Coordination of Intermodal Transport in Yangtze River Economic Belt in China Based on the Fourth-Party Logistics

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Abstract: With the deepening of economic integration, intermodal transport has become a central issue worldwide in recent years. China also pays great attention to this issue and promotes the development of intermodal transport in Yangtze River Economic Belt in China. However, the coordination of intermodal transport is a multi-sector, multi-agent and multi-mode process and some problems emerge in the development of intermodal transport in Yangtze River Economic Belt. This paper aims to provide some advice for the improvement of intermodal transport in this region. This study first identifies the barriers to the development of intermodal transport from the aspects of policies, actors, terminals, transshipment services, and information systems. In addition, this study proposes that 4PL can promote standardization, coordination, utilization and innovation of information in the intermodal chain. Furthermore, this paper tries to design the 4PL platform and makes suggestions for the development of the 4PL platform in Yangtze River Economic Belt. Meanwhile, the Chinese government is required to enact some supporting policies to encourage 4PL to play the role of coordinator in the intermodal chain.

Keywords: Integrated Transport, Intermodal Transport, Fourth-Party Logistics, Information Platform.

1. INTRODUCTION

In the new global economy, intermodal transport has become a central issue worldwide[1]. Trade globalization has greatly increased the freight flows among different countries. According to the report from Reports and Data, the market share of global intermodal freight transport is expected to reach 73.38 billion by 2026. Most issues adopt the definition of intermodal transport from The European Conference of Ministers of Transport[2], which defines intermodal freight transport as "the movement of goods in a single freight unit through two or more successive modes of transport, with no handling of the freight during transportation".

China also channels great effort into the development of intermodal transport. In 1970, China introduced the concept of international container transport[3], from which intermodal transport has become a significant transportation mode in China. In 2014, China launched the Intermodal Transport Demonstration Project to improve the integrated transportation system. In 2021, China proposed to promote the integrated development of various modes of transportation in the 14th Five-Year Plan. By 2022, China has conducted the fourth Intermodal Transport Demonstration

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Project and published Measures for Administration of the Intermodal Transport. However, the volume of intermodal freight transportation in China is still growing slowly. Intermodal transport makes up less than 5% of the total freight volume up to now, while the proportion in Europe and US is generally over 30%. Due to the low price of road transportation, the volume of road transportation in China accounts for about 75% in recent years and keeps increasing nowadays[4].

The Yangtze River Economic Belt is the key development region of intermodal transport in China. The Yangtze River Economic Belt covers eleven provinces, which are usually divided into three parts according to the watershed discretization[5]. The government has formulated a three-year action plan to promote the development of intermodal transport in the region in 2018 and the proportion of the Intermodal Transport Demonstration Projects in Yangtze River Economic Belt is up to 37.1% by 2022. That is because the intermodal transport in Yangtze River Economic Belt is fundamental to the integrated development of the regional economy. Intermodal transport extends the coverage of services of seaports by connecting the seaports with inland ports, which contributes to driving the industry development of inland areas. Additionally, intermodal transport gives full play to the overall advantages of the industrial division of labor and coordination. It is an opportunity to build the cross-region industrial transfer pattern and foster the important growth poles in China through the match of the transportation mode and the industry layout. Furthermore, intermodal transport also leads to three-industry integration as it improves the distribution of agricultural and industrial products. With the reduction of unnecessary transshipment operations, the supply chain has been improved and the costs are reduced.

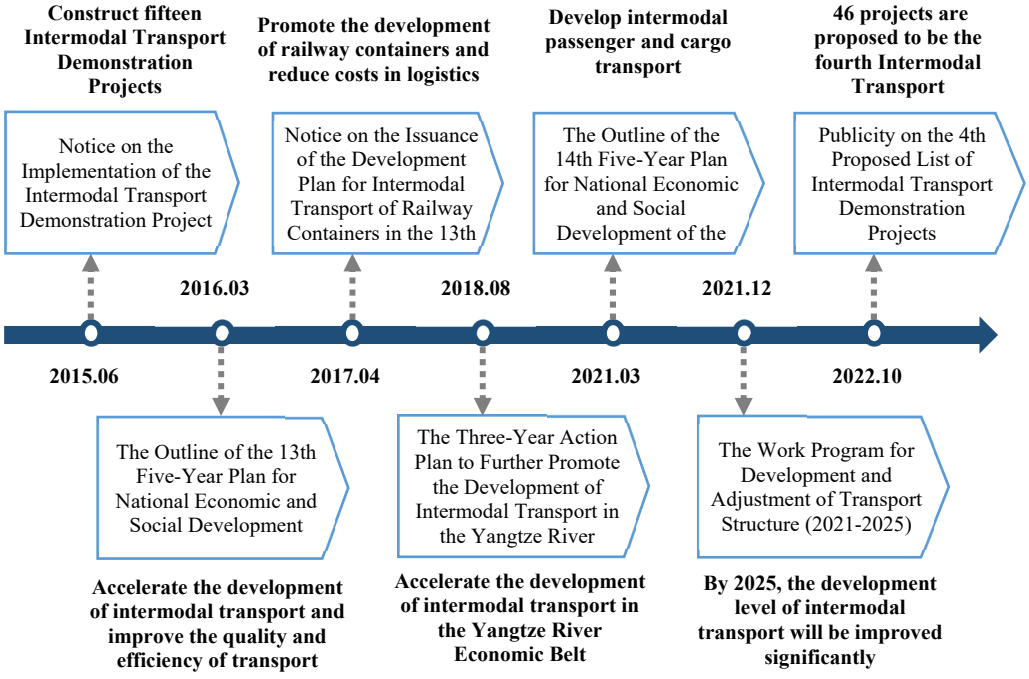

Figure 1. Policies of intermodal transport in China

2. RELATED LITERATURE

More recent attention has focused on integrated transport. The concept of integrated transport has become an important guiding rule of transport policies in several countries[6]. Various studies have tried to clarify the definition and features of integrated transport. NEA7 defines integrated transport as "the organizational process through which the planning and delivery of elements of the transport system are brought together, across modes, sectors, operators and institutions, with the aim of increasing net social benefits". Eggenberger and Partidário8 propose five forms of transport integration, which are "substantive, methodological, procedural, institutional and political". In general, integrated transport often relates to the term "intermodal"[9], which is an important part of the integrated transport network. In addition, some issues study the importance of integrated transport. Booth and Richardson10 state that transport planning is a process that involves multiple agencies, sectors and modes, thus the balance of different interests, issues and policies is needed. However, operational managers sometimes focus more on a limited sub-set of the transport system[9].

As a critical part of integrated transport, a large and growing body of literature has studied intermodal transport. Some literature also uses the term "multimodal transport", but "intermodal transport" and "multimodal transport" are generally used interchangeably[2]. Agamez-Arias and Moyano-Fuentes2 identify three research lines of intermodal transport which include basic principle, way of improvement and system modeling. Nowadays, most literature pays attention to the optimization of the intermodal transport system as various decision problems demand the operation research techniques[11]. Zhang et al.[12] establish a collaborative planning model considering the collaborations among carriers and propose an Adaptive Large Neighborhood Search heuristic method[12]. Abbassi et al.[13] suggest a robust optimization model for dealing with uncertainties of using costs, transport costs and capacities of terminals[13].

The concept of fourth-party logistics (4PL) has been put forward for many years. But the essays on 4PL are significantly fewer than for 3PL. Some studies are trying to clarify the definition of 4PL or putting 4PL into the application. In 1996, Accenture first proposed the definition of 4PL, putting forward that "the 4PL is an integrator that assembles its own resources, capabilities and technology and those of other service providers to design and manage complex supply chains"[14]. Nowadays, it is widely accepted that 4PL is a certain evolution of 3PL[15] as it extends the ability to integrate the entire supply chain. Thus, 4PL has become an inevitable tendency in the logistics industry[16]. 4PL is not responsible for transporting the freight by itself but provides optimized solutions for customers through integrating the capabilities and resources of its partners[17 18], bringing huge earnings to enterprises[14].

There is a relatively small body of literature that is concerned with the combination of 4PL and intermodal transport. Some papers focus on the model optimization of the intermodal transport system in which 4PL takes participates. Mes and Iacob[19] model the synchromodal planning of intermodal transport and propose an algorithm to select the best combinations of modes for every order[19]. Van Heeswijk et al.[20] consider the case that 4PL takes responsibility for matching orders to carriers and set main arcs and free arcs to solve the problem[20]. Sitek and Wikarek[15] design the supply chain from the view of 3PL/4PL/5PL and propose a mixed integer linear programming problem to optimize the cost of production, transport, distribution and

environmental protection15. However, few have studied the way of improvement of intermodal transport system from the perspective of 4PL.

Consequently, this paper aims to explore suggestions for the development of intermodal transport with the support of 4PL. In addition, the paper attempts to focus on the Yangtze River Economic Belt to make sure that the solutions are in touch with reality. The remaining part of the paper proceeds as follows. Chapter three of this paper will introduce the intermodal transport system. Based on the system, the paper identifies some problems in Yangtze River Economic Belt in Chapter four. Furthermore, Chapter five clarifies the advantages of 4PL applied in the intermodal chain. Ultimately, we propose some advice on the development of intermodal transport in Yangtze River Economic Belt from the perspective of 4PL.

3. INTERMODAL TRANSPORT SYSTEM

The intermodal transport system consists of several components and there is a need for management of the intermodal chain to coordinate different components. It is important but difficult to establish an integrated intermodal transport system.

3.1 Components

Policies. The policy of the government is thought of as a key component in the intermodal transport system. The government should clarify the strategic positioning of intermodal transport and formulates some policies to provide support such as the land policy, the logistics policy, the infrastructure policy and the environmental policy[21]. Additionally, the government needs to make some regulations, concerned with the administration of the freight, the right and obligation of the actors, and the content and the validity of the transport bills. The Ministry of Transport in China promulgated Terminology for Intermodal Freight Transportation and Intermodal Loading Unit Marking in 2017, which filled the gap in the intermodal transport standard[22] in China.

Actors. The intermodal transport system is composed of many different companies and related actors[1], including shippers, carriers, facility and physical infrastructure managers, institutional authorities and customers[23]. Shippers generate the transport demand while carriers perform the transport. Facility and physical infrastructure managers take responsibility for the construction and maintenance of the infrastructure. Institutional authorities are the actors who formulate laws and regulations. Customers receive the freight through intermodal transport.

Terminals. An intermodal freight terminal is the place where freight transshipments between variable transport modes happen. The terminal can be the railway station, port terminal, road cargo station or airport. “Vehicle loading and unloading, cargo and vehicle sorting and consolidation, convoy make up and break down, and vehicle transfer between services” are the major operations in terminal[24]. The efficiency and effectiveness of services in the terminal are crucial to the quality and cost of the intermodal chain[25].

Transshipment services. There is different equipment used for freight transshipment (shown in Figure 2). The first is loading units which mainly include semitrailers, swap bodies, and containers[26]. Carrying tools, such as flatcars and ro-ro ships, serve as the facilities that hold the loading units. Transshipment facilities mean a lot to the mechanization of intermodal transport operations, which include gantry cranes, reach stackers and straddle carriers[1].

Information systems. Information interchange among variable transport modes is the essential basis of intermodal transport operations. In addition, actors in the chain of intermodal transport also need to exchange information and data[27]. The construction of the information system depends on the development of Information and Communication Technologies (ICT), which increase data flow and quality of information, improving the methods to solve operation problems in intermodal transport.[28]

Figure 2. Freight transshipment equipment

3.2 Intermodal Chain

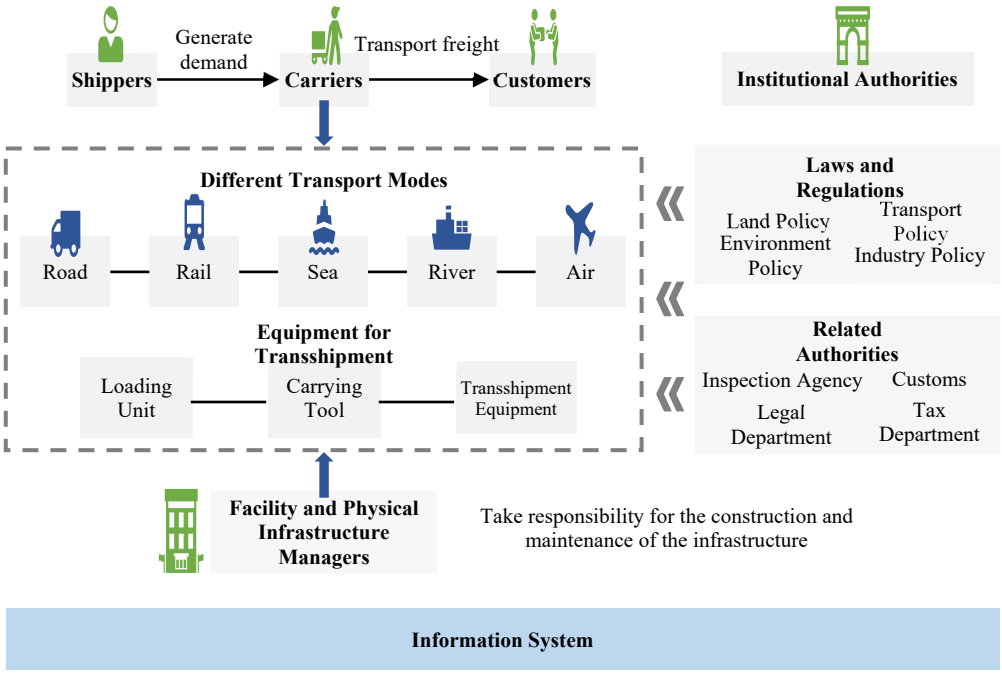

Figure 3. Figure of the intermodal chain

The intermodal chain achieves door-to-door service and takes place over long distances[24], which needs the coordination of different actors and transport modes. Commonly, shippers may be the producers of freight or some agency companies who generate demand. Then carriers, such as railway, road transport companies and shipping companies, take responsibility for providing freight services. Sometimes, the freight needs to be transshipped among different modes, thus requiring an integrated information system. Taking sea-rail-road transport for example, before the containers arrive at the seaport, the coordinator should notice the railway to make sure the swift transshipment. Then, the containers are loaded into the rail using the standard equipment and another transshipment is made in the rail terminal. Ultimately, the freight is picked up by the cargo and transported to the customers. It needs to be mentioned that the institutional authorities play an important role in the process as the laws and regulations make sure the successful flow of freight in the chain. Generally, involving so many market players and institutional authorities, it's difficult to coordinate the intermodal transport chain to some extent.

4. PROBLEMS OF INTERMODAL TRANSPORT SYSTEM IN YANGTZE RIVER ECONOMIC BELT

This chapter identifies problems of the intermodal transport system in Yangtze River Economic Belt. In general, the coordination difficulties of the intermodal chain are the main barriers to the development of intermodal transport in the region.

4.1 Policies

Yangtze River Economic Belt lacks an integrated department for intermodal transport. With many interest groups, it is still a complex task to manage intermodal transport. Thus, the government in the United States has established the National Intermodal Transport Committee to guide the development of intermodal transport at the national level[3]. However, China has not established a department or committee which works out to coordinate and resolve the hidden conflicts, resulting in many problems. For example, neighboring ports may repeatedly increase their transport recourses, leading to overcapacity[29].

From the perspective of the specific policies, although the government has promulgated many technical standards, there is no unified standard system. China has enacted more than thirty intermodal transport standards but the standard system has not been constructed yet. Thus, the standards used in the economic belt are different[5], leading to high transport costs. While the United States and Europe have established more perfect standard systems after more than a half-century of development[30].

4.2 Actors

Cross-regional coordination mechanism of Yangtze River Economic Belt has not been established. There still exist many administrative barriers to promoting intermodal transport among eleven provinces. The differences in opinions and positions make it difficult for cross-regional coordination[31]. For example, waterway regulation requires the joint decision of multiple provinces while different opinions of related provinces add to the difficulty of the regulation[32]. In addition, Yangtze River Economic Belt also lacks a unified intermodal transport plan.

Different institutional authorities have little communication and information interchange, resulting in difficulty in customs clearance sometimes. For instance, institutional authorities, such as the quarantine department, customs and immigration checkpoint, repeatedly check the freight. Therefore, extra operations in transshipment between different modes result in the transport time extension[33], which needs some measures to reduce processing time[34]. Uiwang Inland Container Depot (ICD) in Korea has adopted a public-private partnership pattern. Apart from the freight companies, customs and some other government departments also lie in ICD[21], which promotes information interchange and reduces transport time.

4.3 Terminals

There exists the “middle one-kilometer dilemma” in the connection of different intermodal transport terminals. The volume of container transport increases greatly in recent years, leading to demand growth in inland transport. However, the shortage of connection resources happens between ports and inland areas, resulting in the bottleneck of intermodal transport [35]. Take sea-rail mode for example, railway connection stations in Yangtze River Economic Belt are generally constructed in the early time, which are unable to meet the increasing distribution demand of ports[32]. Some ports even have no linked railway to transport the freight and heavily rely on road transport. Among ports in more than 2,800 kilometers of the waterway, there are less than 10 ports that can carry out intermodal transport between rail and water[36]. Consequently, the volume of sea-rail transport only accounts for 1.5% of the total port freight volume in China while the proportions in the United States and Germany are more than 20%[37]. It is worth mentioning that the United States has built more than 1,400 intermodal transport channels.

4.4 Transshipment Service

Mismatch of the transport equipment makes it difficult to ensure a fast transshipment process between different modes. Transshipment refers to the operation that transfers the flow from one mode to another mode[38]. However, the mismatch between different equipment, usually resulted from the inconsistent standard of equipment, increases to the difficulty of transshipment sometimes. Zhang et al.[39] point out that the pallets mismatch the containers and the loading units mismatch the flatcars in China[39]. However, the United States and Europe put great emphasis on the standardization of transport equipment. For example, the National Intermodal Transport Committee in the United States has studied the standards of intermodal transport by investigating the comparative advantages of different standards for many years[3].

The lack of "one bill of lading" is the main barrier to intermodal transport in Yangtze River Economic Belt. When the freight arrives at the terminal, it takes more time to type the information into the system repeatedly, increasing the waiting time. Additionally, the transport bill is connected closed to the transport responsibility[40]. Thus, a unified transport bill is beneficial to clarify the responsibilities among variable carriers. However, China still has no unified transport bill while 90% of the contents of different transport bills are almost the same[22]. Furthermore, some applied transport bills used in small range just suit international transport but not domestic transport[22].

4.5 Information systems

Information silos about the management of intermodal transport are common phenomena existing in Yangtze River Economic Belt. In particular, the lack of interchange of information between railway and port makes it impossible to dynamically supervise the state of in-transit freight[29]. Consequently, data accessibility which extends across various actors in the chain plays a significant role in intermodal transport[41]. However, many pieces of literature state that actors are unwilling to share valuable information due to competition[42] or security risk of community technology[43].

Some information platforms have been constructed in Yangtze River Economic Belt but the entire operation level needs to be improved[5]. The platforms only serve for sharing basic public information or transaction between different market actors. Thus, the intelligent transportation system needs to be employed to improve the operation ability in intermodal transport, such as responsiveness[44] and service quality[45]. New technologies and analytical tools are required to optimize transportation decisions46, which include routing, scheduling, monitoring and tracking of goods[47].

5. ADVANTAGES OF 4PL APPLIED IN INTERMODAL TRANSPORTATION

A single 3PL is unable to provide integrated service for the intermodal chain, while 4PL can be the leader of the entire supply chain that integrates many 3PLs and other service providers such as consulting, financial and IT departments. 4PL integrates almost all companies involved in the intermodal chain[48]. In practice, 4PLs mainly have consulting companies, IT companies, 3PLs and logistics platforms led by government. Commonly, government establishes 4PL platform

with the support of professional private companies, which is beneficial to the development of intermodal transport.

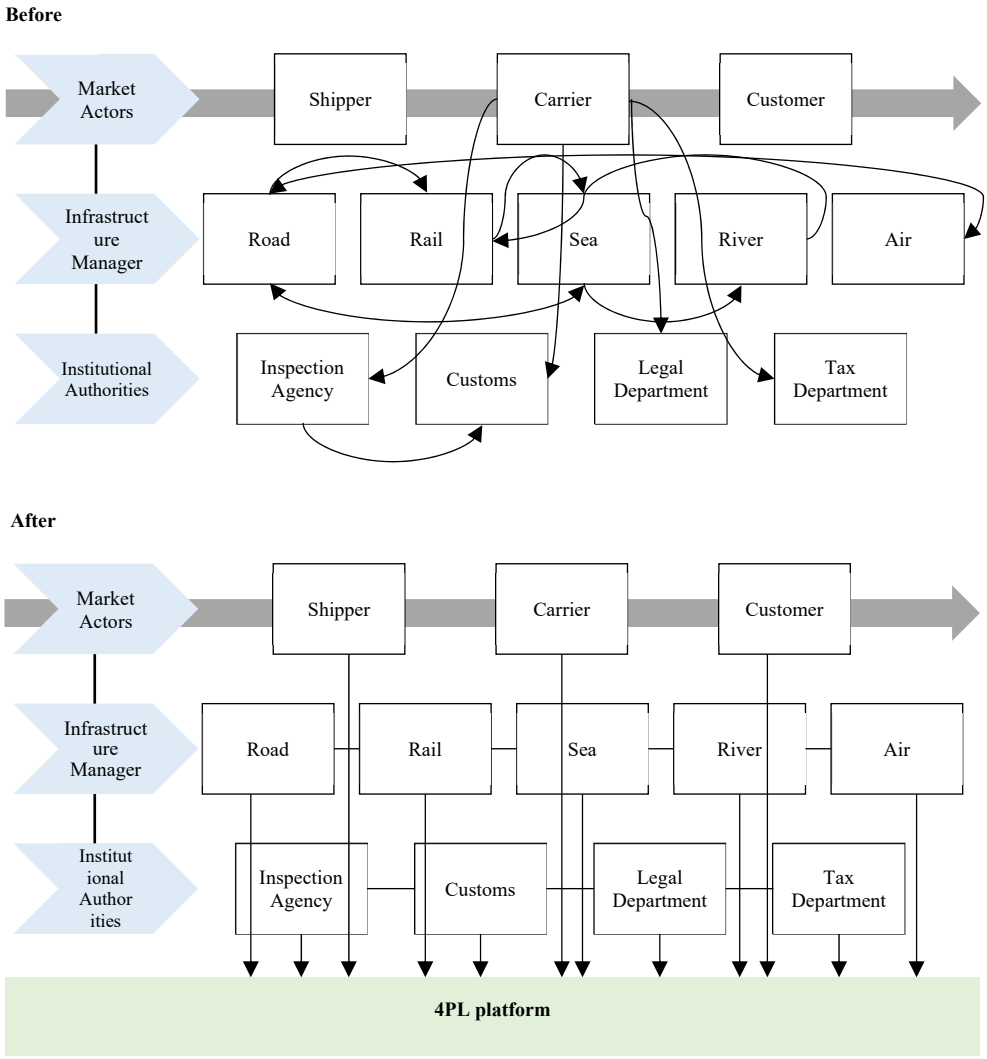

Figure 4. Advantages of 4PL in the coordination of intermodal chain

Based on integrated 4PL platform, the information interchange of different actors and modes in the chain is improved. The rise of 4PLs promotes the development of the network model which is replacing the traditional linear model in the supply chain[49]. That's because 4PL creates the opportunity for information integration through the application of IT systems, communication flows and so on. 4PL combines the customers with other actors in the intermodal chain[50]. In addition, 4PL promotes the information interchange among rail, port, road and air, thus promoting the "one bill of lading" and reducing the time on typing the information into another

freight management system repeatedly. Information interchange and integration lay the foundation for improving the operation of intermodal transport.

4PL achieves the integrated design of the intermodal transport system. It is regarded as a point of the interface in the intermodal chain[18], which promotes the match of supply and demand. 4PL integrates a large quantity of 3PLs[51] and makes the advantages of existing operation resources of firms to meet the demand[52]. Furthermore, it not only considers the logistics decisions, such as vehicle routing and scheduling but also pays attention to solutions for the management of infrastructure, financial transactions, human resources and so on[46]. Thus, 4PL can improve almost all activities in the entire intermodal chain.

4PL also provides professional management knowledge and rich experience for intermodal transport enterprises. Most logistics firms and 3PLs are small and medium-sized enterprises and put more emphasis on scale expansion but not on improvement of service quality. Additionally, it is uneconomical for them to form an intelligent management system to improve the management level only for themselves[53]. While 4PL has an edge in formulating innovative and professional solutions as it integrates the abilities of lead consulting companies and IT providers[54]. What's more, the abilities can be shared by varieties of companies in the intermodal chain which splits the cost. Nowadays, 4PLs are trying to improve their operational level in the hard environment (i.e. material flow, capital flow and information flow) and the soft environment (i.e. organization style and operational procedures)[16].

Finally, 4PL can play the role of coordinator between the government and logistics firms. As 4PL collects most of the data and information in the intermodal chain, it provides powerful support for government decisions. For example, 4PL can identify the bottleneck of the intermodal chain through data analysis and provide advice for the government in infrastructure construction. Especially for the Public-Private Partnership logistics platforms, the government has more access to obtain the operation data and find out the problems.

6. SUGGESTIONS FOR 4PL APPLIED IN INTERMODAL TRANSPORTATION

The design of the information system of 4PL is first considered in this chapter. Then this part provides more advice on the information standardization, coordination, utilization and innovation from the perspective of 4PL. In addition, China government needs to channel great effort into the development of intermodal transport.

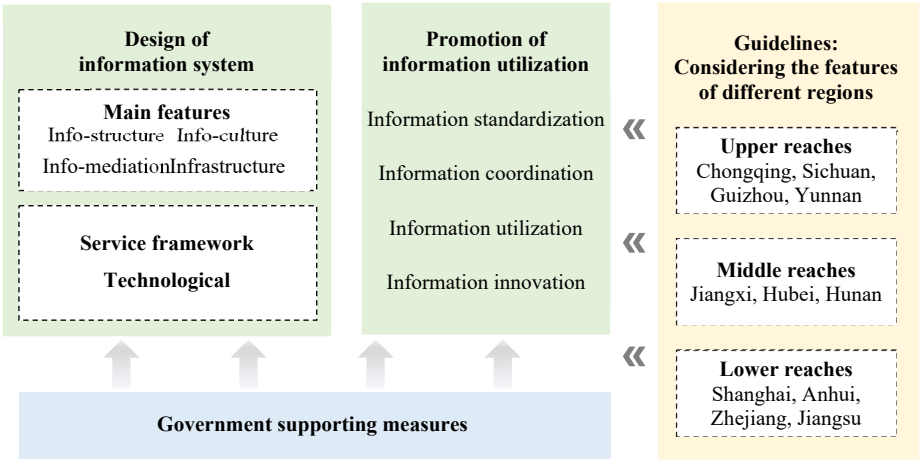

Figure 5. Structure of suggestions for 4PL applied in intermodal transport

6.1 Design of information system

4PL is considered the coordinator among different actors and it must obtain detailed information to improve efficiency in the supply chain. Information management is crucial to promoting the service level of the 4PL platform. The features of the 4PL platform can be identified to clarify the role of 4PL in the intermodal chain. This part also constructs the framework of the 4PL platform based on BI-lateral Resource Integration Service (BIRIS). The conception of BIRIS is first put forward by Wang and Xu[55] and has been applied to many fields. This part considers the intermodal transport from the perspective of BI-lateral market and creatively designs the framework which regards the 4PL as the coordinator of BI-lateral market.

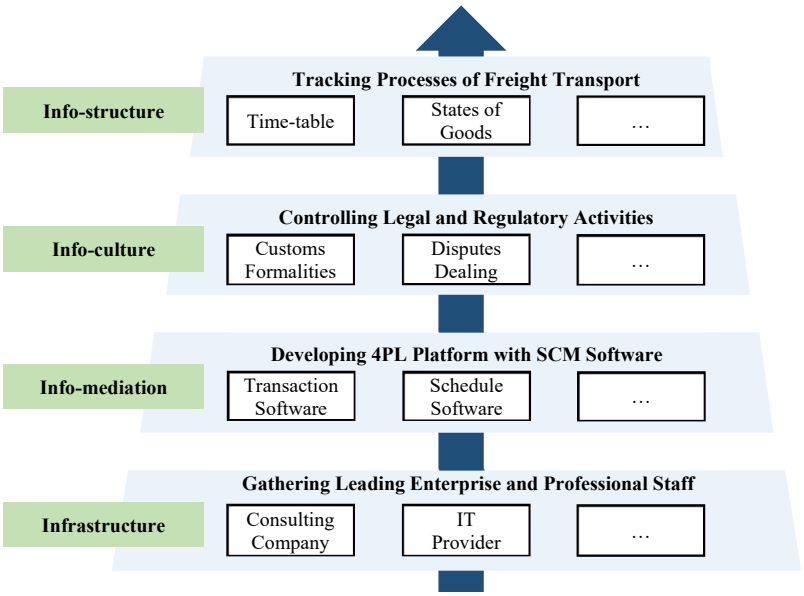

Figure 6. Features of the 4PL platform

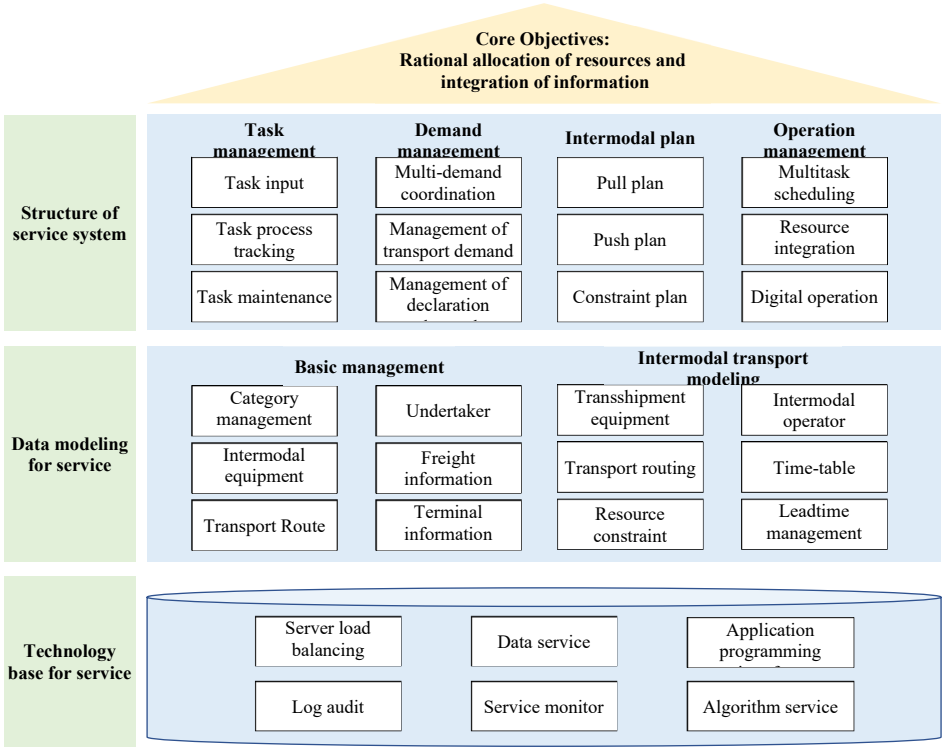

Figure 7. Service framework of the 4PL platform

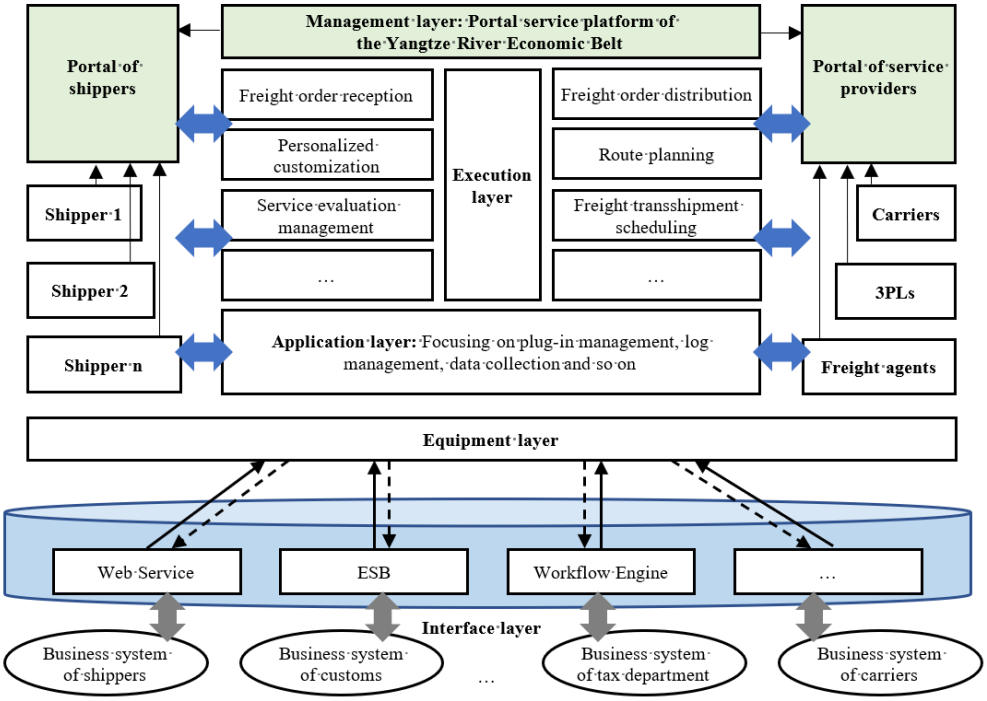

Figure 8. Technological framework of the 4PL platform based on BIRIS

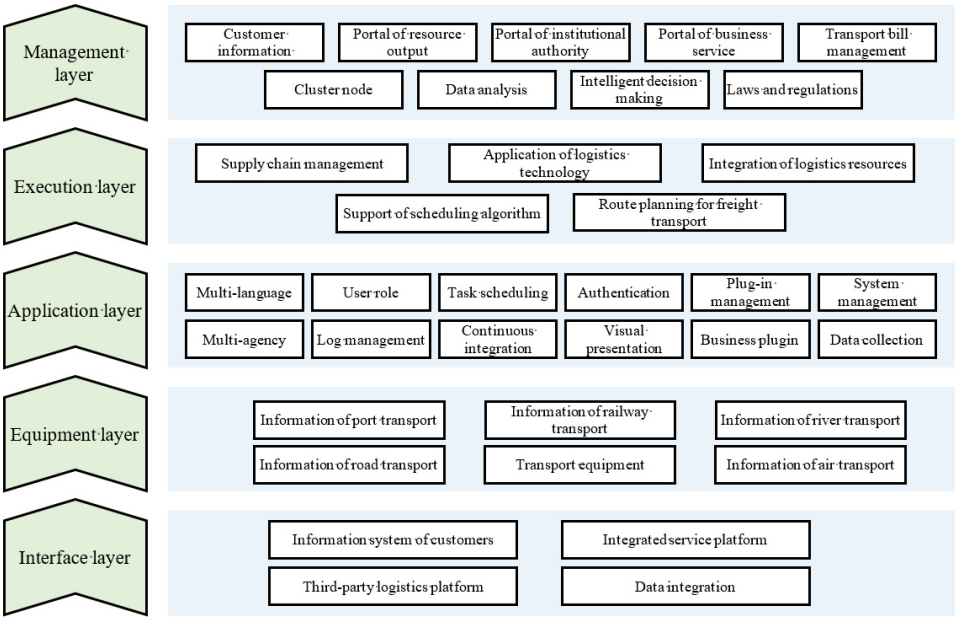

Figure 9. Technological components of the 4PL platform

The features of 4PL platform include infrastructure, info-mediation, info-culture and info-structure[18] (shown in Figure 6). The 4PL platform is built on the infrastructure and it should gather various leading enterprises and professional staff in different fields, which develops an entry barrier to the 4PL industry. Info-mediation refers to various software, such as transaction software and schedule software, which are applied to optimize the material flow, capital flow and information flow in the intermodal chain. Info-culture means that 4PL takes part in the broadcasting of common standards and takes responsibility for controlling legal and regulatory activities. Consequently, 4PL is required to link the platform with some institutional authorities to deal with customs formalities, transport disputes and so on. Info-structure is referred to the function of process tracking in the 4PL platform. 4PL should collect information of the freight from origin to destination and track the time-table of different modes to make sure the fluent flow.

The framework of 4PL platform is constructed based on BIRIS55, which is a popular service pattern that is composed of customers, service providers and a third-party platform. Applying this pattern to the field of intermodal transport, 4PL is supposed to serve as the coordinator to connect the shippers and service providers. Figure 7 and Figure 8 respectively show the service framework and technological framework of the 4PL platform. The technological framework of the 4PL platform has five main components, including management layer, execution layer, application layer, equipment layer and interface layer (shown in Figure 9). Actors including shippers and carriers can log into the portal website to manage freight orders. 4PL can provide services such as personalized customization for shippers and transshipment scheduling for service providers through the data integration and analysis in the execution layer and application layer. The realization of the interaction in the front end is based on the infrastructure in equipment layer. Meanwhile, in interface layer, 4PL achieves integration of information through connecting existing business system of the actors into the 4PL platform.

6.2 Promotion of information utilization

Initially, the most important thing is to establish a unified information standard. As the interdependence increases among different actors, 4PL needs to unify Electronic Data Interchange (EDI) format to ensure information flow smoothly. In particular, the popularization of “one bill of lading” is crucial to improving efficiency in this data interchange system, while the government has emphasized that in the 14th Five-Year Plan. Therefore, 4PL has the responsibility to broadcast the unified transport bill parting with the government. The unified transport bill is required to adapt to different transport modes, including rail, water, air and road. Through analyzing multiple transport bills used in practice, the designer should study and formulate the transport bill which suits the entire intermodal chain. The transport bill should include not only basic items generally used but also optional items especially for some transport modes.

Based on the unified information standard, 4PL should promote information interchange and establish a communication mechanism for intermodal transport. The data from the internal system of different actors converge in the 4PL platform, preventing data silos. In addition, 4PL should provide a platform where multiple interest groups can exchange their opinions. The coordination of these groups is an essential motivation for pushing the development of intermodal transportation[56]. Therefore, with the support of 4PL, the cross-regional communication mechanism should be made available to coordinate cross-regional decisions, such as waterway

regulation. According to The Work Program for Development and Adjustment of Transport Structure (2021-2025), it is important to promote the open exchange of government data on intermodal transport. As the interest groups have been extended to the financial department, customs, inspection agencies and some other institutional authorities, the 4PL platform ought to open data interfaces to these institutional authorities to ensure smooth freight flow. Furthermore, great efforts are needed to converge various intermodal enterprises, promoting cooperation and information interchange. As a result, 4PL can align the operation processes in the intermodal chain to reduce possible problems.

There is a definite need for 4PL to improve its ability of information utilization, promoting the seamless connection between different transport modes. This requires the 4PL platform to encourage all transport modes to share information including time-table, the capacity of vehicles, location of the freight and so on, which make up of the checklists used for processing all shipments. To achieve effective utilization of information, 4PL should redesign the information system and use the algorithm to optimize some operational decisions such as vehicle routing, freight routing, infrastructure construction and so on. Furthermore, 4PL needs to facilitate the ability to design integrated solutions for the entire intermodal chain. It is required to optimize not only transport activities but also the operations of inventory control, order management, funds management and some other activities. Consequently, 4PL becomes the coordinator who controls the supply chain completely and provides customized solutions for different customers. Based on the integration of all modes and activities, 4PL can maximize the benefits of the whole supply chain.

4PL should evolve and innovate constantly through the application of advanced information technology. Information and communications technologies (ICT) are beneficial to information interchange and seamless connection in intermodal transport, which include “Internet of Things” (IoT), artificial intelligence (AI), big data analytics, cloud computing and machine learning. 4PL is supposed to drive the universal application of Radio Frequency Identification (RFID) and Global Positioning System (GPS) to track, monitor and control vehicles and freight. Meanwhile, big data and cloud computing could be applied to serve for route optimization, mode choice and some other decisions. For example, 4PL needs to bundle smaller batches of goods into large flows to achieve high-frequency transport.

6.3 Government supporting measures

The government ought to take some measures to support the development of intermodal transport, thus helping take the most advantage of 4PL. It is worthwhile to mention that the development plan of intermodal transport in Yangtze River Economic Belt should adapt to the industry development. The plan needs to consider the features of different regions such as the economic development level, the major industries and the condition of infrastructure. For example, the cities in the upper reaches of the Yangtze River continue to promote electronic and communication device manufacturing by linking CHINA RAILWAY Express to the inland areas. The cities in the middle reaches of the Yangtze River could focus on competitive industries such as the engineering industry and enhance the ability to transship different engineering equipment. The cities in the lower reaches of the Yangtze River play the role of promoting international trade. More specific suggestions are given as follows. Initially, the establishment of Yangtze River Economic Belt development committee is needed to enhance the coordination between different interest groups and promote the formulation of some related regulations. Different interest groups

are supposed to attend communication conferences every year to report problems in time and find out solutions together. Secondly, a key policy priority should be to plan for the long-term care of intermodal transport. China can formulate various preferential policies for intermodal enterprises, such as providing cheap lands and tax breaks. In addition, the special fund should be made to support the development of talents in this field. Thirdly, continued efforts are needed to improve the collection and distribution system of intermodal transport. In particular, railways should be constructed to connect the ports and the infrastructure needs to be improved to lift the capacity of inventory, handling and delivery. Finally, to ensure seamless connection, China is supposed to unify the standard of intermodal transport equipment, including loading units, carrying tools and vehicles.

7. CONCLUSION

This study sets out to explore the way of improvement for intermodal transport in Yangtze River Economic Belt. Consequently, this paper initially introduces the intermodal transport system, including policies, actors, terminals, transshipment services and information systems. Then some problems of the intermodal transport system have been identified. To find out whether 4PL suits the intermodal chain, the paper points out the advantages of the combination of 4PL with intermodal transport. Furthermore, the study tries to design 4PL platform based on BIRIS. The most important finding to emerge from this study is that 4PL can indeed promote information standardization, coordination, utilization and innovation in the intermodal chain. Meanwhile, the government is supposed to take some measures to support 4PL and other enterprises.

Overall, the integrated intermodal transport system based on the coordination of multiple sectors, agencies and modes is crucial to the development of the regional economy in Yangtze River Economic Belt. It not only benefits the reduction of the cost of transport but also strengthens the links of city strips along the river and promotes three-industry integration. Thus, this paper contributes to exploring new ways of development of Yangtze River Economic Belt. The practical implication of this paper is that government can consider taking advantage of the 4PL platform for intermodal transport. Finally, considerably more work still needs to be done to establish a more detailed and professional 4PL platform for intermodal transport.

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