

# Countermeasures and Measures for Optimizing the Collection and Distribution System of Coastal Container Ports Under the Background of Yangtze River Delta Integration

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## Abstract

With the implementation and promotion of the Yangtze River Delta integration policy, the coastal container ports have also ushered in further development, but also to the collection and distribution system of each port has brought great pressure. As one of the most important ports in the Yangtze River Delta, Shanghai port has a representative collection and distribution system. Taking Shanghai port as an example, this paper analyzes the existing problems, advantages and disadvantages of the collection and distribution system of Shanghai port, and puts forward corresponding suggestions and measures, which can be used for reference to optimize the collection and distribution system of coastal container ports in the context of Yangtze River Delta integration.

## Keywords

Container collection and distribution; Shanghai port; Countermeasures and suggestions.

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## 1. Introduction

### 1.1 Research Background

The Yangtze River Delta, according to the concept of economic geography, refers to the Jiangsu and Zhejiang economic belt with Shanghai as the leader. The Yangtze River Delta is located at the intersection of the busy coastal shipping lines and the T-shaped river sea transport of the Yangtze River. It has obvious geographical advantages and good economic foundation. At present, there are 8 major coastal ports and 26 inland ports in the region, mainly including Shanghai, Ningbo Zhoushan port and Lianyungang port, including Suzhou, Nanjing, Zhenjiang, Nantong, Wenzhou and other coastal and lower Yangtze River ports, which is one of the areas with the largest port density in China. From January to October of 2019, the port group of Yangtze River Delta completed a total cargo throughput of about 4.104 billion tons, a year-on-year increase of 10.5%; container throughput of 42.09 million TEU, a year-on-year increase of 4%. Among them, Shanghai port, Lianyungang port, Ningbo Zhoushan port, Nanjing port, Zhenjiang port, Suzhou Port, Nantong port, Jiangyin port, Taizhou port and Hangzhou port have a throughput of more than 100 million tons.

Ports with container throughput of more than 10 million TEU include Shanghai port and Ningbo Zhoushan port.

In terms of the proportion of container throughput, Shanghai port is far ahead of the Yangtze River Delta port group with 47%, accounting for nearly half of the total, followed by Ningbo Zhoushan port, with a total of 29%. Suzhou Port ranks third as a inland port with 7%, Lianyungang with 5%, and other ports with 4% or less. It can be seen from the above figure that Shanghai port and Ningbo Zhoushan port area of the Yangtze River Delta port group have obvious advantages.

Shanghai port is located in the front of the Yangtze River Delta. The northern part of Shanghai city is the estuary of the Yangtze River and the middle part of China's coastal coastline. Shanghai port is an important intersection between the transportation of the East and the west of the Yangtze River and the North-South coastline of China. Such geographical environment determines that Shanghai port is one of the most important coastal ports in China and one of the most representative ports in the Yangtze River Delta region.

Ports in the Yangtze River Delta	Cargo throughput(10,000 tons)		Container throughput (10,000TEU)	
	Accumulated since the beginning of the year	current month	Accumulated since the beginning of the year	current month
total	410,371	42,684	4,209	776
Coastal port	ShangHai	55,720	5,683	363
	LianYunGang	19,576	1,982	403
	YanCheng	6,676	667	21
	JaXing	9,020	966	151
	NingBoZhouShan	93,832	9,272	2,349
	TaiZhou	3,986	453	33
	WenZhou	6,117	656	67
	ShangHai	4,380	420	1
River port	NanJing	21,506	2,160	274
	ZhengJiang	26,689	2,844	35
	SuZhou	43,708	4,462	521
	NanTong	26,593	3,034	125
	ChangZhou	4,467	475	27
	JiangYin	18,148	1,966	45
	YangZhou	7,747	768	41
	TaiZhou	23,377	2,340	29
	XuZhou	3,365	387	3
	WuXi	5,212	565	4
	SuQian	1,245	161	7
	HuaiAn	6,463	714	20
	HangZhou	11,177	1,443	6
	HuZhou	9,401	1,072	42
	ShaoXing	1,895	192	5
	JinHua	71	2	...

Fig.1. Cargo throughput and container throughput of the Yangtze River Delta port group from January to October 2019

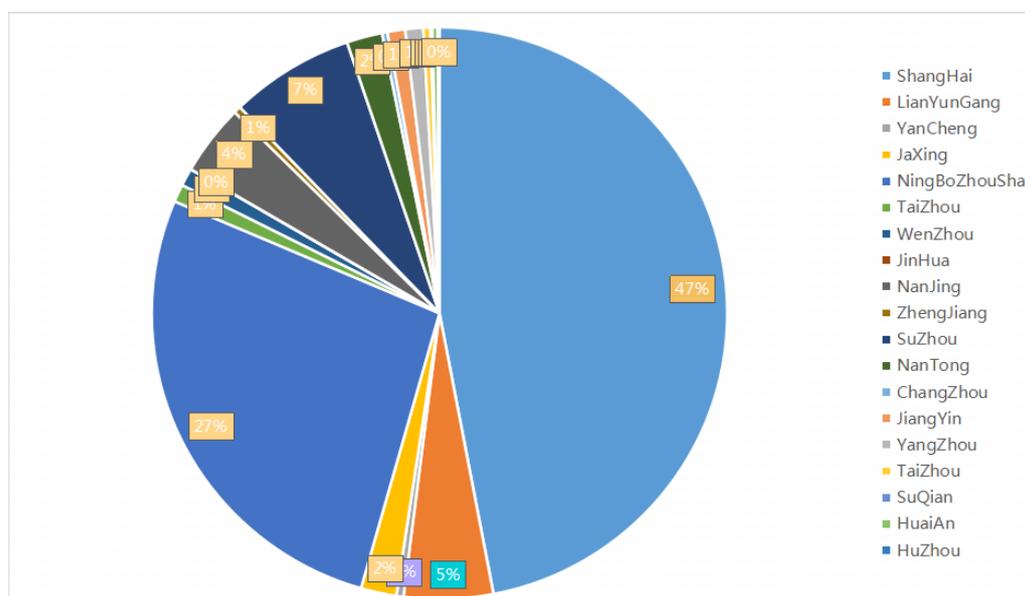


Fig.2. The proportion of container throughput of each port in the Yangtze River Delta port cluster from January to October 2019

### 1.2 Research content

This paper first describes the related concepts of port collection and distribution system, analyzes the relationship between the various systems, and then takes Shanghai port as the research object, introduces the basic situation of Shanghai port, discusses the problems existing in the collection and distribution system of Shanghai port, as well as the advantages and disadvantages, and puts forward corresponding suggestions and measures. The optimization countermeasures and measures of export collection and distribution system can be used for reference.

## 2. Related concepts of port collection and distribution system

### 2.1 The basic concept of port collection and distribution system

The collection and distribution system is a transportation complex formed by various transportation modes in the socialized transportation scope and unified transportation process according to their respective technical and economic characteristics. It is mainly composed of integrated transportation network and its combination system, integrated transportation production system and integrated transportation organization management coordination system. The construction of the collection and distribution system must be carried out in accordance with the principles of high-quality service, high-efficiency transportation and high-efficiency economic and social benefits. In terms of transportation construction, it is necessary to make overall planning and reasonable layout; in terms of transportation equipment configuration, it is necessary to achieve coordination, high efficiency and complementary advantages in organization and management[1].

Port collection and distribution system is the artery of port economic energy transmission, the channel between port and hinterland, and the main external condition for the existence and development of port. If we say that the port economy is the mother, the port is the heart, and the port city is the center, then the port collection and distribution system is the "blood vessel", which continuously transports energy for various parts[2]. The physical and logical "zero distance transfer" and "seamless connection" that it can realize are the heights that all kinds of transport hubs should reach. Only when any modern port has a perfect and smooth collection and distribution system can it become a real water and land transportation hub in the comprehensive transportation network[3].

There are four main routes for the source and direction of goods in the port: roads, railways, inland rivers, and branch lines. Each mode of transportation has its specific transportation routes and means of transportation, forming its own technical operation characteristics, economic performance, and reasonable and effective scope of use. Various modes of transportation are connected with ports to form a collection and distribution system for centralized and evacuation ports handling cargo services.

### 2.2 The interrelationship of the various systems of port collection and distribution

The collection and distribution system is established on the basis of various transportation methods, and is also an organic whole united by various transportation methods due to the requirements of the transportation production process itself.[4]

The characteristics of highway transportation are flexible, fast and convenient, which can go deep into the smaller "economic cells" to realize the "door-to-door" direct transportation service with high speed; the crisscross highway transportation network, combined with trunk and branch, plays the role of "artery" and "capillary" in national economic and social development; the investment of highway transportation is small, and the recovery is fast and easy. Management, technical requirements are relatively low. However, highway transportation also has obvious disadvantages: small loading capacity, large energy consumption per unit volume, high transportation cost and easy to cause pollution.

Railway transportation has large capacity, low cost (unit cost is inversely proportional to transport volume and distance), low energy consumption, and strong adaptability. However, the cost of short-distance railway transportation is higher and the transportation speed is slow.

Waterway transportation is a transportation method that uses ships as a means of transportation to carry passengers and goods along routes in waters such as oceans, rivers, lakes and other waters. It has the advantages of large carrying capacity, low cost, high productivity, low energy consumption, and low investment. However, there are also weaknesses such as slow speed, many links, large influence from natural conditions, and poor mobility.

The branch line transportation is relative to the trunk line transportation. It is a form of transportation that plays an auxiliary role to the trunk line transportation on the basis of the trunk line transportation. As a supplement between the transportation trunk and the shipping location, branch line

transportation mainly undertakes the transportation tasks from the supplier to the assembly site on the transportation trunk and from the assembly point on the trunk to the distribution station in the transportation supply chain. Generally speaking, the distance of the branch line is much shorter than that of the main line, and the transportation volume is also much smaller. At the same time, the construction level of the branch line is much lower than that of the main line. The corresponding transportation means are relatively poor. Therefore, the transportation speed may be slower and equal. The turnaround time may be longer. The above several transportation methods have their own advantages and shortcomings. Only by combining their strengths and avoiding weaknesses can the overall effectiveness of the collection and distribution system be brought into play.[5]

The port collection and distribution system plays a coordinating role for various modes of transportation, and its influence is mainly manifested in the collection and distribution capacity of the port collection and distribution system. The collection and distribution capacity of the port collection and distribution system is a total indicator to measure the scale of the hub. Strengthen the construction of the port collection and distribution system, so that the various transportation methods can closely cooperate and coordinate with each other to achieve the goal of seamless connection.[6]

### **2.3 Collection and distribution system of the world's major container ports**

Due to the law of the development of container transportation, in order to maximize the transportation efficiency and economic benefits of the transportation system, the container transportation system has formed three stable trunk flights and container hub ports in the world, and also formed the branch network and branch port matching the trunk line and hub port. In the process of the formation and development of these container hub ports, due to their status on international routes, the scope and level of hinterland economy, the conditions of ports themselves and the cities relying on them, different development modes and types of container hub ports have been formed, and their own port collection and distribution systems have also been formed.

#### **2.3.1 Transition container hub port**

The major container hub ports in the world that have been transformed are Singapore and Hong Kong. The development of the container hub port in the mid-transformation mainly relies on its unique location conditions to form an international trunk container port, which is developed by collecting and distributing the surrounding branch port containers.

#### **2.3.2 Hinterland-based container hub port**

Hinterland-based container hub ports mainly include Los Angeles, Oakland, Long Beach, Rotterdam, Hamburg, etc. The hinterland-based hub port is mainly formed through its location advantages, open port policy, and perfect and efficient inland network.

#### **2.3.3 Composite container hub port**

The formation and development of composite container hubs such as Kaohsiung and Busan share some common characteristics of the mid-transition and hinterland-based type. In the early stages of its development, the composite container hub port mainly relied on the direct hinterland of the port itself to form a scale, and became the main container port in the region, and on this basis became a transit port for other branch ports.

#### **2.3.4 The development trend of port container collection and distribution system**

The formation and development of a composite hub port has some common characteristics of the mid-transition and hinterland type, but its shipping center is still regional, and the container throughput usually exhibits rapid growth and large fluctuations.[7]

## **3. Overview of Shanghai Port**

### **3.1 Analysis of Geographical Conditions of Shanghai Port**

Shanghai Port is located in Shanghai, on the west coast of the Pacific Ocean and on the coast of the East my country Sea. It is located in the middle of the mainland coastline and at the mouth of the

Yangtze River. Shanghai Port is located at the intersection of the "T"-shaped main axis along the Yangtze River industrial belt and the open coastal zone in my country. It is backed by Shanghai City and the Yangtze River Basin. It has a vast economic hinterland and convenient waterway and air transportation. It is a major coastal hub port and external An important port for communication, it is also one of the world's famous ports.

Shanghai Port is one of the most famous international trade ports, and it has trade relations with more than 500 ports in more than 200 countries and regions. In international shipping, it is 9270 nautical miles from Panama, 5400 nautical miles from San Francisco, 5,100 nautical miles from Vancouver, 1040 nautical miles from Yokohama, 820 nautical miles from Kobe, 2571 nautical miles from Singapore, and 6,500 nautical miles from Sydney. In domestic shipping, there are regular or irregular flights from Dandong and Dalian in the north to Zhanjiang and Fangcheng in the south; and up to ports along the Yangtze River. It is an important transit point for water transportation in the areas along the Yangtze River and the north-south coastal areas. . Upstream along the Huangpu River, via the Sunzhou and Shensu Outer Port lines, it can be connected to the inland waterway network of Jiangsu and Zhejiang provinces, and connects to the North-South Grand Canal.[8]

The container terminals of Shanghai Port are mainly distributed in the three major port areas of Yangshan, Waigaoqiao and Wusong. There are 46 container berths, 155 container suspension bridges, 463 tire cranes on site, and a total container yard area of 6.34 million square meters. SIPG actively promotes the optimization system of shipping collection and distribution, and connects the three major port areas by providing fast water and land container shuttle barge services.[9]

Time	Cargo volume					
		Railway	highway	waterway	ocean transportation	civil aviation
1990	22,848	1,257	8,714	12,864	2,246	13
1995	22,531	1,376	6,273	14,845	2,778	37
2000	47,954	1,055	28,369	18,442	7,022	88
2001	49,545	1,080	28,869	19,496	7,210	100
2002	54,196	1,131	29,756	23,174	7,129	132
2003	58,669	1,208	30,678	26,621	7,832	162
2004	63,180	1,284	31,554	30,148	8,603	194
2005	68,741	1,278	32,684	34,148	10,091	222
2006	72,617	1,223	33,799	37,342	11,766	290
2007	78,108	1,143	35,634	34,557	12,575	305
2008	84,347	1,012	40,328	41,041	12,197	298
2009	76,967	941	37,745	42,728	11,916	371
2010	81,023	956	40,890	37,986	15,172	356
2011	93,318	888	42,685	49,389	16,258	338
2012	94,376	825	42,911	50,302	17,491	335
2013	90,345	694	43,809	46,697	15,485	361
2014	91,236	549	42,848	49,770	16,451	371
2015	90,568	471	40,627	48,787	18,145	387
2016	88,689	461	39,055	48,268	18,912	395
2017	97,257	482	39,743	56,619	23,871	423

Fig.3. Cargo Transport Volume in Major Years in Shanghai (10,000 tons)

### 3.2 Main transportation subnets of Shanghai Port's collection and distribution system

#### 3.2.1 The main road transportation network of Shanghai container transportation

Due to the relatively high cost of road transportation, if freight, personnel wages, and postage are considered, the reasonable distance is between 300 km and 500 km. At present, the main source of containers in the Shanghai port area is the Yangtze River Delta. The transportation structure of this kind of transportation has led to a large dependence on roads for the collection and distribution of containers in Shanghai Port.

#### 3.2.2 The railway network of Shanghai container transportation

In container transportation, generally considering that the transportation distance is more than 400, railway transportation is suitable. However, the economic hinterland of Shanghai port is mainly concentrated in Jiangsu, Zhejiang and Shanghai. These areas are suitable for general transportation within 400 km. Among the indirect economic hinterland of Shanghai port, Anhui, Hunan, Hubei, Jiangxi and other places are suitable for railway transportation. At present, the container railway

transportation of Shanghai port is still relatively backward, the main reason is that the railway transportation special wharf of Shanghai Port occupies too few railway lines. It mainly depends on Yangpu Port Station and Luchao port central station. However, as the main container terminals of Shanghai port are Waigaoqiao terminal and Yangshan Port terminal, there is no direct railway line for these two terminals. Container transportation by rail needs to be carried out by short barge with collecting trucks, resulting in additional container transportation and container handling costs, which makes the advantage of low freight rate of railway transportation not Obviously.

### 3.2.3 Waterway transportation network of container transportation in Shanghai

Shanghai port is located at the mouth of the Yangtze River, which makes it possible for Shanghai port to maintain convenient and smooth waterway transportation with cities along the Yangtze River by waterway transportation. The main economic hinterland of Shanghai port is mainly concentrated in Shanghai, Jiangsu Province, Zhejiang Province, Anhui Province, Hunan Province, Hubei Province, Sichuan Province, Jiangxi Province and Chongqing city. Among them, Shanghai, Jiangsu Province, Hubei Province and Chongqing city can collect and distribute containers through the Yangtze River waterway and Shanghai port. The container waterway transportation of Shanghai port includes river sea intermodal transport, river sea intermodal transportation and sea sea sea transit. Among them, river sea intermodal transport is mainly through the Yangtze River, river sea intermodal transport is mainly through Huangpu River and other inland rivers, and sea sea transfer mainly refers to international container transport through Shanghai port. In terms of the current inland and riverside container collection and distribution volume, river sea intermodal transport occupies a dominant position, while river sea intermodal transport occupies a very small share.

## 4. Problems of container collection and distribution system in seaport

The road collection and distribution is nearly saturated and the urban traffic pressure is great. In recent years, the container transportation structure of Shanghai port has been continuously optimized, and the proportion of highway in the collection and distribution transportation has been declining. However, due to the lack of container railway collection and distribution conditions in Shanghai port, the inland waterway level in Shanghai is relatively low, and the Inland River Collection and distribution transportation development is slow. Moreover, Yangshan port area is located in the East China Sea, and inland river vessels can not directly The railway and waterway collection and distribution of Shanghai port are still subject to certain restrictions in navigation and attached operations. In 2017, the highway collection and distribution proportion of Shanghai Port still reached 41%, and the highway still plays an important role in the whole collection and distribution system. However, the external expressway system of the port area is extremely weak. At present, there are few external expressways in the land area of the port area. Only S2, g1501, S20 and A30 are connected to the trans Provincial Expressway Network of the Yangtze River Delta through the urban expressway network. Moreover, S2 and A30 are toll roads, which increase the transportation cost of enterprises and affect the agglomeration and development of enterprises.

There is a serious shortage of inland river infrastructure, and there is a large space for water to water conversion. The conditions of Shanghai Waterway collection and distribution channels are insufficient. Most of them are low-grade ones, and the number of channels above grade three is only 175 The results show that the construction progress of inland river container port area does not match the construction of inland waterway; the docking degree between inland port and outer port is poor; the degree of ship standardization is low; the construction of container port area in inland river does not match the construction of inland waterway; the degree of docking between inland port and foreign port is poor; the degree of ship standardization is low; the construction of container port in inland river does not match the construction of inland waterway Although the shuttle bus from Cang to Yangshan has been opened, there is still a secondary transfer of container transportation in the middle and upper reaches of the Yangtze River.

The railway is separated from the wharf, and the proportion of sea rail intermodal transport is too small. There are too few container terminals connecting the railway in Shanghai port. At present, only 2 container berths at Jungong road terminal are equipped with railway lines. The 16 container berths and 6 branch berths of Waigaoqiao port and the large container berths of Yangshan deep water port are not directly connected by railway. The construction of Pudong Railway lags behind and the development of Shanghai port container terminal is out of step and does not match each other. As a result, the total cost of short barge charges is higher than that of domestic surrounding ports. The railway department and other departments are in the state of fragmented management, poor coordination and low awareness of market and service. The current situation of separation of Shanghai Port Railway and wharf objectively increases the import and export cost of sea rail intermodal box in Shanghai port, and weakens the competitive advantage with other ports.[10]

## **5. Countermeasures and suggestions for the development of container collection and distribution system in Shanghai Port.**

For a long time, Shanghai international shipping center is mainly located in the Yangtze River Delta, which belongs to the appropriate range of highway collection and distribution. With the industrial upgrading of Shanghai and even the whole Yangtze River Delta region, the industries with large import and export of raw materials are gradually transferred to the central and western regions. The collection and distribution distance of Shanghai international shipping center has been increased, which requires medium and long-distance transportation modes such as waterway and railway. Moreover, waterway transportation and railway transportation are both green and safe transportation modes with environmental protection, energy saving and large capacity. Giving full play to the role of waterway transportation and railway transportation in port collection and distribution system can not only reduce the pressure of high pollution road transportation, but also promote the economic development of local areas and strengthen the connection between inland hinterland and ports Department. Therefore, Shanghai port, as the largest port in China, should be the representative port. From the perspective of developing container sea rail intermodal transport, river sea intermodal transport and international transit, we should increase the proportion of waterway and railway transportation modes in the collection and distribution system, and build an environmental protection and energy-saving collection and distribution system.[11]

1. We will improve the infrastructure of inland navigation, build a water highway, study the widening project of the navigation width of the Yangtze River Estuary Deepwater Channel, continue to promote the waterway regulation project, start the construction of high-grade inland waterway, open up the high-grade inland waterway connecting Jiangsu Province, Wuxi and Changzhou, speed up the docking with the Yangtze River Delta inland river network, and realize the access to Waigaoqiao port area and Yangshan deep-water port area The Inland River Collection and distribution channel is connected with high standard, and the high-level inland river container collection and distribution network connecting the Yangtze River Delta region is constructed. We will accelerate the standardization of specialized inland river transport ships, and strengthen the R & D and application of low-carbon green technology in key areas of inland rivers. We should attach importance to the connection between inland river port area and seaport port area, solve the problem of short barge transshipment, realize the effective connection between inland water transportation and other modes of transportation, and enhance the competitiveness of inland water transportation.

2. Continue to promote the construction of inland ports (dry ports), improve the construction of inland ports and related service facilities, and attach importance to and extend the radiation and services to the middle and upper reaches of the Yangtze River and inland ports , Mainly including the economic hinterland provinces and cities of northern Jiangsu, Anhui, Henan, Hubei, Shaanxi, Sichuan and Chongqing. Continuously expand the service scope of the hinterland of Shanghai Port through the construction of inland ports (dry ports), enhance the attractiveness of the ports along the Yangtze

River and the cargo flow of the vast central and western regions, and enhance the resource concentration and port and shipping radiation capabilities of Shanghai ports.[12]

3. Support the development of inland waterway navigation, improve the water-to-water transfer system, accelerate the formation of an inland waterway maintenance mechanism, promote the standardization of specialized inland water transport ships, and strengthen the R&D and application of low-carbon green technology in key areas of inland waterways. Attach importance to the connection between the inland river port area and the sea port area, solve the problem of short-barge transfer, realize the effective connection between inland river transportation and other modes of transportation, and enhance the competitiveness of inland river transportation. Encourage enterprises to develop inland waterway shipping, and give certain policy support and economic subsidies to enterprises engaged in inland waterway shipping. Through specific preferential measures such as fee reduction and exemption for inland shipping companies, financial subsidies, and interest-free loans, we will further support the development of inland container shipping companies and fully optimize the collection and distribution system of Shanghai International Shipping Center.

4. Establish a sea-rail combined transport coordination mechanism, increase financial subsidies, establish a sea-rail combined transport coordination mechanism, promote communication and coordination between participants in the sea-rail combined transport, give railway container companies more rights to adjust freight rates, and build advanced multi-modal The combined transportation information system forms an open, fair and transparent sea-rail combined transportation environment. The railway department should give preferential treatment to the container freight rate of the sea-rail combined transport and allow the freight rate to be significantly reduced in order to compete with road transportation. Once a large market scale and stable customer base are formed, the freight rate may be appropriately increased as the transportation cost decreases. , To become a powerful lever for market operations.

5.Speeding up the development of the new Haihe River direct transportation mode The emergence and gradual expansion of the Haihe direct waterway collection and distribution method is a necessary step for the comprehensive development of the hub port collection and distribution system. The canal collection and distribution channel that runs vertically through the origin of the container source is a water transportation resource that has not yet been fully utilized, the density of water transportation is low, the direct transportation method is blank, and the transportation volume has great potential. The use of the new ship type to break through the Haihe Transit bottleneck, will form a new transportation method with huge potential, significant economic benefits, and sound development of the transportation layout, and become the Shanghai port rear collection and transportation with the Yangtze River basin (including the canal water system) as the economic hinterland An indispensable link in the system.[13]

## 6. Conclusion

Under the conditions of a market economy, my country's container ports have achieved rapid development. As the Yangtze River Delta integration policy has risen to a national strategy, it has also put pressure on the collection and distribution capabilities of coastal container ports. Optimized research helps container ports adapt to the development of the times faster.

This article investigates and analyzes the current situation and existing problems of the container collection and distribution system in Shanghai, and proposes optimized countermeasures and measures for the container collection and distribution system of Shanghai Port. On this basis, it also has certain reference for the same type of coastal container ports. significance:

1.To improve the collection and distribution system and solve the efficient, rapid and environmentally friendly operation of domestic trade in coastal container ports, we should start from increasing the ratio of water-to-water transfer and iron-to-water transfer. Although the current waterway and railway collection and distribution volume has increased to a certain extent, there is still a big gap in the construction of container collection and distribution system compared with the rapid development of

demand. From an overall point of view, it is urgent to start with unified understanding, rational layout, overall coordination, improvement measures and other aspects to comprehensively strengthen the planning and construction of coastal container port waterways, railways and other collection and distribution subsystems.

2.From the perspective of various collection and distribution methods, the ability of road collection and distribution organization is the most complete. However, with the rapid development and change of the port development environment and service demand, the transportation capacity of the road collection and distribution channels in coastal container ports and the surrounding roads will be able to bear Heavy pressure is prone to transportation bottlenecks. With the expansion of the coastal container port economic hinterland and the development of the foreign economy in the central and western regions, the waterway and railway collection and distribution subsystem will become a collection and distribution method with great development potential in the coastal container port collection and distribution system. Coastal container ports should take the expansion of the economic hinterland and the development of the foreign economy in the central and western regions as an opportunity to vigorously develop sea-rail combined transport, river-sea combined transport, and international transit.

3.Coastal container ports continue to develop railway and waterway collection and transportation methods, strengthen the connection between the port and the hinterland, while reducing the port road collection and distribution volume, alleviate the pressure of port city road traffic, reduce environmental pollution, and promote port cities Sustainable development of transportation, economy and society.

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