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Study on Countermeasures to Improve the Resilience of International Freight Forwarding Industry Based on Digital Transformation

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Abstract: This study, grounded in the theories of supply chain resilience and digital transformation, analyzes the essence and shortcomings of resilience in the international freight forwarding industry. It explores how digital transformation empowers resilience building in this sector, including data visualization, intelligent decision-making, ecosystem collaboration, and organizational change. Additionally, it addresses the challenges faced during digital transformation by proposing collaborative development strategies at the corporate, industry, and policy levels. The aim is to enhance industry resilience through a three-dimensional synergy system, thereby supporting the stable development of the international freight forwarding industry in an uncertain environment.

Keywords: Digital transformation; Freight forwarders; Industry resilience.

1. Introduction

As the new development pattern of dual circulation at home and abroad deepens and the global supply chain restructures, the strategic importance of the international freight forwarding industry in ensuring smooth trade is becoming increasingly prominent. According to World Bank data, for every 1% decline in global trade volume, international freight forwarding revenue decreases by 1.8%, highlighting its strategic value as the nerve center of trade. However, multiple uncertainties such as geopolitical conflicts, escalating trade barriers, and extreme weather events pose severe challenges to the resilience of the international freight forwarding industry. The "14th Five-Year Plan for Modern Logistics Development" clearly lists "enhancing the resilience of industrial and supply chains" as a core goal, while the "Guidance on Promoting High-Quality Trade Development" emphasizes that digital transformation is the key driver of industry upgrading. In this context, how to enhance industry resilience through digital means has become a focal point of both theory and practice.

Currently, the international freight forwarding industry is undergoing a profound transformation from being labor-driven to data-driven. Blockchain technology enables traceability of goods and paperless documentation, IoT devices monitor transportation status in real-time, big data analysis optimizes route planning, and artificial intelligence assists in demand forecasting and anomaly handling. These technologies have demonstrated significant resilience during emergencies such as the COVID-19 pandemic and the Suez Canal blockage. However, issues like system compatibility, data privacy risks, and high transformation costs for small and medium-sized enterprises have also emerged during their implementation. This study, based on supply chain resilience theory and digital transformation theory, explores the pathways and strategies for building resilience in the international freight forwarding industry under the impetus of digital transformation, aiming to provide actionable solutions for high-quality industry development.

2. The Connotation and Shortcomings of The Construction of International Freight Forwarders Resilience

2.1. Definition and characteristics of industry resilience

Christopher & Peck (2004) proposed the term "Supply Chain Resilience", which refers to the ability of a system to maintain its functions, recover quickly and achieve adaptive evolution when facing disturbances. The research of an increasing number of scholars such as Desjardine (2019), Wiliams and Shepherd (2016) shows that the stronger the organizational resilience of an enterprise, the stronger its ability to cope with environmental turbulence, and the smaller the losses suffered by the enterprise. Wiliams et al. (2017) proposed that organizational resilience is regarded as the ability of an organization to maintain a good performance level or reach a more ideal level when facing adversity. It is a multi-dimensional comprehensive ability demonstrated by the organization in dealing with adverse situations, including predictive ability, coping ability, recovery ability, development ability, and even breaking through the status quo and achieving new success.

McKinsey & Company (2024) reported that in 2024, the global supply chain will enter a new phase of agile resilience, where companies need to enhance their supply chain recovery speed through technological leverage and ecological restructuring. As a core node in the supply chain, international freight forwarding companies resilience refers to their ability to maintain stable operations, quickly recover, and adapt to new environments when confronted with external shocks such as geopolitical conflicts, natural disasters, and trade frictions, as well as internal challenges like supply chain disruptions and technological changes. Therefore, the resilience of international freight forwarding industry directly determines the entire chains risk resistance capability, which is manifested in the dynamic balance of agility, redundancy, and synergy:

1. Agility: The ability to quickly identify risks and adjust resource allocation.

2. Redundancy: Reduce the dependence on a single node through resource reserves and network backup.

3. Synergy: real-time information sharing and decision-making with cargo owners, carriers, customs and other stakeholders.

2.2. Industry resilience and weaknesses

The traditional freight forwarder operation mode is highly dependent on manual operation and experience decision-making, and there are significant defects in information acquisition, decision-making speed, resource allocation and risk early warning. According to the survey data of China International Freight Forwarders Association (CIFA), we summarize the systematic characteristics of the resilience of the freight forwarding industry shown in Table 1.

As can be seen from Table 1, the traditional freight forwarding operation model has significant resilience shortcomings, mainly reflected in four aspects: information black holes, decision-making delays, resource rigidity, and risk blind spots. In terms of the information black hole, most enterprises need to manually check the booking status of sea freight, and only 32% of them have achieved full-process visualization, which has increased the cost of tracking each shipment by 8 to 12 US dollars. In terms of decision-making delay, the average abnormal response takes 4.7 hours. 60% of the events rely on phone/email communication, and the hourly delay cost reaches 0.3% of the freight value. The problem of resource rigidity is prominent. The gap period of multi-modal transport exceeds 36 hours. Data silos lead to a 28% loss in connection efficiency, with an average annual loss accounting for 2.1%-3.4% of revenue. In terms of risk blind spots, only 15% of enterprises use AI early warning models. The misjudgment rate of geopolitical risks is as high as 64%, with an average loss of 146,000 US dollars per misjudgment.

Table 1. Systematic characteristics of the resilience of the freight forwarding industry

Shortage type	Typical manifestations	Data support	Economic impact measurement
Information black hole	The booking status of shipping needs to be checked manually	Only 32% of enterprises realize the whole process visualization	The cost of tracking a single shipment increases by $8 to $12
Decision-making is sluggish	The average time for abnormal response was 4.7 hours	60% of events rely on phone/email communication	The cost of delay per hour is 0.3% of the value of freight
Resource rigidity	The window period of multimodal transport exceeds 36 hours	Data silos result in a 28% loss of connectivity efficiency	The annual loss accounts for 2.1% to 3.4% of revenue
Risk blind spots	Only 15% of enterprises use AI early warning models	The misjudgment rate of geopolitical risks is as high as 64%	A single misjudgment resulted in an average loss of $146,000

It is evident that these shortcomings severely restrict the industry's ability to withstand risks, and digital transformation is the key to breaking through these bottlenecks. Ivanov (2023) proposed the important theory of digital supply chain resilience, revealing a bidirectional enhancement mechanism between digital transformation and supply chain resilience. Zhang Sisi et al. (2023) found that the digital economy primarily boosts regional economic resilience through three pathways: improving survival support, economic development support, and environmental support. Lu Binbin and Geng Huiru (2025) discovered that digitalization mainly enhances corporate resilience by improving internal control systems and reducing debt financing costs. Therefore, digital transformation has become the key to breaking through the bottleneck in building industry resilience.

3. The Enabling Mechanism of Digital Transformation for The Resilience Construction of Freight Forwarders

In the context of increasing uncertainty in the global supply chain, digital transformation has become a strategic choice for the international freight forwarding industry to build resilience. Traditional freight forwarding models rely on manual operations and fragmented information systems, making it difficult to cope with emergencies such as port congestion and natural disasters, as well as fluctuations in market demand. This paper proposes the application of digital technology to reshape data flow, decision-making logic, and organizational structure, creating a fourfold empowerment mechanism for freight forwarding companies to enhance their resilience.

3.1. Intelligent Monitoring: Build a fully transparent monitoring system throughout the entire chain

The in-depth application of Internet of Things (iot) and blockchain technologies has enabled real-time tracking of goods status and the immutability of data. Combined with AI prediction models, potential risks (such as port congestion and shipping route disruptions) can be identified in advance, and transportation plans can be dynamically adjusted. For instance, COSCO Shipping Lines has equipped cross-border e-commerce goods with GPS and temperature sensors, and uploaded real-time location, temperature and humidity data through a blockchain platform, reducing the response time to abnormal events by 40%. Meanwhile, by leveraging big data to analyze dynamic variables such as global shipping capacity, fuel surcharges, and port efficiency, AI algorithms automatically plan the optimal transportation routes, reducing time and costs. McKinsey research shows that full-chain data visualization can reduce inventory costs by 25% and transportation delay rates by 18%.

3.2. Effective Decision-making: Enhance the ability of risk prediction and resource allocation

Artificial intelligence algorithms generate precise risk warnings by analyzing massive historical data such as port congestion records and weather models. At the same time, enterprises can provide compliance training for dangerous goods transportation, combine intelligent algorithms to optimize transportation routes, and reduce the risks of dangerous goods transportation. Furthermore, digital systems can preset emergency response procedures and plans. In the event of sudden risk events, they can quickly activate the emergency mechanism and, in combination with the dynamic pricing model of ocean shipping booking price algorithms based on supply and demand, help enterprises quickly optimize their quotation strategies in market fluctuations and enhance their market competitiveness.

3.3. Ecological Synergy: Building a digital supply chain network

The decentralized trust mechanism based on blockchain and the automated execution logic of smart contracts effectively break through the collaboration barriers among cross-border supply chain entities. The immutable feature of blockchain ensures the trusted traceability of data throughout the entire process of logistics, customs clearance, settlement and other links. Smart contracts, on the other hand, automatically trigger cross-border payments, document circulation and other operations through preset rules, which can reduce manual intervention and shorten the contract performance cycle. Blockchain and smart contract technologies break through the bottleneck of cross-border collaboration and promote the coordination of all links in the supply chain. The "Customs, Inspection and Trade" collaborative platform of Shenzhen Port utilizes zero-knowledge proof technology to make sensitive data usable but invisible. In 2024, the Yangtze River Delta Freight Forwarder Alliance completed the customs clearance of 27,000 goods through this platform, with the error rate reducing from 1.2% to 0.3%. Freight forwarders' associations from Beijing, Tianjin, Hebei and Liaoning signed a multimodal transport cooperation agreement to promote the integration of regional logistics resources and enhance the efficiency of supply chain collaboration.

3.4. Organizational Response: Cultivate a digital resilience culture

Digital transformation drives freight forwarders to reform and optimize their traditional organizational structures, breaking down the boundaries between departments and forming a more flattened and flexible organizational structure. Sf International has established a digital operation center, standardizing processes such as order processing, customer service response, and risk control. The efficiency of dynamic cross-regional resource allocation has increased by 60%. Meanwhile, digital transformation encourages freight forwarders to carry out organizational innovation and business transformation, and to try new business models, service models and operation models. For instance, some freight forwarders have launched innovative businesses such as non-vessel operating common carrier (NVOCC) and supply chain financial services through digital platforms, expanding their profit channels and enhancing their comprehensive service capabilities.

The four major empowerment mechanisms proposed above constitute the digital transformation-driven resilience building of freight forwarders, providing a systematic solution for the resilience building of the freight forwarder industry. They drive the industry to shift from passively responding to risks to proactively building resilience, forming a full-chain empowerment system covering "intelligent monitoring - effective decision-making - ecological collaboration - organizational response".

4. Suggestions for Coordinated Development

Challenges such as imbalanced technology investment, data security paradoxes, and talent gaps have emerged during the digital transformation process. Global freight forwarding companies generally face issues of imbalance between technology investment and returns. According to a Gartner report, the failure rate of digital projects in the freight forwarding industry is 52%, with 63% of failures attributed to mismatches between technology investment and business needs. At the same time, the trust paradox in data security and ecosystem collaboration, along with the EUs Data Act and the U.S. National Cybersecurity Strategy 2022-2030, which impose differentiated requirements on cross-border data flows, necessitate additional costs for companies to meet compliance challenges. Additionally, the supply and demand imbalance of digital talent in the industry is characterized by both quantitative and qualitative shortages, especially for small and medium-sized enterprises, which are constrained by cost limitations and struggle to match these demands, leading core talents to flow towards large internet companies.

However, according to the China International Freight Forwarders Association (2024) survey, only 19% of Chinese companies believe they have the capability to meet the challenges of digital transformation, while 68% call for a collaborative mechanism among technology suppliers, industry associations, and the government. In this context, there is an urgent need for a three-dimensional synergy system involving corporate practice, industry ecosystem empowerment, and policy institutional support to enhance the

resilience of the industry system.

4.1. Enterprise level: accurate matching of needs, strengthening compliance and empowerment

First, in view of the mismatch between technology investment and business needs, technology suppliers should design customizable modular platforms, allowing enterprises to select functional modules such as intelligent booking, real-time tracking, compliance management and other functions according to their needs, so as to avoid excessive investment.

Second, adopt a phased implementation strategy to solve the core pain points first, and then gradually integrate advanced functions such as AI prediction to ensure the deep integration of technology and business processes.

Third, in view of the talent gap problem, technology suppliers should provide customized training services to help employees master the use of digital tools.

4.2. Industry level: Improve digital standards and ecological co-construction

First, industry associations should take the lead in formulating international standards for digital transformation of freight forwarding, clarifying requirements such as technology selection, data interface and security protection, so as to promote the interoperability of different enterprise systems.

Secondly, to address the issue of insufficient technical resources for small and medium-sized enterprises (SMEs), industry associations should establish a platform connecting technology suppliers with businesses. This can be achieved through online exhibitions and offline roadshows, helping SMEs select suitable technical solutions. Additionally, integrating industry data resources to create a public data pool would allow companies to access industry trends and capacity data on demand, thereby reducing the cost of data acquisition.

Third, industry associations should cooperate with universities and vocational colleges to train compound talents.

4.3. Policy level: strengthen institutional support and capital guidance

First, tax incentives and financial subsidies have been introduced to encourage freight forwarding enterprises to increase investment in the research and development and application of digital technologies.

Second, increase investment in the digital transformation of logistics infrastructure such as logistics parks, ports and airports, improve the informatization level and service capability of logistics infrastructure, and provide good basic conditions for the digital transformation of freight forwarding enterprises.

Third, the government should build an industry-level digital public service platform to provide one-stop services such as data security testing, compliance consulting and technical training.

Fourth, encourage universities, scientific research institutions and freight forwarding enterprises to carry out industry-university-research cooperation, jointly carry out digital technology research and development and personnel training, and implement digital talent introduction and cultivation plan, and give policy support to digital talents who join the freight forwarding industry.

5. Conclusion

The international freight forwarding industry plays a crucial role in building resilience amid the evolving global trade landscape. Digital transformation offers key opportunities for enhancing industry resilience. By leveraging data visualization to achieve full-chain transparency monitoring, and through intelligent decision-making to improve risk prediction, resource allocation, and ecosystem collaboration, the industry can promote efficient coordination across all supply chain stages. Organizational change fosters a resilient culture within the digitalized international freight forwarding sector.

However, digital transformation also faces multiple challenges such as imbalanced technology investment, the paradox of data security and trust, and talent gaps. To address these issues, companies need to accurately match technology investments with business needs, strengthen compliance, and empower talent; industry associations should improve digital standards, build connection platforms, integrate data resources, and jointly cultivate talent; governments should introduce preferential policies, enhance infrastructure construction, provide public service platform support, and encourage collaboration among industry, academia, and research. Only when corporate practices, industry ecosystem empowerment, and policy institutional guarantees form a three-dimensional collaborative system can the international freight forwarding industry effectively enhance its systemic resilience, ensure smooth global trade, achieve sustainable development in fierce market competition, and contribute key strength to the stability of the global supply chain.

At the same time, this study provides an operational transformation path for industry practice, but does not involve the differentiated industry resilience needs of different market segments. In the future, in-depth analysis can be carried out in combination with specific market segments to promote the industry from "risk response" to "resilience design", and strengthen the supply chain security line in the uncertainty of global trade.

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