

An Empirical Study of Technology Adoption Challenges in Construction Project Management in The Real Estate Sector in India: A Review of Literature

Mahadeo Nalawade¹ and Dr. Swati Kulkarni²

¹Research Scholar at Savitribai Phule Pune University, Pune. INDIA.

²HOD, Department of Civil Engineering, Army Institute of Technology, Pune, INDIA.

ABSTRACT - This study investigates the impediments to technology adoption in the construction project management of India's real estate sector, a pivotal contributor to the nation's GDP. In response to escalating demands for housing, commercial spaces, and infrastructure, technology offers solutions that enhance efficiency and transparency. However, challenges such as limited awareness, high implementation costs, skill shortages, and resistance to change have hindered technology adoption in the Indian context. Conducting an extensive literature review, the paper explores global challenges in technology adoption within construction industries, covering themes like construction project management, digital technologies, ICT adoption, digital twin implementation, and BIM technology adoption. Selected articles delve into the impacts of computer technology, e-procurement, technology innovation, and BIM on project management, offering insights into strategies and acceptance models. Emphasizing the imperative need for a strategic and proactive approach, the study underscores that technology adoption is crucial for achieving sustainable and efficient infrastructure development in India. The paper concludes by advocating for further research to unlock technology's full potential in the dynamic landscape of real estate construction. This comprehensive analysis serves as a valuable resource for researchers, practitioners, and policymakers grappling with the intricate challenges of technology adoption in construction project management.

Keywords - Technology Adoption, Construction, Project Management, Real Estate Sector.

I. INTRODUCTION

The Indian real estate sector faces challenges like limited awareness, high implementation costs, skilled manpower shortage, resistance to change, complex regulatory environments, and diverse markets. A literature review aims to identify and address these obstacles to effective technology adoption in construction management.

II. LITERATURE REVIEWS

The literature review will be conducted to understand the current state of technology adoption in real estate construction around the globe. The review will focus on the challenges faced by real estate construction companies while adopting technology in their projects, and the strategies used to overcome these challenges. This review will also include studies on the impact of technology adoption on the efficiency, cost, and quality of construction projects. This literature review is been done to understand the need for further research.

3.1. The paper, titled "Civil Engineering Construction Project Management Based on Computer Technology" by Li Zhang, Bin Zhu, and

YongGang Zhang and published in the Journal of Physics: Conference Series, investigates the influence of computer technology on the management of construction projects. Highlighting its benefits, the authors discuss how computer technology improves efficiency and effectiveness in various aspects of construction project management, encompassing planning, scheduling, cost estimation, and quality control. Nevertheless, the article acknowledges challenges and limitations, such as the requirement for specialized skills and the high costs associated with software and hardware. Despite these obstacles, the authors express confidence in the transformative potential of computer technology in the construction industry, urging further research to fully explore and leverage its capabilities. They recommend the development of new tools and techniques to overcome challenges and limitations, ultimately advancing project management practices in construction. The paper offers a thorough examination of the role of computer technology in shaping the future of construction

- project management.
- 3.2. In "Patterns of Technological Innovation in the Use of e-procurement in Construction," Samuel Laryea explores technological innovation trends in e-procurement within the construction industry. The article notes the industry's historically slow adoption of electronic procurement compared to manufacturing and other service sectors. Despite this, the past two decades have witnessed a growing utilization of web-based technologies in construction procurement. Laryea identifies three primary patterns of technological innovation: (i) adopting web-based technologies and applications from other sectors, (ii) enhancing and applying already-established technologies in new contexts, and (iii) combining new and existing web-based technologies and applications in construction procurement.
- 3.3. In the Journal of Civil Engineering and Management, Chen. H and Wang H.'s paper, "Exploring the influence of technology innovation on construction project management," examines the effects of technological innovation on construction project management. Using a quantitative approach, the study gathered data from 165 Chinese construction professionals through a structured questionnaire. Employing multiple regression analysis, the research found a significant and positive correlation between technology innovation and construction project management. Specifically, technology innovation positively impacted project efficiency, cost control, and quality management. The study also identified organizational culture, resource availability, and top management support as influential factors in the adoption of technology innovation. The authors emphasize the crucial role of technology innovation in construction project management, advocating for its adoption to enhance project performance. Furthermore, they recommend that project managers consider organizational culture, resource availability, and top management support when implementing new technologies in construction projects.
- 3.4. Golizadeh and Arditi's article, "Factors affecting the adoption of information technology in construction: A review and model," explores the influences on information technology (IT) adoption in construction. Emphasizing IT's crucial role in construction engineering and project management, the paper identifies organizational, technological, and environmental factors affecting IT adoption. The authors propose a model to assess an organization's readiness for IT adoption, derived from a systematic review incorporating six factor groups: organizational, technological, environmental, individual, project-related, and socio-cultural. Each factor is thoroughly discussed, emphasizing its significance in influencing IT adoption in construction. The study underscores the need for a holistic approach, taking into account the needs of stakeholders like project managers, contractors, clients, and end-users for successful IT adoption. The article contributes a comprehensive framework to guide future research and practice in IT adoption within the construction industry.
- 3.5. Osama E. Khalil and Ahmed Abdelraziq's article, "The impact of Technological Innovation on construction projects performance: a case study of Egypt," explores the link between technological innovation and construction project performance in Egypt. Using a mixed-methods approach involving a questionnaire survey, interviews, and case studies, the authors identify four dimensions of technological innovation: product, process, organizational, and marketing innovations. Construction project performance is assessed based on time, cost, quality, safety, and customer satisfaction criteria. Key findings indicate a positive and significant impact of technological innovation on construction project performance in Egypt, with product and process innovations being the most influential. Barriers to innovation adoption include limited financial resources, a shortage of skilled labor, lack of top management support, and resistance to change. Enablers include customer demand, competitive pressure, government policies, and collaboration with external partners. The article concludes that a proactive and strategic approach is crucial for construction firms in Egypt to cultivate a technological innovation culture and capabilities, thereby enhancing construction project performance.
- 3.6. Tarmizi Haron, Mohd Fadzil Arshad, and Mohd Zulhanif Abd Razak's article, "Adoption of Building Information Modelling (BIM): Factors Contribution and Benefits," delves into BIM adoption in the Malaysian construction sector. Using a qualitative approach, the study conducts interviews with industry professionals to assess the current level of BIM adoption and identify contributing factors. Findings indicate that BIM adoption in Malaysia is in its early stages, with a notable lack of awareness and understanding among professionals. The study identifies factors promoting BIM adoption, including enhanced collaboration, communication, cost savings, and

increased efficiency. In summary, the research sheds light on the current state of BIM adoption in the Malaysian construction industry and underscores the potential benefits achievable through its broader implementation.

- 3.7. Jeri Frank's Forbes article, "Why Technology Adoption Is Necessary In Commercial Real Estate," emphasizes the imperative of embracing innovation and digitization in the commercial real estate sector. Frank contends that the industry's sluggish adoption of technology can result in inefficiencies and diminished competitiveness over time. The article also addresses the challenges and opportunities posed by the COVID-19 pandemic, such as the demand for supporting hybrid work models and sustainable practices. Proposing that proptech (property technology) can facilitate automation, streamline operations, enhance data analytics, and improve tenant experiences, the article concludes by urging real estate stakeholders to stay abreast of the latest innovations and technologies while advocating for a tenant-centric approach.
- 3.8. Abiola Akanmu and Chimay J. Anumba's Emerald Insight article, "Cyber-physical systems integration of building information models and the physical construction," explores applying a cyber-physical systems (CPS) approach to enhance coordination between virtual models and physical construction in the building industry. The article contends that the industry's slow adoption of technology can lead to long-term inefficiencies and reduced competitiveness. It also addresses challenges and opportunities from the COVID-19 pandemic, emphasizing the need for supporting hybrid work models and sustainability practices. Proposing CPS—a system integrating computation, networking, and physical processes—the article suggests its utility in automating real estate operations, data analytics, and tenant experiences. Demonstrating the CPS approach through system architectures and prototype systems, the article concludes by advising real estate stakeholders to stay informed about the latest innovations, technologies, and embrace a tenant-centric approach.
- 3.9. Chia-Ling Lee's MDPI article, "Challenges and Strategies for the Adoption of Smart Technologies in the Construction Industry: The Case of Singapore," examines the current status and future potential of smart technologies in Singapore's construction sector. The article advocates for the use of smart technologies like building information modeling (BIM), drones, robotics, artificial intelligence (AI), and the Internet of Things (IoT) to improve productivity, quality, safety, and sustainability. Despite the benefits, the article identifies challenges hindering adoption, including a lack of awareness, skills, standards, incentives, and collaboration among stakeholders. Proposed strategies encompass enhancing education and training, creating regulatory frameworks, providing financial support, promoting collaboration, and fostering a culture of innovation. The article concludes by emphasizing the benefits and opportunities of smart technologies in Singapore's construction industry and urging increased research and development in this field.
- 3.10. The Arpit Singh and colleagues' article on PURE, "Identification and severity assessment of challenges in the adoption of Industry 4.0 in Indian construction industry," addresses key impediments to implementing the Industry 4.0 framework in Indian construction. It emphasizes the industry's slow tech adoption, warning of potential long-term inefficiencies and reduced competitiveness. The article outlines opportunities and benefits Industry 4.0 can bring, including enhanced productivity, quality, safety, and sustainability. Employing a multi-criteria decision-making (MCDM) method based on rough set theory, the authors rank challenges by severity, identifying 25 issues through literature review and expert interactions. Challenges include high initial investment, lack of skilled personnel, legal barriers, security concerns, cultural resistance, and environmental impact. Validation occurs through a survey of 150 Indian construction professionals, followed by the application of Dominance-based Rough Set Analysis (DRSA) to rank challenges. The study identifies the most severe challenge as the substantial initial investment for mobilizing an Internet of Things (IoT) framework. Recruitment of experts for employee training on advanced technology and the proper maintenance of sensitive tools rank as the second and third most severe challenges, respectively. Additionally, less severe but crucial challenges include lack of awareness, standardization, collaboration, and trust among stakeholders. The article concludes by recommending that construction firms use this ranking to prioritize actions and allocate resources effectively. It emphasizes the need for a proactive and strategic approach to technology adoption and implementation in construction firms, calling for further research and development in the realm of Industry 4.0 in the Indian construction industry.
- 3.11. KPMG India's article on "Disruptions in real estate

- in India" explores the impact of technological, environmental, social, and economic factors on the transformation of the Indian real estate and construction industry. The article emphasizes the significance of ConTech, which employs technology to enhance the efficiency, quality, and safety of construction processes. ConTech tools encompass drones, 3D printing, robotics, Building Information Modelling (BIM), and Artificial Intelligence (AI). The adoption of ConTech is highlighted as a means to decrease costs, mitigate delays and errors in construction projects, and enhance collaboration and communication among stakeholders.
- 3.12. The article "Study of Enabling Factors Affecting the adoption of ICT in the Indian Built Environment Sector" by Saurav Dixit, Anna Stefan´ska, Adam Musiuk, and Priyanka Singh aims to investigate the possibilities of substituting traditional methods with Information and Communication Technology (ICT) in the Indian built environment sector. The study identifies the factors that enable the adoption of ICT in the sector, including The level of awareness and knowledge of ICT among stakeholders in the sector, The cost of adopting ICT and the benefits it provides, including increased efficiency and productivity, The availability and quality of ICT infrastructure, including hardware, software, and connectivity, The regulatory environment, including policies and regulations that support the adoption of ICT. The organizational factors that affect the adoption of ICT, include the size and type of organization, and the level of support from management. The study concludes that the adoption of ICT in the Indian built environment sector is affected by a range of factors and that addressing these factors can help to increase the adoption of ICT and improve the efficiency and productivity of the sector.
- 3.13. The article "Technology Acceptance Model for Augmented Reality and Building Information Modeling Integration in the Construction Industry" explores the integration of Augmented Reality (AR) and Building Information Modeling (BIM) in the construction industry. The study proposes a Technology Acceptance Model (TAM) to understand the factors that influence the acceptance and adoption of AR and BIM in the industry. The TAM model consists of four factors that affect the acceptance and adoption of AR and BIM in the construction industry:
- 3.13.1. Perceived usefulness: The extent to which AR and BIM are perceived as useful in improving the construction process.
- 3.13.2. Perceived ease of use: The ease with which AR and BIM can be used in the construction process.
- 3.13.3. Attitude towards use: The attitude of construction professionals towards the use of AR and BIM.
- 3.13.4. Behavioral intention to use: The intention of construction professionals to use AR and BIM in the construction process.
- 3.13.5. The study concludes that the TAM model can be used to understand the factors that influence the acceptance and adoption of AR and BIM in the construction industry. The model can help to identify the barriers to adoption and develop strategies to overcome them, ultimately leading to the successful integration of AR and BIM in the construction industry.
- 3.14. The article "Blockchain Technology in the Construction Industry: A Systematic Review" presents a comprehensive analysis of the applications, benefits, challenges, and future prospects of blockchain technology in the architecture, engineering, and construction (AEC) sector. The study aims to enhance our understanding of blockchain's potential in the AEC industry by examining existing literature and research. The authors identify several key areas where blockchain can be applied in the construction industry, including:
- 3.14.1. Automated project bank accounts: Blockchain can be used to create automated project bank accounts, which would streamline payment processes and reduce the risk of fraud.
- 3.14.2. Supply chain management: Blockchain can improve supply chain transparency and traceability, ensuring that materials and products used in construction projects meet quality and safety standards.
- 3.14.3. Contract management: Blockchain can facilitate secure and efficient contract management, ensuring that all parties have access to the most up-to-date and accurate information.
- 3.14.4. Equipment leasing: Blockchain can enable more efficient and transparent equipment leasing processes, reducing costs and improving resource utilization.
- 3.14.5. Automated project progress tracking: Blockchain can be used to create a decentralized and tamper-proof system for tracking project progress, providing real-time updates to all stakeholders.
- 3.14.6. The authors also discuss the challenges and opportunities associated with blockchain adoption

in the construction industry. These include:

- Data privacy and security: Blockchain's decentralized nature can help protect sensitive construction data, but it also raises concerns about data privacy and security
- Lack of industry-wide standards: The absence of standardized blockchain solutions and protocols in the construction industry hinders widespread adoption.
- Integration with existing systems: Integrating blockchain technology with existing construction management systems and processes can be complex and time-consuming.
- Cost and scalability: Implementing blockchain solutions in the construction industry may require significant upfront investment, and scalability can be a challenge for large-scale projects.

3.14.7. The study concludes that while blockchain technology holds great promise for the construction industry, its successful adoption will depend on addressing these challenges and developing industry-specific solutions. By leveraging blockchain's potential, the AEC sector can benefit from increased transparency, efficiency, and trust in project delivery and management processes

3.15. The article "Emerging trends in real estate: India" by PwC India provides insights into the current and future trends shaping the Indian real estate market. The study highlights key factors driving growth and investment opportunities in the sector, as well as challenges that need to be addressed for sustainable development. The main trends identified in the article cover many aspects of real estate including technology adoption. The adoption of technology and innovative solutions, such as smart cities, Internet of Things (IoT), and Artificial Intelligence (AI), is transforming the real estate sector. Developers are increasingly incorporating these technologies to enhance efficiency, sustainability, and customer experience.

III. CONCLUSION

In summary, the literature reviews reveal a global trend towards increased technology adoption in the real estate construction sector, driven by the potential benefits of improved efficiency, cost control, quality management, and sustainability. The challenges and opportunities identified in the articles point to the need for proactive, strategic, and project-centric approaches to technology adoption in this

dynamic and evolving industry. Technology adoption in construction project management is not just a convenience but a necessity for the real estate sector in India. It addresses challenges, improves project outcomes, enhances competitiveness, and aligns with the country's broader goals of sustainable and efficient infrastructure development. Embracing technology is essential for the growth, innovation, and success of India's construction and real estate industry. That's why further research in these areas is essential to unlock the full potential of technology in real estate construction.

IV. REFERENCES

- [1] Zhang, Bin Zhu, and YongGang Zhang "Civil Engineering Construction Project Management Based on Computer Technology" Journal of Physics: Conference Series. Li Zhang et al 2021 J. Phys.: Conf. Ser. 1852 032050
- [2] Samuel Laryea "Patterns of Technological Innovation in the Use of e-procurement in Construction" Journal of Information Technology in Construction - ISSN 1874-4753. JULY 2014.
- [3] Chen. H, & Wang H "Exploring the influence of technology innovation on construction project management" Journal of Civil Engineering and Management, 26(4), 357-367.
- [4] Golizadeh, H., & Arditi, D "Factors affecting the adoption of information technology in construction: A review and model" Journal of Professional Issues in Engineering Education and Practice, 141(1), 04014018.
- [5] Osama E. Khalil and Ahmed Abdelraziq "The impact of Technological Innovation on construction projects performance: a case study of Egypt" International Journal of Construction Management, 20(3), 218-228
- [6] Siti Nur Aishah Mohd Noor1, Siti Rahma Junaidi, Mohd Khairul Amri Ramly. "Adoption of Building Information Modelling (BIM): Factors Contribution and Benefits" Proceeding International Conference On Global Business and Social Sciences (ICGBSS 2018)13 & 14 October 2018 The Everly Putrajaya Malaysia eISBN 978-967-14841-9-7
- [7] Jeri Frank "Why Technology Adoption Is Necessary In Commercial Real Estate" Forbes on Oct 3, 2022,09:15am EDT
- [8] Abiola Akanmu and Chimay J. Anumba, "Cyber-physical systems integration of building information models and the physical construction" Emerald Insight
- [9] Chia-Ling Lee, "Challenges and Strategies for the Adoption of Smart Technologies in the Construction Industry: The Case of Singapore" MDPI
- [10] Arpit Singh and others, "Identification and severity assessment of challenges in the adoption of industry 4.0

in Indian construction industry” Asia Pacific Management Review Volume 28, Issue 3, September 2023, Pages 299-315

- [11] “Disruptions in real estate in India” by KPMG August 2019
- [12] Saurav Dixit , Anna Stefan, Adam Musiuk c, Priyanka Singh “Study of enabling factors affecting the adoption of ICT in the Indian built environment sector” Ain Shams Engineering Journal 12 (2021) 2313–2319.
- [13] Abdalrahman Elshafey, Chai Chang Saar, Eeydzah Binti Aminudin, Masoud Gheisari, Abdulrahman Usmani "Technology Acceptance Model for Augmented Reality and Building Information Modeling Integration in the Construction Industry" Journal of Information Technology in Construction - ISSN 1874-4753 in March 2020.
- [14] Kucheriavyi, A., & Bosco, F. A.” Blockchain technology in the construction industry: A systematic review” Proceedings of the 2019 International Conference on Engineering, Technology and Innovation (ICE/ITMC) (pp. 1-8). IEEE.
- [15] PwC (2018). Emerging trends in real estate: India. PwC India.

