Supply Chain Risk Management: Disruption, Resilience Strategies, and Recovery Planning

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ABSTRACT

This paper examines supply chain risk management as a strategic approach to identifying, assessing, and mitigating disruptions across global supply networks. It reviews major risk categories, risk assessment methods, and resilience strategies including dual sourcing, safety stock, nearshoring, flexible capacity, and supply chain visibility. The discussion highlights lessons from major disruptions such as COVID-19 and emphasizes the trade-off between efficiency and resilience. It also considers how supply chain mapping, digital platforms, and digital twins can strengthen disruption preparedness, recovery planning, and long-term supply chain robustness.

Keywords: Supply Chain Risk; Resilience; Business Continuity; Disruption; Dual Sourcing; Nearshoring; Risk Assessment; COVID-19

1. INTRODUCTION

Supply chain risk management (SCRM)—the identification, assessment, and mitigation of risks that could disrupt the flow of goods, services, information, or capital through a supply chain—has emerged as one of operations management's highest-priority areas following a succession of major supply chain disruptions that demonstrated the fragility of globally extended, lean-optimized supply chains. The 2011 Tohoku earthquake and tsunami (disrupting Japanese automotive and electronics supply chains globally for months); the Thai flooding of 2011 (eliminating 25% of global hard disk drive production for over a year); and the COVID-19 pandemic (the most severe global supply chain disruption since World War II) each revealed how concentration of production in specific geographies, single-source supplier dependencies, and lean inventory optimization create vulnerability to low-probability, high-impact events.

2. SUPPLY CHAIN RISK TAXONOMY

2.1 Risk Categories

Supply chain risks can be categorized along multiple dimensions. By source: demand-side risks (demand variability, forecast error, customer insolvency); supply-side risks (supplier quality failures, capacity constraints, supplier insolvency, geopolitical supply disruption); operational risks (equipment failure, labor disputes, process quality); and environmental risks (natural disasters, pandemics, regulatory changes, currency fluctuation). By frequency and impact: high-frequency, low-impact operational disruptions (quality escapes, delivery delays) require routine management and monitoring; low-frequency, high-impact disruptions (major natural disasters, supplier insolvency, geopolitical events) require strategic resilience investment. Cranfield University's supply chain risk research (Peck, 2005; Christopher and Peck, 2004) has been particularly influential in developing supply chain vulnerability and resilience frameworks.

2.2 Risk Assessment Methods

Supply chain risk assessment tools include: supplier risk scorecards (quantifying supplier financial health, operational capability, geographic concentration, and compliance performance); supply chain mapping (identifying all tiers of suppliers and their geographic locations); and failure mode and effects analysis (FMEA: systematically identifying potential failure modes in supply chain processes and their probability, severity, and detectability). The COVID-19 pandemic revealed that most firms had incomplete visibility beyond their first-tier suppliers—unable to identify the second and third-tier supplier concentrations in affected regions that ultimately disrupted their supply chains. Comprehensive multi-tier supply chain mapping, enabled by supply chain intelligence platforms (Resilinc, riskmethods, TealBook), has become a SCRM best practice.

Table 1. Supply chain resilience strategies and their cost-benefit trade-offs.

Resilience Strategy	Mechanism	Cost-Benefit Trade-off
Dual/multi-sourcing	Multiple approved suppliers for critical items	Higher unit cost (less leverage); lower disruption risk
Safety stock buffers	Inventory buffers against supply disruption	Higher working capital; faster recovery when disruption occurs
Nearshoring	Relocate supply closer to demand market	Higher unit cost; shorter lead times; lower geopolitical risk
Flexible capacity contracts	Contract rights to surge production capacity	Capacity reservation cost; ability to respond to demand spikes
Supply chain visibility	Real-time monitoring of supplier conditions and logistics	Platform investment; earlier disruption detection; faster response

3. COVID-19 SUPPLY CHAIN LESSONS

The COVID-19 pandemic's supply chain impact—personal protective equipment (PPE) shortages, semiconductor scarcity, port congestion, container shipping rate increases of 500-1000%, and broad consumer goods stockouts—provided the most comprehensive stress test of global supply chain resilience in modern history. The pandemic revealed multiple systemic vulnerabilities: geographic concentration of critical manufacturing in China (PPE, APIs for pharmaceuticals, electronics components); single-source supplier dependencies that had evolved from initial dual-sourcing toward single-sourcing as cost pressure intensified; lean inventory optimization that eliminated safety stock buffers needed to absorb disruption; and supply chain invisibility beyond Tier 1 suppliers that prevented early identification of disruptions.

4. NEARSHORING AND RESHORING TRENDS

The combination of COVID-19 supply chain disruption, US-China trade tensions (2018 tariffs, semiconductor restrictions), and growing recognition of geopolitical supply chain risk has accelerated nearshoring (moving supply closer to demand regions) and reshoring (returning manufacturing to home markets) across multiple industries. The CHIPS and Science Act (2022) committed $52 billion to US semiconductor manufacturing investment; the Inflation Reduction Act's domestic content requirements incentivize EV battery supply chain localization; and multiple European governments have announced critical raw material supply chain security programs. The economic tension between reshoring's higher unit cost and supply security benefits requires careful analytical framework—most reshoring economics are favorable only for the most strategically critical items.

5. CONCLUSION

Supply chain risk management has moved from a specialized risk management function to a board-level strategic priority as the economic, reputational, and social consequences of supply chain disruptions have become undeniable. The COVID-19 pandemic's supply chain legacy—accelerating investment in supply chain resilience, visibility, and diversification—may ultimately produce more robust, though more costly, global supply chains. The fundamental challenge is that resilience and efficiency are in tension: lean, globally distributed, single-sourced supply chains optimized for cost are inherently fragile, while resilient supply chains with redundant sourcing, geographic diversification, and inventory buffers are inherently more expensive. Future research should examine the optimal resilience-efficiency trade-off across different product categories and supply chain contexts, and how digital supply chain twins—virtual models of entire supply networks that enable disruption scenario simulation—can improve risk management decision quality.

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