

Supply Chain Risk Management For Small And Medium Enterprises In Construction Projects

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Abstract- *The construction industry in India, particularly in Maharashtra, relies heavily on Small and Medium Enterprises (SMEs) for project execution, yet these firms face significant vulnerabilities due to fragmented and complex supply chains. This study investigates Supply Chain Risk Management (SCRM) practices tailored for construction SMEs, addressing a critical gap in sector-specific risk mitigation strategies. Through a mixed-methods approach involving surveys, semi-structured interviews with SME owners, project managers, and suppliers, along with case studies of ongoing construction projects in Maharashtra, the research identified key supply chain risks such as material price volatility, supplier delays, transportation disruptions, quality inconsistencies, regulatory uncertainties, and financial liquidity issues. The assessment revealed that risks related to raw material procurement and logistics have particularly high likelihood and severity, yet they are often inadequately managed due to limited resources, lack of formal risk protocols, and low technological adoption among SMEs. The study further highlights the predominantly reactive nature of current risk management practices and the associated operational challenges. To address these issues, the research proposes a simplified, practical four-phase SCRM framework encompassing risk identification, assessment, mitigation, and continuous monitoring. This framework integrates low-cost tools, stakeholder collaboration mechanisms, and localized strategies suitable for resource-constrained SMEs.*

Keywords: Supply Chain Risk Management, Construction SMEs, Risk Assessment, Maharashtra, Construction Projects, Framework Development

economic activity after agriculture, contributing approximately 9.1% to national GVA in FY 2024, with projected real-term growth of 8.1% in 2025 and 6.4% in 2026. This expansion is fueled by government initiatives like the National Infrastructure Pipeline, Pradhan Mantri Awas Yojana (PMAY) for affordable housing, and PM Gati Shakti for multimodal connectivity. The sector directly employs around 71 million people as of 2023, with projections reaching over 100 million by 2030, underscoring its role in job creation and inclusive growth.

A defining feature of the construction industry is its heavy reliance on Small and Medium Enterprises (SMEs), often referred to as Micro, Small, and Medium Enterprises (MSMEs) in the Indian context. MSMEs form the backbone of India's economy, accounting for nearly 35.4% of manufacturing output, 48.58% of exports, and about 31.1% of GDP, while employing over 32.82 crore persons across 7.47 crore enterprises. In the construction sector specifically, SMEs dominate project execution, particularly in subcontracting, material supply, labor contracting, and specialized services. They handle a substantial portion of on-site activities in both public and private projects, from urban housing in cities like Nagpur and Mumbai to rural infrastructure under schemes like PMAY. Unlike large conglomerates (e.g., L&T or Tata Projects), SMEs operate with leaner structures, offering flexibility and cost-effectiveness but facing inherent limitations in scale, capital, and bargaining power. Their contribution is critical for achieving India's \$5 trillion economy target, yet their survival depends on navigating complex operational ecosystems.

I. INTRODUCTION

The construction industry serves as a cornerstone of economic development worldwide, driving infrastructure growth, urbanization, and employment generation. It encompasses a wide array of activities, from residential and commercial building to large-scale infrastructure projects such as roads, bridges, airports, and energy facilities. Globally, the sector contributes significantly to gross domestic product (GDP) and is often viewed as an indicator of overall economic health. In India, construction ranks as the second-largest

II. SUPPLY CHAIN RISK MANAGEMENT

The construction industry forms a vital pillar of economic development across the globe, fueling infrastructure expansion, urbanization, job creation, and overall industrial growth. It encompasses diverse activities ranging from residential and commercial buildings to critical infrastructure projects such as roads, highways, bridges, airports, railways, and energy facilities. In India, the construction sector stands as the second-largest economic activity after agriculture, contributing significantly to the nation's Gross Value Added

(GVA) and serving as a key driver of employment and capital formation. Recent data indicate that the sector contributes approximately 8-9% to India's GDP, with projections showing continued robust growth supported by sustained public capital expenditure and infrastructure momentum. The industry is expected to expand from around USD 640-650 billion in 2024 to nearly USD 963 billion by 2030, registering a compound annual growth rate (CAGR) of about 6.87%. By 2030, the construction sector is anticipated to reach a market size of USD 1.2-1.4 trillion, playing a pivotal role in India's ambition to become a USD 5 trillion economy. A distinguishing characteristic of the Indian construction landscape is the dominant role played by Small and Medium Enterprises (SMEs), often classified as Micro, Small, and Medium Enterprises (MSMEs). These enterprises constitute the backbone of the sector, handling a substantial share of subcontracting, material supply, labor contracting, specialized services, and on-site execution in both public and private projects. Nationally, MSMEs account for nearly 31.1% of GDP, 35.4% of manufacturing output, and about 48.58% of exports, while employing over 25-32 crore people across more than 7 crore registered units. In construction specifically, SMEs dominate fragmented project delivery, offering cost-effective and flexible solutions, particularly in affordable housing under schemes like Pradhan Mantri Awas Yojana (PMAY), urban development in cities like Nagpur, and rural infrastructure initiatives. Unlike large contractors (such as L&T or Tata Projects), SMEs operate with limited resources, thinner margins, and greater dependence on external networks, making them agile yet highly vulnerable to external shocks.

At the heart of construction project delivery lies the supply chain, which involves the coordinated flow of materials (cement, steel, aggregates, MEP components), equipment, labor, information, and finances from multiple tiers of suppliers to the project site. Unlike manufacturing supply chains, construction supply chains are temporary, project-specific, one-of-a-kind, and site-dependent. Materials typically account for 40-60% of total project costs, rendering timely procurement, quality assurance, and logistics critical to success. In India, with the National Infrastructure Pipeline exceeding ₹111 lakh crore and ongoing mega-projects under PM Gati Shakti, any disruption in the supply chain can trigger cascading effects—delays, cost overruns, quality compromises, and contractual disputes. Traditional procurement practices, reliance on local or regional vendors, manual coordination, and infrastructure bottlenecks (especially in regions like Maharashtra) further amplify these challenges.

Supply chain risks in construction are diverse and can be grouped into external and internal categories. External risks

arise from the macro-environment and include material price volatility due to global commodity fluctuations, geopolitical tensions (e.g., Red Sea disruptions, US tariffs on steel and other imports), inflation, currency volatility, natural disasters, and climate-related events. Internal risks encompass supplier insolvency, delivery delays, quality non-conformance, poor coordination among stakeholders, labor shortages, and inadequate inventory practices. Recent industry analyses highlight that external factors—such as raw material supplier issues and interest rate changes—often exert higher impact than internal ones. In 2025-2026, persistent challenges like evolving tariffs, supply chain fragility due to geopolitical developments, and rising material costs have intensified these risks, squeezing margins and stretching project timelines. Deloitte's 2026 Engineering and Construction Industry Outlook notes that nearly half of executives view their supply chains as vulnerable to geopolitical tensions, prompting a shift toward diversified sourcing and indexed pricing.

III. RESEARCH OBJECTIVES

- 1) To identify the major supply chain risks faced by Small and Medium Enterprises (SMEs) in construction projects in India, with focus on Maharashtra.
- 2) To assess the likelihood and severity of these supply chain risks using traditional risk assessment methods.
- 3) To examine the current risk management practices and challenges faced by construction SMEs.
- 4) To develop a practical Supply Chain Risk Management (SCRM) framework for SMEs in construction projects.

IV. RESEARCH METHODOLOGY

This study adopts a mixed-methods research design with a sequential explanatory approach to systematically investigate Supply Chain Risk Management (SCRM) for Small and Medium Enterprises (SMEs) in construction projects. The pragmatic philosophical paradigm underpins the methodology, as it allows the integration of quantitative and qualitative data to provide practical, actionable insights aligned with real-world industry challenges. This design is particularly suitable for the four research objectives, which progress logically from risk identification and assessment (quantitative-dominant) to examination of current practices and framework development (qualitative-dominant synthesis).

The overall approach is divided into three sequential phases:

Phase 1: Risk Identification and Assessment (Objectives 1 and 2)

Phase 2: Examination of Current Practices and Challenges (Objective 3)

Phase 3: Framework Development (Objective 4)

Secondary data from an extensive literature review forms the foundation, while primary data collected through questionnaire surveys and semi-structured interviews/case studies provide empirical validation and depth. This triangulation enhances the reliability and validity of findings. The study is cross-sectional, focusing on risks and practices observed primarily between 2020 and 2026.

This design integrates both quantitative and qualitative strands in a single study, allowing the researcher to leverage the strengths of each while compensating for their respective weaknesses. The underlying philosophical paradigm is pragmatism, which prioritizes practical problem-solving and the use of whatever methods best answer the research questions, rather than adhering rigidly to a single ontological or epistemological stance. Pragmatism is particularly fitting here because the study seeks not only to describe and measure supply chain risks but also to generate a practical, implementable SCRM framework that resource-constrained construction SMEs in India (with a focus on Maharashtra) can actually adopt in their day-to-day operations.

A purely quantitative approach, such as a large-scale survey alone, would enable statistical ranking of risk likelihood and severity but would fail to capture the nuanced, context-specific realities of how SMEs actually manage (or struggle to manage) these risks on the ground. Construction supply chains are inherently project-based, temporary, fragmented, and highly influenced by site-specific conditions, client-contractor relationships, and regional factors such as monsoon disruptions or regulatory delays in Maharashtra. Numbers alone cannot explain why SMEs continue to rely on reactive rather than proactive strategies, what cultural or financial barriers prevent the adoption of even simple tools like risk registers, or how interaction effects between risks (for example, material price volatility compounding cash-flow problems) manifest in real projects. Conversely, a purely qualitative design—such as in-depth case studies or interviews—would provide rich descriptive insights into current practices and challenges but would lack the statistical generalizability and objective prioritization required for Objectives 1 and 2. Without measurable data on likelihood and severity, it would be difficult to develop a credible, prioritized risk profile that can serve as the foundation for a practical framework.

The sequential explanatory mixed-methods design addresses these limitations by following a clear two-phase structure: an initial quantitative phase (questionnaire survey)

followed by a qualitative phase (semi-structured interviews and mini case studies) that builds directly upon and explains the quantitative findings. In the first phase, the survey collects numerical data on the eight major supply chain risks (material price volatility, supplier reliability, delivery and logistics disruptions, financial and cash flow problems, labor shortages, contractual and regulatory risks, geopolitical and economic disruptions, and environmental and natural disruptions). Respondents rate each risk on a 5-point Likert scale for likelihood of occurrence and severity of impact. Traditional risk assessment tools—specifically the Probability-Impact Matrix and Failure Mode and Effects Analysis (FMEA)—are then applied to compute Risk Priority Numbers ($RPN = \text{Severity} \times \text{Occurrence} \times \text{Detection}$). This phase directly fulfills Objectives 1 and 2 by providing an empirically ranked list of risks that is statistically robust and comparable across the sample of 120–150 SME professionals.

The second phase uses the quantitative results to purposefully select interview and case study participants (for example, SMEs that reported exceptionally high RPN scores on specific risks). Semi-structured interviews and mini case studies then explore why those risks are perceived as high, how they are currently managed (or mismanaged), what barriers exist (such as limited bargaining power, thin margins, or lack of formal training), and what low-cost, traditional mitigation strategies would be feasible. This explanatory sequence ensures that qualitative data does not stand in isolation but is deliberately used to interpret, elaborate, and contextualize the survey findings. The outcome is a grounded, evidence-based synthesis that directly supports Objective 3 (examination of current practices and challenges) and Objective 4 (development of a practical SCRM framework).

V. DATA COLLECTION

Pilot testing played a critical role in refining the data collection tools. The questionnaire was pilot-tested with 15 SME professionals (not included in the final sample) to check for clarity, relevance, length, and logical flow. Minor modifications were made based on feedback, particularly in wording of risk descriptions and Likert-scale statements. The pilot study also helped estimate the average time required to complete the survey (approximately 12–15 minutes) and confirmed that the language was easily understandable for respondents with varying levels of education and experience.

The target population for data collection was construction SMEs operating in Maharashtra, with a special focus on the Nagpur region and surrounding areas. This geographical focus allowed for better accessibility, higher response rates, and richer contextual insights into local supply

chain challenges such as material transportation issues, monsoon-related delays, and project-specific dynamics under PMAY and other state infrastructure schemes. Pilot testing is a critical step in any empirical research, especially in questionnaire-based studies, to ensure the validity, reliability, clarity, and practicality of the research instrument before full-scale administration. In this study, the questionnaire survey was pilot-tested to identify and rectify potential issues in wording, structure, relevance, and respondent burden. This process was essential because the target respondents — owners, project managers, and site engineers of construction SMEs — often have limited time and varying levels of formal education. A well-tested questionnaire increases response quality, reduces non-response bias, and improves the overall credibility of the findings related to supply chain risks. The pilot testing was conducted in two stages following established research methodology guidelines (Saunders et al., 2019; Creswell & Plano Clark, 2018). The first stage involved expert review, and the second stage consisted of actual field testing with representative participants.

VI. CONCLUSION

1) The study identified and validated eight major supply chain risks faced by construction SMEs in Maharashtra. The most frequently experienced risks were:

- Financial & Cash Flow Problems (92.4%)
- Material Price Volatility (89.4%)
- Delivery & Logistics Disruptions (85.6%)
- Labor Shortages (81.8%)

2) Using traditional methods (Probability-Impact Matrix and FMEA), the risks were assessed as follows:

Top Risks by Risk Priority Number (RPN):

1. Financial & Cash Flow Problems — RPN 82.9
2. Material Price Volatility — RPN 80.2
3. Delivery & Logistics Disruptions — RPN 69.9
4. Labor Shortages — RPN 64.9

3) Current risk management practices are largely informal and reactive. Coordination meetings with suppliers were the most commonly used practice (mean score 3.85/5), while formal risk registers were rarely maintained (mean 2.78/5).

Major challenges reported:

- Delayed payments from clients (88.6%)
- Limited financial resources (79.5%)
- Weak bargaining power with suppliers (72.7%)

4) Based on the above results, a simple four-phase SCRM framework was developed:

1. Risk Identification (using validated checklist)
2. Risk Assessment (Probability-Impact Matrix + basic FMEA)
3. Risk Mitigation (price escalation clauses, multi-sourcing, coordination meetings, contingency planning)
4. Monitoring & Review (monthly meetings + RACI matrix)

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