

Internet Technology for Efficiency and Resilience in Ocean Transportation Supply Chain Management: A Case Study of China Ocean Shipping Group

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Abstract: With the global maritime transport industry has faced many challenges in recent years, such as market volatility, environmental requirements and technological upgrading. The wide application of Internet technology has changed the management mode of the marine shipping industry and brought new opportunities for its development. Taking China Ocean Shipping Group as a case study, this study aims to explore the use of Internet technology to solve the problems faced by the ocean shipping supply chain and to discuss the importance of Internet technology in the ocean shipping supply chain, its areas of application, and the changes it may bring. Currently, the main problems faced by the marine transport supply chain include human resource costs, logistics information technology level, port and route selection, and shipping market uncertainty, which seriously affect the efficiency and flexibility of marine transport and operating costs. This study discusses Internet technologies to solve practical problems and specific supply chain management measures, including supply chain efficiency, flexibility and operating costs.

Keywords: Ocean transportation supply chain, Internet technology, Efficiency, Resilience, China Ocean Shipping Group

1. Introduction

The maritime transport industry, an integral part of global trade and commerce, has undergone a major transformation in recent years in response to technological advances, market dynamics and evolving consumer demands [1-3]. Over the past few decades, Internet technologies have been incorporated into marine supply chain management, revolutionizing operational processes and increasing efficiency, transparency and adaptability [4, 5]. The introduction to this paper will provide an overview of the current state of the marine supply chain, highlighting key developments and challenges.

The use of Internet technologies in marine logistics dates back to the 1990s when pioneers such as FedEx utilized the Internet to streamline shipment tracking and management, laying the foundation for subsequent innovations. Meanwhile, industry giants like China Ocean Shipping Group Company

(COSCO Shipping) have become leaders in container shipping, implementing digital strategies to address supply chain complexity and improve operational performance. Leveraging digital enablement and "Internet Plus" thinking, companies such as COSCO Shipping have made significant achievements in supply chain efficiency, agility and cost reduction, as evidenced by their annual financial reports and strategic initiatives.

Despite progress, the marine transport sector faces multifaceted challenges, including intense market competition, the need for technological innovation, the complexity of digital transformation, and talent acquisition challenges. These challenges highlight the need to develop comprehensive Internet technology solutions that address specific supply chain pain points and open up new opportunities for growth and sustainability.

This paper explores Internet technology solutions aimed at overcoming the challenges encountered in marine transport supply chains. By analyzing key areas such as human resource costs, logistics information technology levels, port and shipping routing options, and market uncertainty, the paper illustrates strategies to optimize supply chain operations and enhance competitiveness.

2. Overview of Current Situation

The integration of the maritime supply chain with Internet technology began as early as the 1990s. In 1994, FedEx, a global leader in express logistics, introduced the FedEx Ship Manager software. This software utilized the Internet to enhance the efficiency of tracking and managing shipments, thereby cutting costs. FedEx was among the pioneers in adopting Internet technology to manage maritime supply chains. Over time, this technology was refined through ongoing practice and eventually significantly impacted the evolution of maritime supply chain operations [6, 7].

China Ocean Shipping Group Corporation (COSCO), referred to as COSCO Shipping, is the world's third-largest container carrier. In 2015, China Ocean Shipping Group and China Shipping Group implemented a restructuring, and COSCO Shipping was declared on 18 February 2016. COSCO Shipping became the world's third after acquiring Orient Overseas in July 2016 and ranks in the first echelon of the world-class field.

COSCO Haifa (601866. SH/02866. HK) disclosed its annual report for 2023. In 2023, COSCO Haifa realized a total operating revenue of RMB 15.685 billion and a net profit attributable to shareholders of listed companies of RMB 1.409 billion. Currently, the company has taken the following measures to solve the problems of supply chain efficiency and flexibility as well as operating costs: digitally empowering the entire supply chain logistics, making full use of the "Internet+" mode of thinking, taking the market and customer demand as the guide, and taking the digital operation capability as the gripping hand, through the creation of a series of combined products, realizing cross-system data sharing and interaction, and deeply empowering the whole supply chain logistics, as well as the supply chain logistics. Creating a series of combined products achieves cross-system data sharing and interaction, deeply empowers the traditional supply chain industry, realizes real-time sharing of logistics information and collaborative management, improves the efficiency of the supply chain, and reduces communication costs. It has also built the "COSCO-Sea Pass" online customs service platform, which integrates all the customs business operations within the supply chain of COSCO Shipping Logistics and realises digital transformation through the new mode of "Internet + Customs Clearance". COSCO Shipping Group Co., Ltd. also monitors the fleet status in real-time, including ship position, fuel consumption, operational efficiency, etc., by introducing Internet-enabled devices to achieve higher energy efficiency and safety.

Intense market competition and challenges from many domestic and international competitors; pressure for technological innovation and the need to continuously invest in research and development to adapt to the technological development of the industry; the challenge of digital transformation to improve supply chain efficiency and customer service quality; and the introduction

and cultivation of researchers, technicians, and so on, with relevant professional knowledge and skills, which creates cost burdens for maritime enterprises.

3. Internet Technology Solutions for Ocean Transportation Supply Chain Challenges

As an important part of the global logistics system, the ocean transport supply chain has a complex operating environment and faces multiple challenges.

3.1. Human Resource Cost

The human resource cost problem is particularly prominent as the global population structure changes and economic development imbalance, skilled crew, shore-based management personnel and related service personnel supply gradually nervous, demand side for the fierce competition between the shipping companies, the demand for senior Marine personnel, shore-based management talent. In contrast, the supply side, because of the education training system lag and regional economic development differences, makes the relevant talent market supply unable to meet the demand growth; the contradiction pushes up the cost of human resources, putting the shipping company's operating cost pressure to increase. We put forward the following suggestions to solve the problems of the high cost of human resources and the imbalance between supply and demand.

Establish an online education platform. Use Internet technology to break geographical restrictions to share high-quality educational resources. Through the online education platform, excellent ocean-going supply chain experts, courses and learning resources can be concentrated to provide richer and more diversified learning options for the crew and port management personnel engaged in ocean transportation in the future.

Using big data and artificial intelligence technology. Through an in-depth analysis of the learning behaviors, interests, abilities, and specialties of personnel engaged in ocean transportation in the future, we will provide more personalized and accurate learning suggestions and resource recommendations for each personnel member to improve the learning effect and learning motivation.

Carry out distance education and training. Through distance education and training, excellent educational resources and experience can be transmitted to economically backward areas, improve the local education level and talent training ability, and promote the balanced development of the regional economy.

In short, the use of Internet technology can effectively solve the education training system lag regional economic development differences, improve the quality of education and personnel training level, promote the sustainable development of the economy, and finally gradually meet the demand of the talent market supply, then can reduce the cost of human resources, for shipping companies in reducing the operating cost of human resources to make a great contribution [8].

3.2. Logistics Informatization Level

The low level of logistics informatization is a major bottleneck restricting ocean transport supply chain efficiency improvement. Although advanced technologies such as the Internet of Things and big data have been applied to some extent in recent years, the overall demand still cannot meet advanced needs such as real-time tracking, optimizing transportation paths and reducing inventory cost. Information asymmetry is relatively common, affecting the supply chain's transparency and efficiency. For example, a real-time and accurate cargo tracking system is necessary for shipping companies to dispatch ships accurately, optimize transportation routes, and reduce inventory costs. Meanwhile, it is difficult to effectively respond to emergencies, such as ship failure and port congestion, leading to decreased stability and reliability of the supply chain [9].

3.2.1. Real-time Tracking of Cargo Ships

By leveraging IoT technology, cargo ships can be equipped with RFID tags or sensors to monitor location, temperature, and humidity in real time. These devices transmit data to a centralized system via the network, enabling continuous monitoring of cargo ships throughout their journey. Additionally, GPS technology can be integrated, allowing for real-time tracking of the ship's location. This GPS equipment provides instant updates on the vessel's whereabouts, offering insights into the progress of the transportation process. Complementing these technologies, real-time data visualization tools can display the gathered information in a graphical format. This visualization enables management personnel to swiftly comprehend the status of cargo ships, aiding in timely decision-making and proactive management of transportation operations. By seamlessly integrating these technologies, stakeholders can enhance efficiency and transparency in cargo ship monitoring and management processes.

3.2.2. Optimize the Transportation Routes

Artificial intelligence (AI) and machine learning (ML) technologies are crucial in optimizing transportation routes and reducing costs. By leveraging historical transport data, AI and ML algorithms analyze patterns and trends to predict the most efficient transport paths. This predictive capability enables cargo ships to select routes that minimize time and expense. Additionally, route planning software enhances efficiency by automatically determining the optimal transportation route based on the cargo's origin, destination, and specific transportation requirements. By integrating these technologies, cargo ships can streamline their operations, saving time and costs while ensuring efficient delivery of goods.

3.2.3. Reduce the Inventory Cost

Implementing lean inventory management strategies is essential for reducing costs and enhancing efficiency. Companies can minimize excess inventory and improve turnover rates by accurately predicting demand and optimizing inventory levels. Real-time inventory monitoring systems are crucial in this process, providing continuous updates on inventory levels. This real-time data allows for proactive management, helping to prevent inventory backlog and reduce waste. Additionally, optimizing the layout of inventory storage further enhances efficiency. By strategically organizing inventory, companies can minimize handling distance and time, ultimately reducing inventory costs. Integrating these approaches creates a comprehensive inventory management strategy that fosters cost savings and operational effectiveness [10].

3.3. Selection of the Ports and Shipping Routes

The choice of port and route is also the key factor affecting the efficiency of the ocean transport supply chain. The hardware facilities, service quality, charging standard and the planning rationality of the route network of different ports all directly impact the transportation efficiency. For example, severe congestion in some ports may lead to ship steorage and increased cost; unreasonable routes or limited coverage may make the transportation path not optimal, thus reducing the response speed and flexibility of the whole supply chain. In addition, port charging standards and service quality will also impact transportation costs and efficiency. We proposed the following suggestions for a more reasonable choice of ports.

Use Internet technology to collect and analyze large amounts of port and route data. These data can include port throughput, ship entry and exit time, route length, ship speed, cargo type and quantity,

etc. Through big data analysis, we can understand the busy degree of the port, the transportation capacity of the route, and the distribution of goods to provide data support for logistics decisions.

Using the Internet technology for the real-time monitoring of ports and air routes. Through the Internet of Things technology, various equipment and sensors of ports and routes are connected to realize real-time data collection and transmission, real-time monitoring of the operation of ports and routes, finding and solving problems in time, and ensuring the smooth progress of logistics.

Use the Internet technology to optimize the operation of ports and air routes. Through cloud computing and other technologies, the operation data of ports and routes are deeply mined and analyzed to find existing problems and bottlenecks and put forward optimization suggestions. For example, the route should be adjusted according to the distribution of goods to improve transportation efficiency, ships' entry and exit times should be adjusted according to the busy port, and the waiting time should be reduced.

Internet technology can also improve the safety of ports and shipping routes. Through video monitoring, ship tracking and other technologies, real-time monitoring of port and route safety, timely detection and prevent potential safety risks. At the same time, Internet technology is used to establish emergency plans to improve the ability to respond to emergencies [11].

3.4. Uncertainty in the Shipping Market

The uncertainty of the shipping market is a strategic problem facing the ocean transport supply chain. Fuel price fluctuations, trade policy adjustments, geopolitical risks and other factors will drastically impact the demand and demand relationship of the shipping market and then affect the deployment of transport capacity, freight rates and even the signing of long-term contracts. For example, rising fuel prices will lead to increased ship operating costs, which increases freight rates; trade policy changes will affect import and export demand and thus shipping market demand; geopolitical risks will increase transportation risks and costs and reduce the stability of the supply chain. To improve the stability of the supply chain to adapt to the uncertain shipping market, we put forward the following Suggestions through the Internet technology of the shipping enterprise's operating conditions, the shipping and capital market, the company in the shipping enterprise international conventions, laws and regulations, social, political, cultural factors by the enterprise functional departments widely, detailed, continuous collection, analysis, find out the company faces various uncertain factors. On this basis, according to the strategic goals of the company's strategic goals, the pure risks that affect the realization of the company's strategic goals and the opportunity risks that are conducive to the company achieving the strategic goals are identified to formulate countermeasures and promote the company to achieve the strategic goals. Shipping enterprises shall use Internet technology to formulate risk management strategies, formulate overall plans for constructing a comprehensive system, formulate risk management manuals and implement them at various levels. Based on the current situation of the internal control process, risk management, combined with assessed risk, using the Internet technology to find out the key risk control points in the process, combing and refining the specific control content, modifying the system, increasing the monitoring index, strengthen the shipping business, ship management and internal risk control in the capital operation process. At the same time, the risk is ranked according to priority, the risk early warning system is established, special risk management solutions are formulated for emergencies and crisis events, each predictable major risk is optimized, and the major investment decision-making process is optimized [12].

4. Conclusion

In the tide of contemporary digitalization, the architecture of the maritime supply chain is being reshaped. Specifically, the digital technologies of Industry 4.0 bring significant business benefits to Marine logistics centers by improving operational efficiency, reducing costs, enhancing decision-making processes, and optimizing stakeholder relationship management (SRM). Among these technologies, IoT platforms, cloud computing, and blockchain are widely recognized as having a potentially revolutionary impact, and these technologies are expected to change how the industry operates profoundly. These cutting-edge technologies improve the transparency and efficiency of information flow and provide greater security and reliability for managing the maritime supply chain (Parola et al., 2020).

The "Internet + ocean transportation supply chain" has become an important part of the global trade and logistics industry. Internet technology has brought significant opportunities to the ocean transportation supply chain, improving information sharing, efficiency and visibility, logistics tracking, inventory management and payment security. It promotes the shipping industry's resource integration and cooperation, improving transportation planning and route optimization.

In the future, the "Internet + ocean transportation supply chain" is expected to achieve the development goals of higher efficiency, lower cost, and better supply chain management service through continuous innovation and optimization, as well as provide strong support for global trade and economic growth. At the same time, it also needs to deal with technical challenges, regulatory changes, market competition, and many other factors, as well as continue to adapt to the needs of the development of the industry.

Authors Contribution

All the authors contributed equally, and their names were listed alphabetically.

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