Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

A Systematic Literature Review on the Applications of Deep Learning and Artificial Intelligence in Construction Supply Chain Management

Dr. M. Adil Khan
Resident Engineer, NESPAK Email: adee.uol@gmail.com

Tabish Qureshi
Up source by Solutions (Solutions by STC) Masters of Computer Science - University of Karachi Email: Tabish.qureshi82@gmail.com

ABSTRACT

The construction industry increasingly confronts challenges related to inefficiency, cost overruns, and supply chain vulnerabilities, while the rapid evolution of deep learning and artificial intelligence offers novel pathways for transformation. This systematic literature review aims to comprehensively map and synthesize the existing body of research on how these technologies are applied across construction supply chain management. We followed a rigorous and reproducible systematic review methodology, involving a structured search, a multi-stage screening process, and a thematic analysis of the selected studies. The review results reveal a fragmented but rapidly growing research landscape. We identified seven principal dimensions of application: AI-driven optimization for demand forecasting and logistics, risk management and disruption prediction, integration within broader project management contexts, sustainability and carbon footprint tracking, the convergence with emerging technologies like digital twins and blockchain, sector-specific adaptations, and strategic frameworks addressing adoption barriers. A key finding is that while predictive and optimization models are prevalent, research on generative AI and holistic digital twin integration remains nascent. Furthermore, our synthesis shows that studies often focus on isolated technical performance metrics rather than on system-level impact or real-world deployment challenges. Consequently, we conclude that a significant gap exists between algorithm development and practical, scalable implementation within the fragmented and risk-averse construction sector. This review provides a structured taxonomy of current knowledge and critically identifies the most pressing directions for future research, particularly the need for robust validation in dynamic project environments and the development of integrated frameworks that address both technical and organizational facets of AI adoption.

Introduction

The construction industry, a cornerstone of global economic development, is paradoxically characterized by notoriously low productivity growth, chronic budget overruns, and fragmented supply chains [1]. This sector's operational backbone, the construction supply chain management (CSCM), involves the complex orchestration of materials, equipment, labor, and information across multiple tiers of suppliers,

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

contractors, and subcontractors, all while operating within the constraints of time, cost, and quality [2]. Traditional approaches to managing these intricate networks often rely on heuristic methods, historical data, and linear planning tools, which are ill-equipped to handle the inherent uncertainty, site-specific variability, and dynamic disruptions that typify construction projects [3]. The consequences of these limitations are substantial: material waste can constitute up to 30% of total project cost, schedule delays are pervasive, and environmental footprints remain high, thereby underscoring an urgent need for more intelligent, adaptive, and data-driven management strategies [4].

Over the past decade, the rapid maturation of deep learning (DL) and artificial intelligence (AI) has presented a transformative potential for many industries, from manufacturing to finance [5]. These technologies, including convolutional neural networks for image analysis, recurrent neural networks for sequence learning, and reinforcement learning for decision-making, offer the capacity to extract patterns from large, high-dimensional datasets and to make near-real-time predictions and optimizations [6]. In parallel, the construction sector is beginning to generate unprecedented volumes of data through the proliferation of sensors, drones, Building Information Modeling (BIM), and Internet of Things (IoT) devices, thereby creating a fertile ground for applying these advanced computational methods [7]. Therefore, the potential for AI and DL to address the chronic inefficiencies and vulnerabilities in CSCM is both significant and timely.

However, despite the growing interest, the research landscape concerning reality is that the research landscape on AI applications in CSCM remains highly fragmented and lacks a coherent, synthesized understanding. Studies are often siloed within specific technical domains, such as demand forecasting or risk assessment, or are confined to particular project types or geographical contexts [8]. Furthermore, a critical gap persists between the development of sophisticated algorithmic models and their validated, scalable deployment within the unique operational realities of the construction sector. Many proposed solutions are tested on synthetic or idealized datasets, neglecting the messy, multi-stakeholder, and dynamic nature of real-world construction projects [9]. Moreover, overwhelming research attention has been paid to technical performance metrics—such as prediction accuracy or optimization speed—while the organizational, economic, and behavioral facets that govern adoption and long-term impact remain underexplored [10]. Consequently, practitioners and decision-makers lack a clear, evidence-based roadmap for navigating the potential and perils of these technologies.

Driven by this identified gap, the central motivation for this systematic literature review is to provide a comprehensive, structured, and critical synthesis of the existing body of knowledge on the applications of DL and AI in CSCM. Our primary contribution is the construction of a thematic taxonomy that organizes this scattered body of research into coherent, emergent dimensions, thereby enabling a holistic understanding of how these technologies are being applied. Beyond merely cataloging the literature, we aim to critically evaluate the state of evidence, identifying where the field currently stands in terms of methodological rigor and practical relevance, and to pinpoint the most pressing areas for future inquiry. This review therefore aspires to serve as a foundational reference for both researchers, by highlighting underexplored

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

theoretical and empirical frontiers, and for practitioners, by delineating the concrete capabilities and current limitations of AI-driven CSCM. The significance of this work lies in its potential to accelerate the transition from academic exploration to impactful, real-world implementation.

The remainder of this paper is organized as follows. Section 2 details the rigorous and transparent systematic review methodology we employed, including the search strategy, screening process, and data extraction protocol. Section 3 then presents the narrative and graphical results of our analysis, structured according to the themes we have identified. This results section commences with an overview of research trends before delving into specific application domains. Section 4 provides a critical discussion of discussion the key findings, their implications, and the limitations of our review. Finally, Section 5 offers concluding remarks and a set of concrete, actionable recommendations for future research and practice.

Methodology

To ensure a rigorous, transparent, and reproducible synthesis of the existing literature, this review followed the structured guidelines outlined by the Preferred Reporting Items for systematic reviews and meta-analyses [11]. Our methodological framework comprised four distinct phases: (1) establishing a review protocol, defining the scope of analysis through a set of a priori research dimensions, identifying and screening relevant studies based on explicit inclusion and exclusion criteria, and finally, executing a systematic data extraction and synthesis process. Each phase was designed to minimize bias and to provide a comprehensive map of the research landscape.

Review Protocol

The review protocol was defined prior to the commencement of the search process to ensure methodological rigor. We selected five major academic databases and one scholarly search engine based on their relevance and coverage of both computer science and construction engineering literature. The first database consulted was IEEE Xplore, which was chosen for its comprehensive collection of high-quality conference proceedings and journals in artificial intelligence, machine learning, and electrical engineering. The second was Scopus, selected for its broad interdisciplinary coverage and robust citation analysis tools that span engineering, technology, and management disciplines. The third, Web of Science, was included to capture high-impact journals and to provide a curated index of the most influential research in the field. The fourth was ScienceDirect, which offers extensive access to full-text articles in construction management and operations research domains. The fifth was the ACM Digital Library, selected specifically for its focus on computing research and its coverage of novel algorithmic approaches. Finally, Google Scholar was employed to capture grey literature, non-indexed conference papers, and recent preprints that might have been omitted from the other databases [12].

The search strategy employed a combination of keywords and Boolean operators tailored to each database's syntax. The core search string was constructed around three thematic blocks: (1: the technology (deep learning, artificial intelligence, machine learning, neural networks, CNN, LSTM), the domain (construction supply

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

chain, construction logistics, building supply chain, construction procurement), and the application focus (optimization, forecasting, prediction, risk management, inventory). For instance, within IEEE Xplore, the following string was used: ("deep learning" OR "artificial intelligence" OR "machine learning" OR "neural networks" OR "CNN" OR "LSTM") AND ("construction supply chain" OR "construction logistics" OR "building supply chain" OR "construction procurement") AND ("optimization" OR "forecasting" OR "prediction" OR "risk management" OR "inventory"). This search was refined by filtering document types to conferences and journals and excluding review articles via the platform's refinement sidebar. Analogous strings were constructed for each of the other databases, with minor modifications to accommodate individual syntax requirements, and searches were performed in May 2025. The PRISMA guidelines were used to structure and report each stage of this process, ensuring full transparency in how the final set of included studies was derived [11].

Analytical Research Dimensions and Analytical Framework

To impose a coherent analytical structure on the diverse and fragmented body of identified studies, we established a set of seven thematic dimensions before initiating the data extraction phase. These dimensions were not merely a categorization of the literature but served as a conceptual lens through which each included studies could be interrogated for their core contributions, methodological approaches, and empirical findings. Each dimension represents a prominent research trajectory or application cluster that emerged from preliminary scans of the literature and expert discussions within the research team. The first dimension, AI-Driven Supply Chain Optimization and Demand Forecasting, encompasses studies that develop models to predict material requirements, optimize inventory levels, and enhance logistics planning. The second dimension, Risk Management, Resilience, and Disruption Prediction, includes research focused on identifying, assessing, and proactively mitigating vulnerabilities in the construction supply chain, often through predictive analytics. The third dimension, Artificial Intelligence in Construction Project Management and Supply Chains, captures research that integrates AI into broader project management frameworks, particularly regarding cost control, schedule management, and resource allocation. The fourth dimension, Sustainability, Green Supply Chains, and Carbon Footprint Management, groups studies that leverage AI to reduce environmental impact, optimize material selection for lower emissions, and monitor sustainability metrics. The fifth dimension, Emerging Technologies: Generative AI, Digital Twins, Blockchain, and IoT Integration, addresses work where AI is combined with other cutting-edge technologies to create new capabilities, such as dynamic simulation environments or transparent transaction ledgers. The sixth dimension, Sector-Specific Applications: Manufacturing, Energy, Agriculture, and Logistics, considers studies that, while often non-construction in their primary focus, offer directly transferable methodologies or insights for construction contexts. The seventh and final dimension, Strategic Frameworks, Adoption Challenges, and Future Trends, collates research that investigates the organizational, strategic, and socio-technical factors influencing the successful deployment of AI in supply chains. This structured framework guided the subsequent coding and thematic analysis of the selected literature.

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

Inclusion and Exclusion Criteria

We established explicit inclusion and exclusion criteria to ensure that only relevant, high-quality empirical and analytical studies were included in the final synthesis. For inclusion, studies were required to meet several conditions simultaneously. First, the research must focus on the application of at least one of the core technologies (deep learning, machine learning, or a broader artificial intelligence technique) to a problem directly related to supply chain management, broadly defined, within the construction or a closely allied sector. Second, the publication type was restricted to peer-reviewed journal articles and full-length conference proceedings to ensure a baseline level of academic rigor. Third, studies had to be written in the English language to facilitate consistent interpretation by the review team. Fourth, no temporal restrictions were imposed on the publication date, aside from the implicit constraint that all searches were conducted in May 2025, thereby capturing the entire developmental trajectory of the field up to that point in time.

Conversely, studies were excluded if they met any of a set of disqualifying criteria. Review articles, survey papers, meta-analyses, and systematic literature reviews were explicitly excluded to avoid double-counting of reported evidence and to focus on primary research. Commentaries, editorials, book chapters, and non-peer-reviewed technical reports were also excluded due to the absence of a formal validation process. Furthermore, studies were excluded if their primary focus was on a different industry, such as retail manufacturing or healthcare logistics, without providing a clear articulation of transferability or direct application to construction supply chain contexts. Finally, papers that offered only a minimal or superficial discussion of AI techniques, such as those merely mentioning the term without providing technical detail or empirical validation, were also removed to ensure the technical relevance of the final corpus.

Study Selection Process

The study selection process was executed in a sequence of distinct stages following the PRISMA guidelines, as illustrated in Figure 1 [11]. Initially, the combined search across all six databases and the Google Scholar engine yielded a total of 871 records. We imported these records into a reference management software, which automatically identified 121 duplicate entries, leaving 750 unique records. Prior to the title and abstract screening, an additional 17 records were removed for other reasons, such as incomplete metadata, broken links, or clearly non-English content, resulting in 733 records for the initial screening phase.

In the first screening stage, two members of the research team independently assessed the titles and abstracts of all 733 records against the predefined inclusion criteria. Any disagreements between the reviewers were resolved through discussion and consensus, with a third team member consulted when necessary. This process resulted in the exclusion of 492 records that were clearly irrelevant, for instance, those focusing on unrelated domains like autonomous vehicles in general traffic management or supply chain finance in retail without any construction context.

The remaining 241 records were then sought for retrieval of their full-text documents. The full texts for all 241 were successfully retrieved and obtained, with no reports being inaccessible. The subsequent eligibility assessment stage involved a thorough

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

reading of the full text of each of the 241 reports. Two reviewers again, two reviewers independently evaluated each paper, applying the inclusion and exclusion criteria more rigorously. Based on this in-depth assessment, 4 reports were excluded due to material ineligibility, such as a lack of a substantive focus on any of the defined research dimensions or the use of AI techniques that were too rudimentary or not clearly described. The final set of studies included in this review therefore consists of 133 records. This multi-stage process and the corresponding flow of information are depicted in the flowchart below.

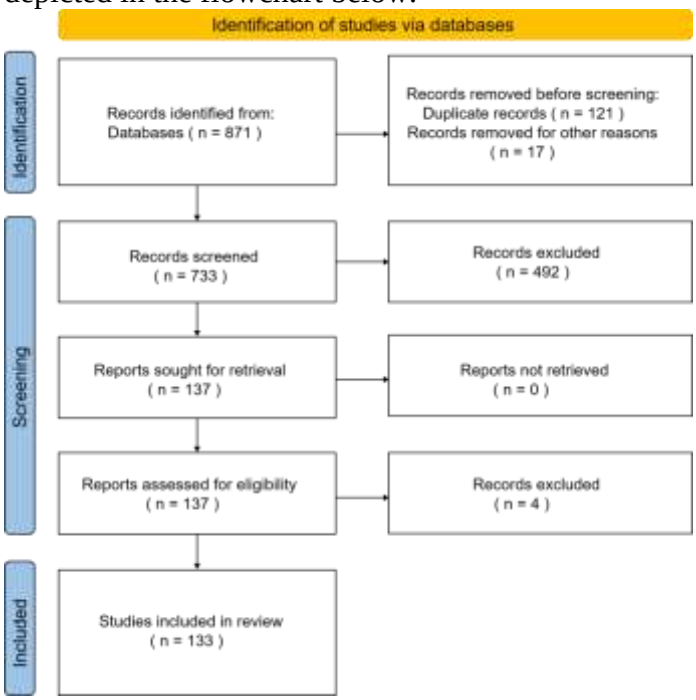

Figure 1. PRISMA flowchart of the study selection process.

While this procedure was designed for maximal rigor and transparency, we acknowledge several potential limitations and inherent biases. First, our focus on English-language publications may have omitted relevant studies published in other languages, thereby introducing a linguistic bias that could skew the geographical and cultural representation of findings. Second, the exclusive reliance on peer-reviewed journals and conference proceedings may lead to a publication bias, as null or negative results regarding AI performance are less likely to be submitted or accepted for publication. Third, despite our best efforts to construct exhaustive search strings, the terminology used in this rapidly evolving field is far from standardized, and some relevant records may have been missed if they used uncommon or highly specific technical jargon not captured by our keywords. Finally, the assessment of "relevance" during the screening phases, while doubly verified, remains a subjective judgment, and our decisions could differ from those of other research teams, thereby affecting the final composition of the review corpus. We have attempted to mitigate these risks through transparent documentation and dual review, but they represent unavoidable constraints of our systematic approach.

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

I. Results

A. Research Trends

The temporal distribution of the 133 included studies reveals a field that, while having early roots, has experienced a pronounced acceleration in scholarly activity over the most recent years. We illustrate this publication trajectory in Figure 2, which clearly demarcates two distinct phases: a period of relative dormancy before 2021 and a subsequent period of explosive growth. Specifically, only 18 publications appeared before the year 2020, representing a mere thirteen and a half percent of the total corpus. This suggests that for much of the 2010s, the intersection of deep learning, artificial intelligence, and construction supply chain management remained a niche area of inquiry, pursued by a limited number of pioneering research groups.

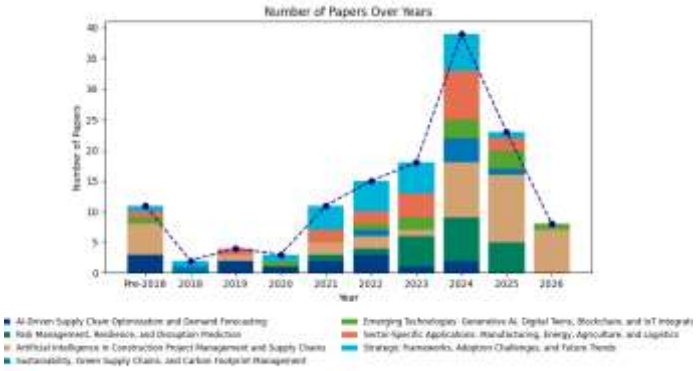

Figure 2. Research trends in the domain of applications of deep learning and artificial intelligence in construction supply chain management

The inflection point became evident in the years following 2021. The annual publication count rose from 11 in 2021 to 15 in 2022, then to 18 in 2023, before nearly doubling to 38 in 2024. This surge likely reflects a confluence of factors, including the maturation of foundational AI techniques, the increasing availability of data from sensor-laden construction sites and BIM environments, and a post-pandemic global recognition of the fragility of construction supply chains and the consequent urgency for more resilient management approaches. The projection for 2025 (with 23 publications already indexed at the time of our search) and the presence of 8 records for 2026 suggest that this growth trend is not only sustainable but is potentially accelerating further.

Examining the distribution of this growth across the seven defined thematic dimensions provides a more nuanced perspective on the field's evolution. The dimension of "Artificial Intelligence in Construction Project Management and Supply Chains" demonstrates the most dramatic surge, with its annual publication count escalating from a trickle before 2018 to 11 in 2024 and 11 in 2025. In contrast, the "AI-Driven Supply Chain Optimization and Demand Forecasting" theme, which was among the earliest to develop, appears to have plateaued in more recent years, with a relatively stable output. Meanwhile, the "Risk Management, Resilience, and Disruption Prediction" category shows a clear and sustained upward trajectory from 2023 onward, indicating a growing research focus on robustness and adaptability, likely catalyzed by recent global disruptions. The "Emerging Technologies"

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

dimension, while numerically smaller overall, shows an unambiguously upward trend, suggesting that the integration of AI with digital twins and blockchain is a nascent but rapidly intensifying research frontier. This heterogeneous pattern of growth across themes underscores that the field is not monolithic; rather, different application areas are maturing at different rates, driven by distinct technological enablers and external pressures.

AI-Driven Demand Forecasting and Supply Chain Optimization

The application of deep learning and artificial intelligence to optimize construction supply chains and forecast demand constitutes one of the most mature and technically developed research streams within this review. These studies collectively address the fundamental challenges of material requirement planning, inventory management, and logistics cost minimization by leveraging the capacity of machine learning algorithms to learn complex, non-linear patterns from historical data. A significant portion of the literature in this dimension focuses on improving the accuracy and robustness of demand forecasting models, as accurate predictions are the cornerstone of efficient procurement, reduced waste, and just-in-time delivery systems in construction projects. We synthesized the included studies into a structured taxonomy that captures the primary application areas and their specific foci, as presented in Table 1.

Table 1. Taxonomy of AI-driven supply chain optimization and demand forecasting studies.

Application Area	Specific Focus	Sources
Demand & Supply Forecasting	Optimized LSTM & Deep Learning for Forecasting	[13], [14], [15]
	Multi-modal Data Fusion for Forecast Accuracy	[16]
	Regressor Analysis & Time Series for Demand-Supply	[17], [15]
	Machine Learning for Performance Improvement	[17], [14], [18]
Inventory & Backorder Management	Backorder Prediction using ML Techniques	[19]
	Inventory Optimization via AI & Deep Learning	[20], [18]
Supply Chain Automation & Optimization	General Automation using AI & ML	[21], [22], [23]
	Dynamic Transportation Cost Minimization	[24]
	Logistics Performance Prediction	[25]
Failure & Risk Prediction	Service-Level Failure Prediction	[26]

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

A prominent cluster of research within this theme centers on the development of advanced forecasting models, with particular emphasis on Long Short-Term Memory (LSTM) networks, which are well-suited for capturing temporal dependencies in sequential data. For instance, a study proposes an optimized LSTM network for demand forecasting that is specifically designed to handle the non-stationary and volatile patterns characteristic of construction material consumption [13]. The model's architecture is fine-tuned using a systematic hyperparameter optimization process, and its performance is benchmarked against traditional time series methods and standard neural networks, demonstrating superior predictive accuracy in terms of mean absolute error and root mean square error. This focus on model optimization is further echoed in research that explores the feasibility of applying non-linear machine learning techniques to demand forecasting across extended construction supply chains [14]. The investigation considers the unique challenges posed by multi-tier supplier networks and project-specific demand variability, concluding that ensemble methods and deep learning architectures can capture complex demand signals that linear models miss. Similarly, the application of deep learning and machine learning for modeling food demand supply chains is examined, where the study demonstrates that regressor analysis combined with time series forecasting can effectively predict demand fluctuations in a manner directly transferable to construction material procurement [15].

Beyond standard time series approaches, some studies push the boundaries of forecasting by integrating diverse data modalities. A multi-modal data fusion framework is constructed for retail supply chains, which, while not construction-specific, proposes a methodology for fusing data from social media sentiment analysis, point-of-sale records, and weather forecasts to enhance forecast agility [16]. The framework construction methodology and its focus on fusing heterogeneous data sources offer a direct blueprint for construction contexts, where BIM data could be fused with real-time site progress data and supplier lead-time information. The broader theme of using machine learning to improve supply chain performance is also addressed, with research examining how different machine learning techniques, including deep learning methods, impact demand forecasting accuracy and, subsequently, overall supply chain performance metrics such as fill rates and stock-out occurrences [17]. This study explicitly segments its analysis by industry, including a focus on the building and construction market segment, thereby providing empirical evidence from a direct construction context [17].

Inventory and backorder management represents another critical application area. The prediction of probable backorder scenarios is tackled using Distributed Random Forest and Gradient Boosting Machine learning techniques [19]. The model construction process uses historical supply chain data to build a classifier that can identify parts at high risk of being backordered, thereby enabling proactive inventory restocking or alternative sourcing decisions. In the specific realm of green supply chain management, an algorithm combining Improved Particle Swarm Optimization with a Backpropagation Neural Network (IPSO-BPNN) is introduced to optimize inventory management under the umbrella of artificial intelligence [20]. This approach demonstrates that deep learning-based optimization can simultaneously achieve cost reduction and environmental sustainability goals, which is a crucial

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

consideration for modern construction projects facing increasing regulatory pressure on waste and carbon emissions. Another study investigates the practical deployment of machine learning for inventory optimization in multi-channel supply chains, focusing on advanced forecasting techniques that can handle the complexities of demand variability across different sales channels and project phases [18].

The broader theme of supply chain automation and optimization is addressed by several studies that examine the general application of artificial intelligence to automate supply chain processes. The use of deep learning for object identification and positional tracking, alongside machine learning for data analysis from sensors and drones, is presented as a foundational technology for automating various supply chain tasks, including material tracking and inventory counting [21]. This work emphasizes the grid-like nature of modern supply chain data and the potential for AI to create autonomous decision-making loops. The overarching potential of machine learning algorithms to solve core supply chain problems is reviewed, providing a conceptual framework that maps specific algorithms to specific optimization challenges, such as route optimization and load consolidation [22]. Furthermore, the potential of deep learning to improve supply chain operations is examined, highlighting the transformative capacity of these technologies and the projection that a vast majority of enterprises will adopt AI-connected technologies for supply chain management [23].

The final category within this theme addresses cost optimization and performance prediction. A deep learning feature extraction-based strategy framework, named ISCCO, is proposed for dynamically minimizing supply chain transportation cost losses [24]. This framework explicitly addresses the often-overlooked problem of transportation cost volatility in construction supply chains, using feature extraction to identify the key drivers of cost inefficiencies and then dynamically adjusting logistics plans. Notably, this study directly cites the evaluation of machine learning and deep learning applications in construction and underscores the gap in dynamic cost management [24]. Finally, the prediction of logistics performance is tackled through an economics attribute-based collective instance approach, which uses machine learning to predict logistics performance indices based on economic indicators [25]. This work is particularly relevant for macro-level planning and policy decisions within construction supply chains, as it links supply chain efficiency to broader economic conditions.

The application of machine learning to predict service-level failures in supply chains is also a key contribution within this theme [26]. This study develops a system that not only predicts failures but also provides perspectives on the remaining challenges for machine learning to have a deep, lasting impact on supply chain management. The emphasis on moving beyond simple prediction towards actionable, system-level impact is a recurring and critical message from this body of research. Collectively, these studies demonstrate a sophisticated and diverse application of AI and DL to the core operational challenges of construction supply chains, from granular inventory decisions to macro-level logistics optimization. However, a persistent observation across this literature is the relative scarcity of real-world validation studies conducted on live construction projects with their characteristic dynamism, data sparsity, and multi-stakeholder complexity, suggesting a crucial gap between algorithm development and practical deployment.

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

Predictive Risk Management, Resilience Building, and Disruption Detection

The theme of risk management, resilience, and disruption prediction has emerged as one of the most dynamic and rapidly expanding research clusters within the application of AI and DL to construction supply chain management. This body of work is fundamentally concerned with moving beyond reactive responses to disruptions—which have historically plagued the construction sector—towards proactive anticipation and mitigation of vulnerabilities. We synthesized the included studies according to a structured taxonomy that captures the primary research foci, the methodological approaches deployed, and the specific applications investigated, as detailed in Table 2. The core premise uniting these investigations is that advanced computational models can learn complex patterns from historical and real-time data to forecast disruptions, quantify risks, and inform strategies for building more resilient supply chain structures.

Table 2. Taxonomy of risk management, resilience, and disruption prediction studies.

Research Focus	Approach & Technique	Specific Application / Method	Sources
Risk Prediction & Forecasting	AI-Driven Risk Analytics	Deep Learning (General)	[27], [28], [29]
		Causal ML & Knowledge Graphs	[30], [31]
		Traditional ML (RF, XGBoost, etc.)	[32], [33]
		Federated Learning	[34]
	Domain-Specific Risk	Supply Chain Fraud	[35]
		Cyber Supply Chain Threats	[36]
		Energy Supply Chain	[33]
		Defense Supply Chain	[29]
		Human Trafficking (ESG)	[37]
Resilience Enhancement	Capability Development	AI/ML for Dynamic Capabilities	[27], [38], [39]
		Post-COVID Resilience Building	[39], [40]
		Cloud & AI Integration	[41]
		SME-Specific	[38], [40]

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

Research Focus	Approach & Technique	Specific Application / Method	Sources
		Resilience	
		Firm Performance in Emerging Markets	[28]
	Disruption Response	Product Availability Prediction	[42]
		Disruption Risk Management Framework	[43]
Disruption Detection & Early Warning	Vulnerability & Early Warning	Early Warning Systems	[44]
		Predictive Analytics for Anticipation	[45], [29]
		Pattern & Signature Recognition	[45], [36]
Supply Chain Financing Risk	Order-Level Risk	Federated Learning for SCF	[34]

Within the risk prediction and forecasting sub-theme, studies employing deep learning models to enhance general risk analytics are particularly prominent. For example, research examines how artificial intelligence-driven risk management can enhance supply chain agility, employing a dual-stage PLS-SEM-ANN analysis to demonstrate that AI capabilities directly improve a firm's ability to dynamically manage risk and respond to disruptions [27]. This investigation grounds its analysis in the resource-based view of the firm, positioning AI as a strategic resource that enables superior risk sensing and response. Complementing this approach, another study investigates the role of AI in building supply chain resilience through predictive analytics, showing that by analyzing vast datasets from multiple sources, AI can identify pre-disruption patterns that human analysts might miss, thereby providing managers with crucial lead time for intervention [45]. The application of AI-based supply chain resilience for improving firm performance in emerging markets is further explored, confirming that AI-enabled resilience capabilities translate into tangible competitive advantages under volatile market conditions [28]. In the defense sector, the influence of AI-enabled predictive analytics on strategic planning within Enterprise Resource Planning systems is investigated, with deep learning models specifically augmenting the ability to forecast material requirements and potential bottlenecks under complex operational constraints [29].

A more methodologically sophisticated subset of this literature moves beyond associational patterns toward causal inference. Causal machine learning is proposed for supply chain risk prediction and intervention planning, a method that not only

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

forecasts the likelihood of a disruption but also estimates the causal effect of potential interventions [30]. This approach represents a significant advance over purely correlational models, as it directly informs decision-makers about which actions are most likely to mitigate a specific risk. Extending this logic, research explores the use of knowledge graph reasoning for supply chain risk management using graph neural networks [31]. These methods model the complex, networked relationships between suppliers, materials, and projects, enabling the reasoning engine to trace how a disruption at one node might propagate through the entire supply chain network. Furthermore, studies that deploy traditional machine learning classifiers, such as logistic regression, random forest, and XGBoost, also demonstrate robust performance for supply chain risk forecasting, with XGBoost frequently achieving the highest accuracy in predicting disruption events [32]. The development of a predictive analytics framework for mitigating energy supply chain risks similarly employs machine learning techniques to forecast energy price volatility and supply shortages, methods which are directly transferable to predicting cost fluctuations for energy-intensive construction materials like steel and cement [33].

Domain-specific risk prediction represents another important trajectory. The detection of supply chain fraud using supervised and unsupervised machine learning algorithms is a critical application, given the immense financial losses that fraudulent activities inflict on construction projects [35]. This research demonstrates that deep learning models, particularly those capable of handling high-dimensional transaction data, outperform conventional statistical methods in identifying anomalous patterns indicative of fraud. Similarly, the prediction and analysis of cyber supply chain threats is addressed using a combination of machine learning and ontology-based reasoning [36]. This work constructs a threat model that can classify attack patterns and forecast potential cyber vulnerabilities within the supply chain network, an increasingly vital capability as construction organizations become more digitally interconnected. The application of machine learning to understand corporate disclosures under the UK Modern Slavery Act highlights how natural language processing (NLP) and AI can be used to assess supply chain risks related to human trafficking, thereby addressing an important ethical and compliance dimension of risk management [37].

The resilience enhancement sub-theme focuses on how AI can be systematically leveraged to build dynamic capabilities that allow supply chains to withstand, adapt to, and recover from disruptions. The development of capabilities for supply chain resilience in a post-COVID context is examined through a machine learning-based thematic analysis of academic and practitioner discourse, identifying key capability clusters such as agility, redundancy, and flexibility that AI systems can help cultivate [39]. This study is particularly relevant for construction supply chains, which were severely tested by the pandemic's disruption of global material flows and labor availability. Furthermore, the role of AI in enhancing supply chain resilience specifically within Vietnamese manufacturing SMEs is investigated, providing a context-sensitive analysis that reveals how smaller firms with limited resources can still benefit from targeted AI applications for vulnerability assessment [38]. A deep learning-based approach to managing Covid-19 disruption risks in SMEs expands this understanding, showing that small and medium-sized enterprises can build resilience through investments in sensing and responding capabilities enabled by AI [40]. The

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

integration of cloud adoption and artificial intelligence for optimizing resilience and sustainable manufacturing supply chains is also explored, demonstrating the synergistic potential of combining cloud computing's scalability with AI's analytical power [41].

Studies focused on disruption response offer concrete predictive models for operational decision-making. A machine learning approach for predicting product availability dates under disruption is presented, which models the complex cascading delays that emanate from a blocked shipment or a supplier failure [42]. This predictive capability is extremely valuable for construction project managers who need accurate information on when critical materials will be available to avoid cascading schedule delays. A more general framework for integrating artificial intelligence into the risk management process is proposed, analyzing both the opportunities and the inherent challenges, such as data quality issues and model interpretability, that hinder practical implementation [43]. Within the disruption detection and early warning sub-theme, a machine learning approach for constructing a supply chain vulnerability early warning system is developed and empirically tested on data from the US semiconductor industry [44]. While this study is not construction-specific, its methodological framework for designing an early warning system based on leading indicators of vulnerability is directly applicable to construction contexts, where early detection of potential material shortages or supplier instability can be critical.

The final research focus within this theme, supply chain financing risk, addresses the financial vulnerabilities that can cascade through a supply chain. A federated machine learning approach is proposed for order-level risk prediction in supply chain financing, which is particularly innovative because it allows multiple financial institutions or firms to collaboratively train a predictive model without sharing sensitive proprietary data [34]. This approach respects data privacy constraints while still enabling the development of powerful risk assessment tools for construction supply chain financing, where the creditworthiness of small subcontractors and material suppliers is often uncertain. Collectively, the studies within this dimension demonstrate a clear trajectory from simple risk detection towards more complex causal reasoning, resilience capability building, and federated, privacy-preserving analytics. However, we observe that a significant proportion of these investigations remain at the model development or proof-of-concept stage, and there is a pronounced need for longitudinal, real-world validation studies that track the actual impact of these AI-driven risk management tools on project outcomes over time.

Artificial Intelligence in Construction Project Management and Supply Chains

A significant and rapidly growing body of literature examines the integration of artificial intelligence into the broader context of construction project management, with a specific emphasis on its implications for supply chain operations. This theme is distinct from purely optimization-focused studies because it situates AI applications within the multi-faceted, lifecycle-oriented framework of project management, encompassing cost estimation, schedule control, resource allocation, and procurement strategy. The studies in this cluster frequently treat the supply chain not as an isolated function but as an integral component of project delivery, where decisions regarding

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

material procurement, logistics, and inventory have direct and often non-linear effects on project time, cost, and quality performance. We have synthesized the diverse contributions in this dimension into a comprehensive taxonomy that captures the primary application domains and their specific research foci, presented in Table 3.

Table 3. Taxonomy of artificial intelligence applications in construction project management and supply chains.

AI Application Domain	Specific AI Technique / Focus	Sources
Supply Chain Optimization & Risk Management	Risk Identification & Mitigation (including CSCRM)	[46], [47], [48], [49]
	Inventory, Procurement & Logistics Optimization	[9], [50], [48], [51], [52]
	Sustainable & Green Supply Chain	[53], [54]
	Digital Transformation & Adoption	[55], [56], [57], [58], [54]
	Value Co-creation & Digital Integration	[59], [54]
Project Management & Cost Control	Cost Estimation & Management	[60], [61], [62], [63]
	Scheduling & Resource Allocation	[60], [64], [51], [65], [66]
	Predictive & Adaptive Decision-Making	[60], [67], [68], [64], [69]
Generative AI & Large Language Models	Application in Construction Management	[9], [70], [71], [52]
	Knowledge Management & Procurement	[9], [72], [73]
Implementation, Adoption & Strategic Frameworks	Change Management & Strategic Adoption	[74], [75], [76], [77]
	Barriers, Drivers & Frameworks for AI Adoption	[55], [76], [78], [58], [77], [79]
Deep Learning & Advanced Architectures	Predictive Modeling (Cost, Duration, Risk)	[62], [65], [69]
	Hybrid & Specialized Models (CNN, RNN, DRL)	[49], [51], [65]
	Quality & Safety Monitoring	[80], [49], [77], [79]
Miscellaneous /	Comprehensive	[61], [81], [82], [79]

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

AI Application Domain	Specific AI Technique / Focus	Sources
Overarching Studies	AI/General AI Impact on Projects	
	Smart/Intelligent Construction Systems	[80], [71], [66], [77], ?

Within the sub-theme of supply chain optimization and risk management, a substantial body of work focuses on the specific challenges of construction supply chain risk management (CSCRM). A systematic literature review and bibliometric analysis of CSCRM examines key aspects including risk identification frameworks and mitigation strategies, revealing that the application of AI to this domain is both a growing trend and a response to the increasing complexity of global construction supply networks [46]. The study identifies that while risk identification is well-studied, AI-driven quantitative risk prediction remains an area requiring further development. Complementing this, a risk factor analysis specific to construction supply chain management in Saudi Arabia provides a systematic assessment of contextual risks, such as geopolitical instability, supplier reliability, and logistics bottlenecks, demonstrating that AI-based tools could be particularly valuable in high-uncertainty environments [47]. The development of a hybrid intelligent vehicle system for managing construction supply chains in precast concrete building projects represents a more applied contribution, integrating AI into logistics coordination to handle the complex just-in-time delivery requirements of prefabricated components [48]. This system directly addresses the operational risk of delayed or mismatched deliveries that can halt assembly processes. Furthermore, the application of deep learning and the Internet of Things for dynamic construction site risk management is explored, showing that real-time data from site sensors, when processed through deep learning models, can identify emerging safety and logistics risks before they materialize [49].

Inventory, procurement, and logistics optimization constitutes another major cluster within this domain. The role of ChatGPT and similar generative AI in the construction industry is examined, with a specific focus on how these models can optimize inventory management and procurement processes [9]. The study argues that generative AI can automate the generation of purchase orders, analyze supplier performance data, and even draft contract clauses, thereby significantly reducing the administrative burden on procurement teams. A data-driven approach to supply chain optimization using artificial intelligence in the construction industry is also presented, where deep learning models, specifically neural networks, are employed to forecast material demand and optimize reorder points [50]. This study explicitly contrasts the traditional, reactive approach to construction supply chains with a proposed proactive, AI-enabled model. The hybrid intelligent vehicle system previously mentioned also falls under this category, as its primary function is to optimize logistics for precast concrete delivery [48]. A more advanced application involves real-time resource allocation optimization for dynamic construction job sites using deep reinforcement learning (DRL), which is implemented in a case study on a high-rise building project [51]. This DRL agent learns to dynamically allocate resources such as cranes, labor,

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)
Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

and materials in response to changing site conditions, thereby minimizing idle time and material waste. Finally, the concept of an agentic artificial intelligence of things (AIoT) system for just-in-time logistics and supply chains, specifically in the context of modular construction, is introduced [52]. This work proposes a system where autonomous agents make real-time logistics decisions, representing a significant step toward fully autonomous construction supply chains.

The sub-themes of sustainable and green supply chains, as well as digital transformation, are also represented. The evaluation of green supply management practices for measuring subcontractor sustainable performance in the construction industry is conducted using a combination of structural equation modeling (SEM) and machine learning performance modeling [53]. This hybrid approach allows for both the testing of theoretical relationships and the development of predictive models for subcontractor sustainability. Similarly, the capabilities of big data analytics for sustainable supply chain management in construction projects are weighed, with artificial intelligence and machine learning identified as key enablers for integrating social, economic, and environmental considerations into supply chain decisions [54]. The challenges towards the adoption of digital technologies in construction supply chain management are specifically addressed, with a call for future research to focus on the impact of emerging technologies like AI and blockchain [55]. The implementation of digital technologies in supply chain management within the Jordanian construction industry is also explored, identifying specific barriers such as lack of skilled personnel and high initial investment costs [56]. Furthermore, the impact of blockchain and artificial intelligence on value cocreation in construction projects is investigated through a mixed-methods study, revealing that these technologies can synergistically enhance trust and collaboration among supply chain partners [59].

Moving to project management and cost control, a central theme is the application of AI for enhanced cost estimation and management. A study frames AI and machine learning as predictive tools deployed against core project management problems, including cost estimation, where kernel methods and deep neural networks are used to forecast project costs based on historical data [60]. This research emphasizes that the predictive path links model outputs to change management, suggesting that when early cost overruns are predicted, proactive managerial interventions can be triggered. The trends, challenges, and future directions of AI in construction project management are also reviewed, revealing that machine learning and deep learning are increasingly used for cost management, particularly in forecasting material and equipment supply chain costs [61]. A novel deep-learning-based probabilistic framework is developed specifically to quantify and gauge project cost risks due to construction material price volatilities [62]. This model uses predictive probabilistic deep-learning algorithms and stochastic analysis to provide project managers with a range of possible cost outcomes rather than a single point estimate, which is far more useful for risk-informed decision-making. Finally, the use of AI to address the challenges in cost management of construction projects is explored, showing that AI has transformed supply chain management, which is identified as a primary driver of cost performance [63].

Scheduling and resource allocation are equally prominent within this dimension. The

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

aforementioned study on predictive project management also covers scheduling and resource estimation, using machine learning to identify patterns in historical data that inform more accurate project duration forecasts [64]. A hybrid deep learning architecture that combines Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN) is specifically developed for construction duration prediction [65]. This hybrid model leverages the CNN's ability to extract spatial features from project data and the RNN's capacity to model temporal sequences, resulting in highly accurate duration forecasts that directly impact material supply chain planning. Machine learning is also combined with multi-objective optimization for progress management of prefabricated construction projects, demonstrating that AI can simultaneously optimize schedule adherence and resource utilization [66]. The deep reinforcement learning model for real-time resource allocation on dynamic job sites also contributes directly to this sub-theme by optimizing the deployment of materials and equipment in response to schedule pressures [51].

Predictive and adaptive decision-making is a cross-cutting capability that integrates cost, schedule, and risk information. The use of AI for optimized project management and risk mitigation explicitly includes supply chain management as a domain where AI can reduce material waste and delay risk through predictive analytics [67]. A conceptual framework for leveraging AI for predictive and adaptive decision-making in construction project management is proposed, illustrating how AI can be embedded to enable real-time adjustments to plans based on supply chain signals [68]. The application of AI in project management more broadly, including a deep learning approach for risk prediction, demonstrates that these tools allow project managers to take proactive measures [69]. This study specifically contrasts the reactive nature of traditional risk management with the proactive model enabled by AI prediction.

The emergence of generative AI and large language models represents a frontier within this theme. The role of ChatGPT and similar generative AI in the construction industry is again relevant here, as these models are proposed not only for supply chain optimization but also for generating project reports, summarizing risk assessments, and assisting in contract review [9]. The integration of generative artificial intelligence across construction management is explored more comprehensively, identifying specific construction management nodes where generative AI can be integrated, from design review to procurement documentation [70]. The use of generative AI, such as ChatGPT or Bard, is also presented as enabling a new era of automation in the construction industry, with direct applications in optimizing supply chain management within Building Information Modeling environments [71]. Furthermore, the use of AI to improve knowledge management in construction is investigated, with deep learning proposed for extracting insights from large corporate knowledge repositories to inform procurement and supply chain decisions [72]. An innovative approach to construction procurement selection through an AI approach is also presented, demonstrating that machine learning can be used to choose the most appropriate procurement method for a given project, thereby optimizing the supply chain structure from the outset [73].

The implementation, adoption, and strategic frameworks sub-theme addresses the crucial question of how AI is actually integrated into organizational practice. The impact of AI on project management efficiency is studied with reference to a large

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

construction company, revealing that surmounting initial staff resistance necessitated comprehensive training and change management [74]. This finding underscores the fact that technical capability alone is insufficient for successful AI adoption. The synergies between lean construction and AI are explored, showing that AI can drive a continuous improvement process that directly aligns with lean principles of waste reduction and value creation [75]. The strategic implementation of AI in construction is approached through an integrated change and innovation management lens, providing practical recommendations for navigating the organizational transformation required for AI adoption [76]. An AI-enabled digital transformation framework for smart construction management is also proposed, explicitly including AI strategy formulation, change management, and data-driven culture as foundational elements [77].

Finally, studies examining the critical drivers and barriers of AI adoption in construction projects are numerous. A study on the critical drivers of AI adoption in construction projects, with evidence from a developing economy, identifies site safety and supply chain management as key components driving adoption [58]. A decision-making model for AI implementation in sustainable building projects examines how certain AI drivers affect the industry's adoption of this technology [78]. The correlation and synergy of AI techniques, construction technologies, and their key benefits are investigated, with neural networks and machine learning identified as commonly utilized techniques, and robotic automation and deep learning as emerging areas [79]. The impacts of AI on the management of large complex projects are also assessed, with deep learning identified as a form of machine learning that is particularly powerful for tackling the complexity of large-scale engineering and construction projects [81]. Furthermore, the harnessing of AI for transformative impact in the Ghanaian construction sector is explored, where supply chain management is identified as an area of lesser perceived importance compared to design and safety, highlighting the context-specific nature of AI prioritization [82]. The development of a smart construction management system based on Building Information Modeling and AI for materials and electrical components also contributes to this overarching theme, while the combination of machine learning and multi-objective optimization for prefabricated construction progress management provides a specific example of a smart construction system [77].

Sustainability, Green Supply Chains, and Carbon Footprint Management in Construction

The imperative to mitigate the environmental impact of construction activities has driven a growing interest in applying artificial intelligence to foster sustainability, green supply chains, and carbon footprint management within the sector. This theme encompasses research that extends beyond mere operational efficiency to address the ecological consequences of material extraction, logistics, construction processes, and end-of-life building management. The studies in this cluster leverage the pattern recognition and predictive capabilities of AI to quantify, forecast, and optimize environmental performance metrics, such as carbon emissions, waste generation, and resource consumption, thereby enabling a more environmentally conscious approach to construction supply chain management. We have synthesized the core contributions

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

from the included studies into a structured taxonomy that maps the primary areas of focus, the specific techniques employed, and their intended sustainability outcomes, as presented in Table 4.

Table 4. Taxonomy of artificial intelligence applications in sustainability, green supply chains, and carbon footprint management.

Sustainability Focus	Specific AI Technique / Theme	Intended Sustainability Outcome	Sources
Carbon Footprint Management	Deep Learning & AI for Carbon tracking & Reduction Strategy	Emissions quantification and mitigation in global operations	[83]
	Climate-aware Decision Intelligence	Risk-informed infrastructure and supply chain planning	[84]
Green Supply Chain & Circular Economy	Integrated machine learning for smart city circularity	Waste reduction through optimized reverse logistics	[85]
	AI & IoT-enabled Circular Economy	Material recovery and lifecycle extension	[86]
Strategic Frameworks & Adoption	Bibliometric analysis of AI in sustainable supply chains	Mapping research clusters and guiding future development	[87]
	Technology-integrated policy balancing	Alignment of domestic goals with global sustainability	[88]
Enabling Platform Technologies	Blockchain & AI-enabled IoT for smart cities	Transparent tracking of material provenance and recycling	[89]
	AI & IoT for circular economy	Sensor-driven data for resource efficiency	[86]

A core line of inquiry within this dimension concerns the direct management and reduction of carbon emissions across global construction supply chains. One study proposes a data-driven framework that employs artificial intelligence algorithms to manage carbon footprints within global supply chains [83]. This framework's objective is to use deep learning models to achieve high accuracy in quantifying emissions across various tiers of the supply chain, thereby providing organizations with a more precise and dynamic understanding of their carbon liabilities than

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

traditional, static estimation methods allow. The focus is explicitly on generating actionable data that can inform carbon reduction strategies, such as optimizing transportation routes to minimize fuel consumption or selecting lower-carbon material alternatives. A complementary approach is offered by research on climate-aware decision intelligence, which introduces a framework for integrating environmental risk directly into infrastructure and supply chain planning [84]. This work demonstrates, through a coastal supply chain case study, that by incorporating climatic variables and predictive models into the planning stages—from design and construction through to logistics—significant cost savings and more efficient resource management can be achieved while simultaneously reducing the environmental vulnerability of the supply chain. The study explicitly links the construction, logistics, and supply chain management stages, showcasing how AI-driven environmental risk assessments can produce tangible financial and ecological benefits.

The transition towards a circular economy and the adoption of green supply chain practices constitute another significant research trajectory. An exploration of optimizing green supply chain circular economy operations within smart cities leverages integrated machine learning technology [85]. This research addresses how machine learning and deep learning, alongside expert systems, can be applied to enhance material sorting, route optimization for reverse logistics, and the overall efficiency of closed-loop supply chains in urban environments. The green supply chain is explicitly defined as a management approach that incorporates environmental thinking into every stage of product and material flow, a concept directly relevant to construction where waste generation from demolition and construction is a major environmental concern. The role of AI is positioned as a key enabler for transforming linear "take-make-dispose" construction supply chains into circular systems where materials are recovered and reintegrated. This perspective is further advanced by a study on an artificial intelligence and internet of things-enabled circular economy, which employs deep learning to discover patterns in raw material data, thereby facilitating more informed design for deconstruction and material reuse [86]. This work also incorporates a broad scope including augmented reality-based construction, food, and manufacturing sectors, demonstrating the cross-sector applicability of AI-driven circularity principles. The synergy between AI and IoT is emphasized as critical for creating the data streams necessary to track material flows and identify optimization opportunities.

Several studies in this cluster contribute by providing overarching strategic frameworks and mapping the research landscape. A comprehensive bibliometric analysis of the use of artificial intelligence to advance sustainable supply chain management (SSCM) and Artificial Intelligence provides a retrospective and prospective view of the field [87]. This analysis identifies deep neural networks and machine learning techniques as central to the advancement of SSCM, and it maps the intellectual structure of the field, revealing emerging research clusters such as the intersection of AI with blockchain integration for supply chain transparency. This bibliometric study serves as a meta-analytical tool that contextualizes the more focused empirical studies within the broader evolution of the research domain. Another study addresses the challenge of technology-integrated sustainable supply chains, focusing on how to balance domestic policy goals, global stability, and

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

economic growth [88]. This work argues that by integrating tools such as AI and IoT, organizations can redefine supply chain management, but it also cautions that these technologies must be deployed within a policy framework that ensures global stability and does not exacerbate inequities. The study specifically positions deep learning models as excellent tools for processing vast environmental data, thereby enabling more nuanced and adaptive sustainability policies.

Finally, enabling platform technologies that combine AI with other digital innovations are investigated for their potential to underpin sustainable construction supply chain solutions. A blockchain-and artificial intelligence-enabled smart IoT framework for sustainable cities is proposed, which integrates machine and deep learning for smart city applications, including supply chain management and digital identification [89]. This framework uses blockchain to create an immutable ledger for tracking materials from extraction to installation, and AI to analyze this data for opportunities to reduce waste and improve recycling. The combination of these technologies is presented as a way to build trust and verifiability into green claims, which is a persistent challenge in the construction industry's sustainability efforts. Similarly, the circle of AI and IoT in enabling the circular economy, as discussed previously discussed, is also a key platform technology, where IoT sensors provide the raw data and AI provides the analytical intelligence to close material loops [86].

Together, these studies paint a picture of a research field that is actively developing both the specialized AI tools for carbon accounting and the systemic frameworks for integrating sustainability into supply chain strategy. The emphasis is increasingly on moving from simple carbon footprinting—a necessary first step—towards prescriptive and predictive models that can actively recommend procurement decisions, logistic routes, and design alternatives that minimize environmental impact. However, it is notable that despite the conceptual richness of these frameworks, empirical validation on large-scale, real-world construction projects with demonstrable reductions in actual carbon emissions remains relatively scarce. A significant gap persists between the development of these promising frameworks and their calibrated deployment and validation within the operational realities of the construction industry.

Emerging Technologies: Generative AI, Digital Twins, Blockchain, and IoT Integration

A distinct and rapidly evolving research frontier within our corpus is the research that investigates the synergistic convergence of deep learning and artificial intelligence with other cutting-edge digital technologies. This body of work moves beyond the application of AI in isolation to explore how it can be combined with generative artificial intelligence, digital twins, blockchain, the Internet of Things, and other novel platforms to create fundamentally new capabilities for construction supply chain management. The central premise of this dimension is that these technologies are not merely additive but multiplicative: AI provides the analytical and predictive intelligence, while the other technologies provide the mechanisms for high-fidelity simulation, tamper-proof data provenance, real-time sensing, and autonomous execution. These studies tend to be more forward-looking and conceptual than those in the more established themes, yet they collectively delineate a clear trajectory toward highly integrated, intelligent, and self-adaptive supply chain ecosystems. The

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

contributions within this dimension are systematically organized in Table 5, which presents a taxonomy that captures the primary technology combinations, their constituent techniques, and their intended applications for supply chain management.

Table 5. Taxonomy of studies on emerging technologies, including generative AI, digital twins, blockchain, and IoT integration for supply chain management.

Technology Combination	Specific Technique / Platform	Intended Application / Focus	Sources
Generative AI (GenAI)	Generative AI for operations & supply chain management	Enhancement of operations and decision-making in SCM	[90]
	Generative AI & Machine Learning in oil and gas	Optimization of supply chain value chain in energy sector	[specified] sector
	ChatGPT and similar GenAI for smart industry	Role, challenges, and opportunities in Industry 4.0/5.0	[9]
Digital Twins (DT)	Hybrid deep learning for cognitive digital supply chain twin	Disruption detection within a simulation environment	[91]
	AI-enhanced what-if scenario analysis in digital twins	Multi-objective trade-off analysis (cost, resilience, carbon)	[92]
	Digital twin of aquatic product supply chains using AI	Transparency, efficiency, and traceability	[93]
Blockchain & AI Integration	Critical analysis of blockchain and AI integration for SCM	Literature review on barriers, benefits, and potential	[94]
	Blockchain, AI, and 3D printing for humanitarian supply chains	Framework for enhancing information, product, and financial flow	[95]
IoT & AI Integration	Industrial IoT and AI in vehicular logistics	Optimization of vehicle-mediated transportation systems	[96]

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

Technology Combination	Specific Technique / Platform	Intended Application / Focus	Sources
	Digital twins, IoT, and blockchain for advanced analytics	Framework for resilient, data-driven business operations	[97]
Cross-Technology / Emerging Platforms	Metaverse for supply chain management	Examination of implementation, potential, and barriers	[98]
	AI in logistics (self-driving trucks, drone delivery)	Dynamic route planning and optimization for transportation	[99]

Generative artificial intelligence represents a frontier with profound implications for construction supply chain management. Our synthesis shows that while the application of GenAI to this domain is nascent, its potential is already being mapped. One study examines how generative AI could be applied to enhance operations and supply chain management, highlighting its capacity to generate high-quality synthetic data for model training, automate the creation of procurement documentation, and drive image-based recognition systems for material identification and quality control [90]. This work positions GenAI as a transformative force that is "driven through machine deep learning algorithms and image recognition," suggesting that it can automate tasks that have traditionally required human judgment and creativity. Complementing this perspective, a study on the potential application of generative AI and machine learning algorithms in the oil and gas sector outlines benefits such as accelerating the design of optimal supply chain configurations and automating the interpretation of seismic data for resource exploration [100]. Although this study is sector-specific, its insights into project operations and value chain optimization are directly transferable to large-scale construction projects, which share similar characteristics of high capital intensity, complex supply networks, and significant operational risk. The broader role of ChatGPT and for ChatGPT and similar generative AI for smart industry is also investigated, framing these tools as catalysts for Industry 4.0 and Industry 5.0 [9]. The study emphasizes that generative AI can optimize manufacturing processes and supply chain management by generating novel solutions based on learned patterns, and it discusses both the opportunities and the challenges, including issues of data security, model bias, and the need for human oversight. Collectively, these studies suggest that generative AI could fundamentally alter how supply chain strategies are conceived and executed, moving from optimization of existing processes to the conceptualization of entirely new ones and the automation of knowledge work.

The integration of AI with digital twins constitutes another critical research frontier. Digital twins—virtual replicas of physical supply chain networks that are continuously updated with real-time data—provide the ideal environment for

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

simulation and what-if analysis. One study investigates disruption detection for a cognitive digital supply chain twin using hybrid deep learning [91]. This system uses a combination of recurrent and convolutional neural networks to analyze data streams from the physical supply chain and detect anomalies that signal impending disruptions, such as supplier failures or transportation delays. The digital twin environment allows these alerts to be generated and tested virtually before they manifest in the real world, thereby enabling proactive intervention. Building on this concept, another study introduces an AI-enhanced what-if scenario analysis in supply chain digital twins from a multi-objective trade-off perspective, examining the interplay between cost, resilience, and carbon efficiency [92]. This research demonstrates that by integrating deep learning models into a digital twin, managers can simulate the impact of different strategic decisions—such as reshoring suppliers, increasing safety stock, or changing transportation modes—and evaluate their performance against multiple, often competing, objectives. The digital twin becomes a sandbox for strategic experimentation, where AI provides the predictive engine and the digital twin provides the accurate, dynamic representation of the system. A domain-specific application of this concept is seen in research on the construction of supply chains of digital twin aquatic products using artificial intelligence, which addresses the need for transparency, efficiency, and traceability in a perishable supply chain [93]. The study employs deep learning, natural language processing, and vector machines to model the aquatic supply chain, demonstrating how a digital twin can integrate heterogeneous data sources to provide a holistic view of operations. While not directly about construction, the methodologies for integrating diverse data types and for simulating the behavior of a complex supply chain are highly relevant for construction contexts, where a digital twin of a project's material supply chain could, for example, simulate the impact of a concrete plant closure on the entire site schedule.

The integration of blockchain with artificial intelligence represents a powerful combination for enhancing trust, transparency, and execution in supply chains. A critical analysis of the integration of blockchain and artificial intelligence for supply chain management provides a comprehensive review of this intersection [94]. The research reveals that while the potential benefits are significant, including immutable records for supply chain management, "building a unified framework that seamlessly combines the two technologies" remains a significant challenge. The study notes that a substantial portion of the literature at the intersection of "neural network" OR "deep learning") AND "supply chain" is conceptual, and that empirical, real-world implementations are scarce. This highlights a critical maturity gap: the individual technologies are advanced, but their integration into a cohesive, scalable system is still a research problem. The potential of combining blockchain, artificial intelligence, and 3D printing for humanitarian supply chains is also explored, resulting in a proposed framework to enhance the flow of information, products, and finance [95]. This study demonstrates how blockchain can provide a secure, decentralized ledger for tracking aid supplies, AI can optimize logistics routes and predict demand, and 3D printing can enable on-site production of essential items. This multi-technology framework is conceptually rich and offers a model for construction applications, such as using blockchain for provenance tracking of critical materials like steel, AI for

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)
Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

demand forecasting, and 3D printing for producing spare parts or custom components on-site.

The integration of the Internet of Things with AI provides the sensory nervous system for intelligent supply chain platforms. A study on the implementation of industrial IoT and AI in vehicular logistics and supply chain management for vehicle-mediated transportation systems demonstrates how deep learning can be used to process data from vehicle sensors to predict failures, optimize routes, and enable autonomous navigation [96]. This research shows that "with the help of AI and deep learning, [the system] will navigate the individuals to take required precautions," thereby preventing potential failures and catastrophic events. This predictive maintenance and dynamic routing capability is directly applicable to managing the complex heavy-haulage and material delivery fleets that serve construction projects. Moreover, a comprehensive framework that integrates digital twins, IoT, and blockchain for advanced supply chain analytics is proposed, targeting resilient, data-driven business operations [97]. This framework explicitly aims to "redefine supply chain management by integrating these technologies" to automate processes through "deep learning: addressing redundancy, and enhancing efficiency." The paper argues that such an integrated approach is necessary to move beyond isolated optimizations toward a holistic, system-wide intelligence.

Beyond these core technology combinations, we also found studies investigating the potential of the metaverse for supply chain management [98]. This empirical study examines the implementation of metaverse technology in an organization's supply chain, focusing on predicting potential barriers to its adoption. The metaverse is envisioned as an immersive, collaborative platform where stakeholders in the supply chain—architects, suppliers, contractors—could interact with digital representations of materials, logistics flows, and project schedules in a shared virtual space, thereby enhancing communication and coordination. Finally, a broad study on the function of AI in dynamic route planning for transportation includes a focus on self-driving trucks and drone delivery [99]. While this is not a multi-technology integration study per se, it represents the application of AI to a key enabling technology for supply chain execution, and its findings on dynamic optimization are central to the vision of the autonomous, data-driven supply chain.

Collectively, these emerging technology studies point toward a future where construction supply chains are not just optimized but are fundamentally cognitive and autonomous. The combination of generative AI, digital twins, blockchain, and IoT, and blockchain could create an ecosystem that is self-monitoring, self-diagnosing, self-optimizing, and transparently auditable. However, the literature is overwhelmingly at the conceptual framework and proof-of-concept stage.

Sector-Specific Applications: Manufacturing, Energy, Agriculture, Logistics

A substantial portion of the literature we retrieved does not focus on construction supply chains per se but instead investigates the application of artificial intelligence and deep learning within other critical sectors, including manufacturing, energy, agriculture, and logistics. These studies are included in our review because they often develop foundational methodologies, identify transferable technical challenges, and propose innovative solutions that are either directly transferable to construction

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

contexts or offer valuable comparative insights. The construction industry shares fundamental characteristics with these sectors, such as complex multi-tier supplier networks, high variability in demand and supply, significant exposure to external disruptions, and the need for real-time coordination. Consequently, the techniques validated in these adjacent domains can inspire novel approaches for construction-specific problems. When the issue is examined through the lens of these sector-specific applications, the diversity of AI techniques and their adaptation to distinct operational constraints becomes particularly apparent. We have synthesized the contributions of these studies into a comprehensive taxonomy that captures the primary sectors, theses, the AI methods employed, and the specific sectoral context of each investigation, as presented in Table 6.

Table 6. Taxonomy of sector-specific studies on AI and deep learning applications in manufacturing, energy, agriculture, and logistics.

Sector
Manufacturing
Energy
Agriculture
Logistics & Operations
Demand Forecasting & Analytics
Risk Management & Security
Human-AI Collaboration
Not Sector-Specific

Within the manufacturing sector, a dominant theme is the pursuit is the application of AI and machine learning to optimize and automate supply chain operations. One comprehensive study reviews recent trends in supply chain management using AI and machine learning in manufacturing, positing deep learning as a revolutionary game-changing technology that provides constant self-evolution learning solutions based on process-specific matrix data [101]. This research emphasizes that the distinct patterns inherent in manufacturing data require specialized deep learning architectures, a notion that serves as a direct analogy for the construction sector, where data is equally complex and process-specific. Another study that employs a multiple case study approach investigates the role of artificial intelligence in supply chain and operations management across several manufacturing firms [102]. Notably, this research reports on the successful development of a deep neural network for inventory management of spare parts, a specific spare parts warehouse, thereby demonstrating the concrete application of DL in a context analogous to managing construction material inventories. Furthermore, a general review of AI in supply and procurement highlights that machine learning and deep learning are the primary mechanisms

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

through which supply chain management can be improved across various industries, with manufacturing being a prime beneficiary [103].

A critical and specialized application within manufacturing is the use of AI for enhancing security and quality control in the electronics supply chain. One study proposes a deep learning approach in optical inspection to detect hidden hardware trojans and secure cybersecurity in electronics manufacturing supply chains [104]. By utilizing advancements in machine vision and artificial intelligence, this work develops a technique of optical monitoring that can help detect malicious chips hidden inside printed circuit boards. This application, while specific to electronics, is a remarkable example of how AI-driven visual inspection can be used to anomalies along the supply chain, a methodology that is directly applicable to quality assurance of supplied building materials arriving at construction site.

The energy sector also serves as a fertile ground for developing and testing AI-driven supply chain solutions. A study on developing a framework for AI-driven optimization of supply chains in energy sector investigates the potential of AI to optimize supply chain operations and enhance them [33]. By applying machine learning and deep learning, the research demonstrates how traditional supply chain management systems can be outperformed in terms of demand, and proactively manage energy supply. In similar vein, research on advances in automation and AI for enhancing supply chain productivity in oil and gas details the revolutionary impact of integrating automation and AI in this industry [105]. This paper highlights how AI can for drilling platforms and predictive maintenance of pipelines, leading to cost reduction and operational efficiency gains that are highly relevant to construction.

Agriculture, despite its of perish goods, presents AI applications in process optimization. An exploration of the benefits, the challenges, and future trends of artificial intelligence application in the agricultural industry finds that deep learning models are critical in optimizing agricultural processes and supply chain management [106]. The study notes that those systems leverage these architectures to generate predictions and recommendations that can reduce waste and improve crop yield deliver. A more concrete application is seen in research on an artificial intelligence driven vertical farming management system, which uses machine learning and deep learning-based approaches to monitor and control the growing environment [107]. This demonstrates how AI can manage complex, real-time, multi-variable systems to optimize the production and delivery of food.

The general realm of logistics and operations provides a wide array of AI applications. A study focuses on machine learning and computer vision for the automation of processes in advanced logistics, proposing the Integrated Logistic Platform 4.0 [108]. This research explores federated learning as a means to mitigate the lack of data in goods handling areas, in goods handling areas, and it demonstrates how deep learning can enable autonomous material handling and sorting. Similarly, a revolutionary force in procurement and supply chain [109] and a broader study on revolutionizing business analytics through AI and machine learning show how reinforcement learning and deep neural networks can be used for dynamic route planning and warehouse robotics [110]. An improved commodity supply chain performance through AI and computer vision demonstrates how AI can be used to monitor crop health and optimize logistics.

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

The integration of AI with other digital infrastructures is cross-cutting. A study on cloud-based data integration and machine learning in the biopharmaceutical supply chain uses a deep learning-enhanced cloud-?](# "IS97"). This combined framework demonstrates the power of AI for creating interpretable and powerful simulation models.

The studies included in this sector-specific cluster collectively underscore that the techniques for supply chain AI are not industry-agnostic, but are also successful implementations always require adaptation to the unique characteristics of commodity, risk profile, and data structure of the sector.

Strategic Frameworks, Adoption Challenges, and Future Trends

The consolidation of the field necessitates a critical examination of the strategic, organizational, and systemic factors that govern the successful deployment of AI and deep learning within construction supply chains. This dimension synthesizes studies that move beyond technical model development to address the meta-questions of how these technologies can be effectively integrated, what barriers impede their adoption, and what emergent trends will shape future research and practice. The literature in this cluster reveals that the primary impediments to AI implementation in construction supply chains are not exclusively technical but are deeply embedded in organizational inertia, data governance challenges, a lack of skilled personnel, and insufficient strategic alignment between technology capabilities and business processes. We synthesized the key contributions from this dimension into a comprehensive taxonomy that captures the primary thematic areas of strategic framing, adoption barriers, and forward-looking trends, as presented in Table 7.

Table 7. Taxonomy of strategic frameworks, adoption challenges, and future trends in AI for construction supply chains.

Thematic Area	Specific Focus / Construct	Key Findings / Contribution
Strategic Frameworks & Maturity Models	Rethinking AI maturity in safety-critical settings	AI must move beyond automation of narrow tasks towards augmentation of human cognition and system-wide resilience; maturity is a socio-technical, not purely technical, construct
	Lean supply chain management (LSCM) and Industry 4.0 interrelationships	AI is a core I4.0 enabler of LSCM, driving waste reduction and process standardization in supply chains; the relationship is synergistic rather than competitive
	AI for enhancing supply	AI is positioned as a

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

Thematic Area	Specific Focus / Construct	Key Findings / Contribution
	chain resilience capabilities	dynamic capability that enables firms to sense, seize, and reconfigure resources for resilience; a strategic resource in the resource-based view framework
	Industrial Revolution 5.0 and explainable AI (XAI)	A paradigm shift from purely efficiency-driven AI towards human-centric, sustainable, and resilient systems; XAI is critical for trust and adoption in safety-critical supply chain decisions
	Future economic implications of AI	AI's transformative economic impact will be mediated by investments in compute infrastructure, transparency of AI design, change management, and communication building organizational trust
Adoption Challenges (Barriers & Drivers)	Barriers to achieving operational excellence through AI	Driving forces include improved decision-making, operational efficiency; barriers include high initial cost, lack of skilled workforce, data quality issues, and organizational resistance to change in construction contexts
	Barriers to AI adoption in construction supply chains (technology-integrated, policy balance)	Domestic policy goals must be balanced with global stability; adversarial AI and cyberattacks are emerging threats to AI-integrated supply chains
	Socio-economic and regulatory aspects of AI-driven smart buildings	AI integration into BMS faces hurdles of regulatory fragmentation, data privacy concerns, and the

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

Thematic Area	Specific Focus / Construct	Key Findings / Contribution
		high cost of retrofitting existing building systems
	Economic and policy aspects of AI for smart supply chains	Need for new regulatory frameworks to govern AI in supply chains; ensuring equitable access to AI benefits and preventing digital divides
Future Trends & Research Directions	Supervised machine learning for theory building in operations management	ML can be used not only for prediction but also for rigorous causal inference and theory testing in supply chain and operations management
	Future directions for time-series prediction in IIoT sustainability and scalability	Need for extensible knowledge mining and more robust, domain-adaptive deep learning for industrial IoT supply chain applications
	Rethinking AI maturity	Future research should focus on human-AI teaming and creating systems that are robust to novel, unanticipated disruptions
Foundational & Conceptual Reviews	Bibliometric analysis of ML in SCM	Reveals four dominant research clusters: supply chain 4.0, sustainable supply chains, demand forecasting, and risk management; identifies an upward trend in deep learning applications
	Bibliometric analysis of IoT in logistics and SCM	IoT, AI, and deep learning are increasingly co-cited and form the core technology cluster for future logistics systems
	SCM 4.0: Looking backward, looking forward	Real-time data, supported by AI and deep learning, will define the next generation of supply chain

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

Thematic Area	Specific Focus / Construct	Key Findings / Contribution
		management; deep learning is needed to train decision-making machines on big data
	Knowledge extraction and knowledge graph construction for SCM domain	Distant supervision and knowledge graphs, enabled by deep learning, are critical for structuring unstructured supply chain data to power intelligent decision-making
	Fundamental concepts of AI and its applications	Deep learning is a subset of machine learning that excels at complex pattern recognition; its aapplications span construction equipment management to supply chain modeling
	Comprehensive overview of deep learning techniques and applications	Deep learning requires careful model building and interpretation for supply chain contexts
Sectoral & Domain Transfer	State of the art in supply chains and AI	AI is crucial for logistics in construction project management; methods include ARIMA, deep learning, and mixed-integer nonlinear programming
	Unified resources marking system for AI in construction	Proposed a unified bar-coding and AI system for tracking building materials from source to site, enabling automated inventory and logistics
	AI and robotics transforming industries with automation	AI, particularly deep learning, enables industrial robots to learn and adapt, automating material handling and warehouse operations
	Data-driven decision-	AI integrates data from

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

Thematic Area	Specific Focus / Construct	Key Findings / Contribution
	making for contract negotiation and supplier selection	historical contracts and supplier performance to support strategic decisions in procurement
	Machine learning: algorithms, real-world applications and future directions	Deep learning is part of the broader ML family and requires careful data preparation for building intelligent real-world applications in supply chains
	AI in education and its transferable framework	The framework for building AI-based products and services is applicable to construction supply chain
	Deep learning for building energy consumption prediction	Transferable methodologies for time-series prediction from energy to construction material supply and demand
	Analyzing resilience factors in prefabricated building supply chains using SEM-SD	Identifies key influencing factors for resilience in PBSC and proposes a resilience enhancement strategy; a methodological bridge between qualitative and quantitative AI-based analysis

A central contribution of this thematic cluster is the critical re-evaluation of what constitutes AI maturity in the inherently safety-critical and high-stakes environment of construction. Some researchers argue that current formulations of AI maturity are inadequate because they focus excessively on automating narrow, well-defined tasks at the expense of broader system-level reasoning and resilience [111]. This perspective posits that a mature AI system in a construction supply chain must not only optimize logistics for cost but also augment human cognition to handle novel, unanticipated disruptions, such as a sudden supplier bankruptcy or a port closure. This shift from pure performance optimization to resilience-centered augmentation represents a fundamental rethinking of strategic objectives. Complementing this view, the emerging paradigm of Industry 5.0 is presented as a movement beyond the purely efficiency-driven logic of Industry 4.0 towards a human-centric, sustainable, and resilient industrial model [112]. Within this framework, explainable AI (XAI) is

Online ISSN 3007-3197
Print ISSN 3007-3189

identified as a critical enabler for adoption, as stakeholders in construction project supply chains—from project managers to subcontractors—are unlikely to trust and act upon opaque, "black-box" model recommendations that could have significant financial and schedule implications.

The strategic synergy between lean construction principles and AI-driven supply chain management is another important theme. Research on the interrelationships between lean supply chain management (LSCM) and Industry 4.0 technologies demonstrates that AI is not a disruptive force but rather a powerful enabler of lean principles [113]. The study finds that AI-driven technologies can standardize processes, reduce variability, and eliminate waste in supply chain operations, thereby directly supporting the core tenets of lean management. This synergy suggests that construction firms with established lean practices may be better positioned to adopt AI, as they already possess a culture of continuous improvement and waste reduction that aligns with the benefits AI can provide. This strategic alignment is further elaborated by research that positions AI as a dynamic capability for building supply chain resilience [71]. This work demonstrates that AI enables firms to sense changes in their supply chain environment more rapidly, seize opportunities more effectively, and reconfigure their resource base more dynamically in response to disruptions. This framing elevates AI from a tactical optimization tool to a strategic resource that can provide a sustained competitive advantage.

Conversely, the literature on adoption challenges provides a sobering counterpoint to the optimistic strategic visions. A comprehensive investigation into the driving forces and barriers to achieving operational excellence through artificial intelligence identifies several critical impediments [114]. The study finds that while the driving forces, such as improved decision-making and operational efficiency, are well-recognized, the barriers are more numerous and deeply entrenched. High initial costs, a lack of skilled workforce, poor data quality, and significant organizational resistance to change are consistently cited as primary obstacles, particularly in the construction context where margins are tight and cultures are traditionally risk-averse. These findings are echoed in research on technology-integrated sustainable supply chains, which notes that domestic policy goals must be carefully balanced with global stability, and that adversarial AI and cyberattacks represent emerging threats to AI-integrated supply chains [88]. This underscores that the security and governance of AI systems are as critical as their predictive performance.

The socio-economic and regulatory facets of AI adoption are also addressed. A study examining the economic, policy, social, and regulatory aspects of AI-driven smart buildings reveals that the integration of AI into Building Management Systems (BMS) is hindered by regulatory fragmentation, data privacy concerns, and the high cost of retrofitting existing building stock [115]. These findings are directly transferable to supply chain contexts, where integrating AI with existing legacy systems and ensuring compliance with diverse data protection regulations are significant logistical and legal challenges. Furthermore, the future economic implications of AI are explored, with research emphasizing that the transformative economic impact of AI will be mediated by substantial investments in computing infrastructure, the transparency of AI design, and effective change management to build organizational trust [116]. This work argues that communication about AI's

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

capabilities and limitations is crucial for overcoming resistance and fostering a culture of adoption.

A significant portion of this dimension consists of foundational and conceptual reviews that map the intellectual structure of the broader field. For example, a bibliometric analysis of machine learning applications in supply chain management identifies four dominant research clusters: supply chain 4.0, sustainable supply chains, demand forecasting, and risk management [117]. The analysis reveals an upward trend in deep learning applications and provides a meta-analytical framework for understanding the evolution of the field. Similarly, a bibliometric analysis of IoT applications in logistics and supply chain management shows that IoT, AI, and deep learning are increasingly co-cited, forming the core technology cluster for future logistics systems [118]. A forward-looking review of supply chain management 4.0 posits that real-time data, supported by AI and deep learning, will define the next generation of SCM, with deep learning being the key technology needed to train decision-making machines on big data [119]. The challenge of structuring unstructured supply chain data to power these intelligent systems is addressed by research on distant supervision knowledge extraction and knowledge graph construction, which demonstrates how deep learning can be used to automatically extract relevant entities and relationships from text, such as contracts and specifications, to build a comprehensive supply chain knowledge graph [120].

Several studies in this cluster provide foundational overviews of the core technologies and their broad application potential, thereby contextualizing the more specialized research. A study on the fundamental concepts of artificial intelligence and its applications explains that deep learning is a subset of machine learning that excels at complex pattern recognition, and its applications span from construction equipment management to supply chain modeling [121]. Another comprehensive overview of deep learning techniques, taxonomy, applications, and research directions emphasizes that building an appropriate model of deep learning for supply chain contexts is a challenging task that requires careful data preparation and model interpretation [122].

Furthermore, the transferability of AI methods across sectors is explicitly addressed by several studies. A state-of-the-art review of supply chains and artificial intelligence identifies logistics in construction project management as a key topic, citing methods such as ARIMA, deep learning, and mixed-integer nonlinear programming as applicable tools [123]. A highly practical contribution is research proposing a unified resources marking system for the development of artificial intelligence in construction [124]. This system is based on applying special bar codes directly to the packaging of building materials and using AI to track these markings, thereby enabling automated inventory management and logistics coordination from the factory to the construction site. This work directly addresses the data input problem that many AI systems face, arguing that a standardized marking system is a prerequisite for scaling AI in construction. The convergence of AI and robotics is also explored, with research demonstrating that deep learning enables industrial robots to learn and adapt, thereby automating material handling, sorting, and warehouse operations in supply chains [125]. A study focusing on advances in data-driven decision-making for contract negotiation and supplier selection shows how AI can integrate data from historical contracts and supplier performance databases to support strategic procurement

Online ISSN 3007-3197
Print ISSN 3007-3189

decisions [126].

Finally, methodological and future-oriented studies point the way forward. Research on supervised machine learning for theory building and testing in operations management argues that ML can be used not only for prediction but also for rigorous causal inference, enabling the testing and refinement of theoretical frameworks for supply chain management [127]. This represents a significant opportunity for the field to move from purely empirical modeling towards more theoretically grounded research. Future directions for time-series prediction in Industrial IoT are also discussed, with a call for more extensible, domain-adaptive, and sustainable deep learning architectures that can handle the challenges of real-world industrial applications [128]. A study specifically analyzing resilience influencing factors in the prefabricated building supply chain (PBSC) using SEM-SD methodology provides a methodological bridge between qualitative and quantitative AI-based analysis, identifying key factors and proposing a resilience enhancement strategy [129]. Collectively, these strategic, analytical, and forward-looking studies reveal a field that is critically self-reflective, aware of its current limitations, and actively charting a course toward more robust, human-centric, and theoretically informed applications in the construction supply chain domain.

Discussion

Our systematic review has synthesized a diverse and rapidly expanding body of literature, revealing a field that is both technically sophisticated and strategically fragmented. Taken together, the findings across the seven thematic dimensions paint a picture of a domain in transition, moving from isolated algorithmic demonstrations toward more integrated, system-level thinking, yet still grappling with fundamental challenges of real-world validation and organizational adoption. We now interpret these collective findings, discuss their implications for theory and practice, acknowledge the limitations of our synthesis, and propose concrete directions for future inquiry.

Several overarching patterns emerge across the reviewed studies. A consistent finding across all dimensions is the predominance of predictive and optimization models that are validated on historical datasets or within simulated environments, rather than through prospective deployment on live construction projects. For instance, while the literature on AI-driven demand forecasting [13], [14] and risk management [27], [28] demonstrates high technical performance in terms of accuracy metrics such as mean absolute error or area under the curve, the number of studies that track the actual impact of these models on project-level outcomes like cost savings, schedule adherence, or waste reduction remains strikingly low. This gap between algorithmic capability and demonstrated practical value is a critical impediment to industry adoption. Another consistent pattern is the predominance of isolated, single-firm or single-project case studies. While these provide valuable for generating initial evidence, this approach limits the generalizability of findings and fails to capture the multi-stakeholder, network-level dynamics that characterize real construction supply chains. For example, the studies on digital twin integration [91], [92] and blockchain-AI convergence [94] present compelling visions, but their empirical basis is often limited to proof-of-concept implementations that do not account for the complexities

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

of coordinating across multiple tiers of suppliers, subcontractors, and clients, and regulatory bodies.

A third cross-cutting observation is the relative scarcity of research that systematically addresses the socio-technical and organizational factors governing AI adoption. The studies that do explore adoption barriers [114], [88] consistently identify high initial costs, skill gaps, data quality issues, and resistance to change as primary obstacles, yet these findings are rarely integrated with the technical model development literature. This suggests a significant disconnect between the communities focused on algorithm design and those concerned with implementation and change management. Furthermore, we note a pronounced imbalance in the geographic distribution of the included studies, with a heavy concentration of research originating from China, India, and a few developed economies, while the construction sectors in many developing nations, which are often characterized by even more fragmented and less digitized supply chains, remain dramatically underrepresented. This geographic bias carries implications for the generalizability of the synthesized findings and for the development of context-sensitive AI solutions.

The theoretical implications of our synthesis are multifaceted. Our findings extend the resource-based view of the firm, which has been a dominant framework in strategic management, by providing concrete evidence that AI capabilities can serve as strategic resources for building supply chain resilience [27], [71]. Our work suggests that these capabilities are not merely incremental improvements but can fundamentally alter a firm's ability to sense, seize, and reconfigure its supply chain operations in response to disruptions. However, our review also reveals that this resource-based perspective has been applied primarily at the level of the individual firm, and there is a clear need for theoretical frameworks that can account for the distributed, network-level dynamics of AI adoption across a construction supply chain comprising many autonomous actors with divergent interests and capabilities. The dynamic capabilities framework offers a promising lens, but its application to this context remains nascent. Furthermore, our synthesis supports the emerging perspective that Industry 5.0, with its emphasis on human-centricity, sustainability, and resilience, provides a more appropriate guiding philosophy for AI in construction than the purely efficiency-driven logic of Industry 4.0 [112]. This suggests that future theoretical work should move beyond techno-centric models of automation towards frameworks that conceptualize AI as a tool for augmenting human expertise and fostering collaborative intelligence across the supply chain.

The practical implications of this review are significant for a range of stakeholders. For practitioners, including construction project managers, procurement officers, and logistics coordinators, our synthesis provides a structured taxonomy of the current AI capabilities and their demonstrated applications. A key takeaway is that while the promise is substantial, the implementation of AI in construction supply chains should not be approached as a one-size-fits-all solution. Instead, practitioners should begin by clearly identifying the most pressing specific problems they face—be it demand forecasting inaccuracy, supplier vulnerability, or carbon tracking—and then selectively adopt the most mature and validated techniques from the corresponding to that problem. For example, a firm struggling with material waste due to poor demand forecasting could benefit from established LSTM-based prediction models [13], while

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189

http://amresearchreview.com/index.php/Journal/about

a firm concerned about supplier financial stability might consider implementing risk prediction frameworks using gradient boosting or random forest classifiers [32]. Furthermore, our findings strongly indicate that technical deployment alone is insufficient; successful adoption requires concurrent investment in data infrastructure, workforce upskilling, and change management processes to overcome organizational strategies that address resistance to change [114]).

Policymakers and industry associations can draw several actionable insights from our synthesis. First, there is a clear need for standardized data formats and interoperability protocols to facilitate the flow of information across fragmented construction supply chains, multi-tier construction supply chains. The proposal for a unified resources marking system [124] is a concrete step in this direction that could be scaled through industry-wide mandates or incentives. Second, policymakers should consider funding large-scale, multi-year pilot projects that demonstrate the real-world impact of integrated AI systems on construction project outcomes, as the current evidence base is insufficient to justify widespread adoption. Third, the findings regarding the challenges of data privacy and security in federated learning contexts [34] and blockchain-AI integration [94] suggest that regulatory frameworks for data governance in construction supply chains are urgently needed to build trust and enable responsible data sharing.

The limitations of this systematic review must be explicitly acknowledged to appropriately contextualize its conclusions. First, despite our comprehensive search strategy across six databases, it is possible that we missed relevant studies published in sources not indexed by these databases, such as proprietary industry reports or non-English-language journals. Given the rapid pace of technological development in this field, it is also possible that important recent preprints or conference presentations were not yet captured at the time of our search in May 2025. Second, our exclusive reliance on peer-reviewed journal articles published in peer-reviewed journals and conference proceedings may have introduced a publication bias, as positive results demonstrating high model performance are more likely to be submitted and accepted for publication than null or negative findings. This bias could lead to an overestimation of the effectiveness of AI techniques in construction supply chain contexts. Third, the subjective nature of our quality assessment and thematic coding, while mitigated by dual-reviewer processes and consensus discussions, remains a potential source of bias. Different research teams might have categorized a given study differently across our seven dimensions, which could alter the apparent prominence of certain themes. Fourth, our focus on English-language publications introduces a linguistic bias that may underrepresent research conducted in non-English-speaking regions, particularly in parts of Asia, the Middle East, and South America where a significant amount of construction activity takes place. Finally, the rapidly evolving nature of the technologies under review means that the landscape we have mapped is a snapshot in time, and the relative prominence of different applications and challenges may shift significantly within a short period.

Based on the gaps and inconsistencies identified in our synthesis, we propose several concrete directions for future research. First, there is an urgent need for longitudinal, real-world validation studies that track the performance of AI-driven construction supply chain systems over the full lifecycle of multiple projects. These studies should

Annual Methodological Archive Research Review
http://amresearchreview.com/index.php/Journal/about
Volume 4, Issue 6 (2026)

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

go beyond reporting technical accuracy metrics to capture the actual impact on project cost, schedule performance schedule, material waste, and stakeholder satisfaction. They should also systematically document the organizational, cultural, data-driven, and infrastructural challenges encountered during implementation. This type of evidence, currently almost absent from the literature, would provide a far more robust basis for evaluating the true value proposition of AI in this context. Second, future research should explore the potential for developing and validating federated learning frameworks51] it is a crucial direction that has only begun to be explored [34] which a very important direction that is only beginning to be explored [34] that respect the privacy and proprietary data boundaries between firms in construction supply chains without sacrificing model performance.

Third, the intersection of generative AI with construction supply chain management is an understudied area with immense potential. Future research should systematically investigate how large language models can be used not only for automating documentation and procurement processes [9], but also for generating synthetic training data for predictive models, simulating supplier negotiation scenarios, and providing intuitive, natural language interfaces for querying complex supply chain data. The robustness, hallucination risks, and domain-specific limitations of these models in this high-stakes context need careful examination. Fourth, there is a need for more theoretically grounded research that integrates insights from organizational behavior, innovation diffusion, and strategic management to explain and predict the adoption of AI technologies in construction supply chains. Future studies should test and extend existing adoption frameworks, such as the technology acceptance model or the diffusion of innovations theory, within the unique context of construction to understand the relative importance of different drivers and barriers. The multi-stakeholder, project-based nature of the industry suggests that co-innovation frameworks and ecosystem-level perspectives may be particularly valuable lenses that deserve further concentrated attention.

Fifth, the development of AI systems that can handle the dynamic, site-specific, and often data-sparse nature of construction projects remains a pressing challenge. Future research should explore transfer learning and domain adaptation techniques that allow models pre-trained on data from one project or region to be effectively fine-tuned for another, thereby alleviating the need for large, locally collected datasets. The integration of expert knowledge and physical constraints into neural network architectures, through techniques such as physics-informed neural networks, is another promising avenue for improving model robustness in environments where data is both scarce and noisy. Sixth, the sustainability dimension, while growing, is often conceptualized narrowly. Future research should expand the scope of AI-driven sustainability assessment to include a broader range of environmental and social indicators within that of environmental, social, and governance (ESG) frameworks. There is also a need for studies that develop and validate AI-driven decision-support tools that can simultaneously optimize for cost, schedule, and carbon footprint, thereby enabling truly multi-objective supply chain management. The integration of AI with life cycle assessment (LCA) tools in a dynamic, project-specific manner is a direction that remains largely unexplored.

Finally, we emphasize the need for methodological diversity in future research. The

Online ISSN 3007-3197
Print ISSN 3007-3189

current literature is overwhelmingly dominated by quantitative modeling studies, with very few qualitative case studies, action research projects, or mixed-methods investigations that can capture the rich, contextual, and human dimensions of AI adoption. Future research should explore how AI systems are perceived, negotiated, and used by different actors in practice, it is essential to balance the focus on algorithmic innovation with a deeper understanding of the human and organizational factors that ultimately determine whether these technologies translate into sustained improvements in construction supply chain performance. The development of human-AI teaming frameworks that define complementary roles for human judgment and machine intelligence in supply chain decision-making represents a particularly fertile area for interdisciplinary investigation.

Conclusion

This systematic literature review has mapped the fragmented but rapidly accelerating research landscape concerning deep learning and artificial intelligence applications within construction supply chain management. We have synthesized 133 studies into seven thematic dimensions, revealing a field characterized by sophisticated technical model development that nonetheless remains predominantly at the proof-of-concept stage. The core finding of this review is that a substantial and persistent gap exists between the demonstrated predictive and optimization capabilities of AI algorithms and their validated, scalable deployment within the dynamic, multi-stakeholder, and risk-averse operational realities of the construction industry. Our synthesis suggests that while AI-driven solutions for demand forecasting, risk prediction, and sustainability assessment are technically mature, their practical impact on project-level outcomes remains largely unsubstantiated by longitudinal, real-world evidence.

The theoretical contribution of this work lies in its provision of a structured taxonomy that organizes a scattered body of literature, thereby enabling a holistic understanding of how these technologies are being applied and where the critical knowledge gaps reside. For practitioners, our review delineates concrete capabilities that are readily adoptable, while also cautioning that technical deployment must be accompanied by concurrent investment in data infrastructure, workforce development, and change management. Future research must prioritize longitudinal validation studies on live construction projects, explore federated and privacy-preserving learning frameworks, and integrate insights from organizational behavior to understand adoption dynamics. The convergence of generative AI, digital twins, and blockchain presents a particularly promising frontier, yet its empirical foundation remains thin. Without a concerted shift towards rigorous, system-level validation and interdisciplinary inquiry, the transformative potential of AI in construction supply chain management risks remaining largely unrealized.

References

[1] M. Hussein, A. Eltoukhy, A. Karam, I. Shaban, *et al.*, “Modelling in off-site construction supply chain management: A review and future directions for sustainable modular integrated construction,” *Journal of Cleaner Production*, 2021.

[2] S. Kim and V. Nguyen, “Supply chain management in construction: Critical

Online ISSN 3007-3197
Print ISSN 3007-3189

study of barriers to implementation," *International Journal of Construction Management*, 2022.

[3] Y. Ebrahimy, S. AbouRizk, S. Fernando, *et al.*, "Simulation modeling and sensitivity analysis of a tunneling construction project's supply chain," *Engineering, Construction and Architectural Management*, 2011.

[4] P. E. Eriksson, "Improving construction supply chain collaboration and performance: A lean construction pilot project," *Supply Chain Management: An International Journal*, 2010.

[5] Y. LeCun, Y. Bengio, and G. Hinton, "Deep learning," *nature*, 2015.

[6] J. Schmidhuber, "Deep learning in neural networks: An overview," *Neural networks*, 2015.

[7] S. Abioye, L. Oyedele, L. Akanbi, A. Ajayi, *et al.*, "Artificial intelligence in the construction industry: A review of present status, opportunities and future challenges," *Journal of Building Engineering*, 2021.

[8] R. Toorajipour, V. Sohrabpour, A. Nazarpour, *et al.*, "Artificial intelligence in supply chain management: A systematic literature review," *Journal of Business Research*, 2021.

[9] N. Rane, "ChatGPT and similar generative artificial intelligence (AI) for smart industry: Role, challenges and opportunities for industry 4.0, industry 5.0 and society 5.0," *Challenges and Opportunities for Industry*, 2023.

[10] G. Shang, S. Low, and X. Lim, "Prospects, drivers of and barriers to artificial intelligence adoption in project management," *Built Environment Project and Asset Management*, 2023.

[11] M. Page, J. McKenzie, P. Bossuyt, *et al.*, "The PRISMA 2020 statement: An updated guideline for reporting systematic reviews," *BMJ*, vol. 372, p. n71, 2021.

[12] E. Orduna-Malea, A. M. Martín, *et al.*, "Google scholar as a source for scholarly evaluation: A bibliographic review of database errors," digibug.ugr.es, 2017.

[13] A. E. Filali, E. Lahmer, S. E. Filali, M. Kasbouya, *et al.*, "Machine learning applications in supply chain management: A deep learning model using an optimized LSTM network for demand forecasting." *International Journal of Advanced Computer Science and Applications*, 2022.

[14] R. Carbonneau, K. Laframboise, and R. Vahidov, "Application of machine learning techniques for supply chain demand forecasting," *European Journal of Operational Research*, 2008.

[15] S. Panda and S. Mohanty, "Time series forecasting and modeling of food demand supply chain based on regressors analysis," *Ieee Access*, 2023.

[16] S. Kalisetty and P. Lakarasu, "Deep learning frameworks for multi-modal data fusion in retail supply chains: Enhancing forecast accuracy and agility," *Available at SSRN 5204878*, 2024.

[17] J. Feizabadi, "Machine learning demand forecasting and supply chain performance," *International Journal of Logistics Research and Applications*, 2022.

[18] V. Mittal, "Inventory optimization using machine learning: Advanced forecasting for multi-channel supply chains," *Available at SSRN 5386001*,

Online ISSN 3007-3197
Print ISSN 3007-3189

2024.

[19] S. Islam and S. Amin, "Prediction of probable backorder scenarios in the supply chain using distributed random forest and gradient boosting machine learning techniques," *Journal of big data*, 2020.

[20] Y. Guan, Y. Huang, and H. Qin, "Inventory management optimization of green supply chain using IPSO-BPNN algorithm under the artificial intelligence," *Wireless Communications and Mobile Computing*, 2022.

[21] R. Dash, M. McMurtrey, C. Rebman, *et al.*, "Application of artificial intelligence in automation of supply chain management," *Journal of Strategic Management*, 2019.

[22] S. Makkar, G. Devi, and V. Solanki, "Applications of machine learning techniques in supply chain optimization," in *International conference on intelligent computing*, 2019.

[23] H. Narne, "Optimizing supply chain management with machine learning algorithms," *Technology (IJARET)*, 2021.

[24] Y. Li and T. Chen, "ISCCO: A deep learning feature extraction-based strategy framework for dynamic minimization of supply chain transportation cost losses," *PeerJ Computer Science*, 2024.

[25] S. Jomthanachai, W. Wong, and K. Khaw, "An application of machine learning to logistics performance prediction: An economics attribute-based of collective instance," *Computational economics*, 2024.

[26] G. Melançon, P. Grangier, *et al.*, "A machine learning-based system for predicting service-level failures in supply chains," *INFORMS Journal on Applied Analytics*, 2021.

[27] L. Wong, G. Tan, K. Ooi, B. Lin, *et al.*, "Artificial intelligence-driven risk management for enhancing supply chain agility: A deep-learning-based dual-stage PLS-SEM-ANN analysis," *International Journal of Production Research*, 2024.

[28] S. Mukherjee, M. Baral, R. Nagariya, *et al.*, "Artificial intelligence-based supply chain resilience for improving firm performance in emerging markets," *Journal of Global Operations and Strategic Sourcing*, 2024.

[29] C. Atakari, "The influence of AI-enabled predictive analytics on ERP-based strategic planning in defense supply chains," *International Journal of Emerging Research in Engineering and Technology*, 2025.

[30] M. Wyrembek, G. Baryannis, *et al.*, "Causal machine learning for supply chain risk prediction and intervention planning," *International Journal of Production Research*, 2025.

[31] E. Kosasih, F. Margaroli, S. Gelli, A. Aziz, *et al.*, "Towards knowledge graph reasoning for supply chain risk management using graph neural networks," *International Journal of Production Research*, 2024.

[32] A. Sheikh, K. Goodrich, and S. Sajja, "AI-powered forecasting for supply chain resilience: Applications of logistic regression, random forest, and XGBoost in the US context," *Am. J. Innov. Sci. Eng*, 2025.

[33] E. Onukwulu, M. Agho, *et al.*, "Developing a framework for AI-driven optimization of supply chains in energy sector," *Global Journal of Engineering and Technology Advances*, 2023.

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

[34] L. Kong, G. Zheng, and A. Brintrup, "A federated machine learning approach for order-level risk prediction in supply chain financing," *International Journal of Production Economics*, 2024.

[35] M. Lokanan and V. Maddhesia, "Supply chain fraud prediction with machine learning and artificial intelligence," *International Journal of Production Research*, 2025.

[36] A. Yeboah-Ofori, H. Mouratidis, U. Ismai, S. Islam, *et al.*, "Cyber supply chain threat analysis and prediction using machine learning and ontology," in *International conference on artificial intelligence and security*, 2021.

[37] D. Nersessian and D. Pachamanova, "Human trafficking in the global supply chain: Using machine learning to understand corporate disclosures under the uk modern slavery act," *Harv. Hum. Rts. J.*, 2022.

[38] P. Dey, S. Chowdhury, A. Abadie, *et al.*, "Artificial intelligence-driven supply chain resilience in vietnamese manufacturing small-and medium-sized enterprises," *International Journal of Production Research*, 2024.

[39] D. Li, B. Zhi, T. Schoenherr, and X. Wang, "Developing capabilities for supply chain resilience in a post-COVID world: A machine learning-based thematic analysis," *IISE Transactions*, 2023.

[40] K. Sun, K. Ooi, G. Tan, and V. Lee, "Enhancing supply chain resilience in SMEs: A deep learning-based approach to managing covid-19 disruption risks," *Journal of Enterprise Information Management*, 2023.

[41] A. Rashid, R. Rasheed, A. Ngah, *et al.*, "Unleashing the power of cloud adoption and artificial intelligence in optimizing resilience and sustainable manufacturing supply chain in the USA," *Journal of Manufacturing Technology Management*, 2024.

[42] M. Camur, S. Ravi, and S. Saleh, "Enhancing supply chain resilience: A machine learning approach for predicting product availability dates under disruption," *Expert systems with applications*, 2024.

[43] G. Țîrcovnicu and C. Hațegan, "Integration of artificial intelligence in the risk management process: An analysis of opportunities and challenges," *Journal of Financial Studies*, 2023.

[44] C. Ju and T. Trinh, "A machine learning approach to supply chain vulnerability early warning system: Evidence from US semiconductor industry," *Journal of Advanced Computing Systems*, 2023.

[45] K. Beta, S. Nagaraj, and T. Weerasinghe, "The role of artificial intelligence on supply chain resilience," *Journal of Enterprise Information Management*, 2025.

[46] F. A. Ganjouei, T. Mokkhamakkul, *et al.*, "Artificial intelligence in the sustainable supply chain management of the civil engineering projects," *Journal of Soft Computing in Civil Engineering*, 2026.

[47] F. Alqahtani, M. Shafaay, E. Alagha, O. Ahmed, *et al.*, "Risk factors influencing construction supply chain management in saudi arabia," *Scientific Reports*, 2026.

[48] Z. Ismail, "Hybrid intelligent vehicle system for managing construction supply chain in precast concrete building construction projects," *World Journal of Engineering*, 2021.

Online ISSN 3007-3197
Print ISSN 3007-3189

[49] M. Samadder, A. Roy, A. Ray, S. Rakshit, *et al.*, "Investigating the impact of artificial intelligence and digital technologies on improving safety in construction environments," *International Journal of Engineering Innovation and Management*, 2025.

[50] A. B. Gomes and M. Saeed, "Artificial intelligence for supply chain optimization in the construction industry: A data-driven approach," *Available at SSRN 5258283*, 2025.

[51] S. Kothapalli, "Real-time resource allocation optimization for dynamic construction job sites using deep reinforcement learning: A case study implementation," *International Journal of Artificial Intelligence, Data Science and Machine Learning*, 2025.

[52] L. Wu, W. Lu, Y. Zou, H. An, and B. Wang, "Agentic artificial intelligence of things (AIoT) for just-in-time (JIT) logistics and supply chain: A case of modular construction," *International Journal of Logistics Research and Applications*, 2026.

[53] S. Qutub, S. Baajajah, D. Alqalayta, S. Ali, *et al.*, "Evaluating green supply management practices for measuring subcontractor sustainable performance in the construction industry using SEM and ML performance …," *International Journal of Construction Management*, 2026.

[54] S. Egwunatum, N. Anosike, *et al.*, "Weighing on the capabilities of big data analytics for sustainable supply chain management in construction projects," *Journal of Sustainability*, 2026.

[55] U. Onyia, I. Ani, and U. Nwankwo, "Addressing the challenges towards the adoption of digital technologies in construction supply chain management," *Discover Civil Engineering*, 2024.

[56] R. Matarneh and B. Mohsen, "Exploring the implementation of digital technologies in supply chain management within the jordanian construction industry," *Procedia Computer Science*, 2024.

[57] T. Cherian and C. Arun, "Digital transformation in supply chain management: A conceptual framework for construction industry," *Indian Journal of Economics and Development*, 2021.

[58] O. Dosumu, J. Tinyimana, *et al.*, "Critical drivers of artificial intelligence (AI) adoption in construction projects: Evidence from a developing economy," *International Journal of Construction Management*, 2026.

[59] Y. Xu, M. Chi, C. Lee, H. Chong, *et al.*, "Effects of the blockchain and artificial intelligence on value cocreation in construction projects: A mixed methods study," *Journal of Construction Engineering and Management*, 2025.

[60] M. Hriday and A. Rehman, "Artificial intelligence and machine learning applications in construction project management: Enhancing scheduling, cost estimation, and risk mitigation," *International Journal of Business and Emerging Industries*, 2025.

[61] S. Savaş, "Artificial intelligence in construction project management: Trends, challenges and future directions," *Journal of Design for Resilience in Architecture and Planning*, 2025.

[62] Y. Jezzini, R. Assaad, and I. El-Adaway, "… framework to quantify and gauge project cost risks due to construction material price volatilities using

Online ISSN 3007-3197
Print ISSN 3007-3189

predictive probabilistic deep-learning algorithms and stochastic …," *Journal of Construction Engineering and Management*, 2025.

[63] S. Shruthi, L. Judson, and V. Paul, "Addressing the challenges in cost management of construction projects by using AI," *Journal of Structural Technology*, 2025.

[64] B. Seyisoglu, A. Shahpari, and M. Talebi, "Predictive project management in construction: A data-driven approach to project scheduling and resource estimation using machine learning," *Available at SSRN 5077301*, 2024.

[65] B. Demiss and W. Elsaigh, "Application of novel hybrid deep learning architectures combining convolutional neural networks (CNN) and recurrent neural networks (RNN): Construction duration …," *Engineering Research Express*, 2024.

[66] Z. Zeng and Y. Gao, "Progress management of prefabricated construction projects based on combination of machine learning and multi-objective optimization," *International Journal of Low-Carbon Technologies*, 2025.

[67] B. Manu, "Leveraging artificial intelligence for optimized project management and risk mitigation in construction industry," *World Journal of Advanced Research and Reviews*, 2024.

[68] C. Soni, "Leveraging artificial intelligence for predictive and adaptive decision-making in construction project management," *International Journal of Technology, Management and Humanities*, 2025.

[69] F. Shoushtari, A. Daghighi, and E. Ghafourian, "Application of artificial intelligence in project management," *International Journal of Industrial Engineering and Operations Research*, 2024.

[70] R. Nyqvist, A. Peltokorpi, *et al.*, "Integration of generative artificial intelligence across construction management," in *IOP conference series: Earth and environmental science*, 2024.

[71] N. Rane, S. Choudhary, and J. Rane, "Artificial intelligence for enhancing resilience," *Journal of Applied Artificial Intelligence*, 2024.

[72] C. Anumba and R. Khallaf, "Use of artificial intelligence to improve knowledge management in construction," in *IOP conference series: Earth and environmental science*, 2022.

[73] J. Lewis, H. Odeyinka, and R. Eadie, "Innovative construction procurement selection through an artificial intelligence approach," *Management*, 2011.

[74] M. Hossain, L. Hasan, M. Dewan, *et al.*, "The impact of artificial intelligence on project management efficiency," *International Journal of Research Publication and Reviews*, 2024.

[75] D. Cisterna, S. Lauble, S. Haghsheno, *et al.*, "Synergies between lean construction and artificial intelligence: AI driven continuous improvement process," in *Proceedings of the 30th annual conference of the international group for lean construction*, 2022.

[76] J. Rosenbaum and N. Bartels, "Strategic implementation of artificial intelligence (AI) in construction: An integrated change and innovation management approach," *Discover Civil Engineering*, 2026.

[77] Z. Lin, D. Jiang, and J. Liu, "AI-enabled digital transformation in the construction industry: A comprehensive framework for smart construction

Online ISSN 3007-3197
Print ISSN 3007-3189

management," in *Proceedings of*, 2025.

[78] A. Kineber, N. Elshaboury, A. Oke, J. Aliu, Z. Abunada, *et al.*, "Revolutionizing construction: A cutting-edge decision-making model for artificial intelligence implementation in sustainable building projects," *Heliyon*, 2024.

[79] F. Salih and I. El-Adaway, "Investigating the correlation and synergy of artificial intelligence techniques, construction technologies, and their key benefits," *Journal of Architectural Engineering*, 2025.

[80] M. Adeel, S. Zaib, M. Awaz, M. Ali, *et al.*, "Building information modeling and artificial intelligence based smart construction management: Materials and electrical," *European Journal of Electrical Engineering and Computer Science*, 2023.

[81] B. Prieto, "Impacts of artificial intelligence on management of large complex projects," *PM World Journal*, 2019.

[82] Z. Mustapha, B. Akomah, O. Kwaku, *et al.*, "Harnessing artificial intelligence for transformative impact in the ghanaian construction sector." *Journal of Applied Science and Engineering Research*, 2024.

[83] R. Huang and S. Mao, "Carbon footprint management in global supply chains: A data-driven approach utilizing artificial intelligence algorithms," *Ieee Access*, 2024.

[84] M. Rahman, M. Islam, M. Tabassum, *et al.*, "Climate-aware decision intelligence: Integrating environmental risk into infrastructure and supply chain planning," *Saudi Journal of Engineering and Applied Technologies*, 2025.

[85] T. Liu, X. Guan, Z. Wang, T. Qin, R. Sun, and Y. Wang, "Optimizing green supply chain circular economy in smart cities with integrated machine learning technology," *Heliyon*, 2024.

[86] T. Ramadoss, H. Alam, and R. Seeram, "Artificial intelligence and internet of things enabled circular economy," *The International Journal of Engineering and Advanced Technology*, 2018.

[87] I. Zejjari and I. Benhayoun, "The use of artificial intelligence to advance sustainable supply chain: Retrospective and future avenues explored through bibliometric analysis," *Discover Sustainability*, 2024.

[88] B. Ameh, "Technology-integrated sustainable supply chains: Balancing domestic policy goals, global stability, and economic growth," *Int J Sci Res Arch*, 2024.

[89] I. Ahmed, Y. Zhang, G. Jeon, W. Lin, *et al.*, "A blockchain-and artificial intelligence-enabled smart IoT framework for sustainable city," *International Journal of Intelligent Systems*, 2022.

[90] K. Khlie, Z. Benmamoun, I. Jebbor, *et al.*, "Generative AI for enhanced operations and supply chain management," *Journal of Infrastructure, Policy and Development*, 2024.

[91] M. Ashraf, A. Eltawil, and I. Ali, "Disruption detection for a cognitive digital supply chain twin using hybrid deep learning," arXiv preprint arXiv:2309.14557, 2023.

[92] J. Wang and R. Jia, "AI-enhanced what-if scenario analysis in supply chain

Online ISSN 3007-3197
Print ISSN 3007-3189

digital twins: A multi-objective trade-off perspective on cost, resilience, and carbon efficiency," *Journal of Computing Innovations and Applications*, 2026.

[93] J. Luo and Z. Xu, "Research on the construction of supply chains of digital twin aquatic products using artificial intelligence," in *Proceedings of*, 2024.

[94] V. Charles, A. Emrouznejad, and T. Gherman, "A critical analysis of the integration of blockchain and artificial intelligence for supply chain," *Annals of operations research*, 2023.

[95] O. Rodríguez-Espíndola, S. Chowdhury, *et al.*, "The potential of emergent disruptive technologies for humanitarian supply chains: The integration of blockchain, artificial intelligence and 3D printing," *International Journal of Production Research*, 2020.

[96] A. Bhargava, D. Bhargava, P. Kumar, G. Sajja, *et al.*, "Industrial IoT and AI implementation in vehicular logistics and supply chain management for vehicle mediated transportation systems," *International Journal of System Assurance Engineering and Management*, 2022.

[97] L. Owusu-Berko, "Advanced supply chain analytics: Leveraging digital twins, IoT and blockchain for resilient, data-driven business operations," *World Journal of Advanced Research and Reviews*, 2025.

[98] S. Bag, M. Rahman, G. Srivastava, *et al.*, "Unveiling metaverse potential in supply chain management and overcoming implementation challenges: An empirical study," *Business Process Management Journal*, 2025.

[99] Y. Adeoye, E. Onotole, T. Ogunyankinnu, *et al.*, "Artificial intelligence in logistics and distribution: The function of AI in dynamic route planning for transportation, including self-driving trucks and drone delivery …," *World Journal of Advanced Research and Reviews*, 2025.

[100] E. Ochieng, D. Ominde, and T. Zuofa, "Potential application of generative artificial intelligence and machine learning algorithm in oil and gas sector: Benefits and future prospects," *Technology in Society*, 2024.

[101] J. Muthu, "Recent trends in supply chain management using artificial intelligence and machine learning in manufacturing," *Educational Administration: Theory and Practice, 30 (6)*, 2024.

[102] V. Cannas, M. Ciano, M. Saltalamacchia, *et al.*, "Artificial intelligence in supply chain and operations management: A multiple case study research," *International Journal of Production Research*, 2024.

[103] A. Chopra, "AI in supply & procurement," in *International conference on artificial intelligence*, 2019.

[104] A. Kulkarni and C. Xu, "A deep learning approach in optical inspection to detect hidden hardware trojans and secure cybersecurity in electronics manufacturing supply chains," *Frontiers in Mechanical Engineering*, 2021.

[105] E. Onukwulu, M. Agho, N. Eyo-Udo, *et al.*, "Advances in automation and AI for enhancing supply chain productivity in oil and gas," *International Journal of Research*, 2024.

[106] S. Saha, A. Ghimire, M. Manik, A. Tiwari, *et al.*, "Exploring benefits, overcoming challenges, and shaping future trends of artificial intelligence application in agricultural industry," *The American Journal of Agricultural Economics*, 2024.

Online ISSN 3007-3197
Print ISSN 3007-3189
http://amresearchreview.com/index.php/Journal/about

[107] M. Siropyan, O. Celikel, and O. Pinarer, "Artificial intelligence driven vertical farming management system," in *Proceedings of the world congress on civil, structural, and environmental engineering*, 2022.
[108] M. D. Capua, A. Ciaramella, and A. D. Prisco, "Machine learning and computer vision for the automation of processes in advanced logistics: The integrated logistic platform (ILP) 4.0," *Procedia Computer Science*, 2023.
[109] P. Muntala, "Prescriptive AI in procurement: Using oracle AI to recommend optimal supplier decisions," *International Journal of AI, Big Data, Computational Intelligence and Machine Learning*, 2021.
[110] F. Ahmed, M. Ahmed, M. Kabir, *et al.*, "Revolutionizing business analytics: The impact of artificial intelligence and machine learning." *American Journal of Advanced Technology and Engineering Solutions*, 2025.
[111] M. Cummings, "Rethinking the maturity of artificial intelligence in safety-critical settings," *Ai Magazine*, 2021.
[112] I. Taj and N. Zaman, "Towards industrial revolution 5.0 and explainable artificial intelligence: Challenges and opportunities," *International Journal of Computing and Digital Systems*, 2022.
[113] A. E. Jaouhari, J. Arif, S. Fellaki, M. Amejwal, *et al.*, "Lean supply chain management and industry 4.0 interrelationships: The status quo and future perspectives," *International Journal of Lean Six Sigma*, 2023.
[114] M. Tariq, M. Poulin, and A. Abonamah, "Achieving operational excellence through artificial intelligence: Driving forces and barriers," *Frontiers in psychology*, 2021.
[115] M. Arun, D. Barik, S. Chandran, *et al.*, "Economic, policy, social, and regulatory aspects of AI-driven smart buildings," *Journal of Building Engineering*, 2025.
[116] A. George, "Future economic implications of artificial intelligence," *Partners Universal International Research Journal*, 2023.
[117] S. Raza, S. Govindaluri, and M. Bhutta, "Research themes in machine learning applications in supply chain management using bibliometric analysis tools," *Benchmarking: An International Journal*, 2023.
[118] I. Zrelli and A. Rejeb, "A bibliometric analysis of IoT applications in logistics and supply chain management," *Heliyon*, 2024.
[119] M. Khan, D. Schaefer, and J. Milisavljevic-Syed, "Supply chain management 4.0: Looking backward, looking forward," *Procedia CIRP*, 2022.
[120] F. Huang and L. Cheng, "Distant supervision knowledge extraction and knowledge graph construction method for supply chain management domain," *Autonomous Intelligent Systems*, 2024.
[121] R. Chatterjee, "Fundamental concepts of artificial intelligence and its applications," *Journal of Mathematical Problems, Equations and Statistics*, 2020.
[122] I. Sarker, "Deep learning: A comprehensive overview on techniques, taxonomy, applications and research directions," *SN computer science*, 2021.
[123] L. Mañay, O. Rodríguez, *et al.*, "Supply chains and artificial intelligence: An approach to the state of the art," *Journal of Industrial Integration and Management*, 2024.

Online ISSN 3007-3197
Print ISSN 3007-3189

[124] A. Ginzburg, O. Kuzina, and A. Ryzhkova, "Unified resources marking system as a way to develop artificial intelligence in construction," in *IOP conference series: Materials science and engineering*, 2018.

[125] H. Singh, "Artificial intelligence and robotics transforming industries with intelligent automation solutions," *Available at SSRN 5267868*, 2020.

[126] O. Kufile, O. Akinrinoye, S. Umezurike, O. Ejike, *et al.*, "Advances in data-driven decision-making for contract negotiation and supplier selection," *International Journal of …, 2022*, 2022.

[127] Y. Chou, H. Chuang, P. Chou, *et al.*, "Supervised machine learning for theory building and testing: Opportunities in operations management," *Journal of Operations Management*, 2023.

[128] L. Ren, Z. Jia, Y. Laili, and D. Huang, "Deep learning for time-series prediction in IIoT: Progress, challenges, and prospects," *IEEE Transactions on Neural Networks and Learning Systems*, 2023.

[129] M. Lin, Y. Ren, C. Feng, and X. Li, "Analyzing resilience influencing factors in the prefabricated building supply chain based on SEM-SD methodology," *Scientific Reports*, 2024.