Review of Demand Forecasting and Shipping in Construction Supply Chain using Mobile Application

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# ABSTRACT

Construction Supply Chain Management (SCM) is essential for driving organizational efficiency and competitiveness. Accurate demand forecasting and efficient shipping are fundamental to a responsive supply chain, yet both face challenges such as demand variability, logistical complexities, and timely delivery requirements. This project explores the use of AI-driven predictive analytics to improve demand forecasting and shipping within construction SCM. By identifying key factors—including supplier reliability, lead times, defect rates, and operational flexibility—the study offers a comprehensive view of the dynamics impacting SCM efficiency. Using Six Sigma and Structural Equation Modeling (SEM) methodologies, this research systematically assesses the role of critical SCM variables. The Six Sigma DMAIC (Define, Measure, Analyze, Improve, Control) framework provides a structured approach to identifying key variables and reducing inefficiencies, while SEM enables insight into relationships among these factors. Findings from this study illustrate how predictive analytics, enhanced by AI and IoT technologies, can elevate forecasting accuracy and logistics efficiency. The project ultimately seeks to support a resilient, adaptable, and optimized SCM framework to meet the evolving demands of the construction industry.

**Keywords:** Supply Chain Management (SCM), Structural Equation Modelling (SEM), Logistics Optimization, Supplier Reliability, Operational Flexibility.

## INTRODUCTION

This overview explores the growing influence of digital technologies in transforming construction and supply chain management practices. Tools like BIM, RFID, IoT, blockchain, and 3D visualization are being applied to improve project efficiency, communication and sustainability. Studies across infrastructure, renewable energy and industrialized construction highlight how these technologies enhance performance and decision-making. Key advancements include real-time monitoring, automation and data-driven planning. Despite the advantages, barriers like high implementation costs and limited technical skills stay. The shift toward greener, smarter construction also underscores the importance of secure data management. Collectively, the research illustrates a clear movement toward integrated and future-ready construction systems.

## LITERATURE REVIEW

**Mehmood et al.** explore how effective Supply Chain Management (SCM) practices impacts transport infrastructure projects' success. Their study emphasizes that Building Information Modelling (BIM) and environmental considerations are vital moderating factors that enhance SCM’s effectiveness. The authors use Partial Least Squares Structural Equation Modelling (PLS-SEM) to analyse how these moderating factors affect SCM outcomes, finding that projects integrating BIM and environmental practices see improved performance and sustainability. Mehmood et al. conclude that adopting these strategies enables SCM in infrastructure projects to be more resilient and responsive to environmental demands, benefiting both project outcomes and sustainable practices

**Masoomi and Zhang** introduce a Neutrosophic Enhanced Best-Worst Method (NE- BWM) to evaluate performance indicators within renewable energy supply chains. Their study addresses the complexity and uncertainty in assessing supply chain performance for renewable energy, a sector that relies heavily on consistent energy quality and robust information-sharing practices. The NE-BWM approach developed by the authors allows for confidence-weighted decision-making, which is critical in renewable energy SCM, where factors such as supply chain cost and collaboration can fluctuate. This model highlights the importance of adaptable decision- making tools in managing renewable energy supply chain complexities

**Daget et al.** examine how collaborative relationships among stakeholders affect design- construction efficiency (DCE) in industrialized construction. They utilize Social Network Analysis (SNA) to quantify the strength and impact of relationships among project stakeholders, such as contractors, designers, and manufacturers. The findings reveal that projects with stronger collaborative networks demonstrate improved efficiency and fewer delays, highlighting the value of structured communication and teamwork. The authors suggest that fostering collaborative relationships from the project’s outset can mitigate traditional inefficiencies in construction, making industrialized construction projects more streamlined and effective

**Karanam, S.,** their study, Karanam and Kumar identify and categorize critical enablers for managing perishable food supply chains, including factors such as cold storage, real-time monitoring, and efficient inventory management. Using deterministic

assessment models, they highlight the importance of technological solutions like RFID

and inventory control systems in reducing food spoilage and ensuring product quality. Their research underscores that effective SCM in perishable goods logistics hinges on fast, precise, and reliable tracking systems to maintain the integrity of perishable items from supplier to consumer **Succar, B.,** propose the Lifecycle Information Transformation and Exchange (LITE) framework, designed to enhance the management of digital and physical assets in construction. Their model supports a seamless flow of information across asset lifecycles, from design to operation, facilitated by tools like BIM and smart contracts. The authors argue that the LITE

framework bridges gaps in information exchange, allowing for efficient data transformation throughout a project’s lifecycle. They emphasize that digital transformation in construction requires not only technology adoption but also a structured approach to managing information for coordinated asset management

**Zhang et al.** analyze quality management in smart construction sites, using a hybrid approach involving DEMATEL, Interpretive Structural Modeling (ISM), and MICMAC. They identify and rank factors influencing quality management, including automation, regulatory compliance, and workforce training. The study finds that automation and standardization are primary drivers of quality management effectiveness in smart construction environments. Zhang et al. conclude that implementing advanced quality management practices and regulatory protocols is essential to achieving higher efficiency and minimizing risks in technologically advanced construction projects

**Zhang, Tang:** Focus on identifying key performance indicators (KPIs) for evaluating green supply chains, utilizing a hybrid model of DEMATEL and the Analytic Network Process (ANP). Their study identifies core KPIs such as environmental impact, service satisfaction, and market share, emphasizing that sustainability practices are increasingly crucial in supply chain evaluation. The authors argue that integrating green practices within supply chain operations not only improves environmental outcomes but also enhances overall economic performance. This research highlights the importance of adopting sustainable practices to achieve a competitive advantage in modern supply chain management

**Li et al.** conduct a comprehensive scientometric analysis of risk management in prefabricated construction, identifying common risk factors such as supply chain disruptions, cost overruns, and safety hazards. The study categorizes risks into major themes, providing insights into each risk’s frequency and impact within the prefabricated construction domain. Their research suggests that an integrated risk management framework is necessary to address the multifaceted challenges associated with prefabrication, positioning scientometric analysis as a valuable tool for understanding the risk landscape in this evolving construction method

**Sharif et al.** present a framework for implementing 3D quality control in prefabrication, utilizing digital templates to enhance precision and reduce measurement inaccuracies. The framework incorporates scan-vs-BIM technology, which automates quality checks by comparing 3D scans with BIM models. The study finds that this digital approach significantly lowers rework costs and improves accuracy in prefabricated components. Sharif et al. suggest that investment in 3D quality control systems can yield cost benefits within a short time frame, encouraging prefabrication facilities to adopt such technologies for streamlined quality management

**Wang, K., Xie, H.,** explore the applications and impact of visual computing on the construction industry through a bibliometric analysis, focusing on how technologies like 3D modelling, laser scanning, and augmented reality are transforming construction workflows.

Visual computing technologies, particularly Building Information Modelling (BIM) and augmented reality, are shown to play a pivotal role in reducing errors and enhancing communication among stakeholders. The study’s findings highlight that integrating visual computing across construction phases—from design to maintenance— can significantly improve efficiency and accuracy, allowing stakeholders to identify potential issues early. The authors advocate for more research on visual computing tools to expand their usage in construction project management, emphasizing that these tools can streamline workflows and facilitate better information management across project teams

**Begić, A**. provide an overview of Construction 4.0 technologies, focusing on how these advancements integrate with Building Information Modelling (BIM) under the

framework of BIM 4.0. This systematic review addresses key Construction 4.0 technologies like IoT, robotics, and Big Data, analysing their potential benefits in real- time monitoring, automation, and data-driven decision-making. The study reveals that although the combined use of BIM and Construction 4.0 technologies can increase productivity and reduce project timelines, adoption rates are still low due to cost and integration challenges. The authors recommend that construction firms actively work to integrate these technologies in order to optimize project workflows and realize the full benefits of digitalization in construction

**Wang, L., Mao,** examine the adoption of digital technologies within off-site construction (OSC), specifically looking at tools like RFID, GPS, IoT, and artificial intelligence (AI). Through a systematic review, they analyse how these technologies enhance OSC efficiency by reducing on-site assembly time and improving precision in material handling. The study finds, however, that the high costs of these technologies, alongside a shortage of skilled labour, are significant barriers to their widespread adoption. The authors recommend that industry stakeholders focus on upskilling the workforce and developing cost-effective digital solutions to enhance the adoption rate of digital technologies in OSC, which could dramatically improve productivity and reduce overall project timelines

**Cepa et al. (2020),** investigate the role of BIM in managing the lifecycle of infrastructure projects, emphasizing its integration with IoT, GIS, and Big Data. Their review highlights how BIM facilitates data storage, retrieval, and visualization, which are essential for effective facility management and maintenance. The study finds that BIM’s application in transport infrastructure has potential benefits, such as real-time data access and cost reduction in maintenance operations, though interoperability challenges limit its efficacy. The authors suggest that overcoming these data integration issues will be crucial to fully realizing BIM’s advantages in infrastructure maintenance and quality control

**Lu et al. (2021),** explore a blockchain framework designed to protect information integrity in construction projects, combining blockchain with smart contracts and digital signature techniques. The study shows that blockchain offers a secure, tamper-proof solution for data management, addressing critical issues of data manipulation and unauthorized access. By

ensuring that information is authenticated and remains unchanged throughout the project lifecycle, this framework can improve data reliability and foster trust among project stakeholders. The authors conclude that integrating blockchain could be transformative for data security in construction, particularly when handling sensitive project information across multiple platforms

**Zhang et al. (2020),** present a WebGIS-based quality control system for the construction of roller-compacted concrete (RCC) gravity dams, utilizing IoT and real- time sensing data. This collaborative system allows project teams to monitor quality metrics continuously, identifying deviations quickly and facilitating prompt corrective actions. The study shows that WebGIS integration with IoT not only streamlines quality management but also enhances cross-functional collaboration by providing a centralized quality control dashboard. The authors highlight the importance of IoT and WebGIS in modern construction, particularly in large-scale projects where real-time data is critical for ensuring quality standards are met

**Faraji et al. (2022),** examine the potential of integrating BIM, blockchain, and LiDAR across the construction lifecycle, aiming to improve accuracy, monitoring, and project transparency. Through a bibliometric analysis, the study reveals that each technology offers unique benefits, such as BIM’s enhanced visualization, blockchain’s data security, and LiDAR’s precise spatial measurements. However, the authors note that effective integration frameworks are still lacking, and they call for future research to develop methods that facilitate seamless data exchange between these technologies. This synergy, they argue, could lead to smarter, more secure construction projects with improved lifecycle management

**Arabshahi et al. (2021),** review the adoption of sensing technologies like RFID and fiber optic sensors, which are used to enhance data collection and monitoring in construction. The study finds that while sensing technology holds significant potential for automation, barriers such as high implementation costs, stakeholder resistance, and lack of technical expertise hinder its adoption. The authors suggest that for sensing

technologies to be widely adopted, the industry must address both human and financial

obstacles. They highlight the transformative potential of these technologies in improving safety, quality control, and overall project management through real-time monitoring and data insights **Olawumi and Chan (2021),** present a Cloud-Based Sustainability Assessment (CSA)

system for evaluating the sustainability of building assets using the BSAM scheme. The CSA system automates the evaluation process, providing secure, reliable, and real-time sustainability assessments that significantly reduce reliance on manual processes. Case studies demonstrate that the CSA system facilitates informed decision- making by offering easy access to sustainability data, promoting transparency, and enabling better resource allocation. The authors suggest that the CSA system supports sustainable development practices by integrating comprehensive data analysis and sharing capabilities across stakeholders in the construction lifecycle.

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**Olawumi, Chan, et al.** explore the potential of digital technologies, specifically blockchain, simulation tools, and BIM, to transform Modular Integrated Construction (MiC) processes. Their comprehensive review uses data curation and science mapping to identify current applications and gaps in digital tool usage within MiC. The findings reveal that digital tools, although promising, are underutilized, particularly in the transportation phase of MiC, where challenges such as data loss and logistical complexities are prevalent. The study highlights blockchain’s potential for data traceability and security across MiC stages, making it easier to monitor and verify modular components. With Canada, China, and the USA at the forefront of adopting these technologies, the authors suggest that wider digital integration, facilitated by blockchain, could streamline the modular construction process, reduce errors, and increase efficiency, thus setting the stage for future MiC advancements

**Sharif, Walker et al.** investigate the use of 3D scanning and visualization techniques to enhance dimensional control in prefabrication, particularly through the accurate management of termination points. In their study, an industrial experiment employing a scan-vs-BIM approach demonstrates that 3D visualization reduces rework by providing real-time dimensional checks and identifying alignment discrepancies early in the assembly process. Their findings suggest that implementing 3D visualization in fabrication shops can minimize costly rework and improve overall precision, especially in complex assemblies where exact alignment is critical. This study advocates for standardized, visual-based methods in prefabrication to improve productivity and reduce errors, 3D dimensional control as essential for quality assurance in modern prefabrication practices.

**Munawar, Iqbal, et al.** present an insightful review on the current applications of big data in construction and its potential to reshape industry practices. They discuss big data’s applications in various areas, including safety enhancement, efficiency optimization, and predictive maintenance, highlighting its transformative role in improving project management and decision-making. However, the study identifies significant challenges, such as data storage, management complexities, privacy concerns, and implementation costs, which hinder the widespread adoption of big data. The authors emphasize that advancing data engineering and developing cost-effective storage solutions are crucial for overcoming these barriers. Their findings suggest that, with further research and refinement, big data could revolutionize construction by enabling predictive analytics, improving quality control, and supporting real-time decision-making through IoT and AI integration

**Zhou, Li et al.,** propose a Historical Building Information Modeling (HBIM)- based framework aimed at enhancing collaboration and data security in architectural heritage restoration projects. The framework integrates blockchain technology with InterPlanetary File System (IPFS) to ensure data immutability and traceability, providing a secure environment for handling sensitive restoration information. Their study, applied to a restoration project case, demonstrates

that blockchain improves data management by safeguarding against unauthorized access and data manipulation, a common challenge in collaborative heritage projects. This framework effectively addresses the limitations of traditional Common Data Environments (CDEs) by offering enhanced data security and collaboration capabilities. The authors conclude that blockchain- enabled HBIM can serve as a secure foundation for heritage preservation, facilitating trustworthy data exchange and collaboration among stakeholders

**Xia et al.,** Deng, provide an in-depth review of the integration of Building Information Modeling (BIM) and Geographic Information Systems (GIS) in developing digital twins for sustainable smart cities. Their study highlights how BIM-GIS integration enables advanced spatial analysis and real-time urban monitoring, which are essential for sustainable city planning. By conducting a bibliometric analysis, the authors identify key trends, challenges, and research gaps in the field, such as the need for standardized data models and improved computational capabilities to manage large datasets. The review emphasizes that digital twins supported by BIM and GIS can facilitate predictive analytics and enhance resource management in urban areas, enabling cities to make data-driven decisions for sustainable development. The authors advocate for increased investment in digital twin research to address these technical challenges and advance sustainable urban planning

**Sharif et al.** explores the critical role of 3D visualization in achieving dimensional control within prefabrication, focusing specifically on the use of termination points as essential reference markers for alignment. The authors designed an industrial experiment using a scan-vs- BIM approach, where they applied 3D laser scanning technology to evaluate the accuracy of prefabricated components. This method allows for a precise comparison between the scanned data and the original BIM model, ensuring that each component adheres to the designated measurements before on-site assembly.

The study emphasizes that accurate dimensional control is essential in prefabrication to avoid costly rework, delays, and misalignment issues during final assembly. Through detailed data collection and analysis, the authors demonstrate how 3D laser scanning, combined with termination point visualization, improves dimensional accuracy by providing a reliable method for pre-assembly verification. This process significantly reduces the potential for errors in complex prefabricated assemblies, making it possible to achieve higher productivity and precision in construction projects.

The findings show that using 3D visualization in prefabrication leads to more efficient workflows, as teams can identify and correct dimensional discrepancies early on. Sharif et al. advocate for the widespread adoption of 3D scanning and termination point methodologies in prefabrication processes, as these technologies not only improve dimensional accuracy but also contribute to sustainability by minimizing material waste. The study’s insights suggest that integrating 3D visualization in prefabrication workflows can optimize resource allocation, reduce project timelines, and support sustainable construction practices by ensuring that

materials are used effectively without the need for extensive on-site adjustments.

**Kim, H., et al.,** explores the use of 3D laser scanning technology for setting out building layouts to ensure alignment with design plans, thus promoting sustainable construction. By using reverse engineering (RE) principles and point cloud data, the study assesses a building's accuracy in location at the construction stage and proposes modifications based on deviations observed. The research emphasizes that setting out is critical for minimizing waste and preventing rework due to misalignment. 3D laser scanning offers high accuracy in data acquisition, making it invaluable in urban planning, real-time monitoring, and as-built documentation. By comparing the scanned layout to the original plan, the study shows how the technology prevents issues like construction delays and excess costs by allowing early-stage adjustments. This case study illustrates the need for advanced surveying tools to ensure sustainable construction practices

**Zhao et al.** leverage Building Information Modeling (BIM) technology to enhance quality control in asphalt pavement construction, focusing specifically on rutting resistance. Rutting, a common issue in asphalt pavements, is addressed by identifying key factors such as aggregate size distribution, asphalt content, and compaction methods. The BIM platform provides real-time tracking of these indicators to optimize material use and reduce rework. The study utilizes static uniaxial creep tests to evaluate rutting resistance, emphasizing the impact of temperature and material composition on pavement durability. BIM technology enables continuous quality monitoring, leading to improved decision-making and resource efficiency during construction. This study advocates for BIM’s broader application in infrastructure projects, suggesting it as an effective tool for reducing waste and ensuring long-term performance

# CONCLUSION

This chapter highlights how technologies like BIM, AI, IoT, and RFID are transforming construction and supply chain efficiency. While these tools offer real-time monitoring, better quality control, and improved collaboration, challenges like high costs and limited expertise remain. BIM plays a central role in integrating digital workflows across the project lifecycle. Sustainability and data security are also gaining importance through tools like blockchain and cloud systems. Overall, successful digital adoption depends on strategic investment, workforce readiness, and industry-wide collaboration.

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