A Study on Optimization Strategies for Supply Chain Management in International Trade

Jiang Min

Cheongju University, Cheongju, South Korea, 28500；

Abstract: With the further development of globalization, the management of the supply chain in international trade meets with new challenges and opportunities. Based on the analysis of the current situation of global trade, this paper discusses three prominent features of modern international supply chains: complexity of cross-border cooperation, combination of logistics and information, and high requirements for responsiveness in risk-prone environment. Then, the paper explores three main problems existing in international supply chains, including information asymmetry, low logistics efficiency and lack of effective risk control. Finally, this paper proposes three corresponding optimization strategies: promoting digitalization and constructing information-sharing mechanism, building flexible and diversified logistics system, and developing predictive and decision-making platform based on big data and artificial intelligence. By building an efficient, transparent and risk-resilient supply chain management system, the enterprise can improve its international cooperation and competition ability, and promote the sustainable development of global supply chains.

Introduction

In the face of increasingly rapid economic globalization and regional integration, supply chains have gradually turned into important bridges linking the world. However, the frequent outbreak of geopolitical conflicts, natural disasters and even epidemics has made supply chain management in international trade more complicated day by day. The traditional cost-oriented model can't meet the new market's requirements of flexibility, stability, resiliency and other aspects any more. Therefore, how to explore the optimization strategies of supply chains has become an important issue that academic circles and enterprises are concerned about. This paper makes a comprehensive discussion on the main features, existing problems and optimization ways of international supply chains[1].

1 Characteristics of Supply Chain Management Optimization in International Trade

1.1 Cross-border Collaboration and Multi-node Complexity

As we know, the supply chain of international trade often covers several countries and regions, including manufacturers, distributors, logistics service providers, port authorities and even end-users. This multi-node characteristic also brings a lot of complexity in supply chain coordination. On the one hand, time difference results in information delay and affects the coordination of decision-making process. On the other hand, language and culture differences raise the cost of information transmission and increase the risk of misunderstanding, which also brings low efficiency to cross-border cooperation. In addition, different legal system, import & export policy and compliance requirement from country to country also bring great challenges in international cooperation. Even a tiny mistake will affect the whole supply chain[2].

To improve the cross-border coordination efficiency, we need to improve the system design and process management. For example, global enterprises should build a unified information platform and process system to avoid the data fragmentation and execution failure brought by the differences between regions. In terms of personnel management, we should train cross-cultural professionals and set up coordination department to ensure the communication and execution

efficiency between different regions. In addition, intelligent translation, cooperation platform and online monitoring system can also help to avoid space and time separation and improve the response and coordination efficiency between different nodes[3].

1.2 High Integration of Logistics and Information Flows

The most prominent aspect of international supply chains is their high integration of logistics flow and information flow. Traditional supply chains place great emphasis on logistics efficiency. However, globalization extends logistics routes and makes them more circuitous, which enhances the importance of information flow. Enterprises should have strong capabilities to grasp, process, and transmit logistics-related data so that they can have a clear understanding of the status of transportation, inventory, customs, and other links. Information flow plays a key role in the flexibility of the supply chain and order responsiveness instead of a complementary role[4].

In recent years, the widespread use of information tools such as ERP (Enterprise Resource Planning), WMS (Warehouse Management System), TMS (Transportation Management System), and supply chain visibility systems have greatly enhanced the response speed and transparency of international supply chains. These information tools can help various links to share information in a timely manner and quickly adjust resource allocation in the face of complicated changes in orders, transportation or demand. Furthermore, with the help of big data and AI algorithms, companies can predict the trend of orders and possible risks, so as to change the traditional chain supply mode of "wait and see" into a kind of dynamic scheduling mode based on information flow.

1.3 Diverse Risks and High Requirements for Responsiveness

compared to local supply chains. On the macro level, political uncertainties, trade policy and exchange rate fluctuation influence these two types of supply chains. Compared to domestic supply chains, international supply chains are more likely to meet changing political environment, tariffs, restrictions on export and devaluation of local currency, which will directly influence the cost or even the possibility of transaction (for example, a 10% tariff on importation or restriction of export to certain countries). On the micro level, international supply chains will also experience transportation delay, natural disaster, port strike and customer cancellation of orders, which will directly influence the smoothness of the whole supply chain.Therefore, enterprises need to improve their forecasting ability and emergency response level[5].

In order to hedge diversified risks, enterprises are no longer relying on single supplier but diversified purchasing and diversified logistics; top enterprises built their "resilient supply chains" by building backup warehouses in different regions and alternative suppliers for different links of the chain. The system for monitoring the whole links can timely discover the potential problems in the supply chain and make the right decision in time. Forward foreign exchange contract can hedge the exchange rate risk and supply chain insurance can offset the possible losses.Therefore, the focus of the supply chain management is no longer controlling the cost, but coping with uncertainties.

2 Existing Problems in the Optimization of Supply Chain Management in International Trade

2.1 Information Asymmetry and Coordination Failures

Information asymmetry continues to be a major bottleneck to achieving efficiency improvement and strategic coordination in international supply chain management. Currently, "data silos" widely exist in global supply chains, where players adopt different management systems, data formats and transmission protocols and thus fail to share information with other nodes efficiently. For example, manufacturers and logistics providers may run in different ERP systems without any interfacing function, which leads to the inability to push order status, stock information and transportation status in real time to all participating nodes. This also leads to an overall delay in response time and postpones the early detection and resolution of problems, which greatly weakens the overall agility and transparency of the supply chain.

Due to the large number of participants in international supply chains, collaboration mechanisms among them are often limited by the lack of common standards, poor platform interoperability or concerns about data security. When changes in order occur or emergencies happen, it's hard for upstream suppliers and downstream distributors to make corresponding adjustments. As such, resource redundancy, mismatches and misdeliveries frequently occur, which all inflate

operating costs. What's more, some companies are still reluctant to share data due to concerns about the leakage of trade secrets, which also lead to coordination failures. Only by establishing an unified data interaction architecture based on blockchain, cloud platforms or API interfaces can we strengthen the inter-organization collaboration mechanism and build clear industry standards in information security to create a solid foundation for international cooperation in the global supply chain.

2.2 Low Logistics Efficiency and Rising Costs

Logistics is one of the most important pillars of the supply chain. The efficiency of logistics has a direct impact on the overall stability and cost efficiency of the entire trade chain. However, the logistics part of current international supply chains still faces many problems.In recent years, major ports around the world have been congested, with long vessel waiting times and severe container stockpiles, leading to shipment delays and increased storage and port detention fees.After the outbreak of COVID-19, a large number of personnel shortages, long quarantine periods and uncertain vessel arrival times once again exposed the logistics links as the key bottlenecks in the efficiency of the entire supply chain.Meanwhile, global oil prices remain volatile, and geopolitical conflicts, climate disasters and other uncertain factors have exacerbated the situation, pushing transportation costs to a significant increase.

For international chain enterprises that depend on long-distance sea and air transportation, the rise in transportation costs will inevitably lead to a squeeze of profit margins and bring more pressure to the company.In addition, due to the uneven development of infrastructure in different countries, especially in developing areas, there are still shortages of railways, highways and ports, which often cause "last mile" delivery problems and affect the overall service quality.To enhance logistics efficiency, it is not enough to simply have more accurate logistics scheduling and path planning, but also needs to focus on the overall development of international infrastructure, transportation capacity and the utilization, and explore new solutions using alternative fuels to achieve logistics efficiency and cost reduction.

2.3 Inadequate Risk Control Mechanisms and Poor Emergency Response

The recurrence of global crises — the pandemic, the Russia–Ukraine conflict, China–US trade tensions — has highlighted the vulnerability of risk management in today's international supply chains. Many enterprises were badly affected in the early months of the pandemic, facing shortages of raw materials, piling up of orders and loss of customers. These issues were mainly due to a lack of risk control — most companies did not identify "black swan" events looking forward, nor did they prepare any backup plans. The vulnerability is also heightened by the heavy reliance on single suppliers or regions when designing supply chains, For example, when lockdowns in parts of Asia began in early 2020, many manufacturers in Europe and North America had to shut down for several months due to their reliance on Chinese material suppliers.

The lack of risk control is also reflected in slow responses to information alerts and poor reallocation capabilities. Historically, companies have treated supply chain management with an emphasis on cost minimisation, making them unprepared to respond in crisis situations. In international supply chains, this shortcoming is magnified by the differences in laws and institutions between countries, which impede the efficient deployment of resources across borders and slow down the reallocation of supply chains, ultimately exacerbating losses.From the very beginning of supply chain design, companies need to adopt a more proactive mindset towards risk management. This includes the use of AI forecasting models, redundant supply chains, diversified sourcing and rapid-response platforms. Developing a risk management system that focuses on sustainability and resilience will be crucial for enterprises in an increasingly uncertain world.

3 Optimization Strategies for Supply Chain Management in International Trade

3.1 Promoting Digital Transformation and Building Information Sharing Mechanisms

To promote good supply chain management, we need to accelerate the digitalization of the whole supply chain and eradicate phenomena like "data silos" and information asymmetry.For international trade, enterprises often encounter time zone issues, regulations obstacles, and communication language problems. If there is no efficient way to share information, the response delay, order mistakes, and wasted resources are inevitable.By incorporating new technologies,

especially blockchain and Internet of Things (IoT), enterprises can realize information sharing and process tracing for different nodes. As blockchain's decentralized, unforgeable, and traceable design can guarantee the authenticity and transparency of the whole supply chain data, and IoT can help to sense and collect information, so as to monitor vehicles, warehouse environment, and goods' status in total.

Building digital supply chains are not only about technology innovation, but also management models transformation. Enterprises need to build a unified data platform, and integrate the whole process of order processing, inventory, transportation, and payment into one visible system.For instance, by using blockchain technology, the logistics process of cross-border trade, including order release, customs declaration, payment, and contract establishment, can all be digitized and recorded on the blockchain. The whole link can monitor the trade status in real time, and all parties can get information transparency, which can reduce response delay, order mistakes, and manual errors, and eliminate fraud.IoT devices can also sense and collect the vehicle's temperature, humidity, and location information, and the warehouse environment and goods location. The perishable or high-value goods can get precise monitoring, and all participants can share information and data. The different links can make coordinated optimization, and the whole industry chain can achieve higher efficiency and response speed.

Meanwhile, the digital transition also needs attention on standardization and technological interoperability. There are variation possibilities for the digital system platform of different enterprises, and there are also conflicts between countries' data transmission policy and privacy protection. Therefore, the information sharing mechanism not only needs to deploy technology, but also needs to enhance the cross-border standardization and policy alignment. At the same time, cybersecurity, privacy protection, and data governance need to strengthen, so that the platform can guarantee the information, and the information can be shared by more enterprises.With the above digital infrastructure, international supply chains will become more transparent, controllable, and resilient, and will provide strong support for enterprises to cope with the complex international market.

3.2 Building Flexible and Diversified Logistics Systems

In response to the uncertainty of the international trade environment, relying on a single logistics route and a centralized supply model is unlikely to work well in maintaining stability and efficiency. In the past few years, the global logistics system has been clearly exposed to its vulnerabilities amid pandemics, geopolitical conflicts, and natural disasters. Therefore, constructing a flexible and diversified logistics network is critical to improving the resiliency of the supply chain.

What does a flexible logistics system look like? Flexibility here means that, in case of certain scenarios, companies are able to rapidly change their transportation plan, distribution path, and warehouse strategy. In contrast, diversified logistics means that companies establish multiple logistics centers, use various transportation methods, and have suppliers stationed in different regions to avoid depending on a single logistics node and path.

In other words, flexible logistics is based on resilient design and real-time response. Companies can create several logistics hubs in different regions to avoid the transportation chain from being delayed or congested. If logistics or transportation is blocked or interrupted, companies can rapidly switch to another path or inventory point to continue logistics distribution. For instance, if transferring production to a neighboring country (nearshoring) can reduce transportation time and tariffs, companies can consider adopting a "nearshoring" strategy to break through transportation limitations. This means that the supply chain is spread over multiple countries/regions, and the company produces or sells in the region where it will be consumed (localized supply chain). Although these structural adjustments will increase one-time investment, they will bring better resilience of the supply chain and customer experience in the long run.

In addition, digital technology provides strong support for flexible logistics. Transportation route optimization systems based on big data and AI, forecasting platforms based on AI, and dynamic scheduling tools can analyze transportation environment and customer demands in real time and automatically recommend the best logistics strategies, helping companies transition from "planned logistics" to "responsive logistics." Companies can also combine sea, air, rail, and road transport modes to balance cost and timeliness. In addition, given the fluctuating energy prices and stringent

environmental regulations, developing green logistics and smart transportation technologies has also become an important part of the logistics system's flexibility.Through an overall and multidimensional reconstruction, the logistics part of the supply chain will become more stable, efficient, and sustainable.

3.3 Improving Risk Early Warning and Emergency Response Mechanisms

In reality, international supply chains face various uncertainties from political, economic, natural and public health factors. Traditional reactive methods are hard to fulfill the new requirement of stability and continuity in trade. Only by converting supply chain management from a reactive mode to a preventive one can we build scientific and efficient risk early warning and emergency response mechanisms. With the development of big data and artificial intelligence (AI) technologies, we can build these mechanisms and tools to support them.

Through integrating historical operation information, environmental information, policy information and market information, companies can establish corresponding risk models and take corresponding countermeasures in time when risks happen. A risk management platform based on big data can track risk sources from multiple dimensions. For example, in the political dimension, the platform can track policy changes, international relations and sanctions risks around the world. In terms of nature, the platform can link up weather, earthquake and flood early warning systems to forecast environmental factors that will affect transportation and warehousing. In the field of supply and demand management, AI algorithms can track order flow, inventory and customer orders to assist companies in making proactive decisions for resource input and production adjustments. The platform also helps companies integrate data from different departments and regions to activate automated responses at key nodes, thereby greatly improving the speed and efficiency of enterprise responses.

4 Conclusion

With the emergence of international trade, the traditional static planning and control of supply chain gradually extended to dynamic and multi-dimensional scheduling. However, under the circumstance of dispersed information, disrupted logistics, and inefficient risk control, the piecemeal solutions can't help enterprises overcome the challenges of international trade. Therefore, this paper believes that only by deeply integrating digital technologies can we break the information isolation and improve the transparency of the supply chain. In addition, establishing a flexible logistics system and diversified supply network can achieve robust logistics and supply. Furthermore, improving the early warning system of risk based on AI and big data can provide enterprises with foresight and rapid response.

Based on this, the supply chain is no longer just a supporting system of enterprise operation, but also a strategic resource to gain the competitive advantage in the global market. In the future, enterprises should promote the construction of resilience and sustainability of the supply chain from three dimensions, namely, technology, organization and institution.Analysis and strategies in this study are expected to provide an implementable path to improve the management of the supply chain.

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Author's Profile: Jiang Min (1995 -), female, Han ethnicity, from Jinan City, Shandong Province. Degree: Master's degree. Research direction: International trade.