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Research on Strategies for Improving Logistics Efficiency at Shanghai Port

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Abstract: Against the backdrop of accelerated global economic integration, the scale of international trade continues to expand. As a key node in the international logistics chain and an important hub of international trade, the logistics efficiency of ports plays a decisive role in regional economic development and even the stable operation of the global supply chain. Shanghai Port, as one of the top ports in terms of global cargo throughput and container throughput, is an important gateway for China's foreign trade and a key strategic resource for participating in international economic cooperation and competition. It not only undertakes the task of transferring and transporting a large amount of domestic goods, but also connects major economic regions around the world, occupying a core position in the global shipping network. However, with the profound adjustment of the global trade pattern, the rapid development of shipping technology, and the increasing demand for logistics services from customers, the logistics development of Shanghai Port is facing many challenges. On the one hand, competition among surrounding ports has intensified, with internationally renowned ports such as Singapore Port and Busan Port continuously improving their logistics service levels and competing for market share in the international shipping market, bringing enormous competitive pressure to Shanghai Port; On the other hand, there are still problems in the logistics operation of Shanghai Port, such as the need for further improvement of port infrastructure, insufficient integration and sharing of logistics information, and poor connection of multimodal transport, which make it difficult for logistics efficiency to meet the growing business needs and restrict the further improvement of Shanghai Port's international competitiveness. In this situation, in-depth research on strategies to improve the efficiency of Shanghai Port's port logistics will not only help Shanghai Port break through development bottlenecks, enhance its core competitiveness, consolidate its position in the global shipping market, but also provide useful references for other domestic ports, promote the overall high-quality development of China's port logistics industry, and better serve the country's opening-up strategy and economic development.

Keywords: Shanghai Port; Port logistics; Efficiency improvement.

1. Introduction

As a super port with the highest global container throughput for over a decade, Shanghai Port is not only the core hub for the integrated development of the Yangtze River Delta, but also the "maritime gateway" for China to connect with the global market. In 2024, the container throughput of Shanghai Port exceeded 47 million TEUs, and the cargo throughput exceeded 720 million tons, directly supporting 12% of the country's foreign trade import and export volume. [1] The logistics efficiency directly affects the stability and international competitiveness of the industrial and supply chains. Against the backdrop of the deep adjustment of the current global trade pattern, the rapid rise of cross-border e-commerce, and the promotion of the "dual circulation" development strategy, the traditional port logistics model is facing multiple challenges such as the large-scale construction of ships, the improvement of transportation efficiency requirements, and the green and low-carbon transformation. For example, the berthing and scheduling efficiency of ultra large container ships, the fast clearance needs of cross-border e-commerce goods, and the optimization of operation modes under carbon emission constraints all put forward higher requirements for the logistics system of Shanghai Port. Therefore, systematic research on strategies to improve logistics efficiency in Shanghai Port is not only a practical need to solve the current bottleneck in port operations, but also a strategic choice to help China build a higher-level open economy.

2. Theoretical Overview

2.1. Ports and Port Logistics

2.1.1. Port

A port refers to a comprehensive infrastructure located along the banks of rivers, lakes, seas, and other water bodies, with functions such as ship docking, cargo loading and unloading, passenger boarding and disembarking, and material storage. It is a hub node for water and land transportation. [2] From the perspective of functional attributes, ports are not only physical spaces for cargo transportation, but also key links connecting different modes of transportation (such as sea transportation, river transportation, railways, highways, etc.). Their core role is to achieve the transportation connection and cargo distribution of "water land" and "land water". From the perspective of development history, ports have evolved from simple "transportation hubs" in the early days to composite economic nodes that integrate logistics, information flow, and capital flow. For example, Shanghai Port not only undertakes cargo loading and unloading tasks, but also integrates diversified functions such as bonded warehousing, international transit, and cross-border e-commerce. From a classification perspective, it can be divided into commercial ports, fishing ports, military ports, etc., among which commercial ports are the core carriers of international trade; According to geographical location, ports can be divided into seaports (such as Shanghai Port), river ports (such as Nanjing Port), and lake ports (such as Jiujiang Port). Different types of ports

have significant differences in logistics scale and functional positioning due to differences in natural conditions. The development level of ports is often closely related to regional economic strength and industrial layout, and their operational efficiency directly affects the transportation cost and turnover speed of goods.

2.1.2. Port Logistics

Port logistics is a full chain service system that integrates transportation, warehousing, loading and unloading, packaging, circulation processing, information processing, and other links based on the infrastructure and location advantages of the port, with the port as the core node, to achieve the full chain service system of goods from the "origin" to the "destination". Compared with ordinary logistics, port logistics has three significant characteristics: firstly, internationalization. As a key link in cross-border trade, port logistics needs to connect with the transportation rules, customs clearance standards, and cultural differences of different countries. For example, Shanghai Port needs to handle goods from more than 200 countries and regions around the world, involving multilingual information exchange and adaptation to international logistics rules; The second is the integration of multimodal transport. Port logistics needs to coordinate the connection of multiple transportation modes such as sea freight, railway, road, and inland waterway, and reduce transit costs through models such as "one order system" and "seamless docking". For example, Shanghai Port's "sea rail intermodal transport" has achieved direct transportation of containers from the port to the inland hinterland; Thirdly, it is systematic and complex, involving multiple entities such as shipping companies, freight forwarders, terminal operators, customs, inspection and quarantine. Any delay in any link may affect overall efficiency. With the development of intelligence and greenness, modern port logistics has transformed from "traditional loading and unloading services" to "integrated supply chain services", becoming an important engine driving regional economy and global trade [3].

2.2. Port Logistics Efficiency

2.2.1. Logistics efficiency

Logistics efficiency refers to the ratio of input to output in the process of realizing the spatial displacement and time value creation of goods in a logistics system, that is, the ability to achieve established logistics goals with minimal resource consumption (such as manpower, material resources, time, and cost). From a micro perspective, logistics efficiency is reflected in the operational quality of individual links, such as the "ton kilometer cost" of transportation and the "inventory turnover rate" of warehousing; From a macro perspective, it reflects the entire logistics system's ability to support the social economy, such as the proportion of total social logistics costs to GDP (approximately 14.7% in China in 2023). The evaluation of logistics efficiency needs to take into account the dual dimensions of "efficiency" and "benefits". The former emphasizes speed and cost (such as the timeliness of goods transportation and the proportion of logistics costs), while the latter focuses on service quality and sustainability (such as the rate of goods damage, customer satisfaction, carbon emission intensity). With the deepening of supply chain concepts, modern logistics efficiency is no longer limited to optimizing individual enterprises or links, but extends to "supply chain collaborative efficiency". Upstream and downstream enterprises reduce inventory backlog through information sharing, reduce empty driving rates through joint transportation, and achieve overall efficiency improvement [4].

2.2.2. Port logistics efficiency

Port logistics efficiency is the concretization of logistics efficiency in port scenarios, referring to the ability and effectiveness of the port logistics system to complete activities such as cargo loading and unloading, storage, transportation, customs clearance, etc. by integrating resources (such as terminal equipment, manpower, information systems) within a certain period of time. The core evaluation logic can be summarized as a "three-dimensional model": firstly, operational efficiency, which is reflected in the quantitative relationship of "input-output", such as the container loading and unloading volume per unit of quay crane (the single machine efficiency of Yangshan Phase IV automated wharf quay crane in Shanghai Port can reach 40 natural containers/hour), and the average time of ships in port (usually controlled within 24 hours in international advanced ports); The second is service efficiency, which involves customs clearance time, customer response speed, etc. For example, Shanghai Port has compressed the customs clearance time of imported goods to an average of less than 4 hours through models such as "two-step declaration" and "early machine inspection"; The third is sustainable efficiency, which means balancing green and low-carbon goals in the process of efficiency improvement, such as replacing traditional fuel vehicles with electric container trucks, using photovoltaic panels to power terminal equipment, etc., to reduce the carbon emission intensity per unit of cargo. The efficiency of port logistics directly determines the competitiveness of ports in the global supply chain and is a core indicator for measuring the level of port development.

3. Analysis of Factors Affecting the Logistics Efficiency of Shanghai Port

3.1. Infrastructure Factors

Infrastructure is the material foundation for port logistics operations, and its level of improvement directly determines the port's carrying capacity and operational efficiency. The infrastructure of Shanghai Port mainly includes dock berths, loading and unloading equipment, and a collection and distribution network. The scale and structure of dock berths affect the flexibility of ship berthing. Large and specialized berths can adapt to the berthing needs of ultra large container ships and reduce vessel waiting time; On the contrary, if the number of berths is insufficient or the tonnage is not matched, it may cause ships to be stranded in port. The technical level and quantity configuration of loading and unloading equipment are equally critical. Advanced shore bridges, yard bridges, and other equipment can improve the speed of cargo loading and unloading, while aging or improper maintenance of equipment can reduce operational efficiency [5].

The smoothness of the collection and distribution network is the key to connecting the port with the inland hinterland. Shanghai Port has currently formed a collection and distribution system that is mainly based on sea transportation and supplemented by railway, public transportation, and water transportation. However, there is still room for optimization in the connection of various modes. Although highway transportation is flexible, it is easily affected by urban traffic congestion. Railway transportation has a large volume and low cost, but lacks competitiveness in short

distance transportation. Inland waterway transportation is limited by natural conditions such as water levels. If there is a bottleneck in the collection and distribution process, the transportation of goods between the port and the hinterland will be hindered, which will increase the pressure on port storage and affect the overall turnover efficiency. In addition, the layout and capacity of storage facilities can also affect the storage and scheduling of goods. Reasonable yard planning can reduce the distance of goods handling and improve storage and retrieval efficiency.

3.2. Technical and Information Factors

In the digital age, technology and information technology have become the core driving forces for improving port logistics efficiency. The technological application of Shanghai Port is mainly reflected in two aspects: automated operations and information system construction. The application of automation technology can reduce manual intervention and improve the stability and accuracy of operations. For example, automated docks achieve efficient coordination of loading, unloading, and transportation through unmanned gantry cranes and AGVs (Automated Guided Vehicles). Compared to traditional manual docks, it can significantly reduce operational errors and time consumption. However, the popularization and compatibility of technology still need to be improved, and the automation transformation of some old docks lags behind, which may form efficiency gaps.

Informationization is the foundation for achieving efficient collaboration in all aspects of logistics, and a comprehensive information system can break down data barriers among shipping companies, ports, freight forwarders, customs, and other parties. Shanghai Port has built electronic ports, logistics information platforms and other systems, promoting the digitization of customs clearance, scheduling and other processes. However, there are still obstacles to data sharing between different systems, and the phenomenon of information silos has not been completely eliminated. For example, if the dynamic information of ships and the clearance status of goods cannot be synchronized in real time, it may lead to poor connection between terminal scheduling and cargo inspection, increasing waiting time. In addition, the application depth of technologies such as big data and artificial intelligence is insufficient, and their potential in intelligent scheduling, demand forecasting, and other areas has not been fully utilized, which has affected the optimal allocation of logistics resources.

3.3. Management and Operational Factors

The management and operation mode are the "software" that determines whether the port logistics system can operate efficiently, directly affecting the efficiency of resource allocation and the smoothness of process connection. The management of Shanghai Port involves multiple entities such as terminal operators, port management departments, and related enterprises, and the soundness of the coordination mechanism among all parties is crucial. If the division of management responsibilities is unclear and the communication process is cumbersome, it may lead to delayed decision-making and affect the speed of emergency response. For example, in the face of sudden weather or equipment failures, an efficient coordination mechanism can quickly allocate resources and reduce work interruption time; On the contrary, it may prolong the recovery period.

The degree of optimization in the operational process is equally crucial, as the efficiency of each link from ship entry, cargo loading and unloading to collection and distribution, affects the overall logistics efficiency. Shanghai Port has a certain foundation in process standardization, but there are still redundant steps in some links, such as insufficient synchronization between cargo inspection and terminal operations, which may lead to secondary handling of goods. The level of supply chain collaboration also needs to be improved. As the core node of the supply chain, ports need to establish close cooperation with shipping companies, shippers, inland logistics enterprises, etc. By sharing demand information and collaborating to develop transportation plans, empty sailing rates and inventory backlog can be reduced. If there is insufficient collaboration, it may lead to wasted transportation capacity or delayed goods, increasing logistics costs.

3.4. Policy and Environmental Factors

Policies and environmental factors, as external conditions, have both guiding and constraining effects on the efficiency of port logistics. Policy support can provide institutional guarantees and resource allocation for the development of port logistics. For example, customs clearance facilitation policies can simplify the declaration process, shorten inspection time, and reduce the cost of goods being detained in ports; Tax incentives and financial support can encourage ports to undergo technological transformation and infrastructure upgrades. Shanghai Port has achieved significant results in improving customs clearance efficiency by relying on policy advantages such as the pilot free trade zone. However, the implementation details of some policies still need to be improved, and there is still room for the release of policy dividends.

Environmental factors include natural environment and market environment. Typhoon, rainstorm, fog and other weather phenomena in the natural environment may directly affect the safety of ship navigation and wharf operations, leading to operation interruption or efficiency decline. The changes in the market environment also bring challenges. Global trade fluctuations may lead to unstable cargo throughput. If ports cannot adjust their capacity allocation in a timely manner, there may be idle resources or insufficient capacity. In addition, the requirements for green and low-carbon development have put forward new constraints on port logistics, such as carbon emission control, noise pollution restrictions and other environmental standards, which promote the acceleration of energy structure transformation and operation mode optimization in ports. In the short term, it may increase operating costs, but in the long run, the technological upgrades brought by green transformation will enhance the sustainable competitiveness of ports.

4. Strategies for Improving Logistics Efficiency at Shanghai Port

4.1. Infrastructure Upgrade Strategy

Infrastructure upgrade is the hardware support for improving the logistics efficiency of Shanghai Port, which needs to be promoted synchronously from three levels: terminal facilities, collection and distribution network, and warehousing system. In terms of dock facilities, the focus should be on promoting the intelligent transformation of existing docks, reinforcing the structure and upgrading the

functions of old berths, increasing the number of large-scale and specialized berths to adapt to the development trend of large-scale ships. At the same time, optimize the configuration of dock loading and unloading equipment, introduce high-efficiency shore bridges, yard bridges and other equipment, and strengthen the daily maintenance and upkeep of equipment to reduce work interruptions caused by equipment failures.

In the construction of the collection and distribution network, it is necessary to further improve the "sea rail public water" multimodal transport system. Increase investment in railway collection and distribution channels, expand the coverage of railway freight lines, and increase the proportion of railway collection and distribution; Optimize the traffic organization of highway collection and distribution, and reduce traffic congestion on roads around ports; Enhance the navigation capacity of inland waterway transportation, dredge inland waterways, and increase the capacity of inland container ships. By integrating the advantages of multiple transportation methods, seamless connection of goods between ports and hinterlands can be achieved. In addition, it is necessary to plan the layout of storage facilities reasonably, build intelligent three-dimensional warehouses, and improve the space utilization and storage efficiency of goods storage.

4.2. Strategy for Technological Innovation and Information Technology Construction

Technological innovation and information construction are key driving forces for improving the logistics efficiency of Shanghai Port. In terms of technological innovation, we should continue to promote the automation and intelligent transformation of port operations. Expand the construction scale of automated terminals, gradually apply automation technology to other port areas on the basis of the existing Yangshan Phase IV automated terminal, and achieve fully automated operations in terminal loading and unloading, transportation, and storage. At the same time, we will strengthen the research and application of green technologies, promote clean energy equipment such as electric container trucks and LNG powered ships, and reduce the environmental impact of port operations.

In terms of information construction, it is necessary to build an integrated logistics information platform, break down information barriers between different departments and enterprises, and achieve real-time sharing and interaction of ship dynamics, cargo information, customs clearance data and other information. Utilizing technologies such as big data and artificial intelligence to conduct in-depth analysis of logistics data, achieving intelligent management such as cargo demand forecasting, ship scheduling optimization, and equipment operation and maintenance warning, and improving the scientific and accurate nature of logistics decision-making. In addition, it is necessary to strengthen the construction of the network security guarantee system to ensure the secure and stable transmission of logistics information, and provide reliable support for the efficient operation of the information platform.

4.3. Management and Operations Optimization Strategies

Management and operational optimization are important guarantees for improving the logistics efficiency of Shanghai Port. In terms of management mode, a unified and coordinated management mechanism should be established to clarify the responsibilities and division of labor of relevant entities such as port management departments, terminal operators, and shipping companies, strengthen communication and cooperation among all parties, and form a working force. Establish a sound emergency management system, develop comprehensive emergency plans, conduct regular emergency drills, improve the ability to respond to sudden weather, equipment failures, epidemics and other emergencies, and ensure the stable operation of port logistics.

In terms of optimizing operational processes, it is necessary to comprehensively sort out and reconstruct the existing operational processes of the port, eliminate redundant links, simplify operational procedures, and achieve efficient connection between cargo loading and unloading, inspection, customs clearance, and other links. Implement a "one-stop" service model to provide customers with full process services from goods entering and leaving the port, and improve customer satisfaction. Strengthen the collaborative management of the supply chain, establish long-term and stable cooperative relationships with upstream and downstream enterprises, and improve the overall efficiency of the supply chain by sharing information, risks, and benefits. For example, establishing a demand docking mechanism with the shipper enterprise and planning transportation plans in advance based on the demand for goods; Strengthen cooperation with inland logistics enterprises and optimize the collection and distribution routes of goods.

4.4. Policy Support and Guarantee Strategies

Policy support and guarantee are important external conditions for promoting the improvement of logistics efficiency in Shanghai Port. In terms of policy support, the government should increase funding for infrastructure construction and technological innovation in Shanghai Port, establish special support funds, and provide subsidies for projects such as port automation and information construction. Introduce tax preferential policies to provide appropriate reductions and exemptions for value-added tax, corporate income tax, etc. of port logistics enterprises, in order to reduce their operating costs. Optimize land use policies, ensure the necessary land resources for port development, and provide spatial support for port expansion and upgrading.

In terms of security measures, efforts should be made to strengthen the training and introduction of logistics talents. Establish a multi-level talent training system, collaborate with universities and vocational colleges to offer port logistics related majors, and cultivate composite talents with professional knowledge and practical abilities. Develop preferential talent introduction policies to attract high-end logistics management and technical talents from home and abroad to join the development and construction of Shanghai Port. At the same time, strengthen the training and assessment of existing practitioners, improve their professional quality and operational skills, and provide talent guarantee for the improvement of port logistics efficiency. In addition, it is necessary to establish a sound logistics industry standard system, standardize port logistics operation processes and service quality, and improve the standardization level of logistics services in Shanghai Port.

5. Conclusion

In summary, this article focuses on the improvement of logistics efficiency in Shanghai Port, analyzing its current situation and the impact of factors such as infrastructure,

technological informatization, management and operation, and policy environment. Based on this, corresponding strategies are proposed: upgrading infrastructure, promoting technological informatization, optimizing management operations, and improving policy guarantees. These strategies provide ideas for Shanghai Port to improve logistics efficiency and enhance competitiveness, helping it maintain its leading position in global port competition.

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