

Global Supply Chain Risk Management: Strategies and Mitigation Approaches in the Age of Uncertainty

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Abstract. Global supply chains today face more challenges than ever before. Issues like inter-country political conflicts, natural disasters such as earthquakes and floods, and health crises like the COVID-19 pandemic have exposed vulnerabilities in corporate supply chain management practices. This paper examines diverse types of supply chain risks and explores how enterprises mitigate these risks. By examining five large international companies and reviewing existing studies and expert opinions, supply chain risks are categorized into three types: operational, network, and systemic risks. The result shows that many companies still use old-fashioned reactive methods instead of planning ahead. A new approach called the “Resilience-Agility Framework” is suggested, which combines preventive steps like working with more suppliers and responsive actions like finding new shipping methods when problems occur. Data shows that companies using such combined strategies managed to reduce the impact of disruptions by 40–65%. This highlights the importance of having a comprehensive risk management plan, especially in today’s unpredictable world.

Keywords: supply chain risks, operational risks, network risks, systemic risks, risk mitigation

1. Introduction

In today's interconnected world, global supply chains are essential for moving goods from production to consumption. However, these networks are increasingly fragile, confronting numerous challenges such as political conflicts, natural disasters, and health crises like COVID-19. According to McKinsey, 85% of companies experienced major supply chain disruptions between 2020 and 2022, yet only 15% had a clear response plan to address such incidents [1]. Most companies focus on immediate operational risks, such as supplier delivery failures, using short-term fixes like keeping extra stock. However, these measures are insufficient for large-scale systemic risks, such as trade wars or port shutdowns, which can cause chain reactions affecting multiple parts of the supply chain [2]. Most companies tend to focus only on immediate operational risks, like a supplier failing to deliver materials. They keep extra stock or find a quick replacement—a short-term fix. But as the World Economic Forum points out, these measures are not enough when dealing with big systemic risks, like trade wars between countries or the shutdown of major ports [2]. These large-scale problems can cause a chain reaction, hurting multiple parts of the supply chain at once.

There are three main reasons why current risk management methods often fail:

1. Siloed perspectives: Different departments in a company often operate in isolation. The purchasing team might not talk to the logistics team, so risks are not managed in a connected way [3].

2. Over-reliance on technology: Some companies believe that advanced technology like AI can solve everything. While AI can help identify potential risks, it cannot always prevent disruption, especially large-scale systemic breakdowns [4].

3. Short-term thinking: Many executives are under pressure to show good financial results every three months. So they prioritize cost-cutting over investments in long-term resilience [5].

This paper tries to answer the question: How can companies develop integrated frameworks to manage interconnected supply chain risks? This study not only enriches the academic research on supply chain risk management theoretically but also provides enterprise managers with concrete risk management tools and strategies in practice, thereby enhancing corporate supply chain resilience. From a societal perspective, the findings contribute to securing the supply of critical materials, controlling inflation, and maintaining social stability. Furthermore, the research offers valuable insights for policymakers, supporting the promotion of international cooperation to collectively address global supply chain risks.

2. Supply chain risk classification

To manage risks, we first need to understand them. Global supply chains face three major types of risks:

2.1. Operational risks

These are day-to-day problems. For example, when a key machine breaks down, or workers go on strike. A representative case occurred in 2022 at Foxconn, a company that makes iPhones. Due to worker protests, production stopped for several weeks, affecting Apple's supply [6]. In 2022, Foxconn's factories in China halted production for several weeks due to worker protests. These demonstrations were primarily sparked by concerns over working conditions and wages. As Foxconn is one of Apple's key suppliers, the incident directly disrupted Apple's production schedules, leading to iPhone supply shortages. Apple was forced to urgently seek alternative suppliers and adjust production schedules to minimize market disruption. This case underscores the direct impact of operational risks on supply chains and highlights the critical need for enterprises to implement preventive measures to mitigate such risks.

2.2. Network risks

These involve issues within the supply chain network. A common example is cyberattacks. In 2021, Maersk suffered a severe ransomware attack. This attack paralyzed Maersk's global IT systems, throwing operations at numerous ports into chaos. Maersk was forced to suspend some operations, urgently restore systems, and collaborate with cybersecurity experts to resume business as quickly as possible. The attack not only impacted Maersk's operations but also triggered widespread ripple effects across global logistics and supply chains. Numerous companies reliant on Maersk for shipping had to rearrange logistics plans to avoid cargo backlogs and delays. This incident underscores the potential threat of cyber risks to supply chains and emphasizes the critical importance of enterprises strengthening their cybersecurity defenses [7].

2.3. Systemic risks

Systemic risks are large-scale, macro-level threats that affect the entire supply chain ecosystem, typically caused by policy changes, international trade conflicts, or climate disasters. For instance, when the U.S. and China imposed tariffs on each other's goods, it caused shortages in semiconductors—a key component in “products ranging from automobiles to computers” [8]. Tariff policies have disrupted the semiconductor supply chain. Many semiconductor manufacturers rely on globalized supply chains spanning multiple countries and regions, from raw material procurement to chip manufacturing. Trade disputes have destabilized certain segments of these supply chains, leading to shortages. Increased costs: Tariffs have raised import costs for raw materials and components, forcing companies to raise product prices and thereby impacting market demand. Market Uncertainty: The unpredictability of trade policies makes long-term planning difficult for businesses. Many companies are forced to reassess their supply chain strategies, seeking alternative suppliers to reduce reliance on any single country.

Understanding these risk categories helps companies better prepare to address various challenges. Different types of supply chain risks require distinct management strategies. For instance, operational risks can be mitigated by increasing equipment redundancy, optimizing inventory management, and enhancing employee training; cyber risks necessitate strengthened cybersecurity defenses, the establishment of emergency response plans, and improved supplier management; systemic risks demand that enterprises adopt diversified and flexible supply chain strategies to reduce dependence on single suppliers or markets. By comprehensively understanding these risk categories, companies can develop more effective risk management plans, thereby enhancing supply chain resilience and adaptability.

3. Risk assessment methods

3.1. Mix of methods

How do enterprises identify and measure these supply chain risks? Successful enterprises typically adopt an integrated approach using multiple methods, as follows:

Qualitative Tools: These include surveys, expert interviews, and risk scorecards, which are used to assess the vulnerability of suppliers. For example, a company might evaluate suppliers based on their financial health, location, and past performance.

Quantitative Models: These involve numbers and data. Simulation software can map how a risk might spread through the supply chain. For instance, if a hurricane hits a port, how will it affect delivery times and costs?

Scenario Testing: Some companies run drills—like war games—to test how they would handle emergencies. For example, how would they respond if a major port suddenly closed?

3.2. Case study

Unilever provides a typical example of effective supply chain risk assessment. Through the application of its “digital twin” system, Unilever has achieved significant results in risk management:

Reduced risk response time: The system helped Unilever cut risk response time by 72% [9]. This means Unilever can react faster to unexpected events, minimizing impacts on production and sales.

Enhanced supply chain resilience: By simulating various risk scenarios, Unilever can preemptively develop response strategies, strengthening supply chain resilience. This not only improves supply chain stability but also reduces economic losses caused by risk events.

Decision support: The system provides real-time data and simulation results, offering robust decision support for management. Using this data, management can more accurately assess risks and formulate more effective risk management strategies.

Unilever's "digital twin" system is an innovative risk management tool that significantly enhances supply chain resilience and responsiveness through real-time data integration, scenario simulation, and contingency planning. The successful implementation of this system has not only delivered substantial economic benefits to Unilever but also provided valuable experience and reference for other enterprises. By adopting similar technologies and methodologies, companies can better navigate complex global supply chain risks, ensuring supply chain stability and reliability.

4. Mitigation strategies

Once risks are assessed, companies need ways to reduce them. Strategies can be divided into two types: preventive and responsive.

4.1. Preventive approaches aiming to avoid problems before they occur

Supplier Diversification: Over-reliance on a single supplier increases supply chain vulnerability. Apple, for example, used to depend heavily on semiconductor factories in Taiwan. But in 2023, they started partnering with companies in India to reduce this risk [10]. Apple is seeking new suppliers globally, particularly in India and Southeast Asia. This strategy not only reduces reliance on any single supplier but also enhances supply chain flexibility and resilience. By partnering with multiple suppliers, Apple is better positioned to navigate risks such as natural disasters, political conflicts, and shifts in trade policies.

Contract Flexibility: Enterprises often incorporate flexible clauses into supplier contracts to adjust order terms in response to unforeseen changes. Nike did this during COVID-19 when they faced shortages of raw materials. Nike incorporated flexible clauses into its supplier contracts, allowing adjustments to order quantities and delivery schedules under specific circumstances. This strategy proved particularly crucial during the pandemic, helping Nike navigate raw material shortages and production disruptions. Through such flexible contractual arrangements, Nike was better positioned to manage supply chain risks and maintain business continuity.

4.2. Responsive tactics are used when a problem has already occurred

Emergency Protocols: Many enterprises develop detailed action plans for emergency scenarios. For instance, Toyota has a comprehensive emergency playbook specifying response procedures in the event of an earthquake.

Data-Sharing Coalitions: Inter-enterprise information sharing enhances collective risk response capabilities. Walmart, for example, has established a supplier portal that provides real-time data access to all supply chain partners. During hurricanes, this helps them reroute shipments and avoid delays.

Other helpful tactics include keeping a safety stock of critical items, using multiple transportation routes, and building strong relationships with suppliers.

- **Cross-Training Employees:** By ensuring that staff members are trained in multiple roles, companies can adapt to unexpected absences or surges in demand. For instance, a restaurant might train its waitstaff to also handle kitchen duties, which can be crucial during a sudden rush or when a cook calls in sick.

- **Regular Drills and Training Exercises:** Conducting regular drills can help employees become familiar with emergency procedures. This is common in schools and hospitals, where fire drills and disaster preparedness exercises are routine, ensuring that everyone knows what to do in case of an actual emergency.

- **Agile Supply Chain Adjustment:** Companies that can quickly switch suppliers or adjust their supply chain in response to disruptions are better equipped to handle crises. For example, a tech company might have backup suppliers for critical components, allowing them to continue production even if one supplier is affected by a natural disaster.

- **Investment in Technology:** Advanced technology can provide real-time data and analytics, which is invaluable for making quick decisions during a crisis. A financial firm might use sophisticated software to monitor market trends and adjust their strategies accordingly to mitigate risks.

- **Clear Communication Channels:** Establishing clear and efficient communication channels ensures that information is disseminated quickly and accurately during a crisis. This could involve setting up a dedicated crisis communication team or using a centralized communication platform to keep all stakeholders informed.

- **Scenario Planning:** Anticipating potential crisis scenarios and formulating corresponding response plans to enhance decision-making efficiency during actual crises. By anticipating different situations and planning responses, they can act more decisively when a real problem arises.

- **Insurance and Risk Management:** Proper insurance coverage and risk management strategies can help mitigate the financial impact of a disaster. Companies should regularly review their insurance policies to ensure they have adequate coverage for potential risks.

- **Employee Support Programs:** In the aftermath of a crisis, it's important to support employees who may be affected. This could involve counseling services, flexible work arrangements, or other forms of assistance to help them recover and return to normal operations.

By implementing these tactics, companies can build resilience and be better prepared to respond to and recover from various types of emergencies. It's about creating a culture of preparedness and adaptability that permeates every level of the organization [11].

5. Conclusion

This study shows that supply chain risks are complex and interconnected. Companies need to use a combination of strategies to manage operational, network, and systemic risks effectively. The Resilience-Agility Framework we propose helps firms prepare for disruptions and respond to them quickly. Empirical evidence indicates that enterprises using such integrated strategies can recover 30–50% faster from supply chain disruptions. However, our research has some limitations. We only looked at a small number of case studies, and most were based in Asia. Future studies should look at supply chains in other regions and sectors—like renewable energy. Technologies like blockchain could also play a bigger role in the future, for example by creating risk-sharing networks. From a societal perspective, improving supply chain risk management is not just good for business—it benefits everyone. It can prevent shortages of essential goods like medicines and food, control inflation, and help maintain stability during global emergencies.

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