not be taken into account only the quay's activities, but also his positioning and the important logistics activities near the inland ports. This article focuses on case studies of inland ports in Europe and North America.

Second, some decision-making simulation methods have been introduced into studying the lowest transport cost. From the perspective of logistics cost and service, the impact of transportation time on logistics cost is estimated, stated by JOHN E. TYWORTH and AMY ZHAOHUI ZENG (1998) [3]. JASON MONIOS and GORDON WILMSMEIER (2012) [4] talked about the theory of basing on the Marine transportation geography, this paper studies the logistics hub with port as the center, and studies how to choose the appropriate frequency of transportation suppliers and

arranging feeder service. "Research on the transformation and upgrading mode and countermeasures of inland waterway logistics service based on informationization" （2014） [5] studied from the overall demand of the logistics market, the low profitability of logistics enterprises, the general shortage of logistics development factors, and the continuing high cost of resource elements.

Third, not only further research at theory, but also apply a lot of research into specific cases. In the foreign theory"A model to calculate the cost of logistics at a macro level: a case study of South Africa", F.J. Botes, C.G. Jacobs & W.J. Pienaar (2006) [6] said that in order to calculate the logistics cost of South Africa, they designed a suitable logistics cost model of South Africa, it was relatively easy to according to the model data to predict the next few years the cost of logistics, and through the comparison with historical data, this model can also be as the research progress update data, improving the sensitivity of data analysis. In China,"study on logistics planning of inland river port" (2012) [7] took Huzhou port as an example, talking that Huzhou port is one of the main ports of 28 inland rivers published by the ministry of transportation in November 2004.

As a developing country, China's logistics industry is small, and its GDP growth is less than 1/3 of that of developed countries, and logistics costs are twice as high as that of developed countries (2009) [8]. Based on port choice and competition in the literature and history data, Gi-Tae Yeo , Michael Roe , John Dinwoodie （2008） [9] studied the shipping company and owner for the regional survey, found the port service, heart conditions and convenience, the logistics cost and the regional center for these important factors. Logistics cost management provides a necessary target level for performance evaluation. Since these supply chains operate in a fixed manner, they are optimized in terms of cost, cycle time, inventory and working capital, thus saving costs （Hua Song and Lan Wang） [10] . Logistics plays a vital role both at home and abroad. It is the link connecting the market. Modern logistics can promote the modernization of circulation, save circulation cost, provide value-added services and create competitive value （2017） [11] . Eric P. Jack [12] want to solve the problem of improving the overall cost of retailer by reverse logistics.

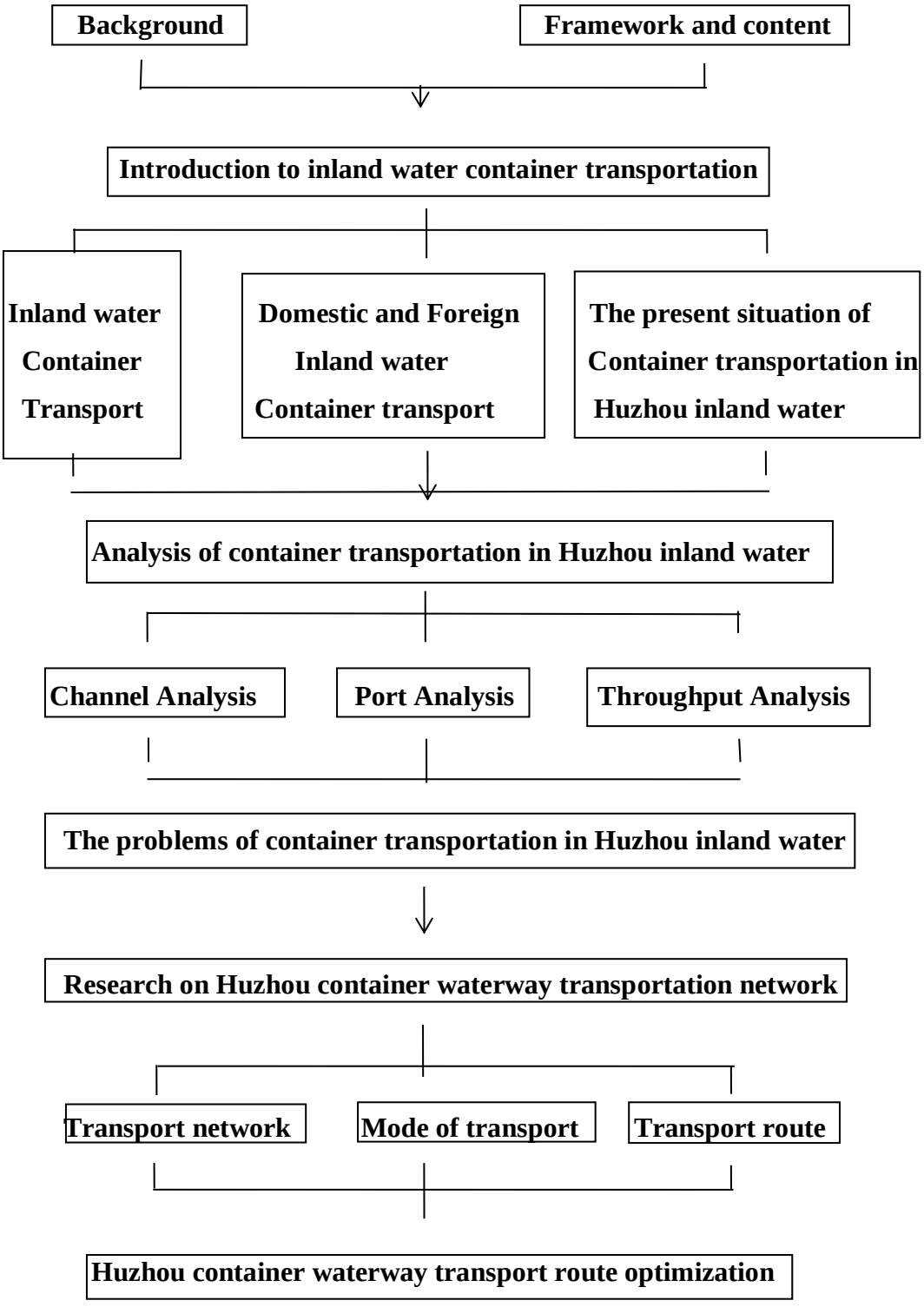
Overall, the main challenges facing the current our country logistics industry can be summarized as: insufficient aggregate demand, logistics enterprise logistics market profit is low, logistics development elements common shortages, resource cost is high (2015) [13]. But the problem of Huzhou port is that at the present stage, there is no path suitable for its development (2015) [14]. Peng huilong (2016) [15] introduced the generation mechanism and classification of logistics cost and then explained the control way of logistics cost.

With the rapid development of social economy in Yangtze river delta region, the comparative advantage of water transportation in Huzhou river is becoming more and more prominent. And making full use of the advantaged waterway transportation conditions, rationally plan and developing the transportation network for transportation and transportation, and seeking the transportation plan with lower cost.

1.3 The framework and content of the dissertation

This thesis is divided into five chapters, the main contents of the chapters are as follows: The first chapter is the introduction, it introduces the background and research significance of the thesis, and proposes the organizational structure of the research. The second chapter is the study of inland water container transportation, this chapter expounds the characteristics of inland water container transportation. Then introduces the present situation at home and abroad of inland water container transportation development, especially the Huzhou development of inland water container transportation. The third chapter analyzes the Huzhou channel of inland water container transportation, port and shipping conditions, together with the present situation of Huzhou water transportation and economic development situation. Then make the scientific forecast of Huzhou waterway container transportation, and put forward to meet the main problem of Huzhou's demand of waterway container transportation needs to improve the Huzhou's water transport system. The fourth chapter is the Huzhou's container of water transportation planning part, first of all, this article puts forward the idea of Huzhou container water transport network, and the various components of a detailed planning and function orientation; the second is to partition container water transport mode, according to the owner of the goods transport demand and transport location is different with different mode of transportation. Put forward

the maximum use of limited resources in the end, inland water transportation route optimization model, based on the model of Huzhou city inland waterway to carry on the division. Optimizing for Huzhou container shipping lines, make the most use of the existing channel resources. The fifth chapter is to ensure the effective implementation of container transportation network, and put forward specific measures and suggestions.



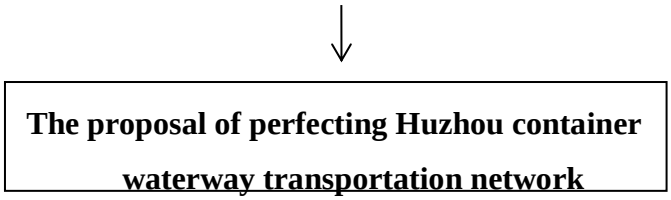


Fig.1.1 The structure graph of full-text

2.Introduction to inland waterway container transportation

2.1 Characteristics of inland waterway container transport

Inland water container transportation is a container transportation method that uses inland water transport as a means. It is highly efficient, economical, environmentally friendly, and green. Under the same transport distance and cargo volume, compared with highway and railway container transport, inland water container transport has the lowest freight rates, the lowest energy consumption and pollutant discharge, and the smallest occupied arable land. And it has become the third largest collection and transportation method for containers outside of highways and railways. Inland container transport has the following advantages:

1)Inland container transport capacity is big

A heavy train can be loaded maximum of 72 TEU, a truck can only ship 2 TEU, a 500-ton container ship that can sail on the fourth channel can be fitted with 30TEU, that's about 0.4 trains or 15 trucks. In addition, inland waterway has a greater ability to pass through railways and roads, which can solve the problem of large-scale transport and alleviate the problem of insufficient road capacity due to economic development.

2)Inland container transport damage is less

The container transport of inland river is more stable than that of railway and highway, small bump, glass containers and other fragile products using water containers can basically reduce the damage to a minimum and the economic benefits are obvious. In addition, because of the waterway is isolated from the surrounding environment during transportation, it is generally not free to dock. The pirates are less likely to commit aboard a ship during the voyage. They are less prone to theft of container cargo during transportation, and the safety of cargo transportation is strong

than railways and highways. Furthermore, at the same batch transportation, the number of vehicles needed for road transport is greater, and the probability of car breakdown is much higher than that of railways and waterways. As long as one vehicle is anchored, it will affect the transit time of the entire batch.

3)Inland river container transportation cost is low

Compared with railway and road transportation, inland river container transportation has certain advantages in cost. Since the railways need cars to handle the containers at both the departure and terminal stations, there is no competitive advantage in the cost of short-haul transportation, which only needs to be compared with the highway. In the Yangtze river delta, for example, from Shanghai to Huzhou, waterway transportation costs between 500 and 700 yuan per standard. Most shippers have achieved better results to transport containers by water. The transport of large shipping capacity of ships can result in the scale economy of transportation, and the average cost of transportation to each container is greatly reduced. It is understood that the price of the inland river freight is about 0.07 yuan per ton per kilometer, while the freight per ton per kilometer of railway and road freight is four to seven times that of inland waterway, about 0.30 yuan to 0.50 yuan.

4)Inland river container can be loaded and unloaded directly at the port

Containers of inland river and road transport can be loaded directly on the dock, reducing the intermediate link. But after railway container shipped to export home, they need to use cars to ship the containers to the dock, generally need to increase freight fees in the city about 500 to 600 yuan, increasing operating costs.

5)Inland river container transportation's fuel consumption is little and pollution is small

The inland river container transportation is a kind of efficient, energy-saving, environmental protection, low cost mode of transportation. So water transportation is the most environmentally friendly mode of transportation relative to highway and railway transportation. The fuel consumption of trains and trucks is about two to seven times that of water.

6)The development of inland river container is conducive to the formation of reasonable production layout

The characteristics and advantages of container transport is the most main is to realize the "door to door" transportation, plus the factories along the river formed the industrial zone along the river and the economic belt along the river. Inland waterways

can provide along the rivers of enterprises with clear, cheap and convenient container "door to door" transportation services.

7)Inland river container transportation can provide hub transportation service for ports

Inland river container transportation can provide branch services for offshore trunk container shipping vessels, provide river-sea direct container transportation services for shippers. It also provides the inland river container transportation service for the development of river industrial zone and river basin economic belt.

2.2 The present situation of foreign and domestic inland waterway container transport

2.2.1 The present situation of foreign inland river container transportation

(1) Western Europe

The inland water network in Europe distribute densely. Several major rivers flow from east to west across many countries, and the estuaries distribute densely too. Making estuaries and river ports close to the sea and taking full advantage of superior water resources and geographical advantages to absorb supplies from the hinterland of Europe. In the European region, the Rhine River is the main line, and many artificial waterways have been built on the base of natural waterways. These natural and artificial waterways are connected and form an inland waterway network extending in all directions in Europe. These rivers reach the sea and reach the North Sea, the Baltic Sea, the Black Sea, and the Mediterranean Sea, forming a complete navigation system through the sea and the sea.

In addition, Europe's estuaries are densely populated, and many important seaports locating in the entrance of the river. Such as the world-class port of Rotterdam, locating in the delta produced by the two major rivers the into the sea which named the Maas River and Rhine River in the southwest coast of Netherlands; the port of Antwerp locating in Belgium downstream of the Skander River which connected the artificial canal the Rhine.

On the base of such a superior inland waterway network and port conditions, at the same time, the fee of inland river container transportation is cheap, and the convenience

of transshipment and timely delivery of goods make it more and more popular. In 1969, the first inland waterway container shipping route appeared on the Rhine. Driven by the Rhine, the inland water container transport in Europe began to develop since the 1970s. In order to achieve sustainable economic development, all countries are vigorously developing inland water container transport.

Western Europe's inland water container transportation has gone through two stages in the process of development: (1) Construction period---from 1975 to the mid-1980s. At this stage, the construction of infrastructure including wharfs, navigation channels, ship locks, etc. has gradually improved. At the same time, the implementation of standardized navigation has reduced the impact of national borders on inland water transport. (2) Development period---after the mid-late 1980s. Inland river ships have made a qualitative leap at this stage. Large-scale shipbuilding is an outstanding achievement at this stage, which is conducive to achieving economies of scale and improving the efficiency of transportation. At the same time, the automation level of the terminal greatly improves the efficiency of the operation. At this stage, a new type of ship was put into operation. In order to reduce the loading and unloading of inland water container vessels in the coastal port twice, the river-sea dual-purpose barges suitable for Rhine container transport have also been put into operation. The ro-ro vessels have also been transported directly to the Rhine River.

So far, Western Europe has formed a relatively complete inland water container transport system, with more than 35,000 kilometers of graded waterways. And the port system for inland water container transport in Western Europe is also relatively complete. There are more than 20 major ports along the Rhine River. A complete inland river container liner transport network is gradually established in Europe.

(2) The United States

The U.S. inland river container transport is mainly concentrated in the Mississippi and Great Lakes basins. The U.S. Inland Waterway has a total length of about 10,000 kilometers, of which nearly 10,000 kilometers are the Mississippi River system. The Mississippi River runs north and south, passing through 31 states on the way. After the container transportation mode demonstrated its superiority in water transportation, inland river container transportation in the Mississippi and Great Lakes basins in the United States developed rapidly and took up a large share of cargo transportation in New York and other estuarine container ports.

However, the U.S. share of inland water container transport is relatively small compared to the developed inland waterways in Europe. On the one hand, because the US channel network is not widely distributed as Europe, and the U.S. river system is north-south, it is inconsistent with the flow of container traffic between the main Pacific-Atlantic coast. It is also subject to competition from the United States Continental Bridge, road transport and the most efficient railway container transport.

(3) Russia

Russia's inland water container transportation has also developed earlier. As early as in the former Soviet era, it attached great importance to the construction of a waterway network for inland waterways. On the base of the reconstruction of natural rivers with the Volga River as the main body, a large number of artificial canals were also excavated. Mainly in the Volga River, after the Kama River and the Volga River were channelized, the main channel was basically formed and improved. At the same time, the excavation of the massive four grand canal Bridges the coastal ports and inland waterways, and formed a perfect channel network with direct and interconnected channels.

Russia currently has 84,000 kilometers of inland waterway mileage, second only to China. A complete network of navigation channels has created good conditions for the development of inland water container transportation. In terms of ship type, the inland river vessels of Russia continue to grow in size due to the improvement of the navigation level. The tonnage of ships has rapidly increased from 1,000 tons to more than 3,000 tons. In order to fully realize the ship’s economies of scale, Russia’s ship tonnage is also increasing. Pay attention to the optimization of container transportation network and organization.

As for the box type, the former Soviet Union imported 20 standard containers and 40 standard containers of international standard containers in the 1980s, further improving the standardization of container transportation, and the special terminal for container transportation has also been built in various river ports. Into the 90s, Russia's inland water container transport experienced a period of stagnation due to the disintegration of the former Soviet Union and the economic depression. After the 21st century, economic recovery resumed development. The Russian government has promoted the development of inland water container transportation from various aspects such as infrastructure and transportation organizations.

2.2.2 The present situation of domestic inland river container transportation

In ancient times, the Yellow River and the Yangtze River were the source of civilization development of the Chinese nation for thousands of years. The convenience of inland water transport has given these regions priority to prosperity. China's river shipping resources are abundant, with dense river networks and numerous lakes. There are more than 5,800 natural rivers in the country. The total length of rivers is about 430,000 kilometers. There are 15 rivers with a length of more than 1,000 kilometers, such as the Yangtze River, Zhujiang River, Qiantang River, and Heilongjiang River, the Beijing-Hangzhou Canal and so on, are mostly important navigable rivers in China. There are more than 900 large and small lakes and 12 lakes with an area of over 100 square kilometers. The total mileage of inland waterways is 123,000 kilometers.

Although China's domestic container transport has started late, it has developed rapidly with the growth of foreign trade and domestic trade demand. And soon formed the Yangtze River Delta and Pearl River Delta container logistics network system, which is based on the Yangtze River Line and the Pearl River water system.

International container shipping has started to develop, the domestic transportation industry has also realized the importance of inland water container transportation and started the construction of inland waterways and port terminals. By 1972, our country has a total of 16000 kilometres of level 4 and above passage, available for 500 - ton ship 25931 inland port berths, 172000 of inland water transport ship, net of 55 million ton. But the vast majority of the port and ship is still applied in the transportation of bulk carrier. After 1973, China continued to develop inland water containers, and inland water container transportation started to take off and was in a slow development stage.

Table 2-1 The slow development stage of Chinese inland containers transportation

Year	**The development situation**
1973	The ministry of communications has organized the development of five tons of water and land transport containers.
1976	The first liner route was opened in the Yangtze river.
1979	The ministry of transportation has built 1000 national standard 5 tons of containers.
1980-1985	Waterway container transport has developed at different levels in the Yangtze river.

1985	The throughput of China's water container port has completed 73,000 cases, and the cargo weight is 200,000 tons.
1990	The throughput of China's waterway container ports has completed 95,000 boxes and the cargo weight is 260,000 tons.

At this stage, China has made deeper explorations in the development of waterway containers, the transformation of container ships, and the opening of routes, and has achieved certain results. In addition, the standardization of management has also been improved. For waterway container freight and port loading and unloading fees, the Ministry of Communications has issued corresponding fee collection standards, making the charging behavior of all aspects of transportation standardized, and the inland water container transportation has begun continuous development. However, the development of inland water container transportation in China is still very slow due to the fact that international container transportation dominates the water transportation and inland shipping has been neglected for a long time.

Table 2-2 The contraction stage of Chinese inland containers transportation

Year	Manifestation	Reason
1990.11	National Waterway Domestic Container Transportation Conference	It has played a role in promoting waterway container transport, but it is not accurate enough to grasp the overall direction of market development.
1990-1995	The inland river container route basically stopped. Similar coastal routes only have Dalian-Tianjin, Dalian-Yantai and Dalian-Shanghai.	The development of road transport and air transport has diverted the passenger and cargo sources of water transport. Many passenger shipping routes have suffered losses. The overall efficiency of shipping companies has

		declined, and the routes have gradually been withdrawn or reduced in capacity.

At this stage, with the help of reform and open-up, China’s foreign trade is very prosperous. Both the government and the waterway transport companies have also focused on international container transport, and China’s inland water container transport has been under ignorance. Not only did it not break through the slow development of the previous phase, it continued to shrink, the routes were cancelled, and the capacity was reduced. Inland shipping container transportation once again reached a trough.

1996 was a watershed for China's inland water container transportation. Since 1996, China's inland water container transportation has developed faster and it has begun a qualitative leap. The main reasons and performance can be summarized as:

(1) The role of logistics in the production and circulation of products is strengthened. With the development of economy, the expansion of market scope, the division of labor, etc., the role of transportation in the process of product trade has become increasingly prominent, and the owner has increased the demand for transportation services. As a result, inland water container transportation has a strong economic support.

(2) The owners’ requirements of the transport quality, time and price continue to increase, China's domestic container transport of high-quality container transport, time reliability, low prices and other advantages continue to highlight, making the river more and more favored by shippers within the economic hinterland.

(3) Proper container supply increased. With the adjustment of China's industrial structure, the technological content of goods continues to increase, and the volume of manufactured goods and high value-added products continues to increase. In addition, with the opening up of markets and the increase of market players, the trend of small batch production of bulk bulk cargoes has changed. Obviously, some containerized bulk bulk cargoes that are not suitable for boxing have been rising.

(4) In terms of technology, the 20-foot and 40-foot international standard containers used in international container transportation are already in use. In 1996, the Inland River began to use standard containers to speed up the standardization of inland water container transportation. This not only facilitates the transshipment of containers, but

also facilitates the combined transport of water and land, expanded the hinterland area of inland water transport. China's first international standard container shipping line service, Shanghai-Nanjing route was opened in December 1996.

(5) Ship type standardization. In order to ensure the safety of water transportation and increase the competitiveness of inland shipping, in 2003, the National Directorate of Transport Directors proposed the national standard for the standardization of ship types for inland river transport. Since then, both the government and academia have carried out a lot of research and promoted the inland rivers in China. In terms of the standardization of ship types, the Ministry of Communications in 2006 also issued the "Outline for the Development of Inland Ships Standardization in China". The development of container shipping vessels is mainly driven by self-propelled ships.

(6) Excessive transport capacity of the highly competitive international container transport system provides certain resources for inland river container transport to be fully utilized. At the same time, the adjustment of foreign trade policies and the pull of domestic demand (including Western Development, etc.) provide the development of inland river container transport. Full resources, good opportunities.

China's domestic container shipping is mainly concentrated in the Yangtze River system and the Pearl River system. With the rapid development of container transportation, the Yangtze River water system has formed a shipping system centered on Shanghai and linked to the Delta region and the Yangtze River. The Pearl River water system has formed Hong Kong as an international shipping center, Shenzhen and Guangzhou as the hubs, and the Pearl River. The shipping system in the areas along the Delta and the West River.

2.3 The present situation of container transportation in inland waterway of Huzhou port

At present, according to the economic development of the industry, Huzhou mainly transports land transport and container transport in container containers. According to statistics from the Huzhou Port Authority, by December 29, 2017, the throughput of Huzhou Port reached 105.4 million tons this year, a year-on-year increase of 21.7%. Three years later, it returned to the ranks of one hundred million tons of big port.

In recent years, the inland river container transport in Huzhou City has taken advantage of the natural advantages of port waterways and low transportation costs,

and the development momentum is rapid. According to calculations by relevant parties, considering the cost of container terminal haulage and lifting, the cost of inland river container transportation in the Yangtze River Delta region is approximately two-thirds to four-fifths of the highway transportation volume.

With the increase of inland waterway grades, the upgrading of bridges and the increase in packing capacity, the cost of inland water container transportation will gradually decrease. In addition, in the "Railway Highway Waterway" three modes of transportation, inland river transport uses natural river resources, and the land resources are less occupied, and is calculated on a per kilometer transportation line. The scale of the inland river line is 2mu, and the railway needs 25mu. The average road needs 40 acres. In the increasingly severe constraints of land factors, inland water container transportation has obvious advantages.

Huzhou produces goods mainly in the textile industry, building materials industry, machinery and electronics industry, forming a special industrial clusters such as Deqing Biopharmaceuticals, Changxing Battery, Anji Chairs, Wuxing Metal Materials, and Nanxun Wood Flooring. Huzhou Port was one of the 28 inland river main ports announced by the Ministry of Transport in November 2004. Huzhou Port administers 6 major ports (Wuxing, Nanxun, Changxing, Deqing, Anji, and Taihu Tourism Port), with 24 major operation areas. It has a land area of 3,927,500 square meters and a water area of 865,700 square meters.

In recent years, the port of Huzhou has continuously improved loading and unloading equipment, enhanced the berthing capacity and throughput capacity of the docks, and continuously improved the capacity for the collection, distribution, and transfer of goods. It has played an active role in promoting the rapid development of the local economy.

Table 2-3 2017 Container Transport Survey Summary

(Sources: Huzhou Port Authority)

Project / Year	**The amount completed in 2016**	**The amount completed in 2017**
Container shipping capacity	Outbound container volume (TEU): **105281**	Outbound container volume (TEU): **145124**
	Inbound container volume (TEU): **101413**	Inbound container volume (TEU): **156054**
	Total (TEU): **206694**	Total (TEU): **301178**
Container freight	Outbound cargo volume (TEU): **709731**	Outbound cargo volume (TEU): **1198239**
	Inbound cargo volume (TEU): **1176019**	Inbound cargo volume (TEU): **2308676**
	Total (TEU): **1885750**	Total (TEU): **3506914**
Outbound cargo species	Ceramics, Groceries, Iron Oxide, Talc, Calcium, Plates; Bamboo Products, Office Chairs, Sofas; Fertilizers, Refractory Materials, Building Materials	Ceramics, Groceries, Iron Oxide, Talc, Calcium, Plates 、 Leisure Furniture; Bamboo Products, Office Chairs, Sofas; Fertilizers, Refractory Materials, Building Materials
Inbound cargo species	Ceramics, ceramic materials, stone, refractories, corn, left ester, plate, kaolin, iron oxide, 96 fused magnesia; waste paper, pulp, crude glycerin, plastic waste, dining tables and chairs; grain, soybeans, magnesia, Stone powder	Ceramic, ceramic raw materials, stone, refractories, corn, left ester, plate, kaolin, iron oxide, 96 fused magnesia; waste paper, logs, starch; waste paper, pulp, crude glycerin, plastic waste, dining tables and chairs; Grain, soybean, magnesia, stone powder

Flow of goods	Flow to Shanghai: **188855** TEU,**1488395** TON	Flow to Shanghai: **256367** TEU,**2625614** TON
	Flow to Zhapu: **12154** TEU,**286127** TON	Flow to Zhapu: **6231** TEU,**137000** TON
	Flow to Taicang: **5369** TEU,**103811** TON	Flow to Taicang: **37954** TEU,**730000** TON
	Flow to others: **316** TEU,**7417** TON	Flow to others: **626** TEU,**14300** TON

In 2017, Huzhou Port took the opportunity to establish "the nation's first inland water development demonstration area" to serve the "One Belt and One Road" and the Yangtze River Economic Belt and other major strategies to accelerate the transformation from "transport stone" to "transport box". The container throughput of inland rivers in Huzhou City showed a spurt growth, with a total of 354,000 TEUs completed in the year, a year-on-year increase of 71.5%, and an actual load rate of heavy boxes of 75.3%. The throughput ranked first in the same type of inland ports in the country.

(1) Container Capacity Development

By the end of 2017, the city had 51 vessels and 2450 TEUs of container capacity; the city had 3 container terminal operators and 3 container transportation companies. Among them: Anji Chuanda Shipping Co., Ltd. has 28 container vessels and 1260 TEUs. Zhejiang Zhongxin Shipping Co., Ltd. has 17 container vessels and 856 TEUs. Zhejiang Putai Shipping Co., Ltd. owns 6 container vessels and 334 TEUs.

(2) Container route development

With the deepening of the combined mode of river and sea transport, the city-level and three-county inland river container transport network has been realized. At present, Huzhou Port has opened seven container routes, such as Anji Shanggang and Shanghai Port, Taicang Port; Changxing Jietong and Ningbo Port, Shanghai Port and Taicang Port; Deqing Multi-functional Port Area and Shanghai Port and Taicang Port.

(3) Development of port container throughput

In 2017, a total of 354,000 TEUs were handled in the whole year, of which 172,400 TEUs were exported and 181,200 TEUs were docked, up by 71.5%, 64.5% and 78.6%

year-on-year respectively. The throughput was ranked for three consecutive years. The province's inland port is the first place, and the proportion of inland container throughput in the province accounts for more than half of the total. Among them, Anji Port completed 242,213 TEUs, an increase of 52.6%; Changxing Port completed 38,382 TEUs, an increase of 129.4%; Deqing Port completed 72,501 TEUs, an increase of 540.4%; Nanxun Port completed 482 TEUs.

(4) The volume of traffic completed by container companies

In 2017, container companies completed 315,196 TEUs and 2,844,947 tons of cargo. Among them, Anji Shanggang International Port Co., Ltd. completed a total of 242,213 TEUs and 1,681,430 tons of freight; the Deqing Multi-functional Port Area completed 72,501 TEUs and 1,157,403 tons of freight; Huzhou Xinhan International Logistics Co., Ltd. completed a total of 482 TEUs, freight forwarding The amount of 6114 tons.

(5) Characteristics and Development Trends in the Development of Container Transportation

1) Development characteristics

First, the joint optimization of the river-sea joint navigation channel network. The navigation channel is used as a link between deep coastal ports and inland river ports for deep communication and cooperation. In the Huzhou navigation area, an upsurge of waterway transformation and upgrading was set up, and the shortcomings of water transport infrastructure were effectively filled. After the completion of the 1,000-ton channel for the Huzhou-Jiaxing-Shanghai Line and the Changxing-Huzhou-Shanghai Line, Huzhou Expressway will accelerate the west extension of the Changxing-Huzhou Line, the “Four Changed Three” regulation of the Huzhou section of the Beijing-Hangzhou Grand Canal, and the construction of a container transport corridor for the high-grade channel network in northern Zhejiang. In order to meet the requirements for three-tier container transportation, we have created a four-horizontal and four-horizontal river-sea intermodal shipping network covering the entire city, opening up a smooth and convenient high-speed channel for container transportation.

Second, the layout of container networks has been significantly expanded. The Deqing multi-functional port area basically realizes full radiation of logistics services in the Hangzhou-Jiaxing-Huzhou area and passes through Taicang Port and Jiaxing Zhapu Port directly to domestic major coastal ports. Through Shanghai Port and Ningbo Port, Zhoushan Port has direct access to major global ports. Domestic trade volume has grown rapidly since the third quarter, breaking through 10,000 TEUs for the first time

in a single month in November, and 72,501 TEUs have been handled in the year, an increase of 540.4% year-on-year. Changxing Jietong Terminal focused on promoting the domestic trade in Shanghai and Taicang and the development of boutique foreign trade in Jiaxing. Since June, the business volume has increased rapidly, and the monthly average has been maintained at more than 3,000 TEUs. The total container throughput reached 38,430 TEUs in the year-on-year. An increase of 129.7%.

The third is the obvious increase in boosting cooperation between the sea and the sea. The Huzhou Port and Shipping Department actively provides services for container ships in terms of systems and policies, and further stimulates the development of inland water container transportation. Facilitated the Ministry of Transport to revise and introduce a new "Administrative Measures for the Navigation of the Grand Canal" to solve the problem of over-limitation of the Wujiang section of the Huzhou-based container ship approaching the Changxing-Huzhou-Shanghai Line route. Launched a one-stop service for the inspection and certification of new container ships; opened a “green channel” for container ships during the period of sealing and traffic control; and actively docked with the maritime departments in Shanghai and Jiangsu to handle special permits and ensure efficient and smooth container transportation. Governments at all levels have issued supporting policies to help enterprises reduce costs and increase efficiency, which has injected strong impetus for the leap-forward development of container river-sea combined transport. The Zhejiang Provincial Government promulgated the “four independent navigation channel” fees for the exemption of inland water container shipping vessels, and the Huzhou Navigation Zone has realized zero-fee charges for administrative services. The Shanghai Municipal Government has adjusted and optimized the support policy for the shipping consolidation and transportation structure project, and the Haihe intermodal container subsidy transferred through Shanghai Port will increase to RMB 50/TEU. The Huzhou County Government rewarded the transport of container transport by river-sea.

Fourth, the total volume of combined transport by sea and sea has increased significantly. The container throughput of Huzhou Port achieved a leap-forward development from 12,000 TEUs in 2011 to 354,000 TEUs in 2017, with an average annual growth rate of 76% and an actual load-carrying rate of 75.3%. Among them, Anji Shanggang, with the cooperation with Shanghai Capital Group’s capital, continuously optimized the port service functions, becoming the “leader” of Zhejiang's inland water container transportation, attracting 23 shipping companies such as

“Maersk”, “Mediterranean Shipping”, and “Sinotrans”. It has access to more than 2,700 ports and regions in the world, allowing more than 300 local companies to trade in 55 countries along the “Belt and Road” route.

2) Development trend

After more than seven years of development, the inland river container transport in Huzhou has gradually matured. In 2018, the Huzhou Port and Shipping Bureau will aggregate multiple effective elements to enable the river and sea combined transport to "accelerate the lead." Conscientiously implement the municipal government's "Opinions on Accelerating the Development of Inland Waterway Container Transport in Huzhou", increase the cultivation of the inland water container transportation leading enterprises and key enterprises, guide the advantageous enterprises to play the role of market organization and resource integration, and actively expand the scale of transportation capacity. Huzhou port will further expand the influence and spillover effect of the construction of the “Inland Water Operational Demonstration Zone” and promote more government support policies to benefit key leading companies. Huzhou port will deepen exchanges and cooperation with the major ports in the Yangtze River Delta, and strive to sign a city-port strategic cooperation agreement with Ningbo Zhoushan Port to further unblock the river-sea combined transportation and distribution system, and continuously increase the transportation ratio of “land to water” and “distribution”.

3.Analysis of container transport in Huzhou port

3.1 Situation of the waterway in Huzhou

<The National Inland Waterway and Port Layout Plan> divided the national inland waterway into two levels: high-grade fairways and other graded waterways. High-grade navigation channels are the core and backbone of the inland waterway throughout the country and are an important part of the national comprehensive transportation system. They can also be combined with other modes of transportation to form a comprehensive transportation channel. Mainly refers to the existing and planned construction of navigable 1,000-ton ships and third-level and above fairways. In some areas, the fairways are restricted to four-grade waterways capable of navigating 500-ton ships.

Huzhou Port is one of China's 28 major inland river ports and an important hub of the integrated transportation system in the Yangtze River Delta. The port berth capacity has reached 129 million tons annually. The rivers in Huzhou are dense and crossing, forming a water network with Huzhou as the center, the east and west Tiaoxi river as the main rivers, and the Taihu Lake with many small ports as tributaries.

Table 3-1 Channel miles in 2015

(Sources: Website of the Huzhou Port Authority)

item	Kilometers
Level 3 channel	105.9 kilometers
Level 4 channel	210.5 kilometers
Level 5 channel	89.4 kilometers
Level 6 channel	185.0 kilometers
Level 7 channel	115.4 kilometers
Below the level 7 channel	473.3 kilometers

Huzhou City is one of the cities in Zhejiang Province where the mileage of inland waterways is relatively long and the proportion of high-grade navigation channels is relatively high. The upper class 4 or higher navigation channel reached 316.4 kilometers, accounting for 26.8% of the total length of the fairway.

（1）Overview of Huzhou section of the Beijing-Hangzhou Canal

The Huzhou section of the Beijing-Hangzhou Canal is located in the central area of the Hangzhou-jiaxing-huzhou Plain, starting from Jiaxing Tongxiang, ending in Hangzhou Yuhang, and passing Huzhou along the way. It is 43.9 kilometers in length. The Huzhou section of the Beijing-Hangzhou Canal has been widened during the “Eighth Five-Year Plan” and “Ninth Five-Year Plan” period. The current status of the fairway is Grade IV. In 2001, the Zhejiang section of the Beijing-Hangzhou Grand Canal was named by the Ministry of Communications as the nation’s first civilized

model fairway. Huzhou Section of the Beijing-Hangzhou Grand Canal currently has 20 cross-border bridges.

（2）Overview of Huzhou section of the Changxing-Huzhou-Shanghai Line

The Changxing-Huzhou-Shanghai Line is located in the economically developed, densely populated and densely populated area of the south of the Yangtze River Network. It starts from Changxing County in the west, passes through Huzhou, Wujiang, Pingwang, and ends in Shanghai. It has a total length of approximately 143.2 kilometers and the Zhejiang section (Huzhou section length) is 75.1 kilometers, including 24.2 kilometers of Changxing section and 50.9 kilometers of Huzhou section. The Huzhou section of the Changxing-Huzhou-Shanghai Line began to implement a full line of rectification in August 2008. The Changxing section of 14.97 kilometers was reconstructed according to the fourth-grade navigation channel standard. The 500-ton ship was navigable, and the 60.13-kilometer section of the Nanxun section was rebuilt to the third-grade channel standard. The1,000-ton ship was navigable, and 3 new integrated service areas were build. There are five port and shipping management checkpoints along the Huzhou section of the Changxing-huzhou-shanghai Line. There are 47 on-board bridges, one ship lock, and two control gates.

（3）Overview of Huzhou section of the Huzhou-Jiaxing-Shanghai Line

The Huzhou-Jiaxing-Shanghai Line is located in the water network area of the northern Zhejiang Plain in the southern part of the Tai Lake and connects the cities of Huzhou, Jiaxing and Shanghai. It is an important east-west transport path in the northern Zhejiang region. The Huzhou-Jiaxing-Shanghai Line has a total length of 104 kilometers, of which Huzhou section is 43.2 kilometers long. The Huzhou section of the Huzhou-Jiaxing-Shanghai Line is the second major waterway linking Huzhou to Shanghai, and the first third-grade waterway in Zhejiang province. The project was started construction in January 2005 and passed acceptance inspection in January 2008 and passed acceptance in December 2009. There are two port and shipping management checkpoints along the Huzhou section of the Huzhou-Jiaxing-Shanghai Line. There are 26 cross-border bridges, one control gate, and one water service area.

（4）Overview of Huzhou section of the Hangzhou-Huzhou-Wuxi Line

Hangzhou-Huzhou-Wuxi Line is located in the north of Zhejiang Province and is an important backbone of Zhejiang Province. The Hangzhou-Huzhou-Wuxi Line route starts from Hangzhou in the south, passes through Huzhou, passes through Tai Lake to Wuxi City in Jiangsu Province, and is an important interprovincial route connecting the economically developed regions and the famous tourist cities of Jiangsu and Zhejiang Provinces in China. Among them, the waterway in Zhejiang Province began at a lock in Hangzhou and ended at Tai Lake in Huzhou with a total length of 106.2 kilometers. Connected with the Beijing-Hangzhou Grand Canal, the Huzhou-jiaxing-shanghai Line and the Changxing-huzhou-shanghai Line, they constitute an important water transport network in northern Zhejiang. The Huzhou section of the channel starts from Deqing County in the south, passes through Huzhou City, and reaches a new port of Tai Lake in the north with a total length of 75.4 kilometers. The Sanliqiao section is 12.9 kilometers long and the Changxing-huzhou-shanghai Line repeats to meet the three-level fairway standard. The Huzhou section of the Hangzhou-Huzhou-Wuxi Line was transformed in accordance with the fourth-grade waterway standard in 2003. It passed the completion acceptance in December 2005 and all the navigation channels reached the fourth-grade navigation standard. There are three port and shipping management checkpoints along the Huzhou section of the Hangzhou-huzhou Line and there are 46 cross-border bridges across the board.

（5）Overview of Huzhou section of the Dongzong Line

The Dongzong Line is located in the water network area of the northern Zhejiang Plain, and communicates with the mainline channels of the Beijing-Hangzhou Grand Canal, the Changxing-huzhou-shanghai Line, the Huzhou-jiaxing-shanghai Line, and the Hangzhou-shanghai Line. It is one of the major backbone routes in the northern Zhejiang Province. The route starts from Nanxun in Huzhou City and merges with the Beijing-Hangzhou Grand Canal to the south (with the Beijing-Hangzhou Grand Canal overlapping 2.07 kilometers). It is 32 kilometers in length, of which the Huzhou section is 23.66 kilometers. The Huzhou section of the Dongzong Line was built in accordance with the fourth-grade channel standards in 2001. It was completed and accepted in December 2003. The entire line of the Huzhou section of the Dongzong Line currently satisfies the navigation standards of the fourth-grade channel. There is a port and

shipping management checkpoint along the route of the Huzhou section of the Dongzong Line. There are currently 15 cross-border bridges across the board.

（6）Overview of Huzhou section of the Dongtiao River

The Huzhou section of the Dongtiao River began in Deqing County, crossed the Huzhou District and ended in a new port of Tai Lake. The total length is 67.94 kilometers, 27.93 kilometers in Deqing County, and 40.01 kilometers in Wuxing District. Dongtiao river, which has undergone years of extension and reconstruction, has good shipping conditions and the current status of the navigation channel meets the four-level standard. There are two port and shipping management checkpoints along the navigation channel of the Dongpuxihu section, and there are 32 bridges spanning the entire route.

（7）Overview of Huzhou section of the Mei-Hu Line

The Meihu Line is located in the hilly area of western Huzhou and passes through Anji, Changxing and Wuxing. The downstream line connects Shanghai, Jiaxing, Suzhou and other cities via the Changxing-huzhou-shanghai Line. It is an important east-west transport path in the Huzhou area and it is also one of the main navigation channels in the northern Zhejiang navigation area. According to the "Inland Waterway Development Plan of Zhejiang Province", the waterway is planned to be a four-level inland waterway. The fairway started in Anji County and entered Wuxing District and entered the Changxing-huzhou-shanghai Line. The total length is 61 kilometers, including 33.15 kilometers in Anji County, 18.09 kilometers in Changxing County, and 9.76 kilometers in Wuxing District. The status quo basically meets the four-level fairway navigation standards. The Meihu Line navigation route will be upgraded to the west extension project of the Changxing-huzhou-shanghai Line during the “Thirteenth Five-Year Plan” period. There are three port and shipping management checkpoints along the route, and there are 16 bridges across the board.

3.2 Status of the port in Huzhou

Huzhou Port is an important infrastructure for the economic and social development of Huzhou City and an important support for the development of mineral resources. It

is an important hub for comprehensive transportation systems in Huzhou City and the Yangtze River Delta Region, and is the main supply port for building materials required for the construction of some cities in the surrounding areas.

The development direction of Huzhou Port is mainly bulk cargo transportation such as energy and construction raw materials. It is actively developing containers, groceries, and tourist passenger transport, and has gradually developed into a storage facility, a mid-conversion facility, a port industry, a modern logistics, and a tourism passenger transportation functional integrated port.

There are a total of 21 ports within the jurisdiction of Huzhou City, with a total length of 60073 meters, 586 terminal units, and 1,533 berths (most of which are dedicated docks for shippers and less than 4% of public docks). The annual capacity of berths is 87.77 million tons and the maximum berthing capacity is 500 tons. In 2005, the cargo throughput was 111.155 million tons, including 14.655 million tons of imports and 96.90 million tons of exports. According to statistics, from 1995 to 2005, the port throughput of Huzhou City increased from 20,622,000 tons in 1995 to 11,155,510 tons in 2005, with an average annual growth rate of 16.59%, and the throughput developed steadily and rapidly.

Table 3-2

(Sources: Huzhou Port Utilization Plan)

	Number of docks				
	Wuxing	Nanxun	Changxing	Deqing	Anji
Changxing-huzhou-shanghai Line	56	27	85	24	50
Huzhou-Jiaxing-Shanghai Line	10	24	32	18	−
Hangzhou-Huzhou-Wuxi Line	25	19	63	33	−

Dongtiao River	43	4	34	26	−
Mei-Hu Line	14	13	−	−	−

In recent years, with the development of water transportation, the demand for the scale and modernization of ports has continuously increased. While expanding the land area and yard area of the port, Huzhou continuously improves loading and unloading equipment, improves the berthing capacity and throughput capacity of ports and docks, and continuously improves the capacity for the collection, distribution, and transfer of cargo transportation. This has helped the rapid development of the local economy. It has been actively promoted. As of the end of 2008, the port of Huzhou was divided into six major port areas, with 446 port companies. The total number of docks occupied by coastlines was 57,704 meters with 1,125 berths, and the annual capacity of berths was 14,450 tons.

3.3 Status of the throughput in Huzhou

According to the geographical location of Huzhou City, the natural resources it possesses, the current status and planning of its transportation network, and the flow of goods and materials formed by the history of Huzhou Port, the direct economic hinterland of Huzhou Port is three counties and two districts under the jurisdiction of Huzhou City. The inland waterway of Huzhou has become a piece of network, with 120 existing fairways and 682 kilometers of the seventh and above fairways. Huzhou Inland Waterway mainly plans to build five main waterways, five feeder routes and eight mine navigation channels.

Table 3-3

2017 Huzhou City Waterway Container Throughput (January-December)

(Sources: Huzhou Port Authority)

	January	February	March	April	May	June
Container quantity	19254	18108	23901	27550	27116	28152

Container quantity of heavy box	13765	11906	17003	20602	19345	19874
Quantity of import container	9815	9853	12936	14496	13901	14342
Quantity of outbound container	9439	8255	10965	13054	13215	13810
Freight volume	196705	169307	236147	277297	260481	300858
Turnover	47050907	42723363	57448696	68019518	64872517	75373808
	July	August	September	October	November	December
Container quantity	30137	33637	38104	32235	37821	37563
Container quantity of heavy box	22547	25801	28336	25154	31682	30312
Quantity of import container	15400	17371	18723	16189	19779	18375
Quantity of outbound container	14737	16266	19381	16046	18042	19188
Freight volume	328931	357680	377479	344043	438132	398273

Turnover	83673633	90386120	94213597	86064543	110500543	99055067

In terms of cargo structure, low-value, heavy-polluted ore-building materials and non-metallic ores accounted for 82.1% of the total throughput in 2005. The proportion dropped to 54.6% in 2010, and will further fall below 50% by 2020. The throughput of coal and oil increased with the urban development rate, rising from 6.4% in 2005 to 12% in 2010 and 14.7% in 2020. Actively utilizing the rich resources of the region, the cement export ratio rose from 9% in 2005 to about 22%. The proportion of steel, timber and other groceries grew from less than 3% in 2005 to 10.9% in 2010 and 13.7% in 2020. With the development of container water transportation, container throughput has grown rapidly, from less than 1,500 TEU in 2005 to 940,000 TEU in 2020.

Table 3-4 Unit: 10,000 tons

Huzhou Port cargo throughput forecast results

(Sources: Huzhou Port Master Plan)

Year	In 2010			In 2020		
Classification of goods	Total	Input	Output	Total	Input	Output
Total	10414	2656	7758	13805	4475	9330
1. Coal and products	1108	1008	100	1800	1600	200
2. Oil, gas and products	142	112	30	236	186	50
3. Metal ore	2	2		3	3	
4. Steel	112	99	13	205	180	25
5. Mineral building materials	4520	200	4320	5540	540	5000
6. Cement	2338	323	2015	3078	373	2705
7. Wood	227	197	30	341	288	53
8. Non-metallic ore	1169	269	900	1294	594	700

9. Chemical fertilizers and pesticides	21	3	18	30	5	25
10. Salt	2	1	1	5	2	3
11. Grain	123	83	40	160	110	50
12.Others	651	359	292	1113	594	519
Among them: Containers	297	131	166	696	341	356
Ten thousand TEU	37	16	21	94.0	45.5	48.5

3.4 Status of the transportation of inland container in Huzhou

Huzhou City is located in the economic hinterland of the Yangtze River Delta. It has abundant waterway resources, large-scale inland logistics terminals and Yangtze River Delta location advantages and other prerequisites. It has obvious advantages in promoting the development of inland water container transportation. The transformation and development of inland river container transportation in Huzhou must continue to do a good job in infrastructure construction, increase financial and financial support, and establish a regional coordination mechanism.

(1) Huzhou has obvious advantages in developing inland water container transportation

Huzhou has a wealth of waterway resources. The city has 120 inland waterways, and the total length of navigable waterways is 1,172 kilometers. The square kilometer fairway density reaches 20.1 kilometers. According to the technical grade of the navigation channel, the rating channel is 687 kilometers, accounting for 58.7% of the total navigation route. Among them, 28. 7 kilometers of Grade 4 and above are in the high-grade route, accounting for 41.4% of the graded fairway mileage. The layout of the navigation channel is based on the skeletons of the 5 mainline channels including the Beijing-Hangzhou Grand Canal, the Changzhou-huzhou-shanghai Line, the Huzhou-jiaxing-shanghai Line, the Hangzhou-huzhou-wuxi Line, and the Dongzong Line.

Huzhou has obvious location advantages. The Huzhou and Deqing County waterways are 200 kilometers away from Shanghai Waigaoqiao Port, while the Anji County Waterway is 270 kilometers from Shanghai Waigaoqiao Port. Taking into account the cost of highways in China and the cost comparison between highway transportation and container shipping, when the distance between them is less than 100 kilometers, inland shipping container transportation cannot compete with door-to-door highway truck transportation. More than 200 kilometers will have the advantage of competition with highways. In the Yangtze River Delta's Hangzhou-jiaxing-huzhou and Suzhou, Wuxi and Changzhou regions, Huzhou has the most potential for development if it uses the inland water container transportation method to dock with the Shanghai port, because Huzhou does not have the Yangtze and Hangzhou Bay outbound ports.

Inland water container transportation has obvious cost advantage. According to relevant calculations, the cost of inland water container transportation is about 2/3 to 4/5 of the highway truck transportation. With the improvement of the inland river navigation level in northern Zhejiang and the increase in the size and standardization of ships, the cost of inland water container transportation has gradually decreased, and the price competitive advantage has gradually increased. In both the highway and waterway transportation modes, the fuel consumption per kilo-ton-km for inland water transport is 5.3 kilograms, while the fuel consumption per kilo-ton-km for road transport is 36.0 kilograms. The cost advantage of inland water container transportation is highlighted.

(2) Restricting the Main Bottleneck of Development of Container Transportation in Inland Rivers in Huzhou

Constraints in the construction of waterway infrastructure. First, the structure of the waterway is irrational. The 5th, 6th and 7th-grade fairways of Huzhou City are 402.3 kilometers, accounting for 58.6% of the total mileage of the graded waterways. The proportion of high-grade fairways of Class 4 and above is relatively small. The reconstruction project of the Beijing-Hangzhou Canal has not yet started, and the Changxing-huzhou-shanghai (Zhejiang section) transformation project is currently under implementation. The Changxing-huzhou-shanghai Line (Suzhou section) has yet to be rectified and will restrict the future development of inland water container transportation.

The second is the lack of bridge clearance. At present, the bridges between the Changxing-huzhou-shanghai Line, which is the main channel for container ships in Huzhou, and the Wuyi Bridge and the Changxing Port Bridge on the Meihu Line are obviously insufficient. This will not only have a certain impact on the navigation of ships during the flood season, but also make it possible for container ships that are put into operation to be loaded with only two stories, and the economic efficiency of ship transportation is reduced by 1/3.

Third, some fairway bends and widths restrict the formation of large-scale inland container ships. The turning radius of the Maozhushan section of the Meihu Line channel is only 120 meters (below the five-level fairway standard). The navigation channels at Anji Wushan Ferry Terminal and so on are relatively narrow, and it is difficult for ships to meet and operate at full load.

Then discuss the constraints of maritime regulations and port management. First, it is limited by the length of shipping vessels on the Beijing-Hangzhou Grand Canal. The Ministry of Maritime Affairs stipulates that the total length of shipping vessels on the Beijing-Hangzhou Canal must not exceed 45 meters. The total length of a 30-TEU container ship is 50 meters. The newly-built and rebuilt vessels for the development of container transportation enterprises are all in the range of 36-48 TEU. The total length will exceed 50 meters and will be affected by the long limit and affect the sailing.

Second, the current customs clearance is limited to A-class enterprises that can be declared by local authorities. Enterprises that are not Class A must be sealed at the Nanxun supervising point, causing containers of non-A foreign trade companies not to be shipped from the Anjiongda Container Terminal.

(3) Effectively Resolve the Countermeasures of Constraining the Development of Container Transportation in Inland Rivers in Huzhou

Accelerating the construction of high-grade channel network. With the principle of giving priority to the construction of mainline navigation channels, we will focus on the construction of the Changxing-huzhou-shanghai Line and the Beijing-Hangzhou Grand Canal and other high-grade channel networks. At the same time, it broadened the financing channels, actively mobilized social forces, and guided the construction of factories, mines, and enterprises along the river. Accelerate the advancement of the re-routing of feeder routes and mines routes, and build an inland waterway network system with direct, efficient, safe, and green routes.

Accelerate the implementation of the bridge reconstruction. In the implementation of the course of upgrading and improving the waterway, we will focus on resolving the transformation of the Wuyi Bridge and the Port Bridge on the Changxing-huzhou Line and the Meihu Line, and increase the clearance to 7 meters to ensure the safety and navigability of the 1,000-ton container ship.

Accelerate the planning and construction of container terminals. According to the needs of the transformation and development of Huzhou's urban industries, the scientific layout of the city's inland river container terminals should be carried out. The principles are as follows: First, the layout of land use in the overall planning of Huzhou Port is to be matched with the overall urban planning and land use planning to ensure that there is a good prospect for development and utilization around it. The second is to select areas that are concentrated in logistics resources and rely on industrial clusters in the city so that they can not only increase the amount of container box source generated, but also supplement the flow of container goods when the container business is insufficient. Relieve the contradictions in the early stage of development of inland water container transportation. Third, the traffic conditions are convenient. Try to set up inland river container terminals near the entrances and exits of the highways in the port, so as to make the land and water connections closer.

Establish regional coordination mechanisms. The vast majority of foreign trade containers in Huzhou are re-transported to the rest of the world through Shanghai, Ningbo, and other ports, and the Yangtze River Delta region is in close contact. The strategy of Jiangsu, Zhejiang, and Shanghai to develop the container transport in the small Yangtze River Delta is not uniform. The three places have not invested enough energy, which will affect the development and growth of inland river container transport in the Yangtze River Delta. In the process of developing container transport in the Yangtze River Delta, it is necessary to coordinate the various aspects of this system. It is not enough to rely solely on the efforts of a local port and shipping administration. It is necessary to strengthen communication and exchanges among the governments of the Yangtze River Delta region and establish a regional coordination mechanism. We will ensure the coordinated development of the planning and construction of the Yangtze River Delta inland waterways, port terminals, and container ships, and form a joint force for the development of inland river container transport in the Yangtze River Delta.

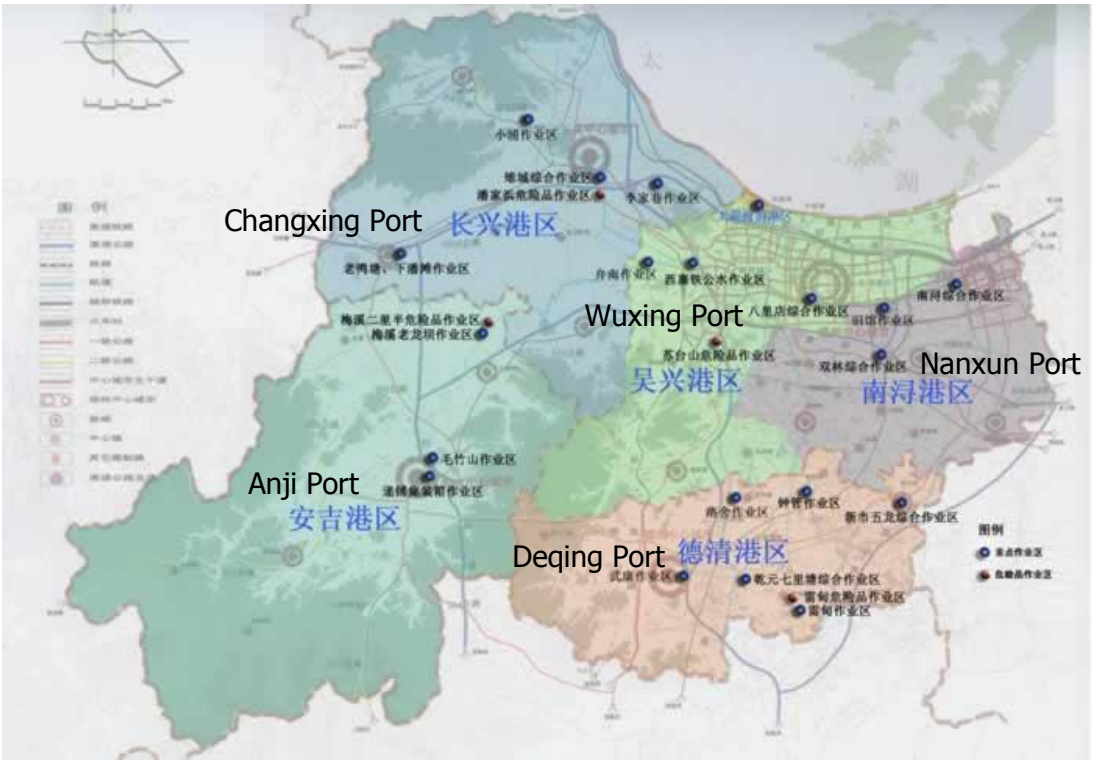
4. Research and optimization of container waterway transport network in Huzhou

According to the review of the literature mentioned above, most of the current literature studies on airline distribution, route design, and network planning are aimed at ocean shipping and coastal transportation. However, research on the planning of inland river container route network is still relatively lacking. Based on the planning of the marine transportation network, the inland river container route network planning needs to take into account the structural characteristics of the inland river container route network.

In the following, the unit cost of each route in Huzhou Port is calculated and the route with the lowest cost is taken as the optimal outbound route.

4.1 Huzhou container waterway transport network planning

According to the data analysis in Chapter 3, we can understand that the basic situation of Huzhou Port is that:



the basic situation of Huzhou Port 1

the basic situation of Huzhou Port 2

Although the problem of the selection of inland waterway transportation routes is much simpler than the route in the city distribution problem, there is no need for too much thinking, and the shipowner can obtain the shortest route of this voyage transportation through his understanding of the waterway. However, this is only a partial optimum and it may not be able to achieve the optimality of the entire inland river route. Due to the advantage of geographical location, some rivers with lower navigational grades have many passing ships and may cause long-term blockage. A large number of ships are congested here, affecting the owner's transit time, failing to guarantee the timely arrival of the goods, or causing unnecessary ship accidents due to the congested channels. Some routes with higher grades may only be a few kilometers more than the shortest distance. They are abandoned by most ship owners and inland water resources cannot be used very well.

In order to make better use of limited inland river resources and give full play to its advantages of environmental protection and low cost, the optimization of inland waterway transportation routes is of great practical significance in the long run. The problem of inland water transportation to ships should also be applied to the problem

of vehicle dispatching in urban distribution, applying scientific methods to select the optimal transportation route.

However, due to the different characteristics of inland water container transportation and vehicle scheduling, it is necessary to take into consideration the characteristics of inland waterway container transportation when planning inland waterway container transportation. Such as the sequence of ports calling at ports, the closeness of routes, the limits of water depth, and the influence of ship locks on routes.

Systematicness of Inland River Container Liner Route Planning

The optimization design of the inland river container route system has three levels of guidance:

(1) Advantages for public container transport operators

Public container transport operators refer to container liner transport companies that specialize in certain regional systems or intra-route transportation. In the face of public customers, the container traffic carried by the general carrier is relatively large, the type of ship used and the tonnage are large, and the transportation efficiency is high, so the unit transportation cost is relatively low. Provide fixed-term and periodical transportation services, make use of professional advantages, and easy to collect scattered freight to achieve economies of scale. Public container transport operators are generally faced with scattered, multi-path goods. How to bundle these small sources of supply and use the advantages of bundled transportation is a systematic project. It is necessary to optimize the route network of inland river container transportation as a unified whole so as to improve the overall service level and market share of inland river container transportation, and it is not possible to consider a single route independently.

(2) Optimize the mutual cooperation of transport systems of a number of inland container ship companies

In order to achieve the sustainable development of inland water container transportation and improve the level of inland water transport services, we must create a scientific and orderly transport environment. The mutual cooperation among various river container ship companies is of great significance to the overall development of the river. Systematic optimization of inland river container transportation can help guide the cooperation of routes between different companies and avoid duplication of

capacity and vicious competition. Without systematic guidance on network planning, various shipping companies tend to be profitable when opening up routes, often concentrating on the most profitable routes. This has led to overlap of routes of various shipping companies on popular routes and increased competition. As a result, wasted capacity. On the other hand, the transportation of cargo volume on non-popular routes has not been met, which has reduced the service quality of inland waterways and is not conducive to improving the competitiveness of inland waterways, and is not conducive to guiding the transport of goods to the transfer of land transport to water transport.

(3) The benefits of optimizing the operating system of a single shipping company

Usually, the demand for cargo transported by a single container shipping company will also be distributed among multiple ports. At the same time, it will operate more than two routes to realize the binding and intensive transport of container traffic between these different pairs of ports, improving the shipping companies. The planning and design of the container liner route network has great significance for improving its own competitiveness.

In summary, the systematic optimization design of inland river container transport has both macroscopic and microscopic roles.

On the macro level, network planning plays a key role in improving the service quality of inland rivers, helping to improve the competitiveness of inland water transport, and guiding the transfer of transport volume from land to water. A good container transportation network is one of the main guarantees for improving the sharing rate of inland water transport, and it will help alleviate the environmental pollution and traffic congestion of land transport.

Microscopically, it can guide the cooperation between different shipping companies in terms of capacity, orderly competition, and achieve a win-win situation. At the same time, for carriers, it is beneficial for the network to play a synergistic role in achieving complementarity between multiple routes, reducing costs, and achieving economies of scale. It is conducive to optimizing the allocation of resources, improving the effective utilization of the container space of the Inland River Line vessel and the operational efficiency of the container; it is conducive to expanding the scale of operations and expanding market share.

At the same time, for shippers, through the bundled transportation of goods, vessels can leave without having to wait until the same destination's cargo is loaded with ships. This can increase the frequency of ship launches, improve service efficiency, and reduce the owner's waiting time.

4.2 Optimization of container waterway transportation route in Huzhou

(1) Assumptions for optimization of inland waterway routing

Since the optimization of the path of inland water container transportation system involves many factors and details, if all these details are considered in the paper, the difficulty will be very large. Therefore, in order to facilitate the research, the following assumptions are made:

1) The data for 2017 are used, and the transportation demand is evenly distributed during the planning period. It is basically constant for a certain period of time.

2) The only type of box is the case. In this study, only the ordinary box is considered. The empty box transfer due to the unbalanced box type is not considered temporarily. Only the unbalanced transport direction is considered in the empty box transfer process.

3) In order to ensure that the schedule of ships on the same route is the same, the type of ship used on the same route and the speed of navigation are the same.

4) The loading and unloading costs of containers are the same in all ports. They do not differ depending on the port or the type of ship.

5) Port and canal costs refer to various expenses incurred in ports, canals, or specific fairways. For example, tonnage tax, berthing fee, terminal fee, pilotage fee, tugboat fee, loading and unloading fee, switching cabin fee, quarantine fee, canal pass fee, agency fee and so on. In the discussion of this paper, the ports of entry are all within the Yangtze River Delta and the port charges are assumed to be fixed.

(2) The goal of this study

The goal of this paper is to calculate the unit transportation cost of the seven inland river containers in Huzhou, and to point out the lowest cost route, just the optimal route. The calculation formula for the unit transport cost of inland river containers is:

$$\text{Unit transport cost} = \frac{\text{OPEX+ Voyage cost}}{\text{TEU}}$$

1) OPEX (Ship Operating Expense)

The cost of transportation costs for each project is called the cost structure. From the cost structure, we know the characteristics of ship transportation costs. Different shipping companies, different types of ships of the same company, the proportion of their costs are often very different. Internationally, there are many different methods of dividing shipping costs. The most common method is divided into fixed cost and variable cost.

The fixed cost is a fixed amount of time within a certain period of time, and its total amount is not affected by the increase or decrease in traffic volume. As long as shipping companies are established, fixed costs will occur even if the traffic volume is zero. Its characteristic is that its total amount is a fixed amount within a certain time range and traffic volume, but the fixed cost of apportioning (burden) of the unit business volume is in reverse of the increase or decrease of the business volume.

It generally includes interest expenses for borrowed funds, depreciation expenses related to time transfer, amortization charges, labor costs for crew members and company employees, and related taxes.

According to the general customary division method of shipping companies in China, items that belong to fixed costs mainly include:

1' The seafarer's fees include the wages, food expenses, various subsidies and allowances, and other social welfare expenses, as well as expenses incurred in various forms on the crew. Different ship types require different numbers of crew members. The number of seafarers is the sum of the number of captains, officers, and crew members. The salary of the crew includes the wages, bonuses, subsidies, allowances and other benefits income of the narrowly paid employees. Generally, the personnel allocation and salary of container vessels in the Yangtze River are as shown in Table 4.1. The crew costs account for approximately 15% to 20% of the total costs.

Table 4-1

Yangtze River Container Ship Crew Configuration and Payroll Reference

(Sources: China Maritime Services Network)

Post	Number of people equipped	Salary (yuan)
Captain	1	8000-8800
Seaman	1-3	2800-3500
Machinist	1-2	2800-3500

2’ The processing fee mainly refers to the cost of lubricants and detergents used on various machines. Compared with fuel, lubricants can be recycled, and their use is much less. The cost of physical treatment for internal-combustion engines accounts for a fraction of the fuel cost, and the higher the proportion of boats for power, the smaller.

3’ The spare parts cost for materials is the cost of various materials consumed during the ship's operation, such as the cost of cables, rigging, timber, oil, etc., and the costs of main engines, boilers, generators, auxiliary engines, and other spare parts.

4’ The depreciation expense is the annual recovery amount specified for the book value of the ship investment. When the ship’s investment is realized in the form of a loan, the cost of repaying the loan interest should also be take into account.

5’ Repair Costs During use of the ship, the wear, corrosion, and damage of various components are inevitable. Within the service life, it is necessary to maintain the ship's good technical condition and airworthiness through regular or irregular repairs. In the operating process, the cost of ship repairs is actual a cyclical expenditure. For example, if a repair or overhaul is carried out once in several years, the shipping companies must withdraw a certain amount of repair costs each year and count them into the current year's costs to accumulate enough repair funds.

6’ Insurance shipping industry is a very risky industry. Ships sailing at sea encounter catastrophes that cannot be prevented or irresistible. The insurance system is to help individual ship owners to transfer this loss allocation to the shipping costs of the entire shipping industry. The owner pays insurance premiums to the insurance company and includes it in cost items. Once the insured ship is lost or an accident occurs, the insurance company will compensate the loss.

7’ Management fees Shipping companies perform transportation production. In addition to ships, they also set up various management departments and agency agencies to carry out personnel, business, finance, dispatch operations, ship maintenance, safety supervision, legal affairs, and material procurement. The total

amount of expenses incurred for engaging in these activities and the expenditures incurred for those engaged in these activities is the management fee.

8' Other operating expenses in this general project usually include various sporadic shipping expenses, such as fresh water supply, navigational tools expenses, nautical charts and navigational books, postal and telecommunications charges, and office stationery charges. Although other expenses include many items, their total amount is generally small, which is only about one percent of the total cost.

2) Voyage cost

The voyage cost is a variable cost in this discussion. Variable cost refers to the cost of the total occurrence of those costs that changes linearly with the change of business volume in the relevant range. Where there is a direct proportional relationship between the change in the total cost and the change in the volume of transportation, it is called variable cost. As the volume of transportation business has changed, the variable costs will also change, and the direction of increase and decrease will be the same. In the process of ocean-going container shipping, the variable costs are related to the voyage, the number of landings, the type and quantity of cargo, and the speed of the ship, and change with these factors. The variable costs include fuel oil, port fees, cargo handling charges, and accident loss fees. For the control of variable costs, based on the variable costs shared by the unit transportation business volume, we started from reducing the cost of unit transportation business.

The variable costs discussed in this paper are mainly fuel costs. The fuel cost is the sum of the various fuel charges consumed by the ship during navigation, parking, and loading and unloading operations. At present, most ships in the world use the internal combustion engine as the main engine of the ship. Only a small part of the supertankers and LNG ships use steam turbines as the host of the ship.

The calculation formula for voyage cost is as follows:

(1) Voyage cost = Ship full fuel consumption * Days

$$\text{(2) Days} = \frac{\text{Route mileage}}{\text{Sailing speed}}$$

Table 4-2

Huzhou City Waterway Transportation Tool Category

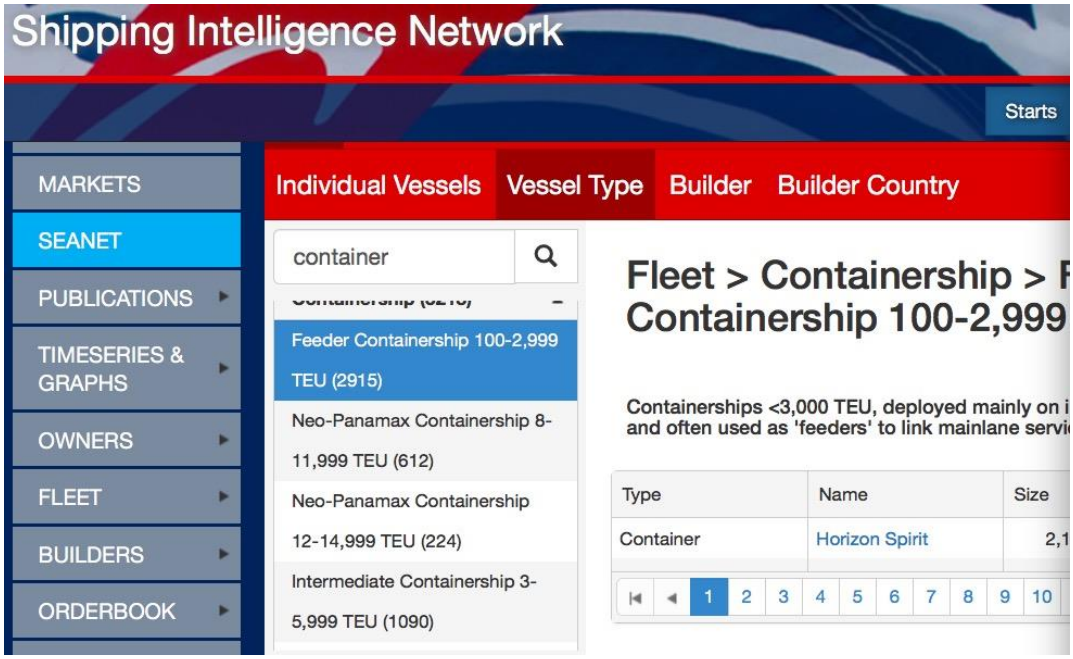
(Sources: Huzhou Port Authority official website)

Ship type	Number of ships	DWT (Tonnage)
1. Passenger ship	77	-
2. Passenger and cargo ship	-	-
(1) Passenger and cargo ro-ro	-	-
(2) Other passenger and cargo ships	-	-
3. Cargo ship	3712	1861590
(1) Other cargo ships	-	-
(2) Oil cargo ship	8	3582
(3) Ordinary cargo ship	3421	1680611
(4) Bulk cement boat	211	86911
(5) Container Ship	51	60466
(6) Hazardous chemicals ship	-	-
(7) Roll-on ship	-	-
(8) Multipurpose vessel	21	30020
4.Tug	4	
Total	3793	1861590

Calculated from the table, the average dwt of the container ship is:

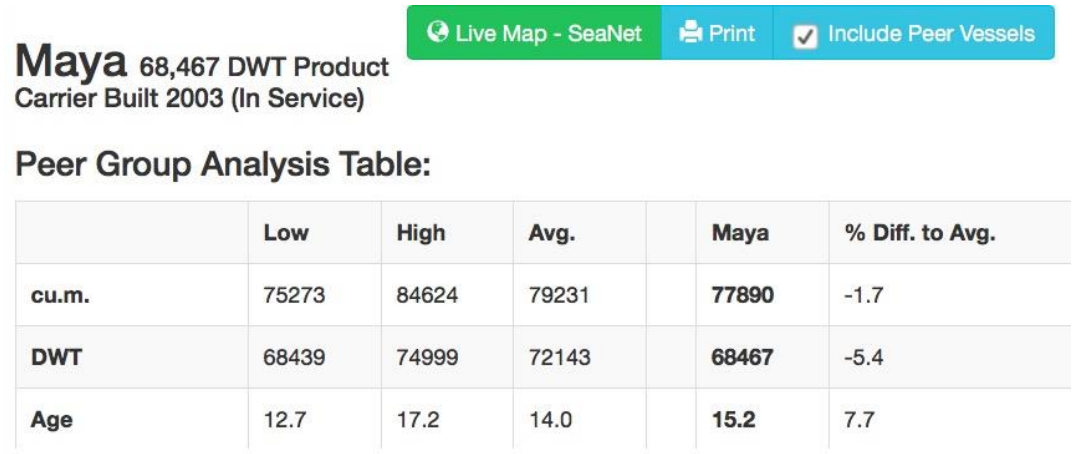
$$\text{Average dwt} = \frac{60466}{51} = 1185.6(\text{ton})$$

Then log in to the Clarkson's official website and download the relevant data.



2898	Container	Kamiwaka	239	TEU	1,801	749	Japan
2899	Container	Ta Yang	100	TEU	1,800	990	Taiwan
2900	Container	Futaba	211	TEU	1,780	749	Japan
2901	Container	Pioneer 8	124	TEU	1,763	1,060	Indonesia
2902	Container	Maya	228	TEU	1,680	748	Japan
2903	Container	Chowgule 7	106	TEU	1,552	1,335	India
2904	Container	Chowgule 8	106	TEU	1,545	1,335	India

Then select the ship "Maya" that is close to the average dwt of the Huzhou container ship, and take the data of this ship as the data to be used in the calculation formula of this paper.



	Low	High	Avg.		Maya	% Diff. to Avg.
cu.m.	75273	84624	79231		**77890**	-1.7
DWT	68439	74999	72143		**68467**	-5.4
Age	12.7	17.2	14.0		**15.2**	7.7

LOA	227.80	228.60	228.25		**228.54**	0.1
Draft	12.02	14.52	13.91		**13.20**	-5.4
Breadth	32.00	40.00	32.45		**32.20**	-0.8
Speed	14.0	16.7	15.2		**15.3**	0.7
Consumption	32.0	53.0	41.6			

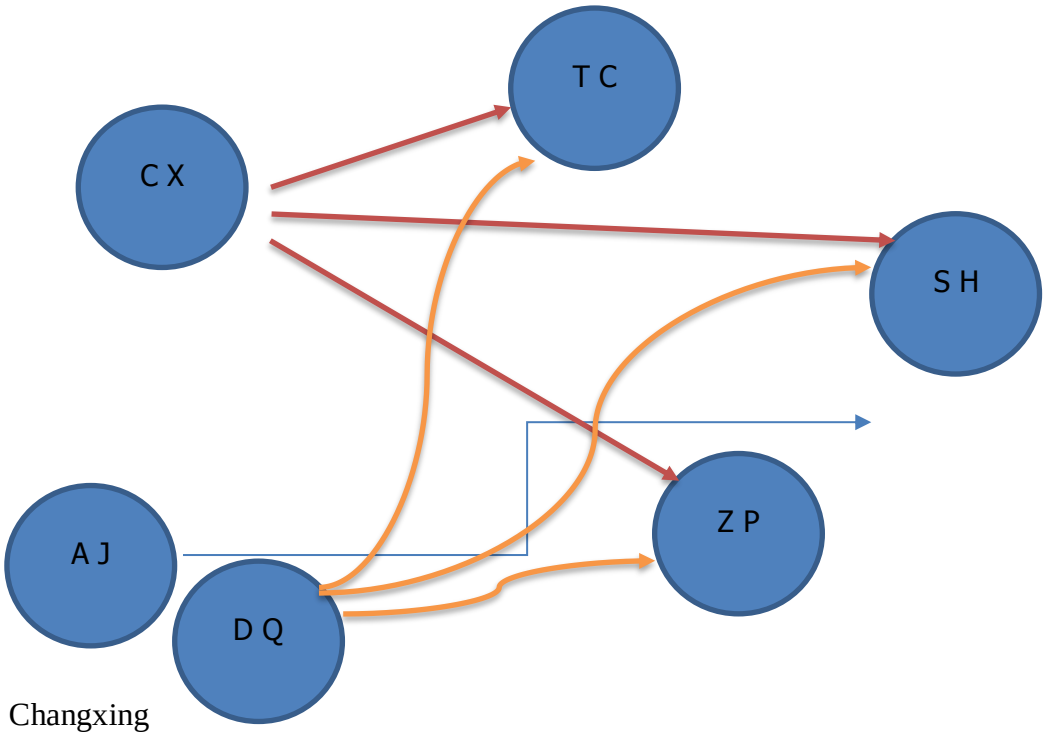
The average sailing speed chosen in this article is 15.2 kts and the average consumption is 41.6 tons every voyage. But the speed of inland water container ships is generally around 20 nautical miles per hour.

Table 4-3

The mileage statistics of Huzhou starting port to the port of destination

(Sources: Huzhou Port Authority official website)

Area	Flow direction	Milage (km)
1.Huzhou Port Anji District	Anji---Shanghai	260
2.Huzhou Port Changxing District	Changxing---Jiangxing Zhapu	155
3.Huzhou Port Changxing District	Changxing---Shanghai	185
4.Huzhou Port Changxing District	Changxing---Suzhou Taicang	260
5.Huzhou Port Deqing District	Deqing---Suzhou Taicang	283
6.Huzhou Port Deqing District	Deqing--- Shanghai	250
7.Huzhou Port Deqing District	Deqing--- Jiangxing Zhapu	142



CX: Changxing

AJ: Anji

DQ: Deqing

SH: Shanghai

ZP: Zhapu

TC: Taicang

The voyage cost of Anji to Shanghai route is calculated as follows:

Voyage cost of Anji to Shanghai=41.6*260/20=540.80

The voyage cost of each route is shown in the following table.

Table 4-4

Flow direction	Voyage cost
Anji---Shanghai	540.80
Changxing---Jiangxing Zhapu	322.40
Changxing---Shanghai	384.80
Changxing---Suzhou Taicang	540.80
Deqing---Suzhou Taicang	588.64
Deqing--- Shanghai	520.00
Deqing--- Jiangxing Zhapu	295.36

(3) Tonnage:

Table 4-5

2017 Huzhou Inland Water Container Transport Forecast

(Sources: Huzhou Port Authority)

Flow direction	**The amount completed in 2017**	**Voyage volume (The amount completed in 2017/12/30/8)**
1.Anji---Shanghai	179760	62.42
2.Changxing---Jiangxing Zhapu	4200	1.46
3.Changxing---Shanghai	16900	5.87
4.Changxing---Suzhou Taicang	8400	2.92
5.Deqing---Suzhou Taicang	29314	10.18
6.Deqing--- Shanghai	59225	20.56
7.Deqing--- Jiangxing Zhapu	2031	0.71

(4) Unit transport cost

In this article, it is assumed that opex is fixed, so the value of opex is no impact on the optimization plan.

The unit transport cost of Anji to Shanghai route is calculated as follows:

$$\text{Unit transport cost of Anji to Shanghai}=\frac{540.80}{62.42}=8.66$$

Table 4-6

Flow direction	Unit transport cost
1.Anji---Shanghai	8.66
2.Changxing---Jiangxing Zhapu	220.82
3.Changxing---Shanghai	65.55
4.Changxing---Suzhou Taicang	185.21

5.Deqing---Suzhou Taicang	57.82
6.Deqing--- Shanghai	25.29
7.Deqing--- Jiangxing Zhapu	416

From the calculation results in the above table, it can be seen that the lowest unit transport cost is route Anji to Shanghai. Obviously, in seven routes, the cost of Shanghai Port is lower than that of Taicang Port and Zhapu Port. The general situation is that, the cost of Shanghai Port< the cost of Taicang Port< the cost of Zhapu Port.

(3) Other factors that affect the optimal path

One of the factors that affect the optimal path: transport costs, is described above. Transport costs are an important factor affecting freight transport efficiency. Different shippers and different types of goods have different sensitivities to transportation costs. Selecting different modes of transport and different transportation routes greatly affects the total transportation costs. It must be noted that there is a mutual restriction between transit time and cost. Transportation time is an important manifestation of the transportation efficiency and transportation service level of the entire transportation process, and is an important factor considered by the transportation organizer when selecting the transportation route. In general, transport modes with shorter transit times have higher transport efficiency, but their service costs are higher. Transport modes with low transport costs have lower transport service efficiency.

See the table 4-3, we can learn that Anji-Shanghai is the longest route(260km). Therefore, the service cost of this line is also the lowest.

From the perspective of the types of goods being transported, the Anji-Shanghai route is more green, safe and efficient. Goods transported on other routes are more demanding on temperature, humidity, danger and perishability.

Table 4-7

2017 Statistics on the types of goods exported by Huzhou Inland Water ports (Sources: Huzhou Port Authority)

Ports	Goods
Anji	Bamboo products, office chairs, sofas

Changxing	Fertilizers, refractories, building materials
Deqing	Ceramics, iron oxide, talcum powder, calcium powder, plates, casual furniture

Compared with the three large logistics parks of Anji, Changxing and Deqing, Anji Logistics Park performed the best. The logistics park is a place with many functions such as storage, storage, information service, loading and unloading, and transfer. The inland container logistics park has comprehensive service functions. It can not only achieve the handling of containers, handling international container multimodal transport operations, but also realize the functions of maintenance, disinfection, storage, empty container dispatching and information tracking in the container land station.

Anji Chuanda Logistics Park is a city-level logistics cluster and was completed at the end of March 2010. The logistics park is based on the Meihu line, close to 11 provincial highways and 04 provincial roads, only 65 kilometers from Hangzhou and 220 kilometers from Shanghai. The logistics park construction project is a key construction project in Zhejiang Province with a total investment of US$4.5 million and an area of 198676 square meters. Along the river bank line, the largest container terminal in the Huzhou River, the Anji Chuanda Logistics Terminal, has five 500-ton container berths and a designed annual handling capacity of 200,000 TEUs.

And Shanghai Port is bordered by the river, backed by Shanghai, and backed by the Yangtze River basin. The economic hinterland is vast. All 31 provinces and cities (including Taiwan Province) have cargo reloading at Shanghai Port. Ninety-nine percent of Shanghai's foreign trade supplies enter and leave through Shanghai Port. The annual foreign trade throughput accounts for about 20% of the country's major coastal ports. As a world-famous port, Shanghai Port’s cargo and container throughput ranks first in the world.

Therefore, Anji-Shanghai is the optimal route relatively from the perspective of transportation unit cost, transportation distance, type of cargo transported, and cargo transfer efficiency. Other containers can also share the transportation volume through Changxing-Shanghai and Deqing-Shanghai.

5. Summary and conclusion

5.1 The main task of developing Huzhou container transport inland

(1) Accelerate the formulation of a special plan for inland water container transportation

The construction of inland water container transportation network is a long-term project and must be implemented in an orderly manner based on relatively well-defined planning. At the same time, due to the obvious public welfare features of docks and waterway construction, investment is large and time-consuming, and the economic development of a relatively small area is not obvious in the short term. Some local plans have encountered difficulties in the supply of funds, land and other factors. It is suggested that the government should take the lead in the entire region, give full play to its leading role, consider various factors, speed up the formulation of a special plan for the development of inland water container transport, and form an optimal planning scheme in terms of route layout, port bursts, waterway construction, ship type R&D, etc. Not only the requirements for container berths, but also the specific planning for the terminal container yard, the container yard station in the port area and the supporting port service system. Under appropriate conditions, this level of planning can be further improved to ensure that the plans are effectively implemented. Once the plan is implemented, government departments must strictly control the investment promotion, planning, examination and approval, and construction processes, so as to ensure that the shoreline resources are handed over to enterprises with strong capabilities and strong operating capabilities. Build an integrated inland river container operation area with large scale, wide radiation, large transport capacity and complete functions.

(2) Establish a multi-party coordination mechanism for inland water container transport

To speed up the promotion of container transport in inland rivers in Huzhou, it is necessary to speed up the establishment of a multi-regional coordination and cooperation mechanism across regions and departments, and to promote convergence. The Department of Water Transportation of the Ministry of Transport and the Shanghai Combined Port Office took the lead to establish a coordination mechanism for the inland river container transport in the Yangtze River Delta. Strengthen and coordinate the planning of inland water container construction in the Yangtze River Delta region,

harmonize construction standards, and coordinate the rectification of major obstacle-hazard structures such as highway bridges and railway bridges to ensure accurate docking of construction time, navigation standards, and terminal capabilities.

The provincial government has taken the lead to establish a multi-coordination mechanism for inland river container transportation in northern Zhejiang, organize three levels of provincial and city governments, and development, transportation, environmental protection, port and other departments, coastal port groups, freight forwarding companies, and cargo owners. Negotiate the settlement of land, funds, support policies and other issues involved in the development of inland river container transport.

The provincial, port and shipping bureau took the lead to establish and strengthen the "portal alliance" between the inland river port and the seaport, to promote the establishment of horizontal alliances among the inland river container ports, and to form horizontal alliances with the coastal ports. Establishing the "Harbor Alliance" coordination mechanism for rivers and seas, and actively attracting Shanghai Port Group and Ningbo Port Group to establish their own port alliance ties in the northern Zhejiang region. Relying on the advantages of capital, management, and shipping routes, the two sides will play a mutual benefit and promote the development of inland water container transportation.

(3) Introduce provincial level support policies

Based on the huge social benefits of inland water container transportation in saving land resources, energy conservation and emission reduction, and stimulating regional economic development, and drawing on the experience of developed areas in inland river container transport, we recommend the introduction of a provincial level support policy for inland water container transport.

During the initial stage of inland water container transportation, certain preferential policies are given. In terms of supply of factors, we will give a certain degree of tilt, and provide certain preferential support for inland water container projects in terms of supply of land elements, collection of land transfer fees, and tax return. At the same time, short-term direct monetary subsidies will be given to newly-developed inland water container transportation businesses.

Explore the use of policy measures to guide the transport of land and sea containers. It is recommended to learn from the experience of the European Union and start the

diversion of container transportation in northern Zhejiang according to different distances and types of goods in advance, and to encourage some of the goods to be abandoned through road tolls and other levers.

(4) Promote investment and financing channels, and innovation in construction mode

Actively develop the "landlord port + port and shipping cooperation" model. In the future development of inland river container terminals, we can draw on the development model of "landlord ports, port and shipping cooperation". That is, through planning to define the area of the port, the entrusted port represents the country's ownership of land, shoreline, and infrastructure in the port area and the rear area. The unified development of land, shoreline, and waterway within the scope, and the leasing of docks and land to the enterprise by lease, and separation of property rights and operating rights. Then take the port and shipping cooperation model for the development of the terminal. In this way, the tripartite interests of the government, port companies, and shipping companies will be considered in an integrated manner. It will also avoid problems arising from the construction of ports and will be conducive to the unification of port, port industry, and regional infrastructure.

(5) Promote the change of inland river container port to regional logistics base

The inland river container port area is the most likely platform for the integration of production factors in the logistics network chain of the northern Zhejiang region. The scope of its services and radiation far exceeds that of a simple inland container port. It not only provides simple logistics service functions such as basic loading and unloading, warehousing, and distribution, but also provides a full-range and flexible logistics value-added service with the Inner River Container Port as the core node of the transportation logistics chain. The port needs to introduce modern logistics concepts and promote the development of traditional ports to logistics-based smart ports. Build a logistics network, set up a container pick-up network, accelerate the construction of a "waterless port", build a fast channel between the logistics park and the port, and improve the port logistics service function. Strengthen cooperation with other modes of transportation, jointly construct a logistics service network, carry out integrated logistics services, and continuously improve the comprehensive capacity of port logistics. Change the pattern of the single business entity, with the goal of building a

regional public logistics base. Actively introduce entities such as raw material storage centers for large-scale production enterprises, regional distribution centers for large-scale commercial enterprises, regional distribution centers for express delivery and e-commerce enterprises, and third-party logistics self-operated logistics centers. Actively attracting third-party logistics companies, freight forwarding companies, and transport companies to enter the market, and promote the maturity of the logistics industry and the continuous growth of the inland container shipping market.

5.2 Development of Huzhou inland container shipping recommendations

Although China's inland water container transportation started relatively late, the inland river container transport in Huzhou has only just begun. However, the inland water container transportation has shown amazing development potential and has become an important support for the national economy and the economic development of the river basin. We should draw on the current situation, characteristics and development trend of the development of inland river container transport in Huzhou and draw on the experience of domestic and international container transport to address existing problems. In order to ensure the implementation and rapid development of the inland river container transportation network in Huzhou, practical and feasible policies and measures are adopted in the planning of inland river container transportation network and infrastructure reconstruction.

(1) Accelerate the construction of inland ports and infrastructure

According to the current situation of the construction of inland river docks and waterways in Huzhou and related supporting facilities, it is still far from meeting the development needs of the inland river container market. Huzhou Riverside docks are mostly grocery docks, and most of the loading and unloading equipment is behind-the-clock grab or lifting equipment, and lack specialized container handling equipment. It is recommended to increase investment in inland waterways and port infrastructure and accelerate the upgrading of Huzhou’s high-grade channel network. While planning and constructing a batch of public inland river container terminals, it is also necessary to encourage enterprises to build self-built inland river cargo terminals and form a community of inland river container terminals.

We will make full use of the advantages of the resources of public docks and cargo terminals in the river dock community, expand the existing container water transport network, form a water transport system that can radiate the entire territory of Huzhou, and establish and improve relevant infrastructure and staffing related businesses. In this way, not only can it take advantage of the scale of its transportation network, it can reduce overall transportation costs, it can also reduce the number of empty ships, improve the utilization rate of terminal equipment, and truly realize a tripartite win-win situation among enterprises, ships and terminals.

(2) Accelerating the Standardization of Inland Water Container Ships

There are few container ships in Huzhou City's inland river transportation. Currently, the ships engaged in container transportation are mostly bulk carriers or general cargo ships after transformation. The carrying capacity is limited, and the existing channel resources are not fully utilized. The shortage of container ships is the main bottleneck restricting the development of the container waterway transportation network in Huzhou City. Only by establishing a professional container shipping fleet can the capacity of container waterway transportation be greatly improved, and the transport capacity advantage and freight price advantage of the container waterway transportation network can be fully utilized.

Therefore, it is a major technical problem that needs to be solved to develop a set of inland waterway transportation ship type standards and develop a container ship type suitable for inland waterway transportation in Huzhou. Huzhou City Government and relevant port departments should take the initiative to contact scientific research institutions and colleges and universities, and combine their own characteristics and transportation needs of Huzhou Waterway to formulate their own development plans and suit the ship type. Formulate inland river container type standards, speed up the adjustment of inland river transportation structure, and develop inland water container shipping fleet. Establish a container fleet that is compatible with modern container shipping methods to ensure the implementation of inland container shipping standards in the Huzhou River.

(3) Strengthen the construction of inland waterway information platform

Further strengthen the construction of the information platform to achieve a high degree of sharing of information resources between the inland port of Huzhou and river

ports, between various departments within the port area, and between shippers, agencies, and inspection units. Improve operational efficiency and ensure the smooth flow of containers between seaports and river ports and smooth customs clearance procedures. Through the use of modern management, informatization, and high-tech means, the document flow, cargo flow, and information flow are integrated to make it reasonable, standardized, and smooth, and to provide the best services to shippers in the shortest time and at the lowest cost. Improve the comprehensive competitiveness of inland water container transport.

At the same time, actively improve the port supervision conditions, through the integration of the international container river port area and customs supervision stations, so that cargo owners can go directly in Huzhou booking booking, customs clearance, inspection, delivery, receipt and a series of customs clearance procedures. Establish a "pass-through point" for customs, realize the "through customs clearance" of inland ports in Huzhou to ports in the world, create a good customs clearance environment, meet the various transportation requirements of shippers, and provide "door-to-door" container transportation services for shippers.

While developing the foreign trade container transportation business, we are striving to open up the domestic trade container transportation business so that container transportation will become a new bright spot in the water transportation industry of Huzhou City.

(4) Strengthen the Talent Training of Canal Container Transportation

Huzhou City's inland water container transportation is still in its infancy, and most of the captains or pilots engaged in inland water transportation do not have the experience of transporting containers and have not received relevant knowledge training, and there are some hidden safety problems. The relevant management department of the inland river transport in Huzhou should organize personnel to do a good job in propaganda and training of some safety knowledge. In addition, the wharf staff of each county and city in Huzhou also lacked experience and related technical knowledge in container transportation management and loading and unloading, and required training in related business knowledge and the use of new container handling equipment.

Therefore, it is necessary to vigorously cultivate all kinds of professional and technical personnel engaged in the management and operation of inland shipping, so as

to provide human resources for the sustainable development and modernization of inland rivers. It is necessary to improve the personnel management system in the transportation industry, promote the reasonable flow of talents, and gradually establish and improve the environment and mechanisms conducive to the growth of excellent talents in the industry, and greatly increase professional skills and management levels. According to the characteristics of water transportation and the requirements for safety production, the qualification and confirmation system for the qualifications of various types of employees in transport enterprises shall be formulated and the employment of certificates shall be strictly implemented. Regular appraisals, continuously improve the overall quality of shipping companies, meet the development requirements of the transportation market, and build a talented team of inland shipping container transport with skilled business, modern management awareness, high management standards, and market development capabilities.

(5) Developing inland container multimodal transport services

At present, container transport in Huzhou is still in its infancy, and its transportation capacity is far from meeting the transportation needs of the current stage. To meet the transportation needs of more enterprises, a variety of transport modes can be combined. For example, to give full play to the characteristics of good road transport accessibility and fast time, and for some companies that are in urgent need of time, the combination of inland water transport and road transport will be used to give full play to the advantages of the two modes of transport. It can not only reduce the company's overall transportation costs, but also meet the company's time requirements.

In addition, when the waterway transportation of Huzhou City goes out of the bottleneck and enters mature stage, the hinterland resources should be further explored and the cooperation between the port, shipping companies and shippers should be actively promoted. Improve the efficiency and economic efficiency of container transportation, develop multimodal transport and integrated logistics services for inland river containers, and give full play to the superiority of container transportation. We will promote direct transportation through the Haihe River and direct transport by dry branches, strengthen the connection with railway and highway container transportation networks along the river, and build a comprehensive transportation system that is compatible with the development of international logistics.

(6) Encouraging the rapid development of local container companies

At present, most of the container cargoes at Huzhou Port are carried by foreign container carrier companies, and local container shipping companies have a very small share. As a city with the goal of developing the city by water, it should have its own powerful container transportation company and actively develop the water transportation industry. In addition, the development of water transport can also add new connotations to the "Water Transport City" project, making Huzhou not only have a strong inland river shipping capacity, but also the unlimited development potential of the river and sea combined transport. Compared with other cities in northern Zhejiang, it has unparalleled advantages.

The relationship between the port and the water transport is complementary and interdependent. The development of the port cannot be separated from the development of the water transport industry. The expansion of container shipping companies and the enhancement of shipping capacity will effectively expand the throughput of the port. It will help improve the status and function of the port, promote the healthy development of the port, and effectively and efficiently exert its due role and potential.

The construction of the port in Huzhou has already started, and the port must be the first to support the development of the water transport industry. When the container transport company in Huzhou starts, it should give certain policies to support and support. The government can fully play the role of communication and bridge and build a platform. In addition, the Huzhou City Government should organize relevant departments such as industry and commerce, taxation, land, maritime affairs, and port and shipping to coordinate and formulate feasible and feasible policies to attract powerful container transportation companies to register in Huzhou.

5.3 Conclusion

As an important part of Huzhou's comprehensive transportation system, Huzhou inland water container transportation must comprehensively analyze and study its development direction, accelerate the pace of construction, and meet the needs of social and economic development. Inland navigation is one of the important means of transportation in the integrated transportation system. In the 1960s, container freight was successfully tested at sea, and container freight transportation was rapidly

promoted and applied. Since the beginning of the 1970s, container shipping has been adopted in the rivers in some areas. By analyzing the development process and characteristics of inland river container transportation at home and abroad, it provides certain reference value for the development of inland river container transportation in Huzhou.

Through the analysis and research of this paper, the following conclusions are drawn:

(1) As a technology-intensive and capital-intensive modern cargo transportation mode, container transportation has effectively promoted the rapid and coordinated development and continuous progress of society and economy in Huzhou and its surrounding areas. The development of inland water container transportation has become a hot topic.

(2) Through the analysis of the unit transportation cost of inland river container transportation in Huzhou area, it provides certain reference value for the scale and planning of inland river container terminals in the future.

(3) Finally, this paper puts forward some strategies, main tasks and suggestions for the development of inland river container transportation in Huzhou, and hopes that the relevant part will provide some reference value in the process of developing inland river container transportation.

5.4 Insufficiency and outlook

However, there are also some deficiencies in this study. On the one hand, although this study has considered many of the features of IWT, consideration is still insufficient. And for the convenience of research, the research of this study has made some ideal hypotheses. On the other hand, although this article qualitatively analyzes the economics of airline optimization to achieve bundled transport, it still lacks a quantitative comparison with actual conditions. The transportation demand during the planning period is also obtained through reasonable assumptions and cannot be compared with actual operations. This is because the current inland waterway transportation companies are scattered and it is difficult to collect actual data. Moreover, the time of this study is relatively limited. The economical nature of the research on this article compared with reality still needs future research to further demonstrate the practical significance of this model.

In addition, because China's inland water transport is still in its infancy, there are still many problems that need to be solved. Corresponding studies on inland water transport are also relatively lacking. In addition to the research in this paper, there are still many research directions that can be extended and deepened in the study of the network planning of inland river container liners.

(1) The study uses the simplest path with the least cost as the optimal path, which is a more theoretical argument. However, in the actual situation, if we simply use the least costly route, all the outbound containers will eventually be concentrated on a route with the lowest calculated cost, which is obviously impossible. The reason is very simple. Everyone comes to this line. This route will be very crowded and even cause congestion. As a result, someone will go the other route, or even change to land. At this time, it is possible to rely on the transport hub to divert the Anji-Shanghai container traffic.

(2) In this study, the optimization of the inland river container liner network mainly considers the trunk of the inland river. In actual transportation, there are also branch lines that can be navigable. The transportation of branch lines will have a certain impact on the transportation benefits of the trunk line and the entire network. Therefore, considering the transportation of spur lines is an important direction for the organic structure and optimization of the inland river system.

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