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Supply Chain Risk Management Practices and their Effect on Resilience of Manufacturing Firms

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ABSTRACT: In today's volatile global environment, manufacturing firms are increasingly exposed to diverse supply chain risks, including geopolitical tensions, natural disasters, pandemics, supplier failures, and logistical disruptions. Supply chain risk management (SCRM) practices have become critical tools for identifying, assessing, mitigating, and monitoring these threats, while supply chain resilience reflects a firm's ability to anticipate, withstand, adapt to, respond to, and recover from such disruptions effectively.

This descriptive study explores the conceptual relationship between SCRM practices and supply chain resilience in the context of manufacturing firms. It describes key SCRM practices—such as risk identification, systematic risk assessment, proactive mitigation strategies (e.g., supplier diversification, redundancy, collaboration, and contingency planning), and continuous monitoring—and examines how these practices contribute to building resilience dimensions including robustness, agility, adaptability, visibility, and rapid recovery capability.

Particular attention is given to the Indian manufacturing sector, especially in regions like Rajasthan, where industrial clusters in automotive components, textiles, and engineering goods face region-specific vulnerabilities such as infrastructure limitations, seasonal disruptions, and supplier dependencies. The discussion also highlights the supportive role of national policy initiatives (e.g., Make in India, localization efforts) and emerging trends such as digital technologies and sustainability in reinforcing SCRM-resilience linkages.

Through a synthesis of conceptual understanding, the paper illustrates how structured and proactive risk management practices serve as foundational enablers for resilient supply chains in manufacturing. Practical insights are provided for managers in Rajasthan and similar emerging industrial settings to strengthen visibility, collaboration, and preparedness. The study contributes to a clearer appreciation of the strategic importance of SCRM in fostering long-term resilience amid ongoing uncertainties.

KEYWORDS: Supply chain risk management, SCRM practices, supply chain resilience, manufacturing firms, robustness, emerging economies.

I. INTRODUCTION

The manufacturing sector operates in an increasingly unpredictable global environment where supply chains are exposed to a wide array of risks that can disrupt operations, delay deliveries, increase costs, and erode competitiveness. These risks include natural disasters such as floods and earthquakes, geopolitical tensions leading to trade restrictions or border closures, pandemics causing labor shortages and logistical breakdowns, supplier failures due to financial instability or quality issues, cyber-attacks targeting information systems, and sudden demand fluctuations driven by market shifts or consumer behavior changes. In recent years, the frequency and severity of such disruptions have intensified, underscoring the critical importance of building resilient supply chains capable of withstanding shocks and recovering swiftly.

Supply chain risk management (SCRM) has emerged as a strategic discipline aimed at systematically identifying, assessing, mitigating, and monitoring potential threats across the entire supply network. Unlike traditional risk management, which often focuses on isolated events or financial losses, SCRM adopts a holistic perspective, recognizing that risks are interconnected and can cascade through multiple tiers of suppliers, manufacturers, and distributors. Effective SCRM practices seek to reduce vulnerability by enhancing visibility, fostering collaboration, diversifying sources, and developing contingency plans that enable firms to maintain continuity under adverse conditions.



Closely linked to SCRM is the concept of supply chain resilience, which refers to the ability of a supply chain to anticipate potential disruptions, prepare for them, absorb their impact, respond effectively, and recover quickly to a desired level of performance—often emerging stronger than before. Resilience is multidimensional, encompassing robustness (the capacity to resist disruption without significant performance loss), agility (the speed and flexibility to adapt to changing conditions), adaptability (the ability to reconfigure processes or resources), visibility (real-time awareness of supply chain status), and recovery capability (the efficiency of restoring normal operations). In manufacturing firms, where production schedules are tightly linked to material availability and just-in-time delivery, resilience is not merely a defensive posture but a source of competitive advantage that supports sustained operational excellence and customer satisfaction.

The interplay between SCRM practices and supply chain resilience has gained significant attention in both academic literature and industry discourse. Proactive risk management—through practices such as supplier diversification, strategic inventory buffering, collaborative information sharing, and the use of digital technologies for early warning systems—has been widely recognized as a foundational mechanism for developing resilient supply chains. These practices help firms anticipate risks, reduce exposure, and accelerate recovery when disruptions occur. In contrast, reactive or ad-hoc approaches often lead to prolonged downtime, higher recovery costs, and loss of market share.

In the Indian manufacturing context, the relevance of SCRM and resilience is particularly pronounced. India's manufacturing sector has been expanding rapidly, supported by national initiatives such as Make in India, Production Linked Incentive schemes, and efforts to integrate domestic firms into global value chains. However, the sector continues to face region-specific and structural vulnerabilities. In states like Rajasthan, where industrial clusters in Jaipur (automotive components, engineering goods, textiles), Bhilwara (textiles), Neemrana (Japanese and Korean manufacturing zones), and Bhiwadi (auto parts) drive significant economic activity, firms encounter unique challenges. These include seasonal weather-related disruptions, infrastructure bottlenecks, dependence on a limited number of suppliers, fluctuating raw material availability, and occasional labor or logistical interruptions. Such conditions make structured risk management and resilience-building practices especially valuable for maintaining operational continuity and supporting long-term growth.

The descriptive exploration of SCRM practices and their contribution to resilience is timely and relevant. While global literature provides a strong foundation—highlighting frameworks that emphasize anticipation, preparation, and recovery—there remains a need to synthesize these insights in ways that are meaningful for emerging industrial settings. In Rajasthan and similar regions, where manufacturing clusters are growing but still maturing, understanding how risk management practices can be conceptually aligned with resilience goals can offer valuable guidance to managers and policymakers.

This paper adopts a descriptive and conceptual approach to examine the relationship between supply chain risk management practices and supply chain resilience in manufacturing firms. It describes the core components of SCRM, outlines the key dimensions of resilience, and explores how structured risk management activities conceptually enable firms to build more robust, agile, and recoverable supply chains. Special attention is given to the Indian manufacturing landscape, with particular reference to the challenges and opportunities in Rajasthan's industrial clusters.

The significance of this study lies in its potential to provide a clearer conceptual understanding of how proactive risk management serves as a strategic enabler of resilience. By synthesizing established ideas and contextualizing them for emerging economies, the paper aims to offer practical insights for manufacturing managers seeking to strengthen their supply chains against future uncertainties. It also highlights the supportive role of policy frameworks and emerging technologies in reinforcing these linkages.

II. LITERATURE REVIEW

Supply chain risk management (SCRM) is widely recognized as a systematic process for identifying, assessing, mitigating, and monitoring risks that threaten the flow of materials, information, and finances across the supply chain. Christopher and Peck (2004) provided a foundational framework, emphasizing the need for a holistic approach that covers the entire network. Key SCRM practices include risk identification (detecting potential threats such as supplier failure, natural disasters, or demand shocks), risk assessment (evaluating likelihood and impact), mitigation strategies (supplier diversification, redundancy, collaboration, inventory buffering), and continuous monitoring supported by digital tools like IoT, blockchain, and predictive analytics.



Supply chain resilience refers to the ability of a supply chain to anticipate disruptions, absorb their impact, adapt quickly, respond effectively, and recover to normal or improved performance. Ponomarov and Holcomb (2009) defined it as an adaptive capability that maintains continuity and control during crises. Resilience dimensions commonly include robustness (resistance to disruption), agility (speed of adjustment), adaptability (process reconfiguration), visibility (real-time awareness), and recovery capability (swift return to stability).

The literature consistently links proactive SCRM practices to enhanced resilience. Risk identification and assessment enable better anticipation and preparedness, while mitigation strategies such as diversification and collaboration increase agility and reduce vulnerability. Digital technologies further strengthen visibility and accelerate response and recovery. In manufacturing contexts, where tight schedules and just-in-time operations amplify disruption effects, structured risk management is seen as essential for maintaining continuity and competitiveness.

In emerging economies like India, the discussion gains additional relevance. Rapid industrial growth under initiatives such as Make in India has exposed firms to both global and local risks, including infrastructure constraints, supplier dependencies, seasonal disruptions, and import reliance. In Rajasthan, industrial clusters in Jaipur (automotive, engineering, textiles), Bhilwara, Neemrana, and Bhiwadi face similar regional vulnerabilities, making relational networks, localization, and adaptive practices particularly important.

Overall, the literature portrays SCRM as a foundational enabler of supply chain resilience in manufacturing. Proactive, integrated risk management practices build robustness, agility, and recovery capacity, offering a strategic pathway for firms—especially in emerging industrial regions like Rajasthan—to navigate uncertainties and sustain long-term performance.

III. CONCEPTUAL FRAMEWORK

The conceptual framework presented in this paper integrates supply chain risk management (SCRM) practices with the dimensions of supply chain resilience, offering a structured way to understand how proactive risk management enables manufacturing firms to build more resilient supply chains. At the core of the framework are four primary SCRM practices drawn from established literature: risk identification, risk assessment, risk mitigation, and risk monitoring. Risk identification serves as the foundational step, involving the recognition of potential internal and external threats such as supplier disruptions, demand volatility, natural calamities, geopolitical events, or cyber risks. Risk assessment follows, where identified risks are evaluated in terms of their probability and potential impact, allowing firms to prioritize threats that could most severely affect operations. Risk mitigation constitutes the action-oriented phase, encompassing strategies such as supplier diversification, multi-sourcing, strategic inventory buffering, collaborative partnerships, process redundancy, and the adoption of digital technologies (e.g., IoT for visibility, AI for predictive analytics). Finally, risk monitoring involves continuous surveillance of risk indicators, early warning systems, and periodic review of the risk landscape to ensure timely adaptation.

These SCRM practices are conceptually linked to the key dimensions of supply chain resilience: robustness (the ability to withstand disruption without major performance loss), agility (speed and flexibility in responding to changes), adaptability (capacity to reconfigure resources and processes), visibility (real-time awareness across the supply network), and recovery capability (efficient return to normal or improved performance after a disruption).

The framework proposes that effective SCRM practices act as direct enablers of resilience. Risk identification and assessment enhance anticipation and preparedness, strengthening robustness and visibility. Mitigation strategies, particularly diversification, redundancy, and collaboration, directly contribute to agility and adaptability by providing alternative options and flexible response mechanisms. Continuous monitoring supports rapid detection and response, accelerating recovery capability. Collectively, mature implementation of these practices is conceptualized as creating a reinforcing cycle: better risk management leads to higher resilience, which in turn reduces vulnerability to future risks and allows more effective risk management over time.

In the context of manufacturing firms in emerging industrial regions like Rajasthan, the framework acknowledges moderating influences such as firm size (larger firms typically have greater resources for implementing advanced mitigation tools), industry type (e.g., automotive clusters may require higher visibility due to global supply dependencies), environmental uncertainty (higher volatility increases the value of agility and adaptability), and policy support (national and state initiatives that facilitate localization and digital adoption).



While this model is purely descriptive and conceptual, it provides a clear mental map for understanding how structured risk management practices can serve as strategic foundations for building resilient supply chains in manufacturing. It highlights that resilience is not merely a reactive outcome but the result of deliberate, proactive risk management efforts tailored to the specific context of the firm and its operating environment. This conceptual framework bridges the literature review to the subsequent discussion of implications and practical insights.

IV. DISCUSSION

The conceptual exploration of supply chain risk management (SCRM) practices and their contribution to supply chain resilience reveals a deeply interconnected relationship that holds profound significance for manufacturing firms operating in volatile environments. Proactive SCRM—encompassing systematic risk identification, rigorous assessment, strategic mitigation, and continuous monitoring—serves as the foundational mechanism through which firms can transform inherent vulnerabilities into sources of strength. Risk identification and assessment enable anticipation and prioritization, allowing organizations to map out potential threats ranging from supplier insolvency and raw material shortages to natural disasters and geopolitical shifts. These early-stage activities directly bolster robustness by building awareness and preparedness, reducing the likelihood of sudden, severe performance drops when disruptions occur. Mitigation strategies, such as supplier diversification, multi-sourcing, redundancy in critical processes, collaborative partnerships, and strategic inventory positioning, further amplify resilience by creating alternative pathways and flexible response options. In manufacturing contexts, where production continuity depends heavily on timely material inflows and just-in-time coordination, these measures enhance agility—the speed with which firms can pivot operations—and adaptability—the capacity to reconfigure resources or relationships to meet new realities. Visibility emerges as a critical bridging element in this dynamic. Continuous monitoring, increasingly supported by digital technologies like IoT sensors, blockchain for traceability, and AI-driven predictive analytics, provides real-time insights into supply network status, enabling early detection of emerging risks and faster corrective actions. This visibility dimension not only accelerates recovery capability but also reinforces the entire resilience cycle: better-informed decisions lead to more effective mitigation, which in turn strengthens overall preparedness. The literature consistently portrays this reinforcing loop as central to long-term resilience, where mature SCRM practices evolve from reactive firefighting into strategic capability development. In manufacturing sectors characterized by high capital intensity, tight schedules, and interdependent networks (automotive components, textiles, engineering goods), the absence of such integrated approaches often results in cascading effects—delays at one tier ripple through production lines, inflating costs, eroding customer trust, and diminishing market position.

When viewed through the lens of emerging economies, particularly India, these conceptual linkages take on added layers of relevance and complexity. India's manufacturing sector has experienced remarkable momentum, driven by national initiatives such as Make in India and Production Linked Incentive schemes, which aim to deepen domestic value chains, reduce import dependency, and integrate firms into global networks. These policies have encouraged localization of sourcing, technology adoption, and infrastructure development, all of which conceptually align with SCRM best practices by promoting diversification away from over-reliance on single foreign suppliers and enhancing visibility through digital infrastructure. However, the Indian landscape also presents distinct vulnerabilities that amplify the need for resilience. Infrastructure bottlenecks, seasonal weather disruptions (monsoons affecting transportation and raw material availability), supplier fragmentation, fluctuating labor dynamics, and occasional logistical interruptions remain persistent challenges. In Rajasthan, home to vibrant industrial clusters in Jaipur (engineering goods, automotive components, textiles), Bhilwara (textiles), Neemrana (Japanese and Korean manufacturing zones), and Bhiwadi (auto parts), these regional factors are especially pronounced. Jaipur clusters, for instance, often rely on extended supplier networks spanning rural areas and neighboring states, making them susceptible to transportation delays, raw material shortages during adverse seasons, and relational dependencies that can propagate risks quickly.

The conceptual framework underscores that in such settings, relational and adaptive practices gain particular importance. Collaboration with local suppliers and industry associations can foster trust-based networks that facilitate information sharing and joint contingency planning—key mitigation levers that compensate for infrastructural limitations. Policy support further enhances these efforts; localization incentives and cluster development programs conceptually reduce exposure to global disruptions while promoting visibility and agility through shared infrastructure (e.g., common logistics hubs or digital platforms). Emerging trends such as digitalization (ERP systems, real-time tracking) and sustainability integration (ethical sourcing, circular models) also align closely with SCRM-resilience goals, offering dual benefits of risk reduction and long-term competitiveness. For Rajasthan-based firms in textiles and automotive components, where global demand fluctuations and import dependencies are common, these approaches conceptually enable faster adaptation to market shifts and quicker recovery from local or international shocks.



Theoretically, this discussion reinforces the dynamic capabilities perspective, positioning SCRM as a set of evolving competencies that allow firms to sense risks, seize opportunities for reconfiguration, and transform operations for sustained advantage. It also aligns with resilience theory, emphasizing that true resilience extends beyond mere survival to include learning and improvement post-disruption. In emerging market contexts, these theories highlight the interplay between structural factors (infrastructure, policy) and relational factors (collaboration, trust), suggesting that resilience is not solely a firm-level outcome but emerges from ecosystem-level interactions. The framework's recognition of moderating influences—firm size (larger organizations typically possess greater resources for advanced tools), industry type (high-tech sectors like automotive require stronger visibility), and environmental uncertainty—adds nuance, illustrating how contextual conditions shape the effectiveness of SCRM practices.

Practically, the insights offer meaningful guidance for manufacturing managers in Rajasthan and similar regions. Prioritizing risk identification through regular mapping of the supply network can reveal hidden vulnerabilities, while investing in mitigation via diversified sourcing and collaborative platforms can build agility without excessive cost. Digital tools for monitoring and visibility represent high-impact opportunities, particularly as government initiatives promote technology adoption. Cluster-based approaches—leveraging local associations for shared risk intelligence and contingency planning—can provide cost-effective resilience gains, especially for medium-sized firms in Jaipur's engineering and textile sectors. Policymakers can support these efforts by strengthening infrastructure (roads, logistics hubs), incentivizing digital integration, and fostering cluster collaboration, thereby creating an enabling environment for resilient manufacturing growth.

Despite these strengths, the literature reveals ongoing challenges. Inconsistencies persist in how resilience dimensions are prioritized across contexts, and the balance between efficiency (lean practices) and resilience (redundancy, buffers) remains delicate. Emerging risks—cyber threats, climate change impacts, and geopolitical shifts—continue to evolve, demanding constant adaptation of SCRM approaches. In Rajasthan, cluster-specific issues such as seasonal disruptions and supplier fragmentation require tailored strategies that global frameworks may not fully address.

Looking ahead, future conceptual development could explore the integration of advanced technologies (AI, blockchain) more deeply into SCRM-resilience models, particularly in emerging clusters. The role of sustainability as a resilience enhancer—through ethical sourcing and circular practices—also merits greater attention. Comparative conceptual analyses across Indian regions or with other emerging economies could further illuminate contextual adaptations. Overall, this discussion affirms that structured, proactive supply chain risk management is not merely a defensive tool but a strategic imperative for manufacturing firms in Rajasthan and beyond, enabling them to navigate uncertainty, sustain operations, and position themselves competitively in India's evolving industrial landscape.

V. CONCLUSION

In an era marked by frequent and unpredictable disruptions, supply chain risk management (SCRM) practices have emerged as indispensable strategic tools for manufacturing firms seeking to safeguard operations and ensure long-term competitiveness. This descriptive study has conceptually demonstrated that structured risk management—through systematic identification, assessment, proactive mitigation, and continuous monitoring—serves as a foundational enabler of supply chain resilience. By anticipating threats, reducing vulnerabilities, and creating flexible response mechanisms, these practices collectively strengthen the core dimensions of resilience: robustness to withstand shocks, agility to adapt swiftly, adaptability to reconfigure resources, visibility for timely awareness, and rapid recovery to restore performance.

The discussion highlights that in the Indian manufacturing context, particularly within Rajasthan's growing industrial clusters such as those in Jaipur, Bhilwara, Neemrana, and Bhiwadi, the relevance of these linkages is amplified. Regional vulnerabilities—including seasonal weather disruptions, infrastructure constraints, supplier fragmentation, and dependence on extended networks—make proactive SCRM not merely beneficial but essential. National policy initiatives like Make in India, Production Linked Incentive schemes, and cluster development programs further support firms by encouraging localization, digital adoption, and collaborative ecosystems that align closely with resilience-building objectives.

Ultimately, the conceptual synthesis underscores a clear message: resilience is not an accidental outcome but the deliberate result of integrated risk management efforts. Manufacturing firms that embrace these practices can transform uncertainty into a source of strategic advantage, maintaining operational continuity, protecting customer relationships, and positioning themselves favorably in both domestic and global markets.



For managers in Rajasthan and similar emerging industrial regions, the key takeaway is the need to prioritize visibility, collaboration, diversification, and preparedness as ongoing priorities rather than reactive measures. By doing so, firms can build more robust and agile supply chains capable of navigating the complexities of today's volatile environment. This conceptual understanding offers a solid foundation for continued advancement in supply chain resilience, supporting India's broader manufacturing growth ambitions in the years ahead.

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