

Impact of Supply Chain Integration on Material Management

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Abstract- *The construction sector faces persistent challenges in material management due to fragmented supply chains, leading to delays, cost overruns, and resource wastage. This study aims to explore how integrated supply chain strategies can optimize material flow, streamline procurement processes, and improve overall project performance. The research adopts a mixed-methods approach, combining quantitative data analysis with qualitative insights. Data were gathered through surveys and semi-structured interviews with key stakeholders, including supply chain managers, procurement officers, and project supervisors, across diverse construction projects. Additionally, the study analyzes case studies of projects with varying levels of supply chain integration to identify patterns and best practices. Secondary data from project documentation, such as procurement records and inventory logs, were reviewed to assess the tangible impacts of SCI on material management outcomes.*

Findings indicate that higher levels of supply chain integration—characterized by real-time information sharing, collaborative planning, and strategic partnerships—significantly enhance material availability, reduce waste, and improve inventory control. The study identifies critical enablers of SCI, including the adoption of digital technologies like Enterprise Resource Planning (ERP) systems, Internet of Things (IoT) for real-time tracking, and blockchain for transparent transactions. However, barriers such as resistance to change, lack of trust among stakeholders, and high initial investment costs were found to impede integration efforts. through long-term supplier relationships, and aligning procurement strategies with project schedules. This study contributes to the field by providing actionable insights for construction firms and supply chain professionals to optimize material management practices, ultimately leading to more

motivated the continuous evolution of the supply chain and of the techniques to manage it effectively. Recently, the pressure of the competitive market and new information technologies has affected the structures of the production systems, calling for:

- reduction of time to market
- higher flexibility of the systems
- drastic reduction of costs
- extended quality concept

Construction industry is broad industry which includes large activity of construction. In this activity material and their procurement is important parameter. About 60- 70% cost engaged in construction are for material itself. Material procurement is prior important step of purchase action. Wider range of supply activity included in procurement process as compared to purchasing action. It typically includes a broadened view of the buying role with enhances participation of buyer in related materials activities.

Procurement process focuses on strategic matter compared to typical implementation process of purchase. During the construction project , materials account for a big part of products and project costs. The total cost of installed materials (or Value of Materials) may account for 50% or more, even though the manufacturing cost may be a minor part of the total, probably 20-30%.

Distribution which focuses on ensuring that the products reach the consumers through an organised network of distributors, warehouses, and retailers.

I. INTRODUCTION

The global market faces a fierce competition today. The introduction of products with shorter life cycles and the heightened expectations of customers have forced business enterprises to invest in, and focus attention on, their supply chains. This, together with continuing advances in communications and transportation technologies (e.g., mobile communication, internet, and overnight delivery), has

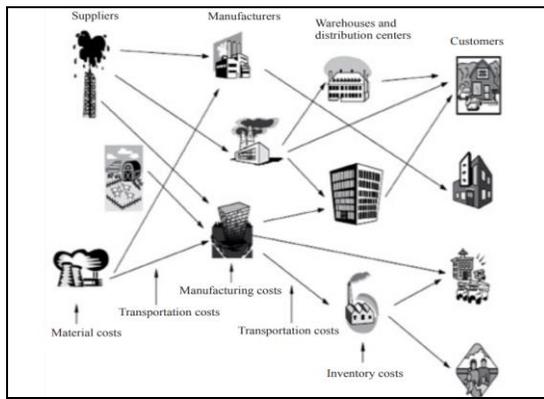


Figure 1 Supply Chain Network

II. IDENTIFY, RESEARCH AND COLLECT IDEA.

Supply chain management (SCM) in the construction industry is essential to the success of projects that often involve intricate coordination, significant material requirements, and strict timelines. The construction industry differs from manufacturing and other sectors in that it deals with unique, one-off projects that require tailored approaches to sourcing, transportation, and on-site delivery. Effective SCM ensures that materials, equipment, labor, and services arrive at the right place, at the right time, and at the right cost. Without a well-managed supply chain, projects are vulnerable to cost overruns, delays, and quality issues.

The construction supply chain involves multiple participants, including suppliers, manufacturers, distributors, contractors, and subcontractors, all working toward a common goal. The process starts with the procurement of materials and extends to the delivery of resources to the site, where they are used in construction. Each stage of the supply chain—planning, sourcing, production, logistics, and operations—must be seamlessly managed to prevent disruptions. Poor communication or misalignment between stakeholders can lead to significant delays, which is why SCM has become a focus for enhancing efficiency in the construction industry. Moreover, construction projects are often characterized by tight schedules and budget constraints, requiring precise planning and execution. The industry's reliance on just-in-time delivery of materials makes SCM even more crucial, as delays or shortages can halt progress and increase costs. A well-structured supply chain allows for better inventory management, reduced waste, and enhanced productivity. By having a clear view of material flows and logistics, construction managers can respond more effectively to changes in project timelines or unforeseen circumstances, ensuring a smoother construction process.

Technological advancements have revolutionized SCM in construction, offering new tools for improving

visibility and coordination across the supply chain. Digital platforms, for instance, allow for real-time tracking of materials and deliveries, enabling better communication between suppliers and construction managers. Building Information Modeling (BIM) is another innovation that integrates supply chain data into the design and planning phases, ensuring materials and equipment align with project requirements. By embracing these technologies, construction companies can increase their resilience and adaptability in managing supply chains, ultimately leading to better project outcomes. In conclusion, supply chain management is a vital component of the construction industry, influencing both project success and profitability. As the industry faces increasing demands for efficiency, sustainability, and cost control, optimizing the supply chain becomes even more critical. Effective SCM strategies help reduce risks, improve collaboration, and ensure timely completion of projects, making it an indispensable aspect of modern construction management.

III. WRITE DOWN YOUR STUDIES AND FINDINGS

Supply Chain Management (SCM) in construction is a critical area of study that addresses the coordination and optimization of material, information, and financial flows across the complex network of stakeholders involved in construction projects. Unlike traditional manufacturing supply chains, construction SCM is characterized by project-based operations, fragmented stakeholder relationships, and unique challenges such as site-specific constraints and fluctuating demand. This literature review synthesizes key findings from academic journals, books, and industry reports to explore the evolution, strategies, challenges, and technological advancements in construction SCM. It examines how SCM enhances project efficiency, reduces costs, and mitigates risks while identifying gaps in current research to guide future investigations. The review is structured around core themes: conceptual frameworks, stakeholder collaboration, technological integration, sustainability, and performance measurement.

The various components of supply chain management in construction industry are briefly elaborated by the following research

Ghaith Al-Werikat, “Supply Chain Management in Construction”:

The construction supply chain plays a major role in the construction market competition. Construction supply chain management assists enterprises by helping to improve competitiveness, increase profits and have more control over

the different factors and variables within the project. This paper discusses the construction supply chain characteristics, challenges and problems supply chains encounter and the benefits of an integrated supply chain in the construction sector.

Briscoe, G. and Dainty, A., Construction Supply Chain Integration: an Elusive Goal:

Purpose To empirically investigate the problems encountered in trying to integrate supply chains in the UK construction industry and to set these problems in the context of the extensive literature on supply chain management and partnering. Design/methodology/approach A brief review of current supply chain issues in the construction industry is provided. Three case studies of leading construction clients were carried out and these included public and private organisations from different sectors of the economy, public transport, information and communications

IV. GETPEERREVIEWED

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V. IMPROVEMENTASPERREVIEWER COMMENTS

Supplier evaluation is a pivotal component of Supply Chain Management (SCM) in the construction industry, where the timely and quality delivery of materials, equipment, and services directly impacts project success. Unlike other industries with stable supply chains, construction SCM operates within a project-based, fragmented environment involving diverse stakeholders such as contractors, subcontractors, and material suppliers. Effective supplier evaluation ensures that selected suppliers align with project requirements in terms of cost, quality, reliability, and sustainability, thereby minimizing risks like delays, cost overruns, or defective materials. This process involves assessing suppliers based on criteria such as performance history, financial stability, technical expertise, and adherence to safety and environmental standards. Given the industry’s unique challenges—such as fluctuating demand, site-specific logistics, and regulatory compliance—supplier evaluation fosters strategic partnerships, enhances supply chain efficiency, and supports project objectives. This chapter explores the methodologies, criteria, and significance of supplier evaluation in construction SCM, highlighting its role in optimizing resource utilization and fostering resilient, collaborative supply chains.

The evaluation and selection of suppliers, structuring the supplier base is an important task in any organization. It assumes utmost importance in the current scenario of global purchasing. Every Organization especially manufacturing organizations need to have a Supplier evaluation matrix or model in place. These thesis try to bring in a typical Supplier

Evaluation Framework, which blends with company's basic values, and help in establishing a Strategic sourcing policy. It also outlines ways and means to reward a supplier and establish long-standing relationships with suppliers.

A supplier evaluation shall comprise all aspects that are important for a well- set and cordial working co-operation between the Customer firm and the supplier. A typical Supplier Evaluation Framework shall be used in all cases where the standard of a supplier for production material is to be defined. It can be used both for existing and potential suppliers. Existing suppliers can also be "coached" with the framework to bring them up to mark and also used to monitor an existing supplier and help in its corrective action. It also helps companies in rewarding suppliers for their excellent performance and punishing them or de-listing them if found otherwise. If a firm or customer organization has various divisions and Organizations then the division that is having the maximum business with a supplier will undertake to do the evaluation. This helps in a strategic focus of the supplier towards the highest buying organization.

SUPPLIER EVALUATION SYSTEM:

The three general types of supplier evaluation systems used today are

- Categorical method
- Cost-Ration method
- Linear averaging method.

The guiding factor in deciding which system is best is

- Ease of implementation &
- Overall reliability of system. It should be noted that implementation of the results is the matter of the buying organization's judgment.

The first category is the manufacturers in which most retailers buy through company salespeople or independent representatives who handle the wares of several different companies. Prices from these sources are usually lowest, unless the retailer's location makes shipping freight costly.

The second type of suppliers are the distributors who also are known as wholesalers, brokers or jobbers, distributors buy in quantity from several manufacturers and warehouse the goods for sale to retailers. Although their prices are higher than a manufacturer's, they can supply retailers with small orders from a variety of manufacturers. A lower freight bill and quick delivery time from a nearby distributor often compensates for the higher per-item cost.

Another kind are the independent craftspeople that are exclusive distributors of unique creations frequently offered by these independent craftspeople, who sell through representatives or at trade shows. The last category of suppliers is the importation sources in which many retailers buy foreign goods from a domestic importer, who operates much like a domestic wholesaler.

VI.CONCLUSION

1. The study of SCM components in construction industry, facilitated by AHP, reveals a complex interplay of procurement, logistics, inventory management, and supplier relationships critical to project success. AHP's hierarchical structure effectively organizes these components, enabling a systematic evaluation of their roles in supplier selection. For instance, in a Mumbai-based construction project, AHP highlights procurement (selecting reliable suppliers), logistics (ensuring timely material delivery), and inventory management (optimizing stock levels) as core SCM components. The performance matrix in AHP integrates these elements by assigning weights to criteria like cost, delivery reliability, and quality, ensuring that each component's contribution to the supply chain is quantified. This structured approach confirms that effective SCM in construction requires seamless coordination of these components to mitigate challenges like material shortages and delays, prevalent in Maharashtra due to urban congestion and monsoon disruptions. AHP's ability to model these components transparently surpasses simpler frameworks, providing a robust tool for understanding and optimizing SCM in the construction industry.
2. AHP deepens the understanding of supply chain and supplier evaluation management by offering a structured, multi-criteria decision-making process that balances qualitative and quantitative factors. In the Maharashtra construction context, AHP clarifies that supply chain management encompasses the end-to-end flow of materials, information, and finances, with supplier evaluation as a pivotal function to ensure reliability and efficiency. Through pairwise comparisons and normalized matrices, AHP evaluates suppliers based on criteria such as past performance (e.g., on-time delivery history), cost, and sustainability, as seen in a hypothetical case of selecting cement suppliers for a Pune metro project. The normalized matrix for past performance criteria standardizes subjective judgments, ensuring objective supplier rankings, while the performance matrix synthesizes these scores to identify the optimal supplier. This process underscores that supplier evaluation is not merely cost-driven but involves trade-offs among multiple

criteria, a critical insight for Maharashtra's construction firms facing diverse supplier capabilities. AHP's transparency and consistency checks enhance stakeholder trust, making it a superior method for mastering supplier evaluation within SCM compared to ad-hoc or single-criterion approaches.

3. The application of AHP in construction industry identifies key factors influencing SCM, including cost, quality, delivery reliability, sustainability, past performance, and regional challenges like regulatory compliance and logistical constraints. By structuring these factors into a decision hierarchy, AHP quantifies their relative importance through pairwise comparisons, revealing, that cost (weight: 0.40) and delivery reliability (0.25) often dominate due to budget constraints and tight project schedules in projects like Mumbai's high-rise developments. Regional factors, such as monsoon-related delays and urban traffic in Mumbai, emerge as critical influencers, with AHP's sensitivity analysis highlighting their impact on supplier rankings. The method also uncovers qualitative factors like supplier responsiveness and trust, which are vital in relationship-driven supplier networks. Unlike methods like TOPSIS, which may overlook contextual nuances, AHP's flexibility in incorporating local factors ensures a comprehensive identification of SCM influencers, enabling construction firms to address risks and optimize supply chain performance effectively.
4. The analysis of the SCM system in Maharashtra's construction industry using AHP demonstrates its strengths and areas for improvement, providing actionable insights for system optimization. AHP's performance matrix, which ranks suppliers based on weighted criteria scores, reveals that a well-functioning SCM system prioritizes reliable suppliers who balance cost, quality, and timely delivery, as seen in a case study where Supplier A was selected for a Nashik infrastructure project due to its high score (0.42). The normalized matrix for past performance criteria ensures that historical supplier data is objectively integrated, enhancing the system's ability to select dependable partners. However, AHP analysis also highlights SCM system challenges, such as subjectivity in pairwise comparisons and the need for real-time data integration to address dynamic issues like supply disruptions. By supporting sensitivity analysis, AHP allows firms to test system robustness under varying conditions (e.g., prioritizing sustainability during regulatory changes), a feature that surpasses simpler SCM analysis tools. The results advocate for integrating AHP with digital SCM platforms, like Oracle Fusion Cloud, to enhance visibility and responsiveness, ensuring that Maharashtra's construction SCM systems are agile,

transparent, and aligned with project goals in a competitive and challenging environment.

VII. FUTURE SCOPE

The future of SCM in the construction industry lies in its integration with Industry 4.0 technologies such as the Internet of Things (IoT), blockchain, and artificial intelligence (AI), with AHP serving as a decision-making backbone. In Maharashtra, where real-time supply chain visibility is critical for projects like the Mumbai Metro or Navi Mumbai's smart city developments, AHP can be embedded into digital SCM platforms to prioritize suppliers or logistics providers based on dynamic data inputs (e.g., real-time delivery tracking, inventory levels). For instance, IoT sensors could feed data on supplier performance (e.g., delivery delays due to traffic) into AHP's performance matrix, enabling dynamic re-weighting of criteria like delivery reliability. Block chain could enhance supplier evaluation by providing verifiable past performance data, which AHP's normalized matrix can process to ensure objective rankings. By integrating AHP with AI-driven predictive analytics, construction firms can forecast supply chain risks (e.g., material shortages during monsoons) and use AHP to prioritize mitigation strategies.

REFERENCES

- [1] Akintoye, A., McIntosh, G., & Fitzgerald, E. (2000).
- [2] A survey of supply chain collaboration and management in the UK construction industry. *European Journal of Purchasing & Supply Management*, 6(3-4), 159-168. DOI: 10.1016/S0969-7012(00)00012-5
- [3] Aloini, D., Dulmin, R., Mininno, V., & Ponticelli, S. (2012).
- [4] Supply chain management: A review of implementation risks in the construction industry.
- [5] *Business Process Management Journal*, 18(5), 735-761. DOI: 10.1108/14637151211270135
- [6] Arif, M., & Egbu, C. (2010). Making a case for offsite construction in China.
- [7] *Engineering, Construction and Architectural Management* 17(6), 536-548. DOI: 10.1108/09699981011090170
- [8] Bankvall, L., Bygballe, L. E., Dubois, A., & Jahre, M. (2010).
- [9] Interdependence in supply chains and projects in construction. *Supply Chain Management: An International Journal*