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Applicability of the Yangtze River's Ports and Decision Analysis of Shipping Companies in the Background of River-Sea Direct Transportation

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Abstract

The article will first cluster the ports in the Yangtze River basin according to the water depth and throughput of the port area, analyze the adaptability of the ports in each cluster to the river-sea direct transport mode, and then select the cluster that is most suitable for the development of river-sea direct transport's port. In the case analysis, combine the three criteria of hub, channel conditions and loading and unloading capacity to carry out ANP network level analysis, and explore the factors that should be taken into consideration when the shipping company chooses a cooperative port. Finally, combined with the results obtained in the examples, it is suggested that the majority of shipping companies should consider the port's loading and unloading capacity and hub when seeking partners. Finally, suggestions are made on the cooperation methods between port companies and shipping companies, and new reference ideas are provided.

Keywords

River-Sea Direct Transportation; K-means cluster analysis; ANP network hierarchy analysis; Decision suggestions.

1. Introduction

The concept of River-Sea direct development dates back to the 1920s. In 1980, the Rhine and Rhone rivers in Europe and the Mississippi river in the United States developed rapidly. River-sea direct transportation is an important part of world shipping, and many shipping developed countries attach great importance to river-sea direct transportation. In western Europe, the United States, Brazil and other developed countries (regions), River-sea direct transportation has reached a fairly high level.

At present, the Chinese Ministry of Transport has issued the "Three-year Action Plan for Deeply Promoting the Multimodal Transport Development of the Yangtze River Economic Belt" [1], which proposes to vigorously promote the development of River-Sea direct transportation. Focus on the development of the Yangtze River and the Yangtze River Delta to Ningbo-Zhoushan Port of bulk cargo and containers, the Yangtze River and the Yangtze River Delta to Shanghai Ocean Mountain container River-Sea direct transportation. Among them, it is clearly planned that by 2020, the Yangtze River Trunk Line, the Yangtze River Delta region to Ningbo Zhoushan Port, and the Shanghai Port Yangshan area will form a direct transportation system between rivers and seas, and further improve the water transport infrastructure system that directly connects trunks, branches, rivers and seas, and forms a network. Multi-modal transport service system of the Yangtze River Economic Belt with reasonable layout, optimized structure, perfect functions and interconnection.

With the rapid development of maritime logistics, the traditional way of transporting rivers and seas has become more and more difficult to adapt to the increasing demand for cargo transportation. In 2018, the country has successively introduced a series of policies and measures, including: Special ships whose construction specifications and draught can ensure the safety of navigation without being limited by the depth of the water; dredging the channel in the inland river section to increase the depth

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of the water and ensure the navigation of the ship; special training for the crew of River-Sea direct ships And issue a separate certificate.

The traditional mode of transport between the Yangtze River inland port and the outer port is river-sea combined transportation. In the Yangtze River inland section, due to the limitations of water depth, channel width, and port's equipment conditions, ships entering the river from the sea have to perform load shedding operations or load cargo Transit to river shipping, this mode of transportation with the participation of river and sea vessels is river-sea combined transportation. And this kind of transportation method not only lengthens the transportation time and transportation cost, but also increases the probability of cargo damage. In this case, the country has actively advocated the river-sea direct transportation method. The river-sea direct transportation mode refers to the use of special river-sea direct ships that are suitable for both river and sea in transportation. This mode of transportation can be carried from an inland river port to a seaport by only one ship. River-sea direct transportation can obviously shorten the transportation time and reduce the cargo loss rate and transportation cost. However, China's current river-sea direct transportation is in the initial stage with limited capacity and no corresponding standards. At present, the river-sea direct transportation plan is only for ports along the Yangtze River to Ningbo-Zhoushan Port or Shanghai Yangshan Port.

FENG et al. [2] calculated the dynamic model of port evolution under the influence of major events based on the development situation after the merger of Ningbo-Zhoushan Port, and predicted the development of Ningbo-Zhoushan Port in the future. Shi Lijuan et al. [3] used ANP network analytic hierarchy process to carry out risk assessment for infinitely closed centers. Wu Dajian [4] also used the ANP network analytic hierarchy process to analyze the risk decision in water conservancy projects, and found the most critical factors. Chen et al. [5] used the network analytic hierarchy process to analyze the distribution of supplier purchases and find out the key factors affecting their decision-making. ZENG et al. [6] constructed the model by analyzing the impact of China 's Belt and Road Initiative, and analyzed the geographical location of the Clark Canal and the surrounding ports to find out the evolution rules of the surrounding ports. Yue Chi [7] analyzed the cargo types and port conditions in Wuhan port, and then carried out cost analysis for different types of goods by using three modes of transportation: river-sea direct transport and river-sea combined transport, and 'mother-child ship'. Superiority and development suggestions. Peng Yun [8] analyzed the port supply chain under uncertain conditions and optimized port resources with the goals of lowest operating costs and lowest carbon emissions. Wang Yan [9] aimed at how the port made M & A investment decisions from the perspective of the supply chain, and provided strong support for the decision of Dalian Port. Duan Liwei [10] analyzed the symbiotic relationship and stability of ports and coal enterprises based on the symbiotic theory and provided decision-making suggestions for its proper development. MARCO et al. [11] optimized a K-means clustering method and derived a new efficient clustering method. MENG et al. [12] pointed out that when using K-means clustering analysis to cluster the targets, realistic factors should be considered, and the results of cluster analysis should be improved based on the realistic factors.

2. Brief introduction and classification of Yangtze River ports and River-Sea direct ships

2.1 Main ports in the Yangtze River and related data

The Yangtze River waters originated from Tibet, and eventually merged into the East China Sea from Shanghai to the West. The Yangtze River is an important waterway in China. It connects the three regions of eastern, central and western China. The total area of the Yangtze River Basin is 1.8 million square kilometers. At present, the Yangtze River has more than 70,000 kilometers of navigational routes, and the freight volume accounts for 60% of the country's core freight volume. It occupies a unique geographical factor and navigation conditions. The main navigable sections have no icing period, navigable in the four seasons, and high shipping value. The rainfall in the area is large, so the runoff is large, the water level is deep, and the navigation capacity is strong. The downstream areas

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mainly flow through The plain area has a small height difference and convenient shipping. These conditions together shape the great economic value of the Yangtze River Basin.

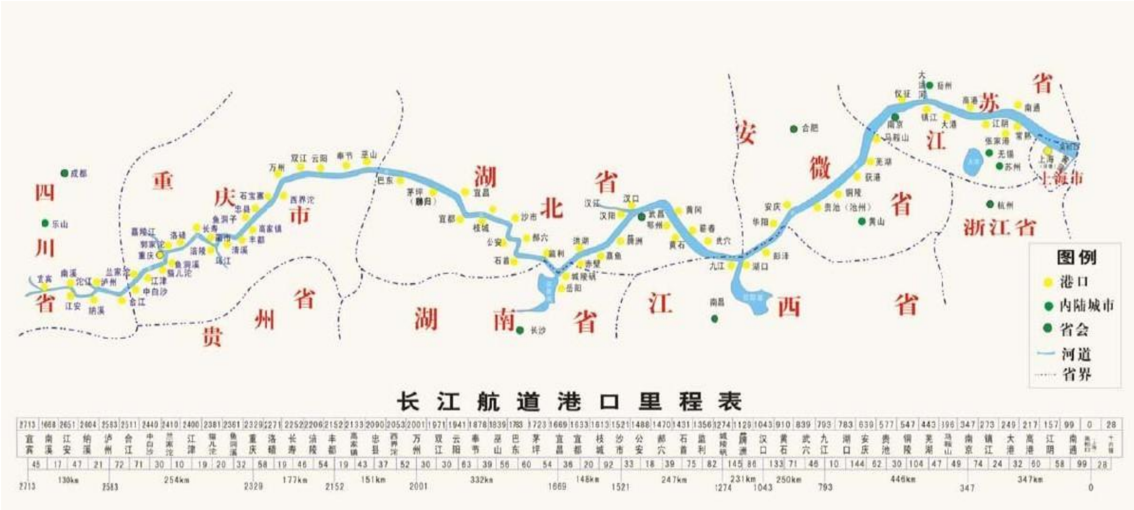

Figure 1 Schematic diagram of the Yangtze River waterway port

As of October 2018, the total foreign trade throughput of ports in the Yangtze River Basin was 118654 t, and the total cargo throughput was 386544.1 t. The data of each port is shown in Table 1.

Table1 Throughput of major ports in the Yangtze River Basin in October 2018

port	Cargo throughput		Foreign trade cargo throughput	
	Throughput of the month / 10,000t	Cumulative throughput from January to October / 10,000t	Throughput of the month / 10,000t	Cumulative throughput from January to October / 10,000t
Shanghai port	6234.9	61007.9	3324.1	33617.3
Ningbo-ZhouShan port	8761.7	91595.1	4107.4	41715.7
Ningbo area	4655.6	48768	2731.8	28992.3
Zhousahn area	4106.1	42827.1	1375.7	12723.4
Jiaxing port	732.8	8153.9	97.8	1029
Taizhou port	625	6217	61.97	535.4
Wenzhou port	532.4	7068.4	32.4	464.6
Huzhou port	990.5	8779.2	13.5	140.2
Lianyungang port	1994.9	19703.3	1035.4	9946.8

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Nantong port	2527.9	21603.8	494	5063.2
Suzhou port	4598.3	44438.5	1257.7	11701.5
Zhangjia gang area	2048.6	19665.1	503.6	4639.3
Changsh u area	589.1	5800	106.6	1029.5
Taicang area	1951.6	18973.5	647.5	6032.7
Taizhou port	2442.7	20143.2	197.3	1851.1
Jiangyin port	1489.5	14635.7	413.7	3723.8
Changzh ou port	873.9	8460.7	83	785.7
Zhenjian g port	1347.9	12707.8	356.2	3203.4
Yangzho u port	1024.93	9731	85.13	926.5
Nanjing port	2178	21314	253	2628
Maansha n port	899.4	8670.5	100.7	998
Wuhu port	1355.1	10000.7	20.2	260.4
Tongling port	839.7	8186.8	2.6	27
Hefei port	430.9	4056.6	2.1	36.5
Total	39871.4	386544.1	11938.1	118654
Note: The data in the table are from the monthly port throughput report issued by China Port Network.				

The upstream area of Yichang Port is affected by the Three Gorges Dam and the navigation conditions are more complicated. Therefore, in this paper, the main ports in the downstream area of Yichang Port are mainly considered.

For specific data, please refer to the statistics on port cargo, container, and passenger throughput statistics of the above-scale ports published by China Port Network every month. Refer to the port cargo throughput data from January 2018 to January 2019 to calculate each month The average increase in throughput is selected. After selecting the peak value of the throughput of a single port and calculating the increase, an approximate throughput of each port is obtained. With reference to the weekly channel size forecast, annual water depth plan and monthly water depth plan issued by the Yangtze River Waterway Bureau, the final data is shown in the following table:

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Table 2 Throughput forecast and water depth data of major ports

port	Throughput / 10,000t	Water depth / m
Suzhou port	4770	12.5
Taizhou port	2286	12.5
Nantong port	2600	12.5
Nanjing port	2300	12.5
Zhenjiang port	1914	12.5
Changzhou port	439	12.5
Jiangyin port	1823	12.5
Yangzhou port	905	12.5
Maanshan port	950	9
Wuhu port	1180	7.5
Shanghai port	6010	15
Ningbo-zhoushan port	9809	18.2
Wuxi port	484	12.5
Tongling port	632	7.5
Anqing port	176	5.5
Chizhou port	348	7.5
Jiujiang port	569	5.5
Wuhan port	426	5
Huangshi port	229	4.5
Baochang port	306	4
Jingzhou port	201	4
Yueyang port	722	4

2.2 Relevant data of River-sea direct ship

The River-sea direct ship is a new type of ship that is different from the traditional river ship and sea ship. In popular terms, it can break through the restrictions of the sea area under the traditional mode. The Yangtze River can also sail smoothly. The new River-sea direct ship is between the river ship and the sea ship in terms of strength requirements and equipment configuration. On April 10, 2018, the first domestic 20,000-ton River-sea direct ship "Jianghai Zhida No. 1" successfully arrived at Maanshan Port and successfully completed its first voyage [13]. This incident marks the official establishment of the third set of shipbuilding standards in China, in addition to inland watercraft and marine vessels, and it also means that China's direct sea-to-sea transportation has officially entered the implementation stage.

The specifications of River-sea direct ships have been planned in detail in the “Standard Series of River-sea direct Cargo Ships” series implemented by the National Standards Committee since November 1, 2009, as shown in Table 3.

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Table 3 Type size of River-sea direct cargo ship

Tonnage / ton class	Length/m	Width/m	Design Draught / m	Designed cargo capacity / t	Host power / kW
1000	60.00	11.30	3.40	1000	2X294
2000	79.00	14.10	4.00	2000	2X441
3000	84.00	15.70	4.20	3000	2X570
5000	100.00	18.00	5.20	5000	2X750
7000	105.60	18.60	5.46	7000	2X993
10000	114,00	20.00	6.00	10000	2X1072
12000	128.00	22.60	6.30	12000	2X1324
19000	149.80	24.20	8.00	19000	2X2206
23000	149.80	24.40	9.80	23000	2X2800

2.3 Classification of ports and ships

K-means clustering algorithm is an algorithm that is solved through a large number of iterative calculations. In order to finally classify the data, firstly randomly select N objects as the initial clustering centers, then calculate the distance between each object in the data and each seed clustering center, and then assign the objects to the clusters closest to them At the center of the class. The cluster centers and the objects assigned to them at this time represent a cluster. When all data objects have been allocated, the cluster center of each cluster will be recalculated based on the existing objects in the cluster. This process is repeated until no new objects are assigned to other clusters or the cluster center no longer changes.

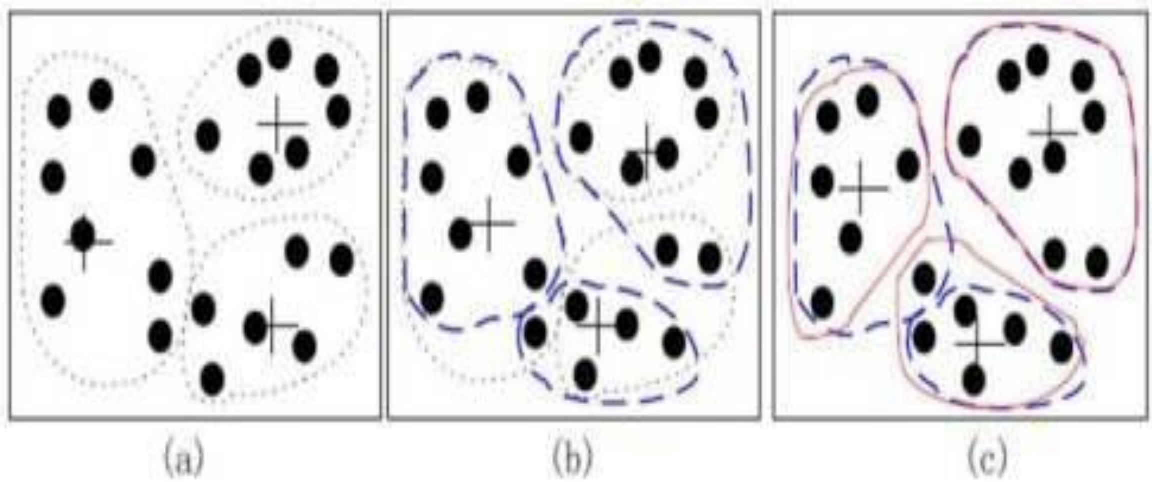

Figure 2 K-means clustering analysis

Due to the large number of ports in the Yangtze River Basin, the differences between the ports and ports due to differences in geographical location, channel conditions, and facility levels are huge. The gap between the middle and lower reaches of the Yangtze River is particularly huge, which makes not every port suitable. Develop River-sea direct transportation, In order to further study the applicability of river-sea direct ships, this paper will use the K-means clustering method to classify many ports and river-sea direct ships from the perspective of throughput and port depth. Transport and types of direct ships suitable for regional development in different ports.

In order to reasonably classify the ports in the Yangtze River Basin from Yichang Port to the estuary, this article explores the influence of the number of clusters on the two factors of the port depth and

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port throughput, and the values of the parameters corresponding to the ship's tonnage and draft. The SPSS software was used to obtain the values corresponding to the two parameters in the case of different numbers of clusters through the k-means clustering method.

Table 4 Data of two factors when each port is divided into three clusters

parameter name	Clustering		
	1	2	3
Monthly throughput	5390.00	973.16	9809.00
Minato Water Depth	13.75	8.63	18.20

Table 5 Data of two factors when each port is divided into four clusters

parameter name	Clustering			
	1	2	3	4
Monthly throughput	5390.00	2184.60	9809.00	540.50
Minato Water Depth	13.75	12.50	18.20	7.25

Table 6 Data of two factors when each port is divided into five clusters

parameter name	Clustering				
	1	2	3	4	5
Monthly throughput	4770.00	540.50	2184.60	9809.00	6010.00
Minato Water Depth	12.50	7.25	12.50	18.20	15.00

Table 7 Data of two factors when each port is divided into six clusters

parameter name	Clustering					
	1	2	3	4	5	6
Monthly throughput	4770.00	939.25	6010.00	9809.00	2184.60	381.00
Minato Water Depth	12.50	8.25	15.00	18.20	12.50	6.85

Due to the improvement of the Yangtze River Channel by the Yangtze River Waterway Bureau, on May 8, 2018, a deep water channel of 12.5 meters below Nanjing on the Yangtze River was officially commissioned and opened to ships at home and abroad. Ships of 50,000 tons and below can reach the Nanjing Port directly through the Yangtze River inlet. Therefore, based on Table 7, the first cluster is merged with the third cluster and the fourth cluster, and finally the cluster analysis results of each port are shown in Table 8.

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Table 8 Cluster analysis results of each port

cluster	Port
1	Suzhou port、shanghai port、Ningbo-zhoushan port
2	Yangzhou port、Maanshan port、Wuhu port、Yueyang port
3	Taizhou port、Nantong port、Nanjing port、Zhenjiang port、Jiangyin port
4	Changzhou port、Wuxi port、Tongling port、Anqing port、Chizhou port、Jiujiang port、Wuhan port、Huangshi port、Yichang port、Jingzhou port

In the same way, cluster analysis can be performed on ships with direct river and sea capacity based on their deadweight and draught. The final result is shown in Figure 9.

Table 9 Cluster analysis results of various types of ships

cluster	Ship tonnage
1	1000 tonnage、2000 tonnage、3000 tonnage
2	5000 tonnage、7000 tonnage、10000 tonnage、12000 tonnage
3	19000 tonnage、23000 tonnage

In Table 9, the draft of the first cluster of ships is about 4 meters, the draft of the second cluster is about 5.74 meters, and the draft of the third cluster is about 8.9 meters. Through the analysis of the water depth of the port areas of each cluster in Table 8, it can be concluded that Shanghai Port and Ningbo-Zhoushan Port of the first cluster of ports are in the open sea, and both the water depth and the port's loading and unloading capacity can be analyzed. Large sea vessels are in operation. Suzhou Port (including Zhangjiagang Port, Changshu Port and Taicang Port) is located at the mouth of the Yangtze River. It has long served as a transit port for river-sea combined transportation. The loading and unloading capacity and water depth can also meet the needs of large sea vessels. Therefore, for the ports in the first cluster, the presence of direct sea-going ships will not have a significant impact on their ports; for the ports in the second cluster, their geographical locations are all in the middle and upper reaches of the Yangtze River, and the water depth in the port area It will be affected by the dry season and the high season of the Yangtze River, but it can guarantee the maintenance of water depths above 7 meters. Its port has a good loading and unloading capacity and good connectivity with inland areas. It actively cooperates with shipping companies and launches policies to attract river-sea direct ships. The docking of direct ships can significantly improve port throughput; for the ports in the third cluster, their geographical locations are all downstream of Nanjing Port, maintaining water At 12.5 meters, but the factors restricting its development are mainly port facilities and connectivity with the inland. Therefore, while improving the level of port loading and unloading, policies can be appropriately introduced to attract ships from rivers and seas to dock; because the ports in the fourth cluster are subject to navigation Due to the limitation of water depth and port loading and unloading capacity, only small and medium-sized river-sea direct ships in Table 9 can be developed according to specific conditions. The summary is shown in Table 10.

Table 10 Development Strategies for Ports in Clusters

ship \ port	1	2	3
1	Not suitable for development	Not suitable for development	Not suitable for development
2	very suitable	very suitable	very suitable
3	Generally suitable	Generally suitable	Generally suitable

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4	Not suitable for development	Generally suitable	Generally suitable

3. Analysis of shipping company decision examples

3.1 ANP network analytic method

The network analysis method is a decision-making method adapted to the non-independent hierarchical structure proposed by Professor T.L.Saaty of the University of Pittsburgh in 1996. It is a new form of development based on the analytic hierarchy Practical decision-making methods.

First of all, we must determine different plans and standards. There is a mutual influence between the standards and plans. We construct judgment matrices in different situations and solve their normalized feature vectors to form a limit super matrix. Solve to obtain the weight factors of different standard plans, and finally summarize them.

3.2 Case hypothesis

China Changjiang Shipping (Group) Corporation (Changhang Shippings for short) is the largest backbone shipping enterprise group in China. Changjiang Shippings takes river-sea transportation as its core competence. It is the only shipping company in China that can realize ocean, coastal, Yangtze, and canal logistics services. It is also one of the country's first 57 pilot enterprise groups and planned enterprise groups. Mainly engaged in dry bulk, liquid cargo, container transportation on the Yangtze River, river-sea combined transportation, and land-based combined transportation. Has a capacity of 762 ships, 2.06 million dwt. Among them, 344 own transport ships, 1.73 million dwt, including: 172 dry bulk carriers, 1.21 million dwt; 113 liquid carriers, 360,000 dwt; 31 container ships, 9,726 TEU. In addition, it has used more than 2 million deadweight tons of social capacity through continuous voyage chartering and other methods. In 2017, the freight volume was 112 million tons. The scale of Yangtze dry bulk cargo capacity, freight volume, transportation revenue and profit are all leading peers; Yangtze River liquid cargo heavy crude oil transportation is in an absolute dominant position; container transportation is third in the upper reaches of the Yangtze River, fifth in the middle reaches, and first in the downstream barge market.

Under the situation that the state has promulgated policies to vigorously promote the development of river-sea direct transportation, Changhang Group, as the largest backbone shipping company in China's domestic rivers, naturally must actively respond to national policies. However, the primary purpose of business operation is to make a profit. The cost of a new type of direct sea-going ship is high. Blind purchase may cause the company's cash flow shortage. Therefore, the best way for Changhang Company is to choose port companies to cooperate. In the cooperation with port enterprises, mutual benefits are achieved. The new ships of Changhang Group will call the cooperative port as the home port, and the port side will also make appropriate preferential policies for the docking of ships under Changhang Company. In this way, it can not only solve the problem of cash flow shortage caused by the development of new-type ships by Changjiang Shippings, but also for the port side, it can increase its own annual throughput figures and increase profit margins. This cooperation model will quickly seize the market and increase corporate reputation and government credit in the emerging stage of the River-sea direct transportation model, which is a good win-win model.

Therefore, Changhang Company should consider various factors when choosing a port party for cooperation, firstly the port's loading and unloading capacity, secondly the port's hub and port area navigation channel conditions. Based on the cluster analysis results of the ports in the Yangtze River in the previous chapter, Yangzhou Port, Maanshan Port, Wuhu Port, and Yueyang Port can be initially listed as optional schemes. From the three criteria of loading and unloading capacity, hub and channel conditions To carry out the ANP network level analysis, and finally make a judgment based on the solved weight factors.

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First, judgement matrices are constructed under three different standards, and then matlab is used to perform normalized eigenvector solution and consistency ratio test, the result is shown in Table 11, Table 12 and Table 13.

Table 11 Judgment matrix under loading and unloading capacity standards

Loading and unloading capacity standards	Yangzhou port	Maanshan port	Wuhu port	Yueyang port	Normalized eigenvector	Consistency ratio
Yangzhou port	1	$\frac{9}{10}$	$\frac{7}{10}$	$\frac{5}{4}$	0.231	0.00026
Maanshan port	$\frac{10}{9}$	1	$\frac{4}{5}$	$\frac{10}{7}$	0.260	
Wuhu port	$\frac{10}{7}$	$\frac{5}{4}$	1	$\frac{5}{3}$	0.322	
Yueyang port	$\frac{4}{5}$	$\frac{7}{10}$	$\frac{3}{5}$	1	0.187	

Table 12 Judgment matrix under channel conditions

channel conditions	Yangzhou port	Maanshan port	Wuhu port	Yueyang port	Normalized eigenvector	Consistency ratio
Yangzhou port	1	$\frac{10}{7}$	$\frac{5}{3}$	$\frac{10}{3}$	0.385	0.0004
Maanshan port	$\frac{7}{10}$	1	$\frac{5}{4}$	$\frac{9}{4}$	0.272	
Wuhu port	$\frac{3}{5}$	$\frac{4}{5}$	1	2	0.227	
Yueyang port	$\frac{3}{10}$	$\frac{4}{9}$	$\frac{1}{2}$	1	0.116	

Table 13 Judgment matrix under port hub standards

port hub standards	Yangzhou port	Maanshan port	Wuhu port	Yueyang port	Normalized eigenvector	Consistency ratio
Yangzhou port	1	$\frac{3}{4}$	$\frac{3}{5}$	$\frac{3}{2}$	0.214	0
Maanshan port	$\frac{4}{3}$	1	$\frac{4}{5}$	2	0.286	
Wuhu port	$\frac{5}{3}$	$\frac{5}{4}$	1	$\frac{5}{2}$	0.357	
Yueyang port	$\frac{2}{3}$	$\frac{1}{2}$	$\frac{2}{5}$	1	0.143	

Then, the judgment matrices of each port under the three indicators are constructed, as shown in Table 14, Table 15, Table 16 and Table 17.

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Table 14 Judgment matrix of various indicators of Yangzhou Port

Various indicators of Yangzhou Port	port hub standards	channel conditions	unloading capacity standards	Normalized eigenvector	Consistency ratio
port hub standards	1	$\frac{15}{4}$	$\frac{3}{2}$	0.345	0
channel conditions	$\frac{4}{15}$	1	$\frac{2}{5}$	0.138	
unloading capacity standards	$\frac{2}{3}$	$\frac{5}{2}$	1	0.345	

Table 15 Judgment matrix of various indicators of Maanshan Port

Various indicators of Maanshan Port	port hub standards	channel conditions	unloading capacity standards	Normalized eigenvector	Consistency ratio
port hub standards	1	$\frac{4}{3}$	$\frac{2}{3}$	0.308	0
channel conditions	$\frac{3}{4}$	1	$\frac{1}{2}$	0.231	
unloading capacity standards	$\frac{3}{2}$	2	1	0.461	

Table 16 Judgment matrix of various indicators of Wuhu Port

Various indicators of Wuhu Port	port hub standards	channel conditions	unloading capacity standards	Normalized eigenvector	Consistency ratio
port hub standards	1	$\frac{1}{2}$	$\frac{2}{5}$	0.182	0
channel conditions	2	1	$\frac{4}{5}$	0.364	
unloading capacity standards	$\frac{5}{2}$	$\frac{5}{4}$	1	0.454	

Table 17 Judgment matrix of various indicators of Yueyang Port

Various indicators of Yueyang Port	port hub standards	channel conditions	unloading capacity standards	Normalized eigenvector	Consistency ratio
port hub standards	1	2	2	0.500	0
channel conditions	$\frac{1}{2}$	1	1	0.250	

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unloading capacity standards	$\frac{1}{2}$	1	1	0.250	

Then consider the interaction between the three characteristics of the hub, channel conditions and loading and unloading capacity, and finally get the weight matrix of the three as shown in Figure 18.

Table 18 Weight matrix for the interaction between hub, channel conditions and loading and unloading capacity

	port hub standards	channel conditions	unloading capacity standards
port hub standards	0.3	0.2	0.6
channel conditions	0.4	0.25	0.3
unloading capacity standards	0.3	0.55	0.1

Through the integration of the above table data, the limit matrix W can be obtained, and then the stable processing of the limit matrix (the model does not consider the weighting operation).

Table 19 Limit matrix W

	Yangzhou port	Maanshan port	Wuhu port	Yueyang port	port hub standards	channel conditions	port hub standards
Yangzhou port	1	0	0	0	0.231	0.385	0.214
Maanshan port	0	1	0	0	0.260	0.272	0.286
Wuhu port	0	0	1	0	0.322	0.227	0.357
Yueyang port	0	0	0	1	0.187	0.116	0.143
port hub standards	0.345	0.308	0.182	0.500	0.3	0.2	0.6
channel conditions	0.138	0.231	0.364	0.250	0.4	0.25	0.3
port hub standards	0.345	0.461	0.454	0.250	0.3	0.55	0.1

Table 20 Final results

	Yangzhou port	Maanshan port	Wuhu port	Yueyang port	port hub standards	channel conditions	port hub standards
Yangzhou port	0.4731	0.4731	0.4731	0.4731	0.4731	0.4731	0.4731
Maanshan port	0.4543	0.4543	0.4543	0.4543	0.4543	0.4543	0.4543
Wuhu port	0.5100	0.5100	0.5100	0.5100	0.5100	0.5100	0.5100

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Yueyang port	0.2533	0.2533	0.2533	0.2533	0.2533	0.2533	0.2533
port hub standards	0.5866	0.5866	0.5866	0.5866	0.5866	0.5866	0.5866
channel conditions	0.4909	0.4909	0.4909	0.4909	0.4909	0.4909	0.4909
port hub standards	0.5772	0.5772	0.5772	0.5772	0.5772	0.5772	0.5772

3.3 Analyzed

After carrying out ANP network hierarchy analysis on Changhang Company in the above case, it can be concluded that:

(1) The best cooperative port of Changhang Company in the case is Wuhu Port.

(2) When choosing a port for cooperation, the port side's loading and unloading capacity and hub are important considerations, and they are almost equally important.

4. Conclusion

In the previous article, the suitability of the Yangtze River Basin ports for the new river-sea direct transport mode was analyzed, and a cluster of ports most suitable for development was selected for case analysis. Finally, decision-making recommendations were made based on the results of the network analytic method . At present, there are still many problems in the development of direct sea-to-sea transportation in the Yangtze River Basin, including:

(1) The logistics network in the Yangtze River Basin has basically been formed, and the development of new direct sea-to-sea transportation requires the development of entirely new business relationships.

(2) During the dry season of the Yangtze River, it will affect the normal operation of large river-to-sea direct vessels.

(3) At present, the number of direct ships in Jianghai is relatively small, and the capacity is insufficient.

(4) Enterprises cannot purchase a large number of Jianghai direct ships due to capital restrictions.

(5) Lack of crew with relevant professional skills.

In order to solve the above problems, the cooperation of the government, shipping companies and ports is needed to effectively solve them. The government should strengthen financial support and policy support for shipping companies to purchase direct sea-to-sea ships, and strengthen dredging operations on the Yangtze River Channel to ensure the navigation capacity of the Yangtze River Channel. In this way, the "Three-year Action Plan for Deeply Promoting Multimodal Transport Development in the Yangtze River Economic Belt" can be fully realized.

Shipping companies should also actively cooperate with ports, and cooperate with port enterprises for mutual benefit. Combined with the cooperation model mentioned in the second section of this article, when selecting partners, focus on the port loading and unloading capacity and port hubs. point. The cooperation between shipping companies and port companies is an effective way to effectively promote the common prosperity of the two companies. Not only can it bring considerable economic profits to the companies on both sides, but it can also quickly complete the seizure of market resources in the early stage of the market and actively respond to the national call. Therefore, it is recommended that the shipping companies actively participate in the negotiation and cooperation with the port side and work together for common development.

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