# Driving Sustainable Construction in Saudi Arabia: The Enabling Role of Technological Innovation and Knowledge Management Aligned to Vision 2030

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**Abstract:** Globally, enterprises are facing unprecedented disruption driven by rapid advances in digital technologies, shifting customer expectations, and new competitive models such as platform-based ecosystems. The construction industry remains one of the least digitally transformed sectors despite its significant environmental footprint, contributing approximately 37% of global carbon emissions. In the Kingdom of Saudi Arabia (KSA), sustainable construction is a strategic priority aligned with Vision 2030, emphasizing innovation and knowledge-driven development. However, a persistent gap exists between theoretical frameworks and the practical implementation of technological innovation (TI) and knowledge management (KM) in construction projects. This study investigates the enabling factors and constraints influencing the adoption of TI and KM practices in the KSA construction sector and evaluates their contribution to sustainable development and project performance. A mixed-methods approach is employed, combining a systematic literature review with empirical data from semi-structured interviews (n=12) and a survey of construction professionals (n=87). The findings reveal that while TI and KM significantly improve decision-making, operational efficiency, and sustainability outcomes, their implementation is hindered by factors such as limited digital competencies, fragmented industry structures, and uncertainty regarding return on investment. The study proposes an integrated '*People - Process -Technology - knowledge*' framework and contributes to knowledge management literature by linking digital transformation and organizational learning with sustainable construction practices. This study identifies critical enablers, including leadership commitment, organizational learning capabilities, and digital infrastructure readiness. This paper concludes by offering key recommendations and implications for policymakers and industry practitioners to accelerate sustainable development in the construction industry alignment to the KSA Vision 2030.

**Keywords:** Technological innovation, Knowledge management, Sustainable construction, Digital transformation, Organizational learning, KSA Vision 2030

## 1. Introduction

The construction industry is inherently knowledge-intensive, requiring effective coordination of information, expertise, and resources to deliver complex projects. Despite rapid advancements in digital technologies, the sector continues to lag behind others in adopting integrated digital and knowledge-driven practices. This limitation is particularly critical in the context of sustainability, where construction activities contribute significantly to global carbon emissions and resource depletion. The current sustainable project management practices increasingly make sure the strategic application of digital technologies and data analytics to better manage the complex and emerging industry challenges (Li et al., 2025). Consequently, construction development projects are progressively adopting technological innovation (TI) and knowledge management (KM) practices to enhance performance, despite the sector's historically slow pace of digital transformation. In Saudi Arabia, the transformation of the construction sector is central to achieving the goals outlined in Vision 2030. Digital technologies such as Building Information Modelling (BIM), Artificial Intelligence (AI), and big data analytics offer significant potential to enhance sustainability performance (Marović et al., 2025). However, the implementation of these technologies remains fragmented and inconsistent across project stakeholders.

Globally, the construction sector and its associated supply chains are responsible for nearly 37% of carbon emissions as per the Global Status Report for Buildings and Construction (UNEP, 2025). Despite this backdrop, this study aims to identify the continued unwillingness in adopting emerging digital technologies to support a comprehensive digital strategy for sustainable development specifically in context of KSA. However, the key barrier remains the perceived lack of clear economic returns for developers and investors, particularly when digital investments are not adequately aligned with project budgeting and financial planning (Plinta and Radwan, 2023). This study aims to explain the tangible advantages of practicing TI and KM in achieving sustainable development, while refining transparency in how project benefits are actualized to end beneficiaries.

Global construction output grew from USD 10.6 trillion in 2017 to approximately USD 12.7 trillion in 2022 (Jones, 2019), yet productivity in the sector has improved by only about 1% over the last two decades, mainly due to low levels of digital adoption (McKinsey, 2020). However, the digital transformation has the potential to

generate up to USD 1.6 trillion in additional value though its uptake remains inconsistent by 46% in the firms that are actively undergoing digital transformation, while 41% are still at early adoption stages (Chakraborty & Jain, 2022). From an environmental perspective, achieving net-zero carbon emissions by 2030 will rely on the extensive adoption of digital technologies, innovative construction practices, and knowledge-based project management approaches (Islam & Ali, 2024). Digital transformation, emerging technologies, and sustainability were initially treated as separate areas of research, but have progressively converged as stakeholders recognize that achieving sustainability goals requires strong digital capabilities for measurement, coordination, and governance (Abaker et al., 2026).

Digital technologies such as BIM, Data Analytics, Cloud, AI exemplify the transformative potential of TI and KM across construction projects planning, design, execution while enabling management (Purushothaman et al., 2025). However, when aligned with modular construction and prefabrication strategies, these innovations offer substantial opportunities to reduce carbon footprints and construction waste (Parracho et al., 2025). Recent literature highlights the growing use of Management Information Systems (MIS), BIM, AI, Machine Learning (ML), Augmented Reality (AR), and robotics in large-scale projects (Abaker et al., 2026; Doan et al., 2025; Datta et al., 2024). In similar contexts, the adoption of digital technologies remains limited, particularly in the case of Saudi Arabia (Olanipekun & Sutrisna, 2021). However, Saudi mega projects are beginning to exhibit signs of cultural and strategic transformation, with leadership increasingly recognizing the importance of integrating TI and KM practices to enhance sustainable construction performance (Alghuried, 2026).

### 1.1 Research Gap

While existing studies have examined technological innovation or knowledge management independently, there is limited research exploring their integrated role as interconnected enablers of sustainable construction, particularly within the KSA context. Furthermore, empirical evidence explaining how stakeholders perceive and adopt these practices remains insufficient.

### 1.2 Research aim and Objectives

This study aims to examine the role of TI and KM as integrated enablers of sustainable construction in Saudi Arabia whereas the main objectives are:

- To identify key enabling and constraining factors affecting TI and KM adoption
- To evaluate their impact on project performance and sustainability outcomes
- To analyze stakeholder perceptions and organizational readiness
- To develop an integrated framework supporting sustainable construction

## 2. Literature Review

Technological innovation has transformed industries globally, yet construction remains relatively under-digitized. Advanced technologies such as BIM, AI, IoT, and robotics have demonstrated potential to improve efficiency, reduce waste, and enhance safety. However, their adoption remains uneven due to organizational, financial, and cultural barriers (Al Mhdawi et al., 2024). The construction industry in KSA has recently started the application of MIS, supported by emerging technologies for some time now such as Building Information Modelling (BIM), Artificial Intelligence (AI), and Machine Learning (ML) across various mega project functions (Gohar, 2025). However, the adoption of such technological innovations remains uneven and limited, particularly due to insufficient integration across the early and critical stages of the project management lifecycle, including project conception, initiation, planning, design, and execution (Zhou et al., 2026).

### 2.1 Technological Innovation in Construction Industry

The rate of digital disruption has accelerated across most global industries; however, despite this rapid evolution, the construction sector continues to lag behind as one of the least engaged in comprehensive digital transformation (Al Mhdawi et al., 2024). The construction industry in KSA has started the application of MIS, supported by emerging technologies for some time now such as Building Information Modelling (BIM), Artificial Intelligence (AI), and Machine Learning (ML) across various mega project functions (Gohar, 2025). However, the adoption of such technological innovations remains uneven and limited, particularly due to insufficient integration across the early and critical stages of the project management lifecycle, including project conception, initiation, planning, design, and execution (Zhou et al., 2026).

In addition to digitalization, advanced technologies such as BIM, Augmented Reality (AR), robotics, and Modern Methods of Construction (MMC) are increasingly recognized as beneficial within construction practices;

however, their application remains fragmented rather than systematically embedded (Alsehaimi and Sanni-Anibire, 2026). In order to achieving knowledge-driven sustainable development requires a cohesive approach that aligns technological innovation with varying levels of industry readiness, innovation maturity, and adoption rates. This means in context of KSA, the construction industry is experiencing a sweeping transformation as innovative technologies revolutionize project management, enhancing efficiency, sustainability, and safety (Houlteurbe et al., 2025).

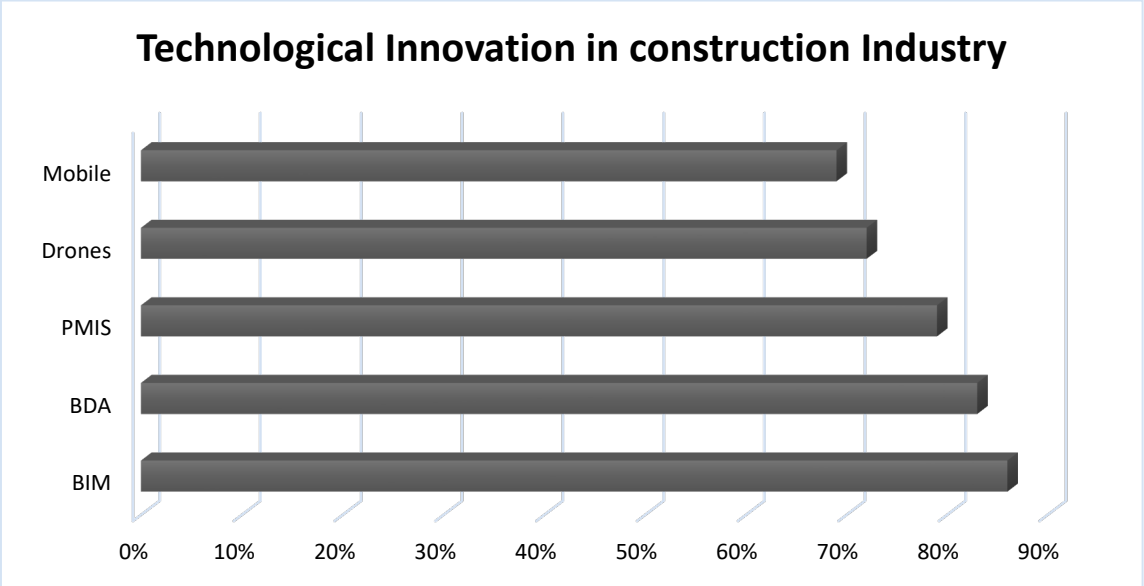


**Figure 1: Technological Innovation in construction Industry (Arab News, 2026)**

### 2.2 Knowledge Management Applications in Construction Projects

Knowledge management involves the systematic creation, transfer, and application of knowledge to enhance performance. In construction, KM facilitates learning from past projects, supports decision-making, and improves coordination among stakeholders. Integrating KM with digital tools enhances organizational learning and operational efficiency. The construction development projects inherently involve the creation, exchange, and utilization of knowledge, which must be effectively shared among team members and stakeholders to enhance overall performance (Khilji and Roberts, 2022).

Knowledge management refers to the capability of enhancing individual competencies, enabling practitioners to take effective and informed actions supported by technological innovation. In essence, KM involves the effective capture, distribution, and utilization of knowledge to support decision-making and performance improvement. Furthermore, digital technologies play a fundamental role in enabling KM processes. From the literature review, the key digital technologies supporting TI and KM in construction projects are discussed by various researchers including Abaker et al., (2026); Alghuried (2026); Arhinful et al., (2026), shown in Figure 2.

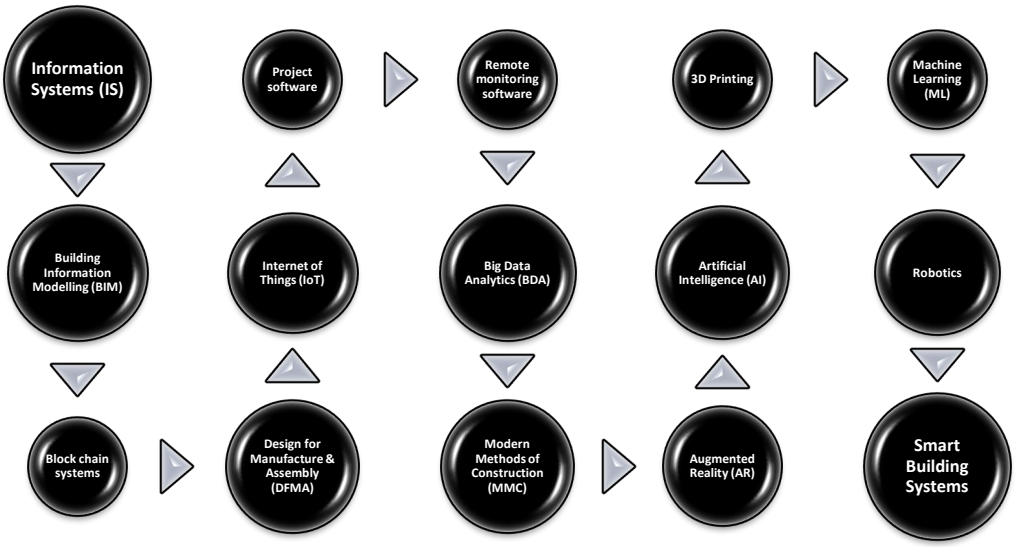


**Figure 2: TI and KM tools in construction industry (Abaker et al., (2026); Arhinful et al., (2026); Author)**

Knowledge management (KM) plays a vital role in the construction industry by facilitating collaboration and integrating lessons learned from project experiences into structured data repositories. These repositories support data analytics, classification, and database development, thereby contributing to continuous improvement (Haider et al., 2023). The effective application of KM practices such as systematic lesson-learned processes, data archiving, and efficient information-sharing mechanisms would significantly improve project efficiency. KM systems enable the dissemination and coordination of knowledge, fostering organizational learning while supporting the adoption of technological innovations. As organizations internalize knowledge and apply it to project management practices, they are better positioned to drive innovation in construction processes and achieve enhanced, long-term sustainable development (Arhinful et al., 2026).

In terms of the construction industry, knowledge management (KM) could be defined as the systematic process of generating, transferring, and applying knowledge to enhance project management practices, particularly in relation to scope, cost, time, quality, and overall team performance (Demirdogen, 2023). According to him, the construction industry has complicated, human-based, dynamic, and fragmented structure and for this reasons the effective Knowledge Management use is the key to eliminate risks and ensure project success. This highlights the critical importance of KM in promoting sustainable construction development, especially in an industry that continuously faces challenges such as limited resources, shortages of environmentally friendly materials, and financial constraints (Hui et al., 2024).

### 2.3 Sustainable Development in the KSA Construction Industry

Sustainable construction requires balancing environmental, economic, and social considerations. Digital technologies enable real-time monitoring, lifecycle analysis, and resource optimization, while KM supports knowledge sharing and continuous improvement. However, integration challenges remain, particularly in fragmented project environments. Mega construction projects across Saudi Arabia are increasingly influenced by technological innovation (TI) and knowledge management (KM) from project inception through to operations and asset maintenance. Furthermore, corporate social responsibility (CSR) plays a fundamental role by guiding stakeholders towards meaningful contributions across economic, social, political, and environmental dimensions, particularly when integrated with advanced technological applications, the research as the main author developed a conceptual model based on literature review as illustrated in Figure 3.

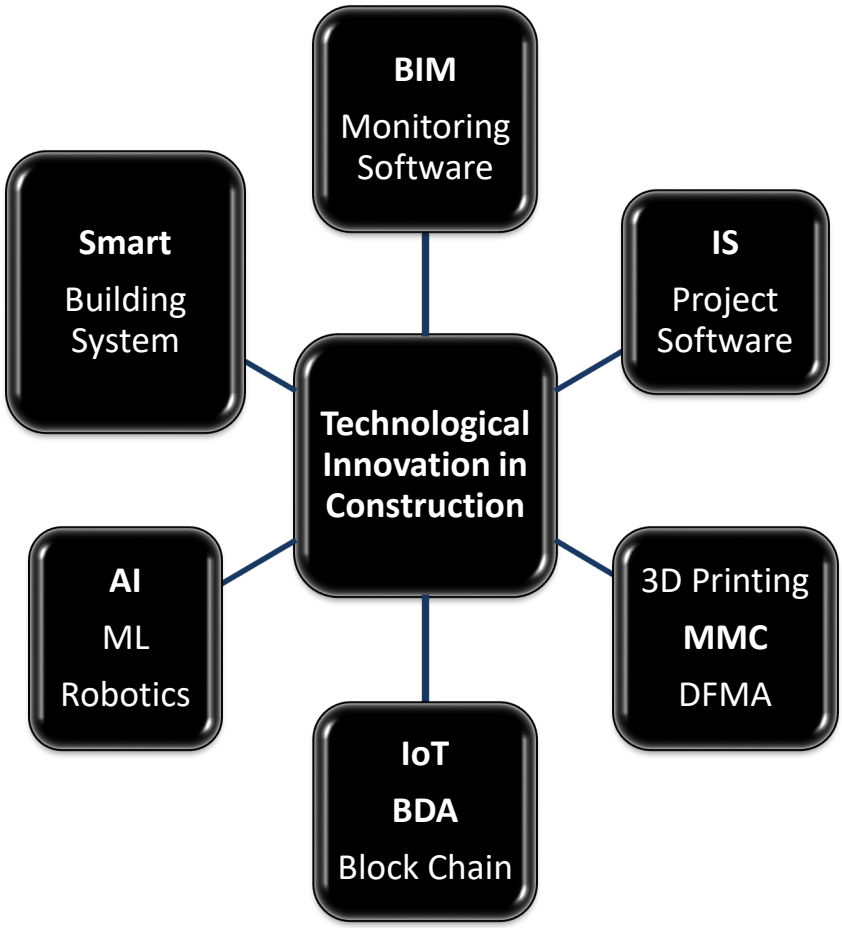


**Figure 3: Key technological innovations in the KSA construction Industry (Author, 2026)**

In the KSA context, the adoption of a coherent and structured framework is critical at key stages of construction to ensure alignment between sustainability strategies and key project decisions (Alazmi et al., 2025). To realize the industry's ambitious sustainability objectives, it is essential to emphasize enhanced organizational agility, improved financial returns, optimized operational efficiency, and more effective utilization of project budgets (Chiang et al., 2024). This means, sustainable development would be defined as the delivery of construction projects through integrated planning, monitoring, and control systems that embed environmental, economic, and social considerations throughout the entire project lifecycle (Alghuried, 2026). From the perspective of industry stakeholders, there is a clear need for greater focus on understanding and appreciating the social, economic, and environmental benefits of sustainability initiatives (Mgammal and Misbah, 2025). Insufficient awareness and limited comprehension of these advantages continue to hinder digital transformation efforts and the effective implementation of knowledge management practices.

### 2.4 Contract Framework in the KSA Construction Industry

The primary purpose of this study is to evaluate technological innovation (TI) and knowledge management (KM) as critical enablers for continuous improvement in knowledge-intensive project domains, including scope, quality, schedule, and cost management. Effective integration of TI and KM supports more informed decision-making and enhances construction project performance throughout the project lifecycle (Sithipolvanichgul et al., 2024; Khilji et al., 2024). Accordingly, the identification of both enabling and constraining factors in mega construction projects requires an evidence-based and methodologically robust approach. In this context, qualitative techniques such as the Delphi method are employed, given the multifaceted nature of expert insights; nevertheless, sufficient empirical evidence exists to support a comprehensive and informed analysis.

This study is structured around four fundamental dimensions that inform contractor selection strategies aligned with Saudi Arabian construction industry requirements. It recognizes that the KSA construction sector encompasses a diverse range of expertise, characterized by varying levels of knowledge, skills, and academic backgrounds, all of which influence industry-wide contracting models and delivery outcomes (Alsohiman

et al., 2023; (Gohar, 2025). The findings emphasize the growing importance of Building Information Modelling (BIM), digital fabrication, and Design for Manufacturing and Assembly (DfMA) as core technological innovations influencing early-stage processes, including contract briefing and preliminary design.

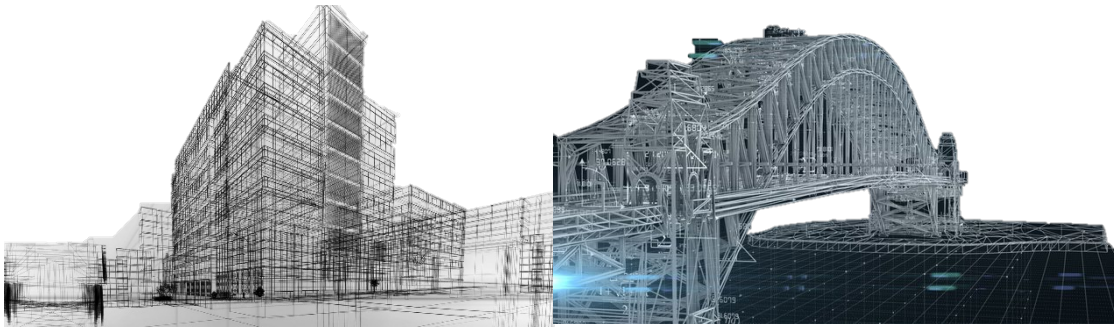

**Figure 4: Visual Illustrations of Digital Representation of Structural and Civil Engineering System (CADD, 2026)**

Furthermore, structural analysis enabled through BIM facilitates accurate determination of slab thicknesses, beam dimensions, orientations, and foundation designs, reinforcing the need for these technologies to be embedded within the project brief (CADD, 2026). Expert perspectives highlight the value of integrating TI and KM applications at project initiation, thereby enhancing stakeholder benefits and strengthening project performance from conception through execution, as depicted in the computer-aided visualizations in Figure 4.

## 3. Methodological Approach

This study adopts a mixed-methods approach combining qualitative and quantitative data. This study investigates the benefits and potential returns associated with technological innovation (TI) and knowledge management (KM) in the construction industry of Saudi Arabia, with a particular focus on their role in advancing sustainable development. Guided by grounded theory principles, the analysis prioritizes twelve highly relevant studies selected from an initial pool of literature, while the remaining sources provide a strong basis for citation support and comparative analysis.

The research objectives are addressed through a comprehensive mixed-methods approach that integrates both primary and secondary data. Empirical data collection includes 12 in-person semi-structured interviews and a questionnaire survey conducted with 87 construction professionals (Manager, Engineers, Consultants). In addition, a systematic review of 22 peer-reviewed academic articles is undertaken to strengthen the analytical framework and enhance contextual understanding. The interview data are selectively analyzed to capture expert perspectives on the practical implementation of TI and KM within construction projects.

The qualitative component of the study involves field-based interviews with key industry stakeholders, including project managers, architects, consulting engineers, contractors, and technical specialists actively involved in construction activities. Construction firms operating in the London area were approached, of which five out of nine agreed to participate, thereby providing access to project teams for in-depth engagement. To ensure the robustness of the findings, a triangulation approach is employed, integrating insights from industry experts with academic literature and professional publications to evaluate the evolving role of TI and KM. The literature review focuses on studies published between 2021 and 2026, allowing for a critical assessment of recent trends, current practices, and emerging directions of TI and KM across various phases of construction projects. This integrated methodological approach enhances data triangulation and strengthens the validity and reliability of the research outcomes.

### 3.1 Research Design

This study incorporates both quantitative and qualitative data whereas data was collected through an online survey and in-person semi-structured interviews, while a systematic literature review further reinforced the empirical research design. The data analysis highlighted the recurrent use of specific terminologies among participants, facilitating the identification of key enabling and constraining factors influencing the adoption of technological innovation (TI) and knowledge management (KM) within the construction industry. This analytical process provided deeper insights into the barriers hindering digital transformation in the KSA construction sector, particularly when compared to other industries that have embraced more advanced, automation-driven practices. Furthermore, the interview data were systematically synthesized and organized into broader

conceptual themes, enabling a more structured examination of prevailing strategic drivers and emerging industry trends.

### 3.2 Sampling Strategy (Data Collection and Analysis)

Participants were selected from construction firms involved in project delivery, including project managers, engineers, architects, and contractors. Five organizations agreed to participate. This approach supported the development of generalizable insights while preserving the richness and contextual depth of participants' experiences, ensuring a balanced integration of empirical rigor and qualitative interpretation.

*The analysis of the collected data identified how construction industry professionals actually get along with and respond to technological advancement. In this context, several key findings were identified during the research survey responses and interview narrations as highlighted below:*

- Research participants demonstrated a generally positive attitude towards the adoption of digital technologies for the respondents, 52% indicated that additional investment in digital solutions is required within the current fiscal year, while a further 37% recommended an increase in previously allocated technology budgets.
- There was broad consensus that organizational success is increasingly dependent on effective technological innovation (TI) and knowledge management (KM). Participants linked TI and KM directly to improved operational efficiency, profitability, access to ESG (environmental, social, and governance) funding, competitive advantage in winning projects, carbon reduction initiatives, and enhanced project safety outcomes.
- Approximately 80% of respondents acknowledged that TI and KM are more critical now than at any previous time, citing rapid technological advancement as a top strategic priority on organizational agenda.
- Key barriers to investment in emerging technologies were identified, including high initial implementation costs, uncertainty surrounding return on investment (ROI), limited knowledge-sharing practices, corporate culture, leadership, low levels of organizational trust, and competitive pressures that influence decision-making on whether to adopt or defer TI and KM initiatives.
- The most significant constraint reported was a shortage of skilled personnel, with 60% of participants indicating difficulties in acquiring suitably trained ITIL and IT skills or resources.
- Further analysis of the online survey highlighted the growing importance of big data analytics. These findings were reinforced during in-person interviews, which revealed a perceived lack of institutional support for advancing TI and KM adoption within the KSA construction industry.

The literature review process initially identified 137 peer-reviewed academic publications related to technological innovation and knowledge management in the context of sustainable development within the KSA construction industry. These publications were systematically screened and collated to support comparative analysis. Following this initial review, the literature was refined to 109 relevant papers through the application of inclusion and exclusion criteria. A further evaluation phase resulted in the shortlisting of 56 highly pertinent studies for detailed data analysis. In the final stage of the review, 27 publications were closely examined for their direct relevance to the core research themes, of which 16 key papers were selected and discussed in depth within the literature review.

### 3.3 Research Findings

This structured and progressive screening process ensured a focused and robust academic foundation for the study. The research findings indicate strong recognition of the importance of TI and KM in enhancing project performance and sustainability. The keywords technological innovation, knowledge management, project management, construction industry, and sustainable development are used to conduct systematic searches across academic library repositories. These searches are further expanded to include related terms such as modern methods of construction, computer-aided design and manufacturing, prefabrication, sustainability, carbon emissions, supply chain management, and construction waste management, all of which are highly relevant to the construction. This provided an integrated overview of the dominant research patterns and thematic relationships whereas the frequently recurring key terms and themes consolidated and categorized as graphically shown in the tabulated visual in Figure 5.


**Figure 5: Keywords Correlation from 'Interview' and 'Literature Review' (Author, 2026)**

In parallel, key terms and statements derived from the interview data are repeatedly identified across the reviewed literature. These recurring concepts were analyzed and correlated to develop a coherent set of themes that reflect both construction project processes and the practical requirements for implementing technological innovation and knowledge management applications. Subsequently, keywords and recurring statements extracted from interviews and academic articles are synthesized and generalized into core conceptual categories. These concepts formed the basis of a thematic analysis framework aligned with the literature.

This shift underscores the necessity of integrating technological innovation (TI) and knowledge management (KM) practices to meet regulatory standards and achieve sustainability objectives throughout the entire project lifecycle. Such an approach requires early incorporation of sustainability considerations within planning and delivery processes, ensuring that outcomes are clearly defined, monitored, and documented from project inception to completion. Equally important is maintaining a strong focus on end-user benefits and securing client acceptance by demonstrating tangible returns on investment (ROI). From the client's perspective, there is growing willingness to invest in digital solutions, including Building Information Modelling (BIM), big data analytics, smart building systems, and advanced construction approaches such as Modern Methods of Construction (MMC) and Design for Manufacture and Assembly (DfMA).

Furthermore, the findings suggest that the adoption of Modern Methods of Construction (MMC) and Design for Manufacture and Assembly (DfMA) significantly improves workforce wellbeing and enhances safety during the construction phase. These approaches also contribute to stronger sustainability performance by reducing carbon emissions and promoting more efficient use of resources. This section of the study identifies and categorizes the principal mechanisms through which construction projects can address sustainability challenges by advancing technological innovation (TI) and knowledge management (KM) practices.

The research findings are systematically organized around four key components i.e., People, Process, Technology, and Knowledge. identified through comprehensive data collection and analysis. Collectively, these elements form the foundation for the successful adoption of innovative construction methods and serve as critical enablers in the delivery of sustainable built environments. The integration of these components provides valuable insights to support industry-wide decision-making processes related to the selection, evaluation, and implementation of technology-enabled and knowledge-driven practices (Khan et al., 2025). The adoption of Modern Methods of Construction (MMC) and Design for Manufacture and Assembly (DfMA) was found to significantly improve safety, efficiency, and sustainability outcomes.

### 3.4 Reliability and Validity

Validity was ensured through data triangulation, while consistency was maintained through structured protocols and iterative coding of qualitative data. However, the process of reviewing, selecting, and implementing TI and KM initiatives within the construction sector remains inherently complex. The construction industry in Saudi Arabia faces numerous supply chain risks due to the complexity of operations, involvement of multiple stakeholders, reliance on imported materials, and fluctuating material costs (Alqahtani et al., 2026). It was further emphasized on the construction industry in Saudi Arabia, a region known for its ambitious mega projects, including the construction of entire cities, airports, and large-scale infrastructure.

Saudi Arabia's reliance on imported construction materials, labor, and technologies further amplifies the risks, making supply chain management a crucial area of focus for project success (Alqahtani at el., 2024). This complexity in KSA construction arises from the industry's exposure to substantial project-related risks, including financial uncertainty, fragmented supply chains, and operational constraints. Consequently, achieving effective alignment among people, processes, technology, and knowledge necessitates strong governance frameworks, informed and strategic decision-making, and a sustained commitment to risk management while advancing sustainability objectives. The research reliability and validity helped to ensure consistency in this study key findings by determining what it recommended to measure while reaffirming consistent and reproducible results.

## 4. Discussion

The findings revealed significant commonalities among client organizations, design teams, and contractors, particularly in their recognition of the fragmented nature of the construction industry in Saudi Arabia. In the recorded stakeholder groups, participants identified critical challenges related to skewed leadership, the lack of dedicated digital teams, limited readiness of KM specialists, and insufficient coordination with project investors. Collectively, these issues impede the effective integration and implementation of TI and KM within construction projects. To address such fragmentation requires a coordinated effort in which the key stakeholders actively collaborate to develop and implement a structured strategy tailored to the specific needs of each project. This means, an integrated approach would facilitate continuous performance improvement, rallied decision-making, and more predictable project results.

The analysis revealed disparities in digital maturity across stakeholders whereas steel contractors demonstrate advanced use of 3D modelling and prefabrication, many consultants continue to rely on 2D systems, limiting integration. Generational differences further affect adoption, with senior decision-makers showing lower engagement with digital technologies. This gap influences organizational readiness and innovation capacity although a key finding is the industry's fragmented nature, resulting in poor coordination, duplication of efforts, and inefficiencies. In this study it was identified that there is a critical need for early stakeholder collaboration and integrated delivery models. The study developed an intangible framework based on the identified four essential pillars including (i) People, (ii) Process, (iii) Technology, and (iv) Knowledge, this is shown in the graphical model below (Figure 6).

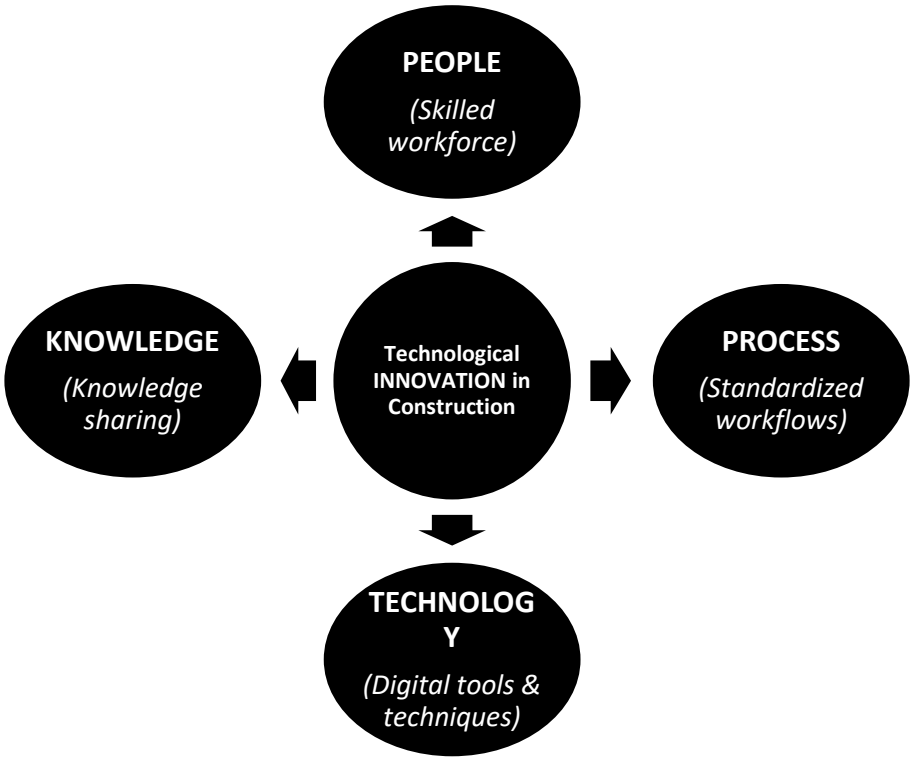


**Figure 6: The research framework based on four pillars as the pragmatic outcome of key findings (Author, 2026)**

Notably, both designers and contractors demonstrated a shared understanding of the strategic importance of technologies such as Building Information Modelling (BIM). They emphasized the necessity of fostering a collaborative working culture that supports the seamless progression of design from conceptualization to execution. This collaborative integration is essential for minimizing rework, enhancing constructability, and reducing inefficiencies associated with siloed or fragmented design practices. The adoption of hybrid and integrated project delivery approaches further reinforces these objectives, enabling more effective alignment of stakeholders and improved overall project performance (Abdulfattah et al., 2023).


**Figure 7: Word Cloud – indication of key terms (Author, 2026)**

A significant proportion of senior decision-makers are aged 35 and above, with some exhibiting limited familiarity or confidence in leveraging emerging digital technologies and their associated benefits (Zhang, 2023; Khilji et al., 2024). This disparity in digital competencies continues to affect organizational readiness and capacity for innovation. From a strategic perspective, industry stakeholders, including designers, architects, and

contractors identified considerable opportunities for increased standardization in construction processes. Participants frequently drew comparisons with the automotive sector, which has successfully integrated technological innovation and structured knowledge management to achieve enhanced efficiency, consistency, and scalability. The dominant themes and recurring terminologies emerging from the data are visualized through a word cloud, highlighting the central concepts underpinning this study (Figure 7).

## 5. Research Implications

This study identified both theoretical and practical implications by contributing in the academic research literature by advocating the KSA construction industry linking TI and KM within a integrated framework through extending organizational learning theory to construction. This study also contributes theoretically by demonstrating the role of KM in enabling digital transformation for continuous business processes redesign with best practices. However, in term of practical implications this study supports policymakers in Vision 2030 implementation aligned to the Saudi Arbia strategic drive by providing a guide to construction organizations in their digital strategy development while emphasizes need for skills development and leadership alignment.

## 6. Conclusion

This study demonstrates that technological innovation and knowledge management are critical enablers of sustainable construction in Saudi Arabia whereas their benefits are widely recognized, implementation remains constrained by organizational, cultural, and economic challenges. The findings highlight the importance of integrated strategies, stakeholder collaboration, and continuous learning. The proposed framework provides a structured approach for advancing digital transformation and sustainability outcomes aligned with Vision 2030. This research study provides a comprehensive examination of the benefits associated with technological innovation (TI) and knowledge management (KM), offering a clear articulation of digital transformation initiatives that enhance stakeholder satisfaction within construction projects. Participating organizations emphasized the importance of continuous project evaluation through the integration of digital twins and knowledge-based project management practices. These approaches enable real-time data processing, monitoring, and feedback across all phases of the project lifecycle, thereby supporting informed, adaptive, and timely decision-making during both design and construction stages.

The findings further suggest that TI and KM initiatives must be embedded across multiple organizational levels, with technology specialists playing a pivotal role in bridging communication gaps among installers, site operatives, and the broader project workforce. However, there remains a general perception that project management teams must continuously enhance their digital competencies, while the wider industry workforce requires ongoing skills development to address existing capability gaps. Resistance to technological change is frequently linked to organizational and behavioral barriers that limit readiness for innovation adoption. Moreover, the study demonstrates that effective stakeholder engagement significantly enhances organizational receptiveness to advanced technologies, including Artificial Intelligence (AI), Building Information Modelling (BIM), the Internet of Things (IoT), big data analytics, digital twins, machine learning (ML), augmented reality (AR), and robotics. Despite these opportunities, many organizations continue to face challenges in integrating such technologies due to cultural barriers, leadership constraints, and limitations in team dynamics. This means that an enabling environment can strengthen sustainable development outcomes and support the evolution of construction project management practices in the Kingdom of Saudi Arabia (KSA), in alignment with the strategic objectives of Vision 2030.

**Ethical and AI Declaration:**Ethical approval for this study was obtained from the relevant institutional ethics committee, and all research activities were conducted in accordance with approved ethical standards. Where artificial intelligence (AI) tools were used, they supported language refinement and formatting only; no AI system was involved in data collection, analysis, interpretation, or generation of research findings, and full responsibility for the content rests with the lead author.

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