



Port Integration in the Yangtze River Delta Area: Practice and Policy Analysis

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Abstract: Port integration in the Yangtze River Delta (YRD) is studied in the paper from the practice and policy analysis in the case when port supply surpasses shipping demand. Firstly, combined with literature analysis method and comparative approach, the port integration practice in YRD is investigated from a holistic view of YRD, especially the provincial port integration in YRD -- larger-scale port integration is discussed, detailed analysis and comparison of each mode of port integration in YRD are made from the aspects of dominant power, territorial scope, realization path, and focus of integration, the result shows that the integration degree of Shanghai port is the highest but hard to be duplicated. Then, the current existing problems in the process of the port integration are collated and examined with qualitative methods, such as fragmented governance and lack of a strong regulatory structure, lack of long-term cooperation mechanism, insufficient implementation strength on port division of labor and positioning, weak soft power of the port cluster, abnormal development of collection and distribution system, low international cargo transshipment ratio restricts the development of Shanghai International Shipping Center (SISC), etc. Aiming to the problems, reasonable and feasible suggestions are proposed from the policy level for the reference of decision-makers, for instance, breaking the administrative barriers by establishing joint port authority, improving the mechanism for port cooperation, strengthening the rigor of planning, accelerating the SISC construction by adjusting cargo structure and enhancing soft power, improving the collection and distribution logistics network, improving FTZs and aligning national strategies to raise the international cargo transshipment ratio, etc.

Keywords: Port Cluster, Integration Mode, Policy Support

1. Introduction

Ports have always been a key element of world's economic development. In this severe challenge of fighting against the epidemic of COVID-19 and resuming work and production, the recovery of the port is a signal of restoring vitality and transmitting the strength of economic recovery. Since the central government decentralized port governance to municipal or local authorities in 2001, the port cities in China have invested heavily in expanding their ports' capacities with the aim of "revitalizing with the port gateways" [1, 2]. However, due to the lack of unified planning, the ports have been gradually faced with grim competitions, and the port industry in China is suffering from various challenges, such as idleness of port assets and oversupply of port capacity. Furthermore, with the slowdown in the growth of shipping demand in recent

years, the above issues have become increasingly serious [3]. Currently, the situations of oversupply and wasting port resources are becoming common phenomena in the Chinese port industry. What's more, with the rapid development of the world economy, the competition among international ports gradually presents the competition among port clusters, and this competition is gradually intensified. As the biggest one among the five coastal port clusters in China from north to south which are delineated by the National Plan for the Layout of Coastal Ports, YRD port cluster has been suffering from such issues the most serious due to it has the largest density of ports.

From the perspective of administrative region, YRD area includes Jiangsu province, Zhejiang province, Anhui province (included in 2015) and Shanghai municipality with provincial-level status. The YRD port cluster includes all ports located in this region. Relying on the unique

geographical advantages of the intersection of the trunk lines of China's north-south waterways and the Yangtze River, it

has become the port cluster with the largest density of ports and shipping routes in the world (Figure 1).

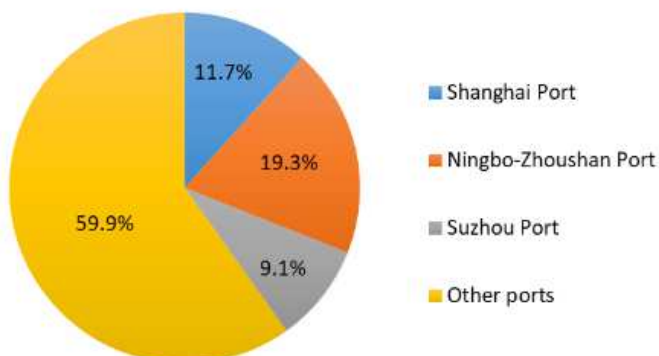


Figure 1. Diagram of the YRD port cluster.

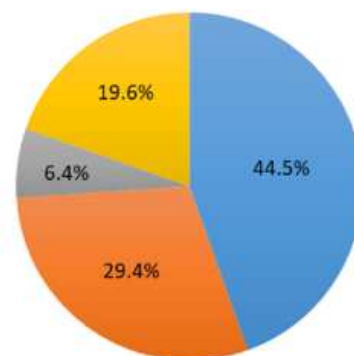
In fact, YRD port cluster has also become the biggest port cluster all over the world in term of port throughput. Figure 2 illustrates the port throughput proportion status in YRD currently. It presents a serious polarization pattern. Shanghai port, Ningbo-Zhoushan port and Suzhou port are the top three in YRD. However, Shanghai port and Ningbo-Zhoushan port take a strong leader position. From the perspective of cargo throughput, a measure of port scale, the proportions of the two ports all surpass 10%; From the perspective of container throughput, a measure of port

quality, the proportions of the two ports are even higher, Shanghai port has always maintained the lead, accounting for 44.5%, followed by Ningbo-Zhoushan port, whose proportion is 29.4%. The two ports are the main market force of the YRD ports cluster. The container throughput proportions of other ports are relatively low, thus basically in the position of feeder. Therefore, the core of the port integration in YRD is to deal with the integration of Shanghai port and Ningbo-Zhoushan port.

Cargo throughput proportion



Container throughput proportion



Source: Compiled according to the data released by the MOT¹ & COSCP².

Figure 2. Port throughput proportion in YRD in 2020.

1 Standard name: Ministry of Transport of the People's Public of China.

2 Standard name: Commission Office of Shanghai Combined Port.

For effectively solving the issues mentioned above, port cities and operators in YRD have been working diligently to implement port integration and port cooperation in the past years. However, the results have not satisfied the expectations, more effective measures need to be formulated and implemented. For the purpose of promoting the integration in YRD by proposing proper suggestions, some issues still need to be further discussed and analysed. What are the main modes of the port integration in YRD? What problems existing in the process of the integration? How to address these problems by the decision-makers?

Aiming to the above questions, this paper explores the modes of port integration existing in YRD currently and compares them so as to find out the advantages and disadvantages of each mode. Then the existing problems in the process of the integration are expounded thoroughly from various aspects taking a holistic view of the YRD. In view of the above problems, the paper puts forward some constructive suggestions on policy level for decision-makers' reference.

The rest of this paper is organized as follows: In Section 2, we provide a literature review and point out the contributions of our work. In Section 3, modes of the port integration in YRD are studied, analysed and compared; In Section 4, problems existing in the process of the port integration in YRD are collated and analysed, and constructive suggestions at policy level are proposed. Finally, conclusions and prospects for future research are summarized in Section 5.

2. Literature Review

Lee and Song (2017), Huo et al. (2018), and Notteboom et al. (2018) indicate that port integration is an emerging and hot topic in maritime economic and port management studies [4-6]. In recent years, scholars have done many studies on the port integration and cooperation in different regions around the world, especially in YRD.

Ng (2013), Notteboom et al. (2009), Tang (2010) discuss the cooperation among competing ports, especially the ports in proximity, is often regarded as a practical strategy to avoid the destructive inter-port competition and the disorderly or extravagant planning and construction [7-9]. Lam et al. (2013), Song and Panayides (2008) discuss the necessity of port cooperation and integration, and point out more and more attention has been paid to the ways of port cooperation and integration [10, 11]. Ruan et al. (2018) propose a port service network that consists of a large hub and multiple ports, where the small and medium ports can share their capacities with the hub ports if the service capacities are integrated into the network. Then, a mixed integer nonlinear programming model is developed to determine the optimal capacity integration in such a network [12]. On the bases of maximizing the social welfare of the external transport system, Guo et al. (2018) propose a multiperiod investment and withdrawal integration mechanism which focuses on addressing the issue of port oversupply by realizing the

maximal social welfare of a closed R-MPG (region with multiport gateways) [13]. Based on the study of Guo et al. (2018), Yang et al. (2018) propose a method for determining the optimal scale of a port cluster in a general closed R-MPG based on continuous location theory and design a multiperiod investment and withdrawal scheme to integrate the ports in a closed R-MPG considering the impact of port industry transformation and upgrade [14].

As to the port integration in YRD, Wang and Ducruet (2012) define the Shanghai–Yangshan dual hub port mode and a pattern of polycentric yet more compact multifunctional and multilayered gateway centered upon Shanghai [15]. Feng et al. (2019) analyse the spatio-temporal evolution of Ningbo-Zhoushan port growing from a feeder port to a hub port finding the historical pathways followed by its expanding in terms of container throughput capacity and total traffic [16]. Wang and Brian (2004) analyse the case of YRD, where the co-operation and governance of Shanghai and Ningbo [17]. Li and Oh (2010) also do a research on competition and cooperation between Shanghai Port and Ningbo-Zhoushan Port and examine that both ports would benefit from cooperation rather than competition [18]. Several chapters in Cullinane and Song (2007) are dedicated to the competition and cooperation issues in YRD [19].

This paper is different with the aforementioned studies in the following aspects:

Firstly, rather than the studies only limited to single small-scale integration, such as Ningbo-Zhoushan Port (e.g., Dong et al., 2018; Feng et al., 2019) [20, 16], this paper systematically collates the modes of port integration existing in YRD currently from a holistic view of YRD. Especially the provincial port integration in YRD -- larger-scale port integration is discussed and analysed in detail, and its integration modes are explored and compared, thus the advantages and disadvantages of each mode are clarified. By studying the port integration in YRD from a broader perspective, it lays a solid theoretical foundation for the whole port integration in YRD from the framework, besides, it provides practical references for the decision-makers to determine the modes of port integration in YRD to be adopted in the future. What's more, the existing problems which impede or restrict the development of the integration are expounded thoroughly from various aspects thus providing clear targets for the decision-makers to focus on and reform. They are the basis of the measures to be formulated by the decision-makers. While policies often play a decisive role in port integration due to China's political system and the dominant position of governments, aiming to the existing problems above, reasonable and feasible suggestions from policy level are put forward in the paper, such as establishing "YRD Joint Port Authority", aligning national strategies, etc., so as to provide references for the decision-makers to address these problems thoroughly and fundamentally, thus substantially realizing the port integration in YRD.

3. Modes of the Port Integration in YRD

In recent years, YRD port industry has entered a round of port reform, which takes the substantial integration of provincial port resources. In the current administrative hierarchy structure of China, the provincial governments have good macroeconomic coordination ability, and have direct leadership functions to the municipal and county governments, thus have become the main promoters of the integration of regional port resources. Particularly necessary to point out that the port integration scheme of Shanghai is made and promoted by the state according to the national strategy of building Shanghai International Shipping Center (SISC), instead of being decided and promoted by the Shanghai municipal government alone. Therefore, the port integration mode of Shanghai is quite different from those of other provinces and needs to be analysed separately.

3.1. Port Integration Practice of Shanghai Municipality

For the purpose of building Shanghai into an international shipping center and addressing the problem that the water depth of Shanghai is not enough to meet the needs of modern ocean transport ships under the trend of upsizing of container transportation, the State Council (China's Central Government) made an important strategic decision in 2001 to build Yangshan deep-water port as the offshore hub of Shanghai port, which complies with related theoretical researches [21-23]. However, Yangshan islands (Figure 3) are not under the jurisdiction of Shanghai municipality, but Zhejiang province. Through the coordination of the State Council, the right to use and manage Yangshan port belongs to Shanghai, and the administrative subordination relationship remains unchanged. All the pilotage income of Yangshan port belongs to Zhejiang. Residents on the original islands would be resettled by Shanghai if they like. This also realized the preliminary cooperation between Shanghai and Zhejiang on port integration. In June 2002, Yangshan deep-water port officially commenced to be constructed. When the first phase of the project was completed and put into operation at the end of 2005, Shanghai port achieved 'cross the river into the sea'. Since then, its container throughput has been soaring, overtaking Hong Kong as the world's second largest port in 2007 and surpassing Singapore to become the world's largest container port in 2010. In December 2017, the fourth phase of the project was completed and put into operation, which became the largest single fully-automated container terminal with the highest degree of comprehensive automation in the world. In 2020, the container throughput of Yangshan port area reached 20.222 million TEU, almost close to the combined container throughput of all US ports. The completion and operation of Yangshan deep-water port has further established Shanghai's status as an international shipping center and strongly supported the development of the urban belt in YRD with Shanghai as the core. Several cities in YRD have built new logistics facilities, such as numerous logistics parks in

Shanghai, Suzhou, Nanjing, Changzhou and Wuxi. Dedicated rail services have been established between Shanghai and the hinterlands (e.g., Nanjing, Chengdu, Hefei, Bengbu, Changsha, Xi'an, Zhengzhou, Chongqing, Yiwu, Wenzhou, Ningbo, Nanchang, and Zhuzhou). Most cargoes move a short distance; the cargoes coming from Yangtze River valley currently account for 95% of Shanghai's rail-sea integrated traffic.



Figure 3. The location of Yangshan Port.

3.2. Port Integration Practice of Zhejiang Province

Port integration of Zhejiang began with the integration of Ningbo port and Zhoushan port due to the two ports are complementary in many aspects as shown in Table 1. The government of Zhejiang province established the Ningbo-Zhoushan Port Management Committee (NPMC) on December 20, 2005, who was authorized to be responsible for the planning, management, development and construction of the two port areas according to the principle of "unified planning, unified construction, unified brand and unified management". Since January 1, 2006, the name of "Ningbo-Zhoushan port" has been officially used instead of the original names of "Ningbo port" and "Zhoushan port". In August 2015, Zhejiang province established a substantive port governing body at the provincial level -- Zhejiang Seaport Development Committee (ZSDC), and built Zhejiang Provincial Seaport Investment & Operation Group Co., Ltd (ZPSIOG) through integrating related assets. In September 2015, Ningbo Port Group Co., Ltd (NPG) and Zhoushan Port Group Co., Ltd (ZPG) merged into Ningbo Zhoushan Port Group Co. Ltd (NZPG) through shareholding. In December 2015, the assets of NZPG were injected into ZPSIOG, becoming a wholly-owned subsidiary of ZPSIOG. In 2016, the assets of Jiaxing port, Wenzhou port, Taizhou port, and Yiwu dry port were injected into ZPSIOG. In September 2016, Ningbo Port Co., Ltd was renamed as Ningbo Zhoushan Port Co., Ltd (NZP), whose main shareholder is ZPSIOG. At present, it has basically formed a new regional port structure of "One Body, Two Wings and Interactive Development", namely, with Ningbo-Zhoushan port as the main body, the southeast seaports (Wenzhou port, Taizhou port, etc.) and Hangzhou bay ports (Hangzhou port, Jiaxing

port, etc.) in north Zhejiang as the two wings, interactively developing Yiwu international dry port and other inland ports such as Jinhua, Quzhou, Lishui and Huzhou, etc. It has effectively promoted the intensive utilization of port

resources, high-efficient of port operation, ordering of market competition, modernization of port services, and effectively enhanced the comprehensive strength, overall competitiveness and external influence of Zhejiang ports.

Table 1. Complementary enumeration for Ningbo port & Zhoushan port.

Ports	Channel Anchorage	Port Development Potential	Ports Scheduling	Economic Hinterland	Policy Opportunity
Ningbo	Weaknesses (W)	Weaknesses (W)	Strengths (S)	Strengths (S)	Weaknesses (W)
Zhoushan	Strengths (S)	Strengths (S)	Weaknesses (W)	Weaknesses (W)	Strengths (S)

3.3. Port Integration Practice of Jiangsu Province

According to the port system reform principle of “One city, one port, one administration” regulated by the MOT, three original national first-class open ports of Zhangjiagang port, Changshu port and Taicang port, which were affiliated to Suzhou city, were combined into Suzhou port in 2002. The three ports correspondingly became three port areas of Suzhou port. At the same time, the resources of port anchorage, shoreline and liner route are integrated. Since then, the competitiveness of Suzhou port has been greatly improved and become the third biggest port in YRD, only after Shanghai port and Ningbo-Zhoushan port. In order to further strengthen the integration of the provincial ports and enhance the comprehensive competitiveness of them, Jiangsu Port Group Co., Ltd (JPG) was established by the provincial government in May 2017. Provincial port and shipping enterprises and the state-owned port enterprise of the cities along the river and coast such as Nanjing Lianyungang, Suzhou, Nantong, Zhenjiang, Changzhou, Taizhou and Yangzhou, were integrated into JPG. It has become an important platform for the resource integration of ports along the river and coast in Jiangsu province, and also the main investment and operation body of state-owned capital in the fields of provincial shipping enterprises, ports and port industry. JPG takes the ports along the river and coast in the province as a whole, carries out unified planning and layout, and implements integrated operation. It is conducive to the integration of resources, the elimination of competition and the improvement of the overall competitiveness of ports in Jiangsu on the basis of exerting the advantages of each port, and also an important measure to link up with the YREZ. In June 2017, Jiangsu provincial government issued Opinions on Deepening the Integration Reform of Ports along the River and Coast, which plans to basically form a shipping logistics center with the function of regional hub through 3-5 years' efforts, cultivate and expand JPG, and take it as an important platform for the port integration reform of the whole province. It also encourages mergers and reorganizations of large port enterprises where conditions permit, and guides high-quality resources to actively participate in the integration reform of ports in the province.

3.4. Port Integration Practice of Anhui Province

Anhui province is an inland province and the ports in Anhui are relatively small and underdeveloped, compared with the ports in other provinces in YRD. In December 2018,

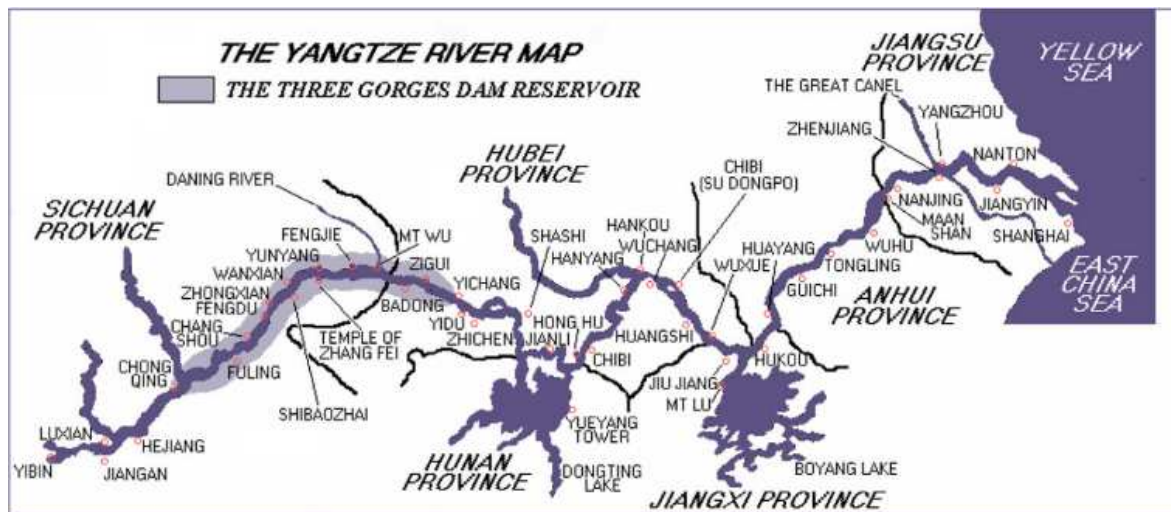
Anhui Provincial Port & Shipping Group Co., Ltd (APPSG) was established by the provincial government. Combined with the fact of the ports in the province, APPSG commenced to integrate 10 large and competitive port and shipping enterprises with high proportion of state-owned assets in ports of Ma'anshan, Wuhu, Tongling, Anqing, Chizhou, Hefei and Bengbu. On the day of listing of APPSG, it signed strategic cooperation agreements with the leading enterprises in the industry, such as SIPG, ZPSIOG, and China COSCO Shipping Group. Since the establishment of APPSG, it has integrated port and shipping resources in the province through market-oriented approaches such as policy guidance, scale improvement and cost reduction. In May 2019, the port resource integration in Anhui province was basically completed, the development platform of port and shipping was initially built, and the overall container shipping layout of “One core and Two wings” (with Wuhu-Shanghai direct route as the core, two provincial branch routes of Hefei-Wuhu and Anqing-Chizhou-Tongling-Wuhu as the two wings) was initially completed. The transshipment time from Anhui port to Shanghai-Yangshan port has been reduced by 5 to 7 days, the container transportation has changed from waiting ship to waiting cargo, and enterprises have significantly reduced cost and increased efficiency. APPSG has established a business cooperation mechanism with SIPG to realize all-round coordination in port berth utilization, routes and shipping schedule arrangement. The effect of port integration has appeared. Data shows that APPSG achieved a port throughput of over 100 million tons in 2020; the container throughput reached 2 million TEU, a year-on-year growth of 24.5%. Ports in Anhui province are experiencing rapid growth, which will be a win-win future for Anhui province and the YRD region.

3.5. Cross-Provincial Port Integration Practice in YRD

Beside provincial port integration practice, there are also many cases of port integration at cross-provincial level in YRD, while the most representative is the “Yangtze River Strategy” (YRS) implemented successively by Shanghai port and Ningbo-Zhoushan port. YRS refers to a resource integration strategy adopted by Shanghai port or Ningbo-Zhoushan port to realize the aims of expanding the economic hinterland, attracting sources and complementation of port functions, etc. (Figure 4). As early as 2002, Shanghai port has begun to implement the YRS through SIPG. Through export of capital, technology and management, it cooperates with the regions along the

Yangtze River, leads and cultivates the regional hub ports in Yangtze River valley, and radiates the surrounding areas, thus carrying on the trans-administrative region port resources integration. In June 2010, Yangtze River Port Logistics Co., Ltd, a company solely owned by SIPG, was established in Shanghai. It is the result of the integration of the resources along the Yangtze River originally and previously acquired by SIPG, including 18 port enterprises in the port cities of Yangtze River valley. With Shanghai as the home port, it operates major ports in Yangtze River valley, such as Chongqing, Wuhan, Jiujiang, Nanjing, Jiangyin, Changsha, Yibin, etc., and sets up large logistics parks and warehouses in some ports. Previously, the 18 enterprises operated independently and lacked synergies

with each other. Through establishing this company, SIPG has substantially integrated its assets along the Yangtze River. It has invested in 22 projects in 12 cities along Yangtze River, forming a complete comprehensive logistics network. The aforementioned cooperation between APPSG and SIPG is also a part of the YRS. Followed the footsteps of Shanghai port, Ningbo-Zhoushan port joined the YRS in 2009. In March 2010, the Wanfang International Terminal in Taicang (Jiangsu), invested by NPG (later merged into ZPSIOG), was officially opened. So far, Ningbo-Zhoushan port has operational berths in Taicang port area, Suzhou port and Nanjing port, and is accelerating the acquisition of stakes in Jiangyin container terminal, aiming to enhance the business layout in the ports along Yangtze River.



Source: Solid Software Pty., Ltd (permission to use this map was kindly granted by Solid Software Pty., Ltd, Australia).

Figure 4. Map of the Yangtze River.

3.6. Comprehensive Analysis and Comparison of Port Integration Modes in YRD

The process of Shanghai port integration can be regarded as that, in accordance with the principle of international hub port construction, Shanghai port construction went from the Huangpu river to the Yangtze River, then to the ocean, and finally realized cross-provincial cooperation. The Shanghai-Yangshan port mode exhibits important differences with generic models due to the development of activities other than sole transshipment, notably in the manufacturing and tertiary sectors, and to the connection of the new port with the hinterland through logistics regionalization. Looking back at the integration process of Shanghai-Yangshan port, it can be seen that it is strongly promoted by the national government according to the positioning of SISC, which is part of the national strategy. It has broken the limitation of provincial administrative barriers completely, made Shanghai effectively use the idle coastline resources of other province and built it into a part of Shanghai port. It has been completely unified in the port administration and port operation, and realized the highest level of integration. Therefore, the Shanghai-Yangshan mode is hard to be

duplicated in the rest of China.

The port integration practice of Zhejiang province is led by the provincial government. As Ningbo port and Zhoushan port have prominent status, adjacent location and complementary advantages, the government started the port integration from the integration of the two ports, and then gradually expanded it to the ports of the whole province, including seaports, river ports and dry ports. In the process, the government broke the regional administrative restrictions and established a new provincial port regulatory authority -- ZSDC, then established ZPSIOG and integrated the ports of the province at the enterprise operation level. The ports of the whole province are integrated into a game of chess and uniformly operated, and substantially integrated from the system, mechanism, capital, and platform, thus realizing the in-depth integration and development of them. In sight of the port integration of Zhejiang province is relatively complete and entirely carried out by the government through administrative means from top to bottom, and the comprehensive integration of administrative management and enterprise operation has been realized, so this mode also belongs to the close-type of government-led even though it is not so close as that of Shanghai-Yangshan port.

The port integration practice of Jiangsu province and Anhui province are also promoted by the provincial government and have basically followed the mode of port integration in Zhejiang province, for example, established a provincial-level port group (JPG and APPSG) and integrated the state-owned operators of major ports in the province. The difference is that, in addition to horizontal integration (integration of port enterprises), the provincial port group (JPG and APPSG) also carried out vertical integration (integration of state-owned shipping companies in the province). What's more, they have not made the reform in port administration, still used the previous administrative system. Therefore, its port integration reform is not as complete as that of Zhejiang province, the degree of integration among ports also appears not so close as Zhejiang ports. Different with ports Jiangsu province, due to the relatively weak strength of Anhui ports, its positioning is very clear in the integration process, and it chooses the strategy of cooperation with other large port and shipping enterprises in YRD such as SIPG, ZPSIOG and COSCO shipping, introduces capital and technology, and achieves rapid development.

The YRS implemented by Shanghai port and Ningbo-Zhoushan port is only the integration of enterprise operation and does not involve administrative management, thus actually a loose-type of enterprise-oriented port integration, which has limited overall influence.

In order to better understand the modes of port integration in YRD, they can be analysed and summarized from five perspectives of dominant power, territorial scope, realization path, degree of integration and focus of integration, which

are actually to answer the five basic questions about port integration: who has led the integration; how much is the geographical scope for integration; what are the specific paths to be accorded to implement integration; to what extent have the ports been integrated; which fields of the ports have been integrated. According to the foregoing, the detailed summary of the port integration modes in YRD is shown in Table 2. The main differences of the modes are as follows: The dominant power of Shanghai is Shanghai port administration authorized by the state council, through establishing a new offshore hub within the administrative areas of other province, thus realizing completed integration in both administration and enterprise operation. Zhejiang set up a new provincial port administration and a new provincial platform company as the main bodies of integration, through a blocky integration mode for municipal port enterprises, also realizing relative completed integration in the both aspects. While Jiangsu and Anhui only set up a new provincial platform company as the main body of integration, through a strip integration mode for specific business segments, thus realizing integration only in enterprise operation. They are all promoted by the governments. However, the YRS is dominated by the two enterprises of SIPG and NPG, through the export of capital, technology, management and cooperates with the regions along the Yangtze river, it has achieved integration only in enterprise operation. Therefore, the degree of port integration in Shanghai is the highest, followed by Zhejiang, Jiangsu, Anhui and YRS. From the territorial scope of port integration, Shanghai and the YRS both belong to Cross-provincial mode, while the three provinces all belong to in-provincial mode.

Table 2. The modes of port integration in YRD.

Integration cases	Dominant power	Territorial scope	Realization path	Degree of integration	Focus of integration
Port integration of Shanghai (Construction of Shanghai-Yangshan Port)	Shanghai port administration authorised by the state council	Cross-provincial region (Shanghai/Zhejiang)	Establish a new offshore hub within the administrative areas of other province	Close	Administration and enterprise operation
Port integration of Zhejiang (Set up Zhejiang Seaport Development Committee (ZSDC) / Zhejiang Provincial Seaport Investment & Operation Group Co., Ltd (ZPSIOG))	Set up a new provincial port administration and a new provincial platform company as the main bodies of integration	Main seaports, inland ports and dry port in the province	Blocky integration mode for municipal port enterprises	Close	Administration and enterprise operation
Port integration of Jiangsu (Set up Jiangsu Port Group Co., Ltd (JPG))	Set up a new provincial platform company as the main body of integration	Main seaports and inland ports in the province	Strip integration mode for specific business segments	Loose-Close	Enterprise operation
Port integration of Anhui (Set up Anhui Provincial Port & Shipping Group Co., Ltd (APPSG))	Set up a new provincial platform company as the main body of integration	Main inland ports in the province	Strip integration mode for specific business segments	Loose-Close	Enterprise operation
"Yangtze River Strategy" implemented by Shanghai port and Ningbo-Zhoushan port	SIPG, NPG	Cross-provincial region (Yangtze river valley)	Through the export of capital, technology, management and cooperates with the regions along the Yangtze river	Loose	Enterprise operation

At present, in term of the port integration in YRD at provincial level, the core main bodies have been basically completed. However, as far as the whole YRD port cluster is concerned, the main contradiction restricting its development

has not been solved. Shanghai port and Ningbo-Zhoushan port, as the two most powerful ports in YRD, have promoted some cooperation in the past few years such as joint developing of Xiaoyangshan, but most of the cooperation is

for the purpose of competition and substantive integration is rare. Therefore, the main contradiction of development of the YRD port cluster is the contradiction of resource integration between Shanghai port and Ningbo-Zhoushan port. In addition, it can be seen that the functional complementarity of the port cluster resource integration is not more reflected, but more is the merger of similar port enterprises, even though functional complementarity is the core of port cluster resource integration. Therefore, it can be concluded that the port integration in YRD is still in development stage, and only should substantial integration be carried out between Shanghai port and Ningbo-Zhoushan port, the qualitative breakthrough of port integration in YRD would appear.

4. Policy Supports to the Port Integration in YRD

In China, governments traditionally hold high control over the port industry. As can be seen from the previous sections, the governments played an irreplaceable and leading role in the process of port integration reform in YRD. The formulation of port policies may bring far-reaching influence on the development of the ports. Therefore, how to formulate policies to coordinate the ports will be the key to the success of port integration in YRD in the future.

4.1. Existing Problems in the Port Integration in YRD

Since the construction of SISC was launched, the port integration in YRD has been carried out gradually, meanwhile the central and local governments have made various policies to promote the integration. However, for more than 20 years, there are many problems in the process of integration, resulting in the slow progress of overall regional port integration, which cannot fully adapt to the current development situation.

4.1.1. Fragmented Governance and Lack of a Strong Regulatory Structure

There has been lots of cooperation in the development of the YRD port cluster, but it is difficult to form regional cooperation or alliance, which is largely due to the lack of a strong management body to plan and coordinate the functions and positioning of ports in this region. The state attaches great importance to the resource integration of the YRD port cluster, and has made relevant regulations on the positioning of the cluster. However, the ports belong to administrative regions of Shanghai, Jiangsu, Zhejiang and Anhui respectively, each local government has actual control over its own ports and put forward the development direction of its respective ports for its respective interests, there is lack of necessary communication and cooperation between ports. As a result, the port cluster planning in YRD is disordered, the development of some ports deviates from their overall regional positioning, the synergy is reduced, the vicious competition is intensified, the port structural contradiction is outstanding, the resource utilization rate is low, and the

resource integration degree of the port cluster is reduced. In order to solve this problem, the central and provincial governments set up the Commission Office of Shanghai Combined Port (COSCP) in 1997, responsible for coordinating the related affairs of the development of ports and shipping in YRD according to the overall arrangement of the State Council on the construction of SISC. However, due to its committee nature, its functions are easily neglected by the local governments, resulting in the lack of its management functions and failure of achieving the expected effects.

4.1.2. Lack of Long-term Cooperation Mechanism

In addition to the first problem above, there is also a lack of effective long-term cooperation mechanism in the YRD port cluster. At present, the competition between Shanghai port and Ningbo-Zhoushan port, the two most important ports in YRD, is still very fierce for the position of hub port, which has become the core problem of the port integration in YRD. The layout structure of “One body, two wings” of the YRD port cluster is changing to the structure of two hub ports and multiple trunk ports, which indicates that all ports have been engaged in fierce competition in order to compete for the status of hub port. Therefore, it is difficult to form an effective alliance or long-term stable cooperation between ports to some extent.

4.1.3. Insufficient Implementation Strength on Port Division of Labor and Positioning

The national and local governments have issued a series of planning policies on the resource integration of the YRD port cluster, among which, the Regional Planning for the Yangtze River Delta Region further clarifies the functional positioning of the major ports in YRD. Despite the high support of the state, the implementation is still led by the local governments who decompose the task of positioning the port cluster. In the process of decomposition, the local governments lack communication and cooperation with each other, thus planning and construction synchronization is poor, and the project schedules are different. In addition, due to the long period of port construction while the periods of relevant planning are usually only 5 years, local governments lack incentive mechanism and may delay the port construction projects on the pretext of long construction time. Instead, they may invest in the construction of port projects that are beneficial to local economy but may not conform to the division of labor among the ports in YRD. The shortsightedness and inaction of the local governments lead to low efficiency of the relevant national planning and slow progress of the port integration in YRD.

4.1.4. Weak Soft Power of the Port Cluster

In recent years, the YRD port cluster takes the port throughput as the main target, and ignores the importance of constructing service ports. The strength of port service capability is reflected in port soft power, including comprehensive services such as insurance and finance. The YRD ports cluster lags far behind other advanced ports in the

world in soft power construction. Taking London port as an example, although lagging far behind Shanghai or Ningbo-Zhoushan port in terms of port throughput, it is the world's largest market for shipping services, particularly in shipping finance and maritime professional services, which include banking, insurance, ship broking, legal accounting, classification society, publishing, and so on. In addition, its accounting service, research service, education training service, technology and engineering consulting service also occupy a very important position in shipping service industry. At present, London's shipping service industry has an international market share of almost 50% in many areas. The value created by these shipping services is even greater than that created by port logistics entities, and shipping services have no destructive impact on environment. In contrast, the soft power of ports in YRD is particularly weak, and the logistics service system of port and shipping needs to be improved.

4.1.5. Abnormal Development of Collection and Distribution System

Data shows that the logistics costs in China are far higher than those in the US, mainly because that the lack of proper multimodal transport leads the transshipment of goods to account for a large proportion of costs, approximately 30% - 50%. At present, in the port collection and distribution system of YRD, the proportion of highway is too high while those of inland waterway and railway are relatively low, and various modes of transport do not connect smoothly. As way of collection and distribution which is economic, efficient and environmental-friendly, sea-rail combined transport has become one of the competitive advantages of ports in developed countries in Europe and America. In Hamburg, the second largest container port in Europe, the proportion of sea-rail combined transport accounts for 30%, and the proportion of container transport over 150 kilometers accounts for 70%. However, in YRD, most of the railways do not extend to the ports, and the goods need to be transported by trucks between docks and railway freight stations. Even in the most developed city of Shanghai, road transportation still accounts for 51.3% and railway transportation only accounts for about 1%. The logistics network based on water, railway, road and air transportation needs to be further connected, and the logistics channel construction needs to be improved. The progress of the high-grade renovation of the five main waterways connecting Shanghai with Jiangsu and Zhejiang varies from place to place, which affects the overall water transfer efficiency. In addition, due to the independent operation of various modes of transport, it does not achieve the integration of their transport, services, charges and management, which affects the convenience of regional multimodal transport. For example, the construction of freight railway is out of sync with the construction of port terminals in Shanghai, resulting in additional barge fees and the total cost higher than other ports. Moreover, China's transportation implements the management of different modes and departments, causing different information

systems are used in different transportation modes. At present, information systems of ports, shipping, roads and railways, have not been connected yet, and there is a lack of unified data sharing platform and business docking interface. To some extent, this has affected the interconnection of logistics and information flow, and hindered the development of combined transport of road-rail and rail-water.

4.1.6. Low International Cargo Transshipment Ratio Restricts the Development of SISC

The international main hub port is the main function of the international shipping center, while the transshipment volume of containers is a very important index to measure the international hub port. Comparatively speaking, the volume of international transshipment containers in YRD is insufficient at present. Although Shanghai now has the world's largest throughput of container for many years, its international transshipment ratio is still very low, represented only 12.2% in 2020. By contrast, that of Singapore is over 80%. International cargoes are thus generally transshipped via foreign hubs. Such evidence confirms that Shanghai's port development has so far been driven by hinterland-related dynamics rather than hub-related dynamics [24].

4.2. Policy Suggestions to the Port Integration in YRD

In view of the problems in the process of port integration in YRD at present, and based on the existing policies of port integration, the following suggestions are put forward for reference of the decision-makers to formulate port policies of YRD.

4.2.1. Establish Joint Port Authority to Break the Barriers of Administrative Areas

In order to break through the bottleneck that the YRD port cluster is divided by the four administrative regions of Shanghai, Zhejiang, Jiangsu and Anhui, the decision-makers can learn from the resource integration experience of the joint port authority of New York - New Jersey port cluster in the US and the high consistency of the local governments in Tokyo bay in Japan, to jointly establish "YRD Joint Port Authority" across administrative regions. It could be set up under the leadership of the MOT and would have the final administrative authority over the planning and construction of the YRD port cluster. The MOT should stipulate that the local governments have to actively cooperate with the work of the joint port authority and must not interfere in the planning and construction of the YRD port cluster, so as to prevent the interest conflicts between them. The joint port authority shall lead the cross-provincial port integration in the region, break through the restrictions of administrative divisions, and carry out unified planning, construction and management in the areas involving regional public resources. In addition, considering that the main contradiction in the resource integration of the YRD port cluster lies between Shanghai port and Ningbo-Zhoushan port, the management of the YRD Joint Port Authority should focus on these two ports. The joint port authority can be built on the basis of COSCP. Through the

establishment of the joint port authority, the decision-makers can break through the shackles of administrative regions, better plan and build the port cluster, reduce unnecessary competition, avoid the confusion of planning and other problems, and greatly liberate and develop the productivity of the port cluster. This is the most fundamental way to the resource integration of the YRD port cluster.

4.2.2. Improve the Mechanism for Port Cooperation to Deepen Port Cooperation

Horizontal association of ports should be further promoted. It is an important way to adjust port structure and promote rational division of labor. Relevant rules and regulations should be enacted to strengthen exchanges and cooperation within and outside the region, so that the integration could develop to a higher form. Cross-shareholding is one of the

good ways to establish a long-term cooperation mechanism between ports. Through capital joint, ports can achieve the state of sharing benefits and risks, effectively avoid the problems of repeat and confusion of port division of labor, duplicate construction of infrastructure and vicious price competition. Meanwhile, it can promote the free flow of production factors between ports and give play to their maximum value. The recommended mode of resource integration in the YRD port cluster is shown as Figure 5. In addition, market regulation and regulatory mechanism, such as YRD port association, shipowners' association, shipping agency association, freight forwarding association, etc., should be promoted to establish and strengthen so as to make up for the shortage of port cluster cooperation leading by the government and the market.

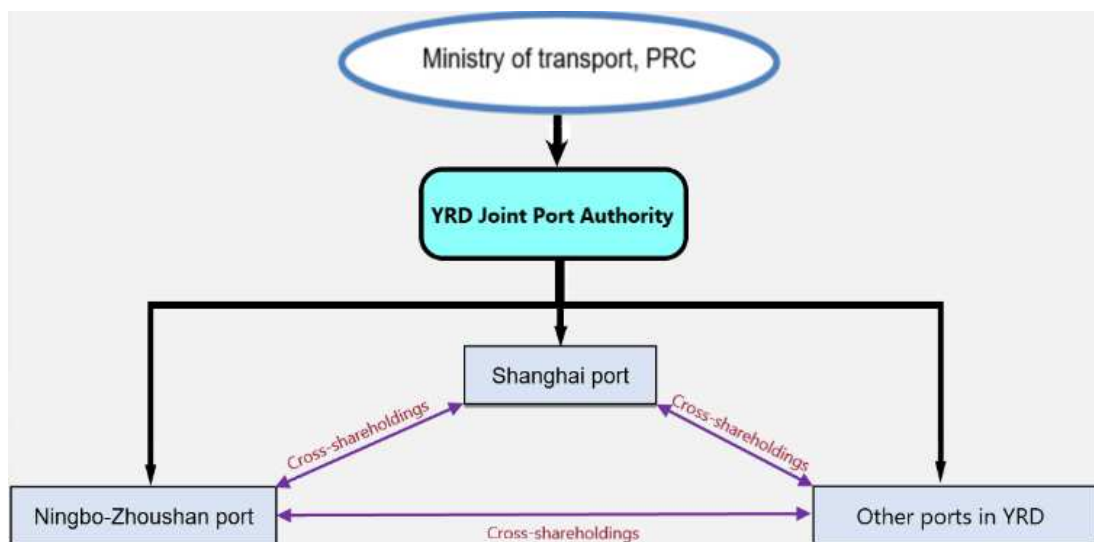


Figure 5. The recommended mode of integration in the YRD port cluster.

4.2.3. Strengthen the Rigor of Planning to Improve the Efficiency of Its Implementation

The functional positioning of the main ports in the YRD cluster has been clearly stated in the relevant plans of the national and local governments and is very reasonable. The focus of the current work is to enhance the rigor of the planning and improve the efficiency of its implementation, which must be under the leadership of the YRD Joint Port Authority. Since the resource integration of the port cluster is a systematic project with many participants, all interested parties in the YRD port cluster should fully communicate with each other about the resource integration projects to be constructed and divide the planned projects reasonably. Projects under division of labor should be in line with local capacity and able to keep pace with other projects. In addition, in the port key projects to be built in the planning, the details such as starting time, completion time, required fixed investment, additional investment, implementing subject, cooperating units, annual construction schedule, etc., must be specified in the form of annex. At the same time, the YRD Joint Port Authority should strengthen the supervision

and management of the resource integration projects, and the parties who achieve the set goals in advance or on time should be given certain rewards, while the parties who fail to complete the projects as required should be given certain penalties.

4.2.4. Accelerate the SISC Construction by Adjusting Cargo Structure and Enhancing Soft Power

The construction of SISC is a national strategy and the ports in YRD bear the common responsibility. International shipping center takes the scale of container transshipment as the main index. In sight of this, the government should formulate corresponding policies to make Shanghai port focus on the development of international container transport and make reasonable adjustment to the cargo structure. For example, the transshipment of bulk cargo such as raw materials and energy can be diverted to other ports in YRD, so as to ensure that the container transportation in Shanghai port is the key point and important growth point for the development of shipping center in the future, meanwhile, promote the development of other ports in YRD. In addition, relevant policies should be formulated to vigorously develop

high-end shipping services such as shipping finance, shipping insurance, maritime law, maritime arbitration, and so on, thus promoting the transformation of the development mode of SISC, from the original simple pursuit of port throughput to the improvement of the comprehensive allocation of shipping related resources or value creation efficiency, from the original amount of labor-intensive to knowledge/technology-intensive value creation. What's more, the governments should introduce policies to promote the upgrade of comprehensive service function of the ports, enhance the abilities on freight logistics service and ship's integrated service, cultivate some characteristic modern shipping services with great influence, develop "Internet + port and shipping services", build a modern shipping service industrial cluster, promote the construction of a maritime silk road shipping big data center and improve the maritime silk road index system, thus enhancing the shipping service influence of the YRD port cluster.

4.2.5. Improve the Collection and Distribution Logistics Network

Policies should be actively introduced to promote the construction of infrastructure for the collection and distribution of goods, and unify the standards for connecting different regions. The governments should actively promote the interconnected development of sea ports, inland ports, air ports and info ports, optimize the multimodal transport system, and speed up the building of a platform for smooth and efficient interconnection between internal and external forces. They should promote the effective connections among different modes of transport, focus on promoting the construction of special railway lines and feeder lines for ports and open up the last kilometer of the railway entering the ports. In addition, the governments should strengthen the cultivation of multimodal transport operators thus realizing the integration of multimodal transport services. By improving the collection and distribution logistics network, the transshipment efficiency can be improved. Decision-makers should actively formulate relevant policies to promote to build the logistics information system of the YRD port cluster, and promote the information resource sharing of the YRD ports. It is suggested that the governments take the lead in developing a new system to integrate with the existing logistics information systems in ports and e-government systems at all levels of governments. By making full use of new technologies and new processes, relying on the port EDI platform, governments could promote the application of intelligent technologies such as Internet of Things, RFID, 5G, Beidou satellite navigation system, etc., and build and improve information management systems, so as to realize the integration of port cluster logistics and port operation service of intelligence and automation. Finally, the data docking and sharing among all stakeholders in the port cluster should be realized, and a comprehensive information network covering the entire port cluster supply chain should be formed to provide a series of information interconnection and integration services such as online booking, warehousing

management, transportation scheme consultation, etc.

4.2.6. Improve FTZs and Align National Strategies to Raise the International Cargo Transshipment Ratio

Facing the fierce competition in the international container port markets, the policy of port liberalization is the key to increase the transshipment ratio of international containers. The governments should further deepen the policies of Free Trade Zones (FTZs) in YRD and improve their openness. The Specific measures include: First, expanding the scope of FTZs, especially the bonded port areas, simplifying the clearance procedures for international container imports and exports, simplifying inspection procedures for foreign vessels entering and leaving ports and shortening their stay in ports; Second, carrying out territorial tax refund policy to the containers imported and exported from the bonded ports, so as to attract the containers to be transshipped from the bonded port, thus reducing the outflow of international containers. In addition, the governments should create favorable conditions for matching port logistics, vigorously develop the port-related industries, focus on land resources and preferential policies to the ports of the logistics park, particularly focus on the construction of port-related industrial base, thus accelerating the development of port-related industrial cluster based on industrial parks. At present, the pilot FTZs have been established in Shanghai, Zhejiang (Zhoushan) and Jiangsu (Nanjing, Suzhou and Lianyungang). The governments should actively copy the foreign advanced FTZ shipping policies, and extend these advanced policies and management to the pilot FTZs of YRD, so as to promote the development of port integration in YRD and further enhance the voice of China in international shipping. In addition, the governments should align national strategies of B&R and "Development Strategy of Yangtze River Economic Zone", further expand the level of opening-up, introduce favorable policies to guide the cooperation between ports in YRD and ports in the middle and upper reaches of the Yangtze River, so as to expand the hinterland and influence of ports in YRD while promoting the development of the middle and upper reaches of the Yangtze River. They should also promote the YRD port cluster to fully participate in the global resource allocation, and enhance the level of internationalization.

5. Conclusions and Future Research

Based on the status quo of development and integration of the YRD port cluster, this paper innovatively takes provincial port clusters as the main research objects to discuss and analyse their integration practice modes. It is found that the port integration mode of Shanghai is the most integrated mode. By establishing Yangshan port area, it has realized high integration on both the port administration and enterprise operation. However, this mode is hard to be duplicated because it bases on the high support of the central government in policy. Zhejiang first integrated Ningbo port and Zhoushan port, then expanded to the province's port

integration, also achieved a high degree of port integration through the integration at the levels of port administration and enterprise operation. However, Jiangsu and Anhui have only realized the integration at the level of enterprise operation, which are less integrated modes. Although cross-provincial port integration practices exist in YRD, such as the YRS, it is also only the integration at the level of enterprise operation, which has limited overall influence. On the bases of the current integration policies and aiming at the existing problems, reasonable and feasible suggestions are put forward from policy level. It is believed that the large-scale port integration of YRD must rely on the power of the high-level government to break the administrative barriers, unify the planning of using resources, give full play to the role of market regulation, and promote the establishment of mutually beneficial cooperation mechanism. In addition, the governments also need to promote and guide the YRD port cluster from the aspects of information sharing mechanism, soft power, collection and distribution system, FTZ construction, aligning national strategies, etc., so as to better integrate the port resources and accelerate the rapid and healthy development of YRD in the future.

As far as future research is concerned, there are three areas of concern: the first is how to deal with the relationship between the central regulatory authority and the local governments in YRD, so as to avoid it to be the same as the COSCP which is a leader department in name only in the integration of port resources; the second is how to ensure the effective division of labor between governments and markets in the process of cross-provincial port resources integration; the third is how to avoid and limit the potential monopoly caused by the reform of regional port integration.

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