

MIDOCEAN UNIVERSITY
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Master of Business Administration



The Impact of Technology on Construction Projects Management in Saudi Arabia

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Introduction:

The construction industry plays a vital role in the economic development of nations, particularly in rapidly developing countries such as Saudi Arabia. With the Kingdom's Vision 2030 driving transformative projects across infrastructure, housing, transportation, and urban development, construction projects have grown in both size and complexity. As a result, the efficient management of these projects has become more critical than ever.

In response to increasing demands for efficiency, transparency, and accountability, the adoption of technology in construction project management has accelerated in recent years. Technologies such as Building Information Modeling (BIM), cloud-based project management platforms, drones, artificial intelligence (AI), and Internet of Things (IoT) are revolutionizing the way construction projects are planned, executed, and monitored. These tools offer the potential to improve project outcomes by enhancing coordination, reducing delays, optimizing resource allocation, and mitigating risks.

Despite global advancements, the adoption and integration of such technologies in the Saudi construction sector face unique challenges and opportunities. Factors such as organizational readiness, technological infrastructure, workforce capabilities, and regulatory frameworks play significant roles in shaping how effectively technology contributes to project success.

This study aims to investigate the impact of technology on construction project management in Saudi Arabia, with a focus on how technological tools and systems influence key management aspects such as planning, cost control, time management, and stakeholder communication. Understanding this impact is crucial for policymakers, project managers, and contractors seeking to leverage digital transformation to enhance performance and ensure the successful delivery of mega and large-scale construction projects.

Problem Statement:

Despite the rapid technological advancement in the global construction industry, the successful integration of technology into construction project management remains a critical challenge, particularly in developing and transitioning economies. In Saudi Arabia, where construction projects are central to national development especially under the framework of Vision 2030 the complexity, scale, and strategic importance of these projects require highly efficient and effective project management practices.

Although technologies such as Building Information Modeling (BIM), cloud-based project control tools, AI-driven analytics, and real-time collaboration platforms are increasingly recognized for their potential to enhance project performance, their actual adoption and effectiveness within the Saudi construction sector are not well understood. Many firms face barriers including limited digital maturity, resistance to change, lack of skilled personnel, and unclear regulatory support.

Moreover, existing literature lacks sufficient empirical evidence on how specific technologies are influencing core aspects of project management in the Saudi context such as planning accuracy, budget control, risk mitigation, communication efficiency, and stakeholder satisfaction. This knowledge gap hinders strategic decision making by project managers, contractors, and policymakers seeking to leverage technology to improve project outcomes.

Therefore, it is essential to investigate the extent to which technology adoption impacts construction project management in Saudi Arabia. This study seeks to address this gap by exploring how technology is being utilized, what challenges are being faced, and how it ultimately affects project success in the local industry context.

Study Objective:

The primary objective of this research is to examine the impact of technology on construction project management in Saudi Arabia. To achieve this main objective, the study seeks to:

1. Identify the types of technologies currently adopted in construction project management within the Saudi Arabian construction industry.
2. Evaluate the effectiveness of these technologies in enhancing key project management functions, including planning, scheduling, cost control, quality assurance, and communication.
3. Analyze the challenges and barriers to successful technology adoption and integration in construction project management practices in Saudi Arabia.
4. Assess the relationship between technology adoption and project performance outcomes, such as timeliness, budget adherence, and stakeholder satisfaction.
5. Provide practical recommendations for improving the implementation and utilization of technology in construction project management in the Saudi context.

Study Importance:

The importance of this study stems from the growing role of construction in Saudi Arabia's national development agenda, particularly under the ambitious Vision 2030 program, which includes the delivery of mega projects such as NEOM, the Red Sea Project, and Qiddiya. These projects demand advanced project management practices that can ensure timely delivery, cost efficiency, and high-quality outcomes.

In this context, technology is increasingly recognized as a critical enabler of successful project management. However, while the global construction industry has embraced various digital tools and systems, the extent and effectiveness of their adoption in the Saudi Arabian context remain underexplored. This study addresses this gap by offering empirical insights into how technology is being utilized in construction project management, the challenges faced, and its impact on overall project performance.

From an academic perspective, this research contributes to the limited body of knowledge regarding the intersection of technology and project management within the Saudi construction industry. It offers a contextualized understanding that reflects the unique organizational, cultural, and regulatory dynamics in the region.

Practically, the study is highly relevant for project managers, contractors, policymakers, and technology providers operating in the Saudi market. The findings will help these stakeholders:

- Make informed decisions regarding technology investments;
- Improve project planning and execution;
- Overcome barriers to technology adoption;
- Develop policies that support digital transformation in the construction sector.

By bridging the gap between theory and practice, this research supports the broader goal of enhancing productivity, efficiency, and innovation in the Saudi construction industry.

Study Questions:

This study aims to address the following key research questions:

1. What types of technologies are currently adopted in construction project management in Saudi Arabia?
2. How do these technologies impact critical areas of project management such as planning, scheduling, cost control, quality assurance, communication, and risk management?
3. What are the main challenges and barriers facing the adoption and integration of technology in construction project management in Saudi Arabia?
4. To what extent does technology adoption influence overall project performance, including on-time delivery, budget adherence, and stakeholder satisfaction?
5. How do organizational factors such as company size, digital maturity, and leadership support affect the success of technology implementation in construction project management?
6. What practical strategies can be implemented to enhance the effective use of technology in construction project management in the Saudi construction sector?

Research Hypotheses:

- There is a significant positive relationship between the adoption of technology and the overall performance of construction project management in Saudi Arabia. This tests the general impact of technology on project outcomes like time, cost, and quality.
- Technology adoption has a positive effect on time management in construction projects.
- Technology adoption improves cost control and budget adherence in construction projects.
- Technology adoption enhances communication and collaboration among project stakeholders.
- Organizational factors (e.g., digital maturity, leadership support) significantly influence the success of technology implementation in construction project management.
- There are significant barriers (e.g., lack of training, resistance to change, technical complexity) that negatively affect the adoption of technology in the Saudi construction sector.
- The use of advanced technologies (e.g., BIM, cloud platforms, AI) is significantly associated with higher stakeholder satisfaction.
- The adoption of Building Information Modeling (BIM) significantly enhances planning accuracy in construction project management.
- Cloud-based project management platforms significantly improve real-time decision-making and information accessibility.
- There is a significant relationship between employee training in digital tools and the successful implementation of construction management technologies.
- Project teams that use integrated digital communication tools experience fewer coordination-related delays compared to teams using traditional methods.
- Projects managed using advanced technologies experience fewer budget overruns than those managed using conventional methods.
- There is a significant negative correlation between perceived implementation barriers and the level of technology adoption in construction firms.
- Firms with higher digital maturity levels demonstrate better performance in managing large-scale construction projects.
- Regulatory support and government initiatives positively influence the rate of technology adoption in Saudi Arabia's construction sector.
- Resistance to change among employees moderates the relationship between technology adoption and project performance.

Previous Studies:

1. BIM Implementation in AEC Firms:

- Almntaser, Sanni-Anibire & Hassanain (2018) conducted a case study of a Saudi AEC firm transitioning to BIM. They found BIM led to faster design cycles, effective information reuse, and higher client satisfaction. However, challenges included client disinterest, limited team expertise, and lack of internal BIM champions.
- Al-Yami & Sanni-Anibire (2021) surveyed a broader sample and revealed that BIM's key benefits are clash detection, quality control, and communication efficiency. Major obstacles were organizational restructuring needs and missing policy frameworks.

2. Benefits & Barriers of BIM in Sustainability:

- Alwakil et al. (2022) assessed BIM in sustainable projects and found top benefits included design efficiency, energy use optimization, and quality improvement. However, barriers such as high costs, skills shortages, and unclear operational data sharing were prominent.
- E. Alasmari et al. (2023), in a survey of 940 Saudi engineers, reported that 61% were familiar with BIM. BIM positively influenced sustainability, life-cycle cost management, and energy analysis but awareness gaps persist.

3. BIM, Life-Cycle Cost & Sustainability:

- Alasmari (2024) used a mixed-methods design with Autodesk Revit, Insight, and Green Building Studio. He found BIM-led design scenarios reduced life-cycle costs by around 40% and CO₂ emissions by approximately 49%, leading to multimillion dollar savings.

4. Critical Success Factors for BIM Adoption:

- Al-Mohammad et al. (2023) applied factor analysis and identified 14 critical success factors including contract standardization, stakeholder alignment, and guideline availability. They grouped factors into environmental, legal, organizational, and governmental dimensions.
- MDPI (2023) conducted interpretive structural modeling, highlighting barriers like IT infrastructure deficiencies, cultural resistance, cost concerns, and lack of government mandates. Recommended countermeasures included formal standards and digital training initiatives.

5. Emerging Trends: Smart Tech & IoT:

Although limited, recent work on AI/IoT in Saudi projects shows emerging applications:

- Al-Qurashi et al. (2025) proposed an AI/IoT-based smart waste-management system in Makkah to optimize collection during peak pilgrimage seasons.

This reflects growing interest in applying smart technologies in large-scale infrastructure.

- A 2024 study examined AI uptake in Saudi construction. It found significant benefits (e.g., resource optimization, safety improvements, schedule acceleration) but also challenges like data quality issues, tool availability, regulatory uncertainty, high costs, and workforce resistance. Recommendations included improved data integration, regulation, incentives, and training.

6. Digital Twins in Riyadh Metro:

- The Riyadh Metro project used digital twin technology to create virtual replicas of tunnels and stations. This optimized coordination, clash resolution, planning, and sustainability monitoring via real-time simulation and stakeholder collaboration.

Theoretical Framework of the Study:

This study is grounded in several well-established management and technology theories that help explain how technological adoption influences the success and performance of construction project management.

1. Technology Acceptance Model (TAM) – Davis (1989)

To explain how users come to accept and use a technology.

- Key Concepts:
 - Perceived Usefulness (PU): The degree to which a person believes that using a technology will enhance job performance.
 - Perceived Ease of Use (PEOU): The degree to which a person believes that using a technology will be free of effort.
- Relevance to this Study:
 - TAM helps explain why construction professionals in Saudi Arabia adopt (or resist) technologies like cloud software, IoT, or AI systems.
 - It can also help assess training needs and design interventions for smoother technology integration.

2. Project Management Triangle (Iron Triangle) – Traditional PM Theory

Explains the balance of three critical constraints in project management: Time, Cost, and Quality.

- Relevance to this Study:
 - The framework helps analyze how technology impacts these core constraints.
 - For example, does AI scheduling reduce delays (time), or do digital twins improve quality with better clash detection?

3. Diffusion of Innovation Theory – Rogers (2003)

Explains how innovations spread within a society or organization over time.

- Key Concepts:
 - Innovation characteristics: Relative advantage, compatibility, complexity, trialability, observability.
 - Adopter categories: Innovators, early adopters, early majority, late majority, laggards.

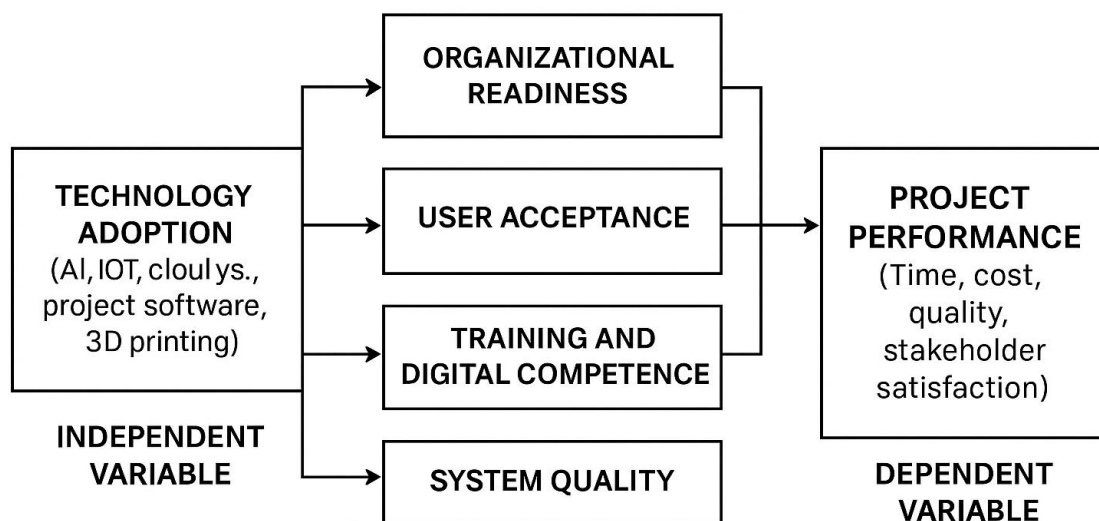
- Relevance to this Study:
 - Useful for understanding how new technologies (like AI or cloud tools) are adopted in the Saudi construction sector.
 - Helps explain resistance to change, slow adoption, or success in early adoption cases (e.g., mega-projects like NEOM).

4. Information Systems Success Model – DeLone & McLean (2003)

Evaluates the effectiveness of information systems through six interrelated dimensions:

- System quality, Information quality, Service quality, Use, User satisfaction, Net benefits
- Relevance to this Study:
 - You can apply this model to assess whether digital systems (cloud PM tools, mobile apps, ERP) actually deliver value in terms of improved performance or user satisfaction.

CONCEPTUAL FRAMEWOK



Research Methodology:

1. Research Design:

This study will adopt a quantitative research design using a descriptive and analytical approach. The objective is to evaluate the relationship between technology adoption and project performance in Saudi Arabia's construction sector.

The descriptive part will provide an overview of current technology usage, while the analytical part will assess the impact of those technologies on key project outcomes.

2. Research Approach:

- **Deductive approach:**
This study is theory-driven. It begins with existing theories (TAM, PM Triangle, etc.) and tests hypotheses based on those theories using collected data.

3. Population and Sample:

- **Population:**
Construction professionals working on large-scale and medium-sized construction projects in Saudi Arabia, including:
 - Project managers.
 - Engineers.
 - IT/tech officers.
 - Contractors and consultants.
- **Sampling Technique:**
Purposive sampling will be used to target individuals who have experience with technology in construction.

4. Data Collection Methods:

- **Primary Data:**
 - A structured questionnaire will be developed based on validated scales from past studies.
 - Questions will cover:
 - Type of technologies used (AI, IoT, 3D printing, software, etc.).
 - Perceived usefulness, ease of use, and system quality.
 - Project performance indicators (time, cost, quality, stakeholder satisfaction).

- Secondary Data:
 - Academic journals, case studies, project reports, and official statistics related to construction technology in Saudi Arabia.

5. Instrumentation:

- The questionnaire will use a 5-point Likert scale (Strongly Disagree to Strongly Agree).
- Sections will include:
 - Demographics.
 - Type and extent of technology adoption.
 - Organizational and user readiness.
 - Project outcomes and perceived benefits.

6. Data Analysis Techniques:

- Descriptive Statistics: Frequency, mean, and standard deviation to summarize data.
- Inferential Statistics:
 - Correlation analysis to explore relationships between variables.
 - Regression analysis to determine the impact of technology on project performance.

7. Ethical Considerations:

- Participation will be voluntary.
- Respondents will be assured of confidentiality and anonymity.
- Data will be used exclusively for academic purposes.

8. Limitations of the Methodology:

- Self-reported data may carry some bias or subjectivity.
- The study may not capture the full picture in smaller firms or rural projects with limited tech exposure.

Instruments of Data Collection:

This study employs a structured questionnaire as the primary tool for data collection, designed to gather quantitative data from professionals involved in construction project management in Saudi Arabia. The tool is developed based on existing validated models, such as the Technology Acceptance Model (TAM) and the Information Systems Success Model.

1. Structured Questionnaire:

The questionnaire is divided into the following sections:

- **Demographic Information:**

This section collects background information about the respondents, such as:

- Age.
- Gender.
- Job title/role.
- Years of experience.
- Type of construction project (public/private, mega/small-scale)
- Location within Saudi Arabia.

- **Technology Adoption:**

This section includes items measuring:

- Types of technologies used (e.g., cloud software, AI tools, IoT devices, 3D printing, digital twins).
- Frequency and extent of use.
- Organizational readiness for technology adoption.
Example item: "My organization actively integrates smart technologies into project workflows."

- **User Perceptions (based on TAM):**

Measures perceptions related to:

- Perceived Usefulness.
- Perceived Ease of Use.
- Intention to Use.
Example item: "Using construction technology improves my efficiency in completing tasks."

- System Quality & Support (based on DeLone & McLean Model):

Items assess:

- System reliability and accessibility.
- Technical support availability.
- Data security and integration.

Example item: “The technology systems I use are reliable and provide accurate, real-time information.”

- Project Performance Outcomes:

This section evaluates the perceived impact of technology on:

- Project time management.
- Budget and cost control.
- Quality of outcomes.
- Communication and coordination.
- Client/stakeholder satisfaction.

Example item: “The use of technology in my project helped reduce overall project delivery time.”

2. Measurement Scale:

- The questionnaire uses a 5-point Likert scale for most items:
1 = Strongly Disagree to 5 = Strongly Agree

3. Validation of the Tool:

- A pilot test will be conducted with a small group of construction professionals to ensure:
 - Clarity and readability of items.
 - Reliability of the instrument.
 - Content validity.

4. Delivery Mode:

- The questionnaire will be administered online (via Google Forms or Qualtrics), enabling access to geographically diverse participants across Saudi Arabia.
- A cover letter will be attached to explain the purpose of the study and obtain informed consent.

Framework of the Study:

This study aims to examine the impact of technology on construction project management in the Kingdom of Saudi Arabia. Therefore, the framework is grounded in both theoretical models and a clearly defined conceptual structure that links technological factors to project management performance.

1. Theoretical Foundation:

This study integrates concepts from the following theories:

- Technology Acceptance Model (TAM):

Developed by Davis (1989), TAM explains how users come to accept and use new technologies based on:

- Perceived Usefulness (PU).
- Perceived Ease of Use (PEOU).

TAM is used here to assess how construction professionals perceive technology and how that perception influences their usage behavior.

- DeLone and McLean Information System Success Model (2003):

This model includes six dimensions:

- System Quality.
- Information Quality.
- Service Quality.
- Use.
- User Satisfaction.
- Net Benefits.

It helps measure the effectiveness and impact of technology systems in construction project settings.

- Project Management Triangle (Iron Triangle):

This traditional model highlights three critical project constraints:

- Time.
- Cost.
- Quality.

The triangle is used to evaluate how the adoption of technology affects these performance dimensions.

2. Conceptual Framework:

The conceptual framework outlines the key variables and how they relate to one another. It connects the theoretical foundations to the real-world context of construction project management in Saudi Arabia.

Independent Variable:

- Technology Adoption:
Includes the use of tools such as:
 - Cloud-based project management platforms.
 - IoT devices and sensors.
 - Artificial intelligence systems.
 - Mobile and digital communication tools.
 - 3D printing and digital twins.

Mediating Variables:

- Organizational Readiness.
- Digital Competency of Staff.
- Perceived Ease of Use.
- System Quality and Support.

These influence how effectively technology is integrated and used.

Dependent Variable:

- Project Management Performance, assessed by:
 - Schedule adherence (Time).
 - Budget control (Cost)
 - Project outcomes (Quality).
 - Stakeholder satisfaction.
 - Collaboration and coordination.

3. Visual Representation (Diagram):

The framework can be visually represented as a diagram, where arrows show causal or correlational relationships between technology adoption and project outcomes, possibly mediated by readiness or user attitudes.

4. Purpose of the Framework:

This framework serves multiple purposes:

- Guides hypothesis development

- Informs survey/questionnaire design
- Determines statistical techniques for analysis
- Ensures alignment with research objectives and questions
- Identifies gaps and mediating factors that influence outcomes

References:

1. Theoretical References:

These sources provide the theoretical models you use in your framework and hypotheses.

Theory	Key References
Technology Acceptance Model (TAM)	Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. <i>MIS Quarterly</i> .
Information Systems Success Model	DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. <i>Journal of Management Information Systems</i> .
Diffusion of Innovation	Rogers, E. M. (2003). <i>Diffusion of Innovations</i> (5th ed.). Free Press.
Project Management Triangle	Atkinson, R. (1999). Project management: cost, time and quality, two best guesses and a phenomenon, it's time to accept other success criteria. <i>International Journal of Project Management</i> .

2. Technology in Construction:

This help build your literature review and justify the importance of technology in Saudi Arabia's construction sector.

- Ofori, G. (2015). Nature of the construction industry, its needs and its development: A review of four decades of research. *Journal of Construction in Developing Countries*.
- Alaloul, W. S., Liew, M. S., Zawawi, N. A. W. A., & Kennedy, I. B. (2019). Industrial revolution 4.0 in the construction industry: Challenges and opportunities for stakeholders. *Ain Shams Engineering Journal*.
- Ali, A. S., & Al Nsairat, S. F. (2021). Technology adoption in the construction industry: A review of drivers and barriers. *Journal of Engineering, Design and Technology*.
- Alotaibi, H., Sutrisna, M., & Chong, H.-Y. (2016). Critical success factors for construction projects in Saudi Arabia. *International Journal of Project Management*.

3. Saudi Arabia-Specific Studies & Reports:

You must include localized references that reflect construction trends in the Kingdom.

- Vision 2030 Reports – Saudi Government.
- NEOM Official Reports.
- KPMG (2021). GCC Construction Outlook
- Ministry of Municipal and Rural Affairs and Housing (MOMRAH) – Strategic construction goals and digital transformation policies.

4. Methodological Sources:

For your research methods and data analysis justification:

- Creswell, J. W. (2014). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (4th ed.). SAGE Publications.
- Sekaran, U., & Bougie, R. (2016). Research Methods for Business: A Skill Building Approach (7th ed.). Wiley.
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2018). Multivariate Data Analysis (8th ed.). Pearson.

5. Project Management and Technology Strategy:

These can help with the performance metrics, success factors, and strategy adoption:

- Kerzner, H. (2017). Project Management: A Systems Approach to Planning, Scheduling, and Controlling. Wiley.
- PMI (2021). A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Seventh Edition.