

REVIEWING EMERGING TECHNOLOGIES ADOPTION AMONG CONSTRUCTION PROJECT MANAGERS IN NIGERIA

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Abstract

Though emerging technologies are available to improve project performance, project managers in the Nigerian construction sector avoid their adoption. This has resulted in the rate of failed projects within the Nigerian construction sector due to poor coordination of construction tasks relying on obsolete processes. Hence, the review of literature to ascertain the influencing factors of project managers' avoidance in implementing emerging technologies in their professional practice. Using thematic analysis, four (4) influencing themes were identified in the literature namely; technology, organizational, environmental and sociocultural related factors. These themes evidenced the influencing factors in emerging technologies adoption among project managers in the Nigerian construction industry. The potentials of emerging technologies adoption on project managers' performance in the construction industry is impacted in terms of cost, quality and time of successful projects delivery. However, technology avoidance behaviour of project managers will lead to project abandonment, continued inadequate automated evaluation, monitoring of construction project performance. Therefore, the study recommends that stakeholders in the Nigerian construction industry must continue to navigate through the barrier factors limiting construction project managers' adoption of technology to lower the rate of failed and abandoned projects in the Nigerian construction industry.

Keywords: Construction Industry; Project Manager; Emerging Technologies; Developing Countries; Technology Adoption

INTRODUCTION

The construction industry is vital for the development of any nation, as the pace of physical infrastructure produced from the industry can determine the pace of economic growth (Olatunji *et al.*, 2016). In Nigeria, the Construction Industry (CI) accounts for 3–8% of gross domestic product (Waziri *et al.*, 2017), and it is estimated that the industry will account for 13.2% of Gross Domestic Product (GDP) globally by 2025 (McKinsey, 2021). Hence, the contribution of the industry to the economies and wealth of a nation is enormous (Pan *et al.*, 2018), such that it requires Emerging Technologies (ET) to continuously drive its contribution sustainably (Ogunde *et al.*, 2017).

Ghada (2021) described ET as scientific breakthroughs with the potential to establish new industries or transform existing ones. They include dramatic inventions that result in discontinuous innovations, as well as more evolutionary technologies that result from the convergence of previously distinct research lines. For the Construction Industry (CI), Kissi *et al.* (2022) avow that these ET offer a simplified construction process. Therefore, it is imperative that the need for efficiency in managing the construction process through ET offers perhaps, the best opportunities to enhance its function and efficiency (Kissi *et al.*, 2022). With the rapid advancement of technology, Construction Firms (CF) are embracing emerging solutions to improve their practices. ET are digital innovations like Internet of Things (IoT), Building Information Modelling (BIM), and blockchain hold great potential for revolutionizing the construction process in CF (Kissi *et al.*, 2022).

However, Holt (2015) adjudges that CF are a slow adopter of technology, of late, the technology available to increase productivity and hence profit margins have seen appreciable adoption and advancement. Consequently, Takim *et al.* (2013) found that the reason for lagging implementation of technology is that CF still adhere to old business models and processes for decades. Furthermore, Chen and Zhang (2018); Ben-Daya *et al.* (2020) emphasize issues like initial investment costs, technology adoption, interoperability concerns, the need for skilled personnel and organizational preparedness. Olawumi and Chan (2019) also affirmed that while many construction projects in developed countries are progressively enforcing technology innovations, the cultivation of the technology in developing countries is lagging. Similarly, there is an agreement in the literature that problems are more serious proportionately in developing countries and more apparent throughout the execution of projects by project managers (Kissi *et al.*, 2022).

According to Project Management Institute (PMI)'s definition, and as adopted for this study, a Project Manager (PM) is a person assigned by the performing organization to lead the team that is responsible for achieving the project objectives (PMI, 2017). Research shows that adoption and utilization of cutting-edge technology have advanced among

PM in developed countries, but, construction project managers in the Nigerian CI are five years behind in the adoption spectrum of new technology (Adebisi *et al.*, 2018; Hamma-Adama *et al.*, 2018). Though new technologies are available to improve project performance, PM in the Nigerian construction sector avoid their adoption (Akande *et al.*, 2018; Ozumba and Shakantu, 2018). This technology-adoption avoidance behaviour may be resulting in continued substandard evaluation and monitoring of construction project performance in the Nigerian CI (Afolabi *et al.*, 2018; Amusan *et al.*, 2018). Scholars have repeatedly documented the high rate of failed projects (e.g., 66% in a recent survey) within the Nigerian construction sector, and question why construction PM in Nigeria remain slow to adopt new technologies for improving decision-making processes and project success rates (Afolabi *et al.*, 2018; Hamma-Adama *et al.*, 2018).

Adoption itself results from a series of individual decisions to begin using the new technology. These decisions are often the result of comparing the uncertain benefits of the invention and the uncertain costs of adopting it (Ghada, 2021). However, the developing CI remains clueless about these ET (Darko and Chan, 2018). Also, clear-cut clarification on the several emerging technologies that best fit the improvement of collaboration was not delved into so much. Studies on the associated challenges were equally given less attention (Osabutey and Croucher, 2018). Kissi *et al.* (2022); Ngowi *et al.* (2005) were among the few researchers who hinted that the lack of literature regarding the impact of adopting emerging technologies within the CI in developing countries such as Nigeria has hindered CF growth. Therefore, the need for this study to unprevail influencing factors hindering the adoption of ET by PM in the Nigerian CI.

LITERATURE REVIEW

Construction Emerging Technologies and their Applications

Mura (2020) argued that new enabling technologies and construction methods are emerging that will assist enterprises and the construction sector in various ways. Construction ET is described by Irizarry and Costa (2016) as a revolutionary paradigm in which three transitions occur: industrial production and construction, cyber-physical system, and digital technologies. BIM (building information system), CDE (common data environment), cloud-based systems engineering, AR/VR (augmented reality/virtual reality), big data and analytics, blockchain, and laser scanners are all instances of emerging innovations. Robotics and automation, sensors, the internet of things, industrial manufacturing, off-site and on-site construction, employees using wearable sensors, and devices fitted with sensors all fall into the category of cyber-physical systems (Irizarry & Costa, 2016). Below and as shown in Figure 1. is a brief outline of each of these ET and their contributes to improved efficiency in CI.

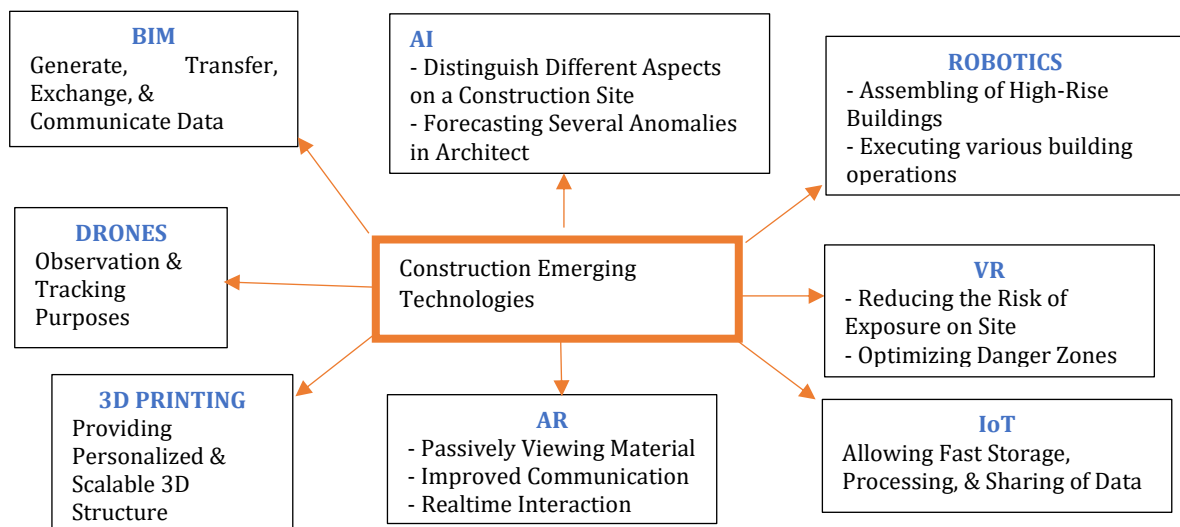


Figure 1: Emerging Technologies in Construction
Source; Autor's Construct, 2024

Challenges in the implementation of Emerging Technologies

Holt (2015) state that stakeholders in the CI have been reluctant to follow the digital world in adopting innovations. The attitude not only obscures their understanding of the technology but also it obscures the potential limiting factor of these technologies. Galanakis (2013) mentioned that opportunities and challenges in the field are discussed to inspire researchers to investigate the critical parameters that prevent, for the moment, the broad commercial implementation of ET in the particular application. As a result, continuous demand for hardware and software upgrades has been a significant challenge for implementing several ET, according to the Qi and Costin (2019) survey.

Delgado *et al.* (2020) stated that when it comes to interoperability between BIM systems and augmented reality (AR) and virtual reality (VR) models, it is difficult to automatically update BIM models and construction schedules from AR and VR systems. Thus, the lack of integration between data standards makes it challenging to integrate BIM data photogrammetry and CI VR platforms. Qi and Costin (2019) further submitted that the high cost of purchasing both hardware and software of these innovations challenges stakeholders in their quest to use them in various walks of the construction process. Another concern that Delgado *et al.* (2019) raised is the unclear value that construction companies can get from adopting these technologies. More specifically, there is very little in the way of cost-benefit studies for adopting these innovations as reported in the literature (Pan *et al.*, 2018). It is widely noticed that the adoption of these innovations can minimise costs related to labour and injuries. At the same time, these technologies are considered expensive and the cost includes the technology systems, software, skilled engineers and training (Delgado *et al.*, 2019).

Afolabi *et al.* (2017) reported on the economies of cloud computing in project delivery. However, they made mention of poor network connectivity among the challenges to cloud adoption by the construction industry. Project sites, at times, might be in an underdeveloped area or a rural area, usually with low or no internet connectivity. Power infrastructure projects, such as underground cabling, overhead lines or substations are prime examples that span larger geographical areas with poor connectivity across the construction route (Bello *et al.*, 2021). Kabra *et al.* (2017) argue that organisational culture also affects the implementation of these technologies. Applying the scenario in the construction industry, most stakeholders lack the confidence and skills to adopt these technologies and leave them far behind when building reliable data and information processing capabilities. Qi and Costin (2019) added in their study that despite the increase in the systematic adoption of emerging technologies that would improve several things, the prevalence of pervasive conservatism in the construction industry may still impede this move.

Hence, the CI is reported to be among the least digitized sectors globally (Gandhi *et al.*, 2016). The peculiar characteristics of the construction industry, such as the uniqueness of the products, the variability of expertise and technology, and the tendency for the players in the industry to be risk-averse make the construction industry-unique and very different when compared to other industries (Fadun and Saka, 2018). Thus, the decision to adopt and deploy technology in the CI is affected by a variety of influencing factors (Nnadi *et al.*, 2018).

Emerging Technology Adoption Behaviour of Construction Project Managers

Several studies have shown the high rate of failed projects within the Nigerian construction sector due to poor coordination of complex tasks as expected by the project managers (Afolabi, *et al.*, 2018). A deeper understanding of the barriers confronting construction project managers in Nigeria to adopt new technologies for improving decision-making processes to lower the rate of failed and abandoned construction projects remains poorly understood (Muhammad *et al.*, 2018).

The lack of application of technology and the use of obsolete and inappropriate technology influenced PM practices in Nigeria, which hindered successful public project delivery (Afolabi *et al.*, (2018)). Technology leads to improved business decisions and quality of construction project delivery (Kamaruddin *et al.*, 2016). But paucity exists in the technology adoption behaviour among construction PM in the Nigerian Construction Industry (NCI), with five years' lag in their adoption spectrum on new technology when compared to PM in developed countries (Hamma-Adama *et al.*, 2018). Although, ET are available to improve project performance, PM in the Nigerian construction sector avoid their adoption (Akande *et al.*, 2018; Ozumba & Shakantu, 2018), there is a gap in the literature on why construction project managers in the NCI remain slow to adopt new technologies (Akande *et al.*, 2018).

METHODOLOGY

The study is primarily a desk research and secondary data was used in the study. Thus, various journals, conference proceedings, textbooks, thesis and policy documents were perused. Published literature were searched. Databases such as Science Direct, Taylor and Francis, Emerald Insight, Google and Google Scholar were consulted. The search expression includes a combination of the following keywords: "Project Manager", "Technology", "adoption", "Emerging Technologies", "Construction Industry" and "Developing Countries" The inclusion criteria applied were all types of articles related to construction technology, peer-reviewed articles, and articles published seminar papers. this is to ensure that studies are searched as extensive as possible in order to reduce risk of publication bias and to identify relevant evidence as much as possible to purposefully extract published scholarly literature in the last twenty years (2004-2024). The exclusion criteria were articles written in languages other than English, and articles for which full text was not available.

Data Analysis

This study used thematic analysis. The potential themes are identified through database searching and theme familiarization in the literature.

RESULTS

The results of this research are discussed in the subsequent sub-sections.

Project Manager and Technology Adoption in Nigeria's Construction Sector

The Nigerian construction industry is still at the lowest ebbs in its adoption. The result of a recent study revealed that out of the 59% of the project managers in the Nigerian construction industry that are aware of BIM technology, only 23% are using the BIM technology and the usage is still far below BIM full capability (Hamma-Adama *et al.*, 2018). Although ET are available to improve project performance, scholars have identified that PM in the Nigerian construction sector avoid their adoption (Akande *et al.*, 2018; Ozumba and Shakantu, 2018). Whereas the adoption and utilization of cutting-edge technology have advanced among PM in developed countries, project managers in the NCI are still generally about five years behind in the adoption spectrum of ET (Adebisi *et al.*, 2018; Hamma-Adama *et al.*, 2018).

Ejohwomu *et al.* (2017) avow that PM in the NCI are not inculcating technologies in project monitoring and evaluation. Consequently, Adebisi *et al.* (2018) posit that it leads to delay in the issuance of project reports and ineffective reporting. Furthermore, Olaniyan (2019) found that the task of monitoring and evaluating project performance using an automated approach has not been given serious attention by PM. The lack of technology and the use of obsolete and inappropriate technology for the execution of construction projects in Nigeria hindered project managers' effectiveness towards successful project delivery (Fadun & Saka, 2018).

Factors Influencing Project Manager Adoption of Emerging Technologies

Many factors have been offered in the literature as influencing emerging technology adoption among project managers, which is categorized into technology, organizational, and environmental-related factors (Waziri *et al.*, 2017), and sociocultural related factors (Ojoko *et al.*, 2018). Technology related factors include a feature of the ET to be adopted about its ability to meet the needs of the project and the organizational objective (Sepasgozar and Davis, 2018), difficulty in demonstrating the evidence of benefits an organization will derive from adopting technology (Aduwo *et al.*, 2016), and deficiency in the technical skill required to support the use of the technology by PM (Muhammed *et al.*, 2015). Organizational related factors include internal policy and bureaucratic procedure inherent in the decision-making process towards technology adoption (Usman & Said, 2014), criteria for evaluating the technology for project objectives and needs (Sepasgozar and Davis, 2018), the readiness of the members of the adopting organization to accept and embrace a change from the old ways of doing things (Waziri *et al.*, 2017), and high investment cost associated with the adoption of new technology (Aduwo *et al.*, 2016).

Environmental factors are factors external to the adopting organization and of which the adopting organization has little or no control. These include lack of effective government policies and dysfunctional regulatory environment (Waziri *et al.*, 2017), a general state of infrastructural deficiency (Chete *et al.*, 2014), and constraints of sourcing fund for technology investment within the domestic banking environment (Sepasgozar & Davis, 2018; Usman & Said, 2014). Sociocultural factors include the general state of cyber insecurities in developing countries (Amusan *et al.*, 2018; Waziri *et al.*, 2017) combined with tendencies of people in the workplace to conform to unethical practices during technology utilization (Oladinrin and Ho, 2016; Ogunyemi and Laguda, 2016).

CONCLUSION

The potentials of adopting ET in the construction industry in developing countries such as Nigeria cannot be overemphasized. However, the adoption of ET by project managers in Nigerian construction industry is lagging behind due to; technology, organizational, environmental and sociocultural related factors. Additionally, ET adoption is hampered by the level of readiness of the members of the adopting organization to accept and embrace a change from the old ways of doing things and high investment cost associated with the adoption of new technology. The effectiveness of the ET largely depends on the activities and roles performed by the project managers in the sector. Thus, the study suggests that ET influence the performance of project managers positively in enhancing project cost, duration quality and overall, the client satisfaction. Consequently, project managers avoidance behaviour will result in project abandonment, continued inadequate automated evaluation, monitoring of construction project performance and hence, ineffectiveness of project managers in project delivery.

RECOMMENDATIONS

The study recommends the following:

- i. Construction firms should provide training and incentives to project managers to encourage the adoption and use of emerging technologies.
- ii. Awareness is necessary, but it is not enough to lead to adoption, being technologically ready to adopt is the sine qua non to technology adoption by construction project managers in Nigeria

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