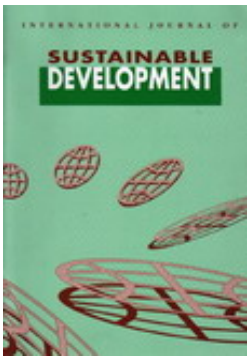

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Formation mechanism and management strategy of logistics supply chain risk

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Formation mechanism and management strategy of logistics supply chain risk

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Abstract: In order to reduce logistics delays and improve logistics continuity, this paper researches the mechanism and management strategy of logistics supply chain risk formation, and analyses the impact of risks based on the overall structure of the logistics supply chain. The mechanism of risk formation is explained from the aspects of relationship closeness, external environmental factors, information asymmetry, globalisation, and complexity. Finally, risk management strategies are proposed from the aspects of establishing supplier risk assessment and management mechanisms, diversifying supply chains and resource sources, strengthening information sharing and coordination mechanisms, warning and predicting risk events, and establishing flexible supply chain planning and inventory management strategies. Case studies have shown that the application of this strategy can reduce the delay of logistics supply chain, and the interruption time can be reduced to 2.4 h.

Keywords: logistics supply chain; risk formation mechanism; management strategy; risk events.

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1 Introduction

With the rapid growth of the global economy and the ever-expanding supply chain network, logistics supply chains now face a host of risks and challenges. The intricate nature of these supply chains, along with the unpredictable impact of various internal and external factors, can lead to disruptions, delays, or other risk events (Esmizadeh, 2021; Ahmed, 2021). Hence, it becomes imperative to comprehend the formation mechanism of logistics supply chain risks and develop corresponding risk management strategies. By delving deep into the mechanics of risk formation, businesses can effectively identify and understand potential risks, allowing them to take proactive measures that ensure smooth supply chain operations and enhance operational efficiency (Van et al., 2022). By studying the mechanism of logistics supply chain risk formation, enterprises can predict and evaluate the economic losses caused by potential risks, and adopt appropriate management strategies to reduce these losses and protect their interests. Effectively managing logistics supply chain risks can reduce interruptions and delays, and improve the adaptability of enterprises to market changes (Grover and Dresner, 2022; Nimmy et al., 2022; Borbon-Galvez et al., 2021). By studying the mechanism of risk formation and formulating corresponding management strategies, enterprises can improve their competitiveness and gain greater market share. Understanding the formation mechanism of logistics supply chain risks can help better cope with the impact of unpredictable factors such as environment, society, and politics on the supply chain. By adopting corresponding management strategies, the logistics supply chain can be promoted towards a more sustainable direction, reducing negative impacts on the environment and society. Investigating the mechanism behind risk formation and developing effective management strategies holds immense importance not only for individual enterprises but also for ensuring the stable growth of the entire industry and promoting sustainable economic development.

Wang (2023a) presents an innovative supply chain model for effectively managing risks in logistics supply chains. As the system gradually improves, the scale of logistics enterprises continues to expand, and their capital flow accelerates under this innovative model. By analysing the various types of supply chain risks, feasible risk management strategies are proposed. However, it is important to note that significant funding risks still exist when implementing this strategy. Fu and Gu (2023) introduces a logistics supply chain risk management strategy that revolves around chain-to-chain competition. This strategy establishes a game model in both non-coordinated and mixed scenarios to achieve balanced development and effectively manage risks across multiple supply chains. However, it is important to note that implementing this strategy may result in reduced profits for logistics companies. Wang (2023b) introduces a logistics supply chain risk management strategy designed specifically for small and medium-sized casting enterprises. Recognising the unique characteristics of these enterprises, such as supply chain diversity, service decentralisation, and elevated risks, this strategy proposes targeted solutions that aim to enhance efficiency and reduce costs. However, it is crucial

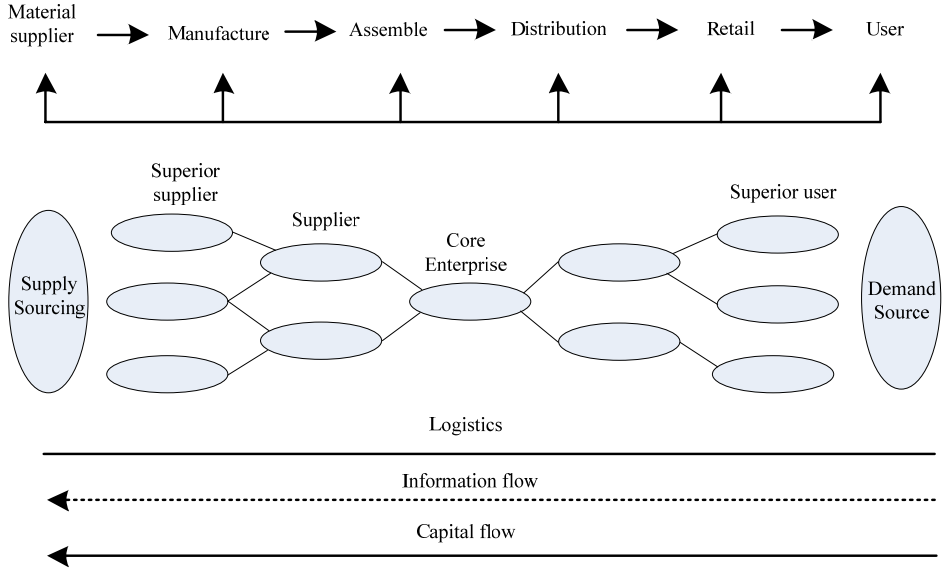
to acknowledge that the effectiveness of this strategy relies on long-term data analysis, which may pose challenges in terms of short-term risk management.

To effectively address the issues associated with current risk management strategies, a new mechanism and strategy for risk formation are introduced. This innovative approach thoroughly examines the risk formation process, taking into account the structure of the supply chain. Based on this analysis, a detailed risk management strategy is proposed, specifically tailored to the characteristics of risk formation and its impact.

2 Risk analysis

The logistics supply chain comprises essential entities including suppliers, manufacturers, distributors, and retailers, which are supported by key logistics services such as warehousing and transportation. These interconnected components collaboratively facilitate the movement of materials and ensure timely product delivery to satisfy customer demands (Ray, 2021). In this process, information flow plays a vital role as it fosters information sharing and coordination among various links within the supply chain, leveraging information systems and technology. The logistics supply chain structure is shown in Figure 1.

Figure 1 Logistics supply chain structure



The main structure is as follows:

Supplier: Suppliers play a pivotal role in the supply chain as they provide the vital raw materials, components, and other necessary materials for enterprises. Effective selection and management of suppliers are critical in ensuring the stability and quality of the logistics supply chain.

Manufacturer: The manufacturer is the process of processing and producing the final product from the raw materials and components provided by the supplier. They need to develop production plans based on market demand and plans, and ensure that the quality and performance of the products meet customer requirements (Dias et al., 2021).

Distributors: Distributors are responsible for storing, sorting, and distributing products produced by manufacturers to end customers or retailers. They play a role in connecting and delivering products in the supply chain, while also requiring supply chain coordination and inventory management based on market demand.

Retailer: Retailers are the closest link to end customers, selling products to consumers or end users. They play a direct and indirect role in meeting customer needs, which is crucial for timely delivery and providing a good shopping experience (Tsetskhladze et al., 2021).

It is crucial to analyse the risks in the logistics supply chain. Firstly, by anticipating and avoiding potential risks, enterprises can take corresponding measures before risk events occur. Secondly, risk analysis helps to develop effective risk management plans, provide enterprises with the ability to identify and evaluate risks, and develop targeted response strategies. In addition, risk analysis can also improve the response speed and flexibility of enterprises, enabling them to adjust logistics and transportation strategies faster to adapt to market changes and quickly respond to emergency situations. Finally, risk analysis helps to protect a company's reputation and customer relationships, by predicting and responding to risks, avoiding delays, quality issues, or unexpected events in the supply chain, and ensuring that products are delivered on time and meet customer expectations. In summary, by analysing logistics supply chain risks, enterprises can better understand potential risks and develop corresponding management strategies to maintain supply chain stability and reliability, and maintain their reputation and customer relationships. The impact of logistics supply chain risks mainly includes the following points:

1 *Supply delay and interruption*: In the logistics supply chain, various risk events may cause interruption or delay in the supply chain. For example, natural disasters such as earthquakes, floods, or hurricanes may cause damage to logistics infrastructure and prevent the normal transportation of goods. Political instability, social unrest, or labour disputes may lead to supply chain downtime or operational obstacles. This will prevent companies from delivering products on time, resulting in order delays, reduced sales revenue, and even potential loss of customer trust, further affecting the company's market share and competitiveness.

2 *Cost increase*: The cost increase caused by logistics supply chain risks may come from multiple sources. For example, if loss or damage occurs during the transportation of goods, the enterprise may need to pay additional fees to compensate for the loss or repurchase the goods, thereby increasing transportation costs. In addition, in order to reduce supply chain risks, enterprises may need to invest more resources to implement risk management strategies, such as increasing insurance coverage and strengthening supplier audits, which will also increase management costs. These additional costs may ultimately be reflected in product prices, affecting the profitability and market competitiveness of the enterprise.

3 *Inventory backlog*: The uncertainty brought about by logistics supply chain risks makes enterprises tend to excessively purchase raw materials or products to ensure the continuity of the supply chain. This may lead to the problem of inventory backlog, occupying the company's funds and increasing warehousing costs. In addition, if there is a delay or interruption in the supply chain, enterprises may need to rely on inventory to meet customer demand, further increasing the possibility of inventory backlog. However, inventory backlog can also cause resource waste, reduce capital turnover, and may even lead to inventory expiration or quality degradation (Lin et al., 2021).

4 *Brand reputation damage*: Logistics supply chain risks may lead to product quality issues, delivery delays, etc., thereby seriously damaging the brand reputation of the enterprise. For example, if there is a quality issue at a certain point in the supply chain, it may lead to the company's products being questioned or even recalled in the market, thereby affecting consumers' trust in the brand and purchasing decisions. Similarly, if delivery delays result in customers not being able to obtain products on time, customers may lose confidence in the enterprise and may even turn to competitors. Restoring a company's reputation and consumer trust requires time and effort, and may require re-establishing supply chain partnerships, strengthening quality control and customer service.

5 *Damaged customer relationships*: Logistics supply chain risks have a direct impact on the delivery capacity and service quality of enterprises, and customers have increasingly high expectations for the reliability and timely delivery of enterprises. If there is a delay or interruption in the supply chain, resulting in customers not being able to obtain products or services on time, customers may feel disappointed, dissatisfied, or even lost. In a fiercely competitive market, losing customers may have a significant impact on the company, including reduced sales, reduced market share, and negative word-of-mouth effects.

Understanding and managing logistics supply chain risks is crucial for businesses. Effective risk management can help businesses reduce potential impacts and improve their risk resistance in market competition (Zhu and Cao, 2021; Cao et al., 2021).

3 Risk formation mechanism of logistics supply chain

By gaining a deeper understanding of how risks are formed, enterprises can effectively identify and comprehend potential sources and factors that influence risk. This knowledge enables companies to develop appropriate strategies and measures for risk management, effectively addressing potential issues. Furthermore, analysing the formation mechanism of supply chain risks helps enterprises remain vigilant, make timely adjustments and optimisations to supply chain links, improve supply chain resilience, minimise potential economic losses, and ensure timely product delivery and customer satisfaction. In summary, analysing the risk formation mechanism aids enterprises in establishing a robust risk management system, enhancing the sustainability and competitiveness of the supply chain. The main aspects of the risk formation mechanism can be summarised as follows:

1 *Tightness of supply chain relationships*: In a logistics supply chain, multiple participants including suppliers, manufacturers, distributors, and retailers form a complex network. These participants engage in the exchange of information, goods, and funds at various stages. Any issues arising in any particular link can have a significant impact on the entire supply chain. For instance, if a supplier faces production delays or delivery difficulties, it directly affects the manufacturer's production schedule and timely delivery of products. Hence, each link within the supply chain presents potential risks.

2 *External environmental factors*: The formation of supply chain risks is also influenced by external environmental factors, such as natural disasters, political instability, regulatory changes, and economic fluctuations. Natural disasters such as earthquakes, floods, or typhoons may cause traffic interruption, facility damage, and loss of goods. Political instability and social unrest may lead to traffic control, labour disputes, or supplier shutdowns, thereby affecting the normal operation of the supply chain. Regulatory changes may lead to trade barriers or changes in environmental compliance requirements, causing uncertainty and additional costs to the supply chain.

3 *Information asymmetry*: The smooth flow of information plays a vital role in coordinating and managing supply chains. However, when there is a lack of symmetry in information, it can lead to the creation and spread of risks. For instance, if a supplier fails to promptly communicate any problems or delays to the manufacturer, it hinders the manufacturer's ability to make timely adjustments, potentially causing delivery delays. Similarly, if distributors do not provide suppliers with timely feedback on market demand or inventory levels, it undermines the supply chain's ability to anticipate and respond to fluctuations in demand, thereby increasing the overall risk.

4 *Globalisation and supply chain complexity*: As globalisation continues to advance, logistics supply chains confront an array of risks and challenges. The extensive reach of supply chains across various countries and regions entails navigating distinct political, legal, and cultural contexts. Consequently, logistics operations, compliance, and customs clearance become increasingly intricate. Any disruptions occurring at any node within the supply chain can trigger widespread consequences that permeate the entire network.

The emergence of risk within supply chains is influenced by numerous factors, encompassing the tightness of the supply chain, external environmental elements, information asymmetry, globalisation, and the inherent complexity of the supply chain structure. Familiarising oneself with these mechanisms facilitates the ability of enterprises to efficiently identify and manage risks, as well as enhance the stability and adaptability of their supply chains.

4 Risk management strategy

Risk management strategies are vital for the efficient operation of enterprises. Firstly, they help minimise disruptions to business operations by ensuring timely delivery of supplies and uninterrupted production, thereby reducing potential losses and customer

dissatisfaction. Secondly, these strategies enhance supply chain resilience and flexibility through early detection and proactive measures, enabling companies to effectively respond to market changes and unforeseen events. Additionally, they facilitate cost control, waste reduction, and improve competitiveness by optimising resource allocation and efficiency. Moreover, these strategies ensure compliance with regulations and policies, promoting sustainable development for enterprises. In summary, risk management strategies are essential for maintaining the stability of supply chains, enhancing customer satisfaction, building resilience to risks, and laying a strong foundation for sustainable enterprise growth. Based on the aforementioned risk formation mechanisms, the following targeted risk management strategies can be proposed:

1 *Establish a supplier risk assessment and management mechanism*: Enterprises should assess potential supplier risks and establish supplier management mechanisms. This includes regularly monitoring the financial status, production capacity, and supply capacity of suppliers, developing alternative supplier plans to respond to unexpected situations, and establishing close communication and cooperation with suppliers.

2 *Diversified supply chain and resource sources*: Enterprises can choose multiple suppliers to diversify risks and avoid excessive reliance on a single supply chain. In addition, explore diversified resource sources, including finding new suppliers and expanding supply networks, to establish alternative paths and solutions in the supply chain to mitigate risks caused by a single factor.

3 *Strengthen information sharing and coordination mechanisms*: Establishing effective information sharing and coordination mechanisms is essential for ensuring a smooth flow of information across various stages. This includes utilising advanced technology and information systems to track logistics in real-time and promptly share relevant information. By doing so, companies can enhance their ability to quickly respond to potential risks and fluctuations in demand.

4 *Early warning and prediction of risk events*: Utilise tools such as data analysis, market research, and predictive models to provide early warning and prediction of potential risk events. By timely identifying and evaluating various possible risk factors, enterprises can make accurate decisions and take corresponding response measures to minimise the impact of risks.

5 *Establish flexible supply chain planning and inventory management strategies*: Promote agile planning and inventory management strategies by closely monitoring market demand and assessing potential risks. Establishing an effective demand forecasting mechanism empowers enterprises to promptly adapt production plans and adjust inventory levels in response to market fluctuations, thus mitigating risks.

6 *Strengthen cooperation and collaboration*: Forge strong partnerships throughout different stages and establish effective communication channels. Foster the sharing of risk information and best practices, while enhancing collaboration with government departments and relevant industry organisations to stay abreast of the latest regulatory and policy updates.

7 *Establish disaster recovery plans and emergency response mechanisms*: Develop disaster recovery plans and emergency response mechanisms based on potential risk events. This includes backup plans, emergency contact information, material reserves, and disaster drills to enable timely response and minimise risks in unpredictable situations.

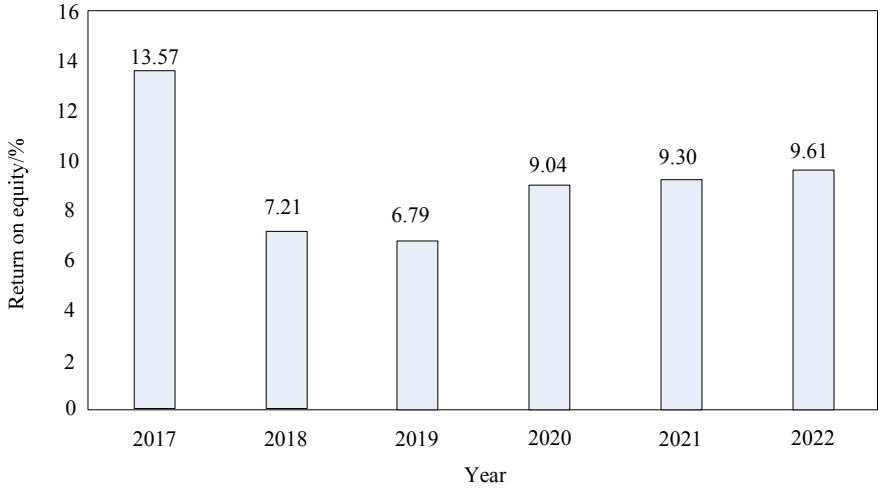
By establishing supplier risk assessment and management mechanisms, diversifying supply chains and resource sources, strengthening information sharing and coordination mechanisms, warning and predicting risk events, establishing flexible supply chain planning and inventory management strategies, strengthening cooperation and collaboration, and establishing disaster recovery plans and emergency response mechanisms, enterprises can better manage and respond to risks.

5 Case study

5.1 Sample data

The net asset income data of the logistics enterprise from 2017 to 2022 is shown in Figure 2.

Figure 2 Net asset income data from 2017 to 2022



From Figure 2, it can be seen that the logistics enterprise had a relatively high net asset return in 2017, the lowest year-on-year net asset return in 2019, and a relatively stable net asset return from 2020 to 2022.

The enterprise has a workforce of 660 employees, showcasing a diverse educational structure. In order to meet the business management requirements, it is crucial for the logistics company to establish a comprehensive risk management strategy. This will enable the enterprise to meet the criteria set forth in the example analysis. Refer to Figure 3 for the breakdown of employees based on educational qualifications, and consult Figure 4 for a visual representation of the professional personnel composition within the company.

Figure 3 Employee education (see online version for colours)

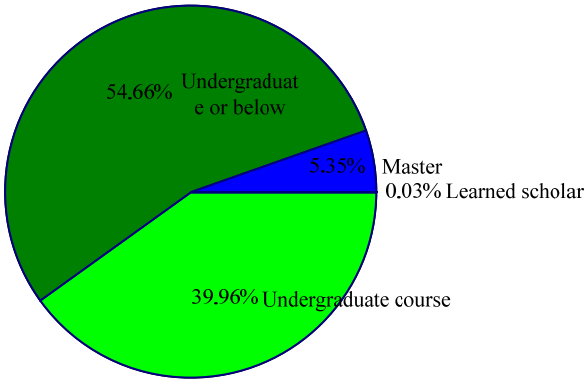
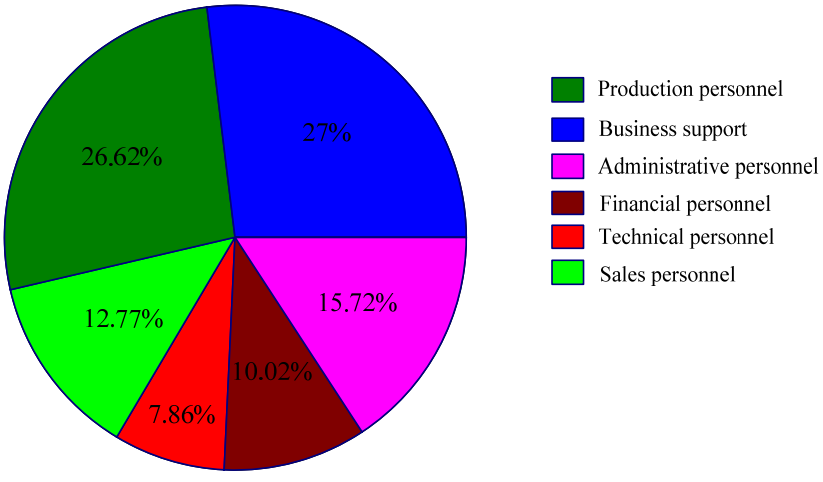


Figure 4 Composition of professional personnel (see online version for colours)



Collect logistics data from the enterprise for one week in March 2022 as sample data, as shown in Table 1.

Table 1 Logistics data

Item number	*Number of incoming storage/piece*	*Number of delivery/piece*
1	11,807	31,706
2	11,349	30,185
3	7354	9827
4	5343	1837
5	5663	5896
6	1508	11,208
7	7504	8774
8	2511	12,656

5.2 Scheme description

In order to analyse the practical application effect of the proposed risk management strategy, the proposed strategy will be applied to the target logistics enterprise for a six-month logistics supply chain risk management. The supply delay rate, logistics cost, and logistics continuity of the logistics enterprise before and after the application of this strategy will be analysed.

Supply delay: Supply delay refers to the delay or delay in the expected or agreed delivery time of a logistics enterprise.

Logistics cost: Logistics cost refers to various expenses and expenses related to logistics activities, including expenses incurred in transportation, warehousing, logistics management, and other links.

Logistics continuity: Logistics business continuity refers to the ability to maintain normal logistics operations in the face of unexpected events, disasters, or unforeseen circumstances. This includes ensuring that all links in the logistics supply chain (such as warehousing, transportation, etc.) can continue to operate in unexpected situations.

5.3 Result of case analysis

1 *Delivery delay*

Supply delay is a vital factor in managing logistics supply chains as it directly impacts the smooth operation of other links within the chain. Late deliveries can lead to untimely order completion, subsequently affecting customer satisfaction and sales performance. By monitoring and implementing necessary measures to address supply delays, managers can mitigate their negative impact. Table 2 illustrates the supply delay situation in logistics enterprises following the application of the risk management strategy discussed in this paper.

Table 2 Supply delay results

Supply delay rate	
Before applying the strategy in this paper	*After the application of this paper's strategy*
15.3%	1.6%

Based on the data provided in the above table, it is apparent that the implementation of the strategy discussed in this paper has yielded a significant decrease in the supply delay rate, dropping from 15.3% to a mere 1.6%. This has effectively mitigated the occurrence of supply delays. The strategy outlined in this paper has also contributed to improved responsiveness across various facets of the supply chain, including enhanced on-time delivery rates from suppliers, streamlined warehouse material preparation and organisation, and optimised transportation arrangements. These positive developments have fostered superior coordination and cooperation within the supply chain, resulting in a noticeable reduction in supply delays.

2 *Logistics costs*

By adopting risk management strategies, enterprises can prevent and mitigate various logistics supply chain risks, such as supply delays, traffic congestion, weather disasters, etc. Reducing the occurrence of these risk events will reduce related costs, such as emergency transportation costs, loss of goods or raw material costs, etc. Logistics supply chain risk management strategies help improve the visibility and responsiveness of the supply chain, thereby more accurately predicting demand and optimising inventory management. An appropriate inventory level can reduce inventory holding costs and avoid situations of surplus or shortage, thereby reducing logistics costs. Therefore, the application effect of this strategy can be analysed by analysing the logistics cost after the application of the strategy. The logistics costs before and after the application of this strategy are shown in Table 3.

Table 3 Logistics costs

Logistics costs	
Before applying the strategy in this paper	*After the application of this paper's strategy*
256,000 yuan	187,000 yuan

From the data in the table, it can be seen that before the application of the strategy in this paper, the logistics cost was 256,000 yuan, while after the application of the strategy in this paper, the logistics cost decreased to 187,000 yuan. This indicates that the strategy proposed in this paper has played a certain role in supply chain management, reducing logistics costs. The application of this strategy may involve optimising procurement, transportation, and warehousing processes, thereby reducing logistics costs by improving operational efficiency and reducing unnecessary costs. This can be achieved through measures such as reasonable route planning, reducing storage and transportation costs, and optimising inventory management.

3 *Logistics continuity*

By adopting risk management strategies, enterprises can predict and evaluate these potential risks, and take preventive measures to mitigate their impact on logistics continuity. Preventing and reducing the occurrence of risk events can ensure the continuity of logistics operations. The logistics continuity before and after the application of the management strategy in this paper is shown in Table 4.

Table 4 Logistics continuity

Interruption time	
Before applying the strategy in this paper	*After the application of this paper's strategy*
15.9 h	2.4 h

From Table 4, it can be seen that before the application of the strategy in this paper, the logistics continuity interruption time was 15 h, while after the application of the strategy in this paper, the interruption time was reduced to 3 h. This data shows that by adopting this strategy, enterprises can more effectively respond to potential risks and problems,

and reduce the time of logistics interruption. The implementation of this strategy may include establishing a sound crisis management and emergency response mechanism to respond to unexpected events. By reducing logistics interruption time, enterprises can resume normal operations faster and continue to meet customer needs, enhancing their crisis response capabilities.

6 Conclusion

In this research dedicated to the formation mechanism and management strategy of logistics supply chain risks, an extensive analysis was conducted on the overall structure of the supply chain and its various influential factors. Furthermore, the study provided an elaborate explanation of the risk formation mechanism. Through a detailed exploration of this mechanism, multiple risk management strategies were proposed. The research findings indicate that the implementation of the suggested risk management strategy can effectively reduce latency and enhance continuity. The case analysis demonstrated a significant reduction in interruption time to a mere 2.4 h after the application of the aforementioned strategy, further testifying to its effectiveness and practicability. This paper contributes to a deeper understanding of logistics supply chain risk management and offers concrete management strategies. Its findings are of immense significance for enterprises seeking to attain logistics continuity, mitigate risks, and enhance customer satisfaction.

Acknowledgements

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