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DISTANCE IS NO BARRIER: DRIVERS OF THE DEPLOYMENT OF REMOTE CONSTRUCTION MANAGEMENT FOR PROJECT DELIVERY IN SOUTH AFRICA

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ABSTRACT

Addressing obstacles to effective project execution is an essential priority for stakeholders within the construction sector. Utilizing delivery methods such as remote construction management presents considerable advantages that aligns with the aforementioned goal. This research aims to evaluate the deployment of remote construction management in South Africa's construction industry. A quantitative research design was utilized to elicit data from construction professionals located in the Gauteng province of South Africa, selected through purposive sampling. A total of eighty-four responses were received and deemed appropriate for analysis. The collected data underwent suitable analytical techniques using exploratory factor analysis (EFA). The results of the study revealed three primary constructs that serve as the drivers of the use of remote construction management. These are improved project performance and operational efficiency, enhanced health & safety and workforce wellbeing, and optimised organisational operations. Based on these findings, the study made recommendations that can help drive the espousal of remote construction management in the South African construction industry.

Keywords: *Construction; Digital Technologies; Drivers; Remote Construction; South Africa.*

1. INTRODUCTION

The construction sector plays a crucial role in the economic advancement of both developed and developing nations (Ikuabe et al., 2022; Otasowie et al., 2023). This is evident through the establishment of vital infrastructure that supports economic growth, job creation, and community well-being (Adekunle et al., 2024). Additionally, it enables

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the development of physical assets that other sectors of the economy rely on. These physical assets encompass residential properties, manufacturing facilities, office spaces, urban infrastructure, educational institutions, transportation networks, water supply systems, retail businesses, and more. According to Olanrewaju and Ibrahim (2020), the construction industry in South Africa is highly significant due to its impact on the country's Gross Domestic Product (GDP). On a global scale, this industry constitutes 13% of the world's GDP (McKinsey, 2017).

The execution of construction projects involves a multitude of both organized and unforeseen activities aimed at achieving the desired success of the project (Hetemi et al., 2020). Typically, these activities encompass various job roles that contribute to reaching project objectives. These objectives often focus on aspects such as timely completion, cost efficiency, quality standards, sustainability, and health and safety (Aghimien et al., 2021; Ikuabe et al., 2024). The fragmented structure of construction project execution has created difficulties in optimizing project delivery. This situation is further intensified by the use of traditional project management methods. As noted by Ikuabe et al., (2023), construction companies face challenges in integrating the necessary resources, technology, and skills required for project execution due to the ever-changing nature of the industry's business environment. As a result, the delivery of projects has been facing challenges such as insufficient performance, delays in execution, reduced productivity, budget overruns, and diminished quality (Aghimien et al., 2024). Therefore, it is essential to explore alternative methods for improving project delivery in the construction sector. One possible method is remote construction management.

Remote construction management, as noted by Weippert et al. (2022), leverages technology to oversee construction projects from a distance without the necessity of being physically present at the job site. Additionally, Wolfram (2023) emphasizes that remote construction management involves the administration and supervision of construction projects from a location away from the site, utilizing digital communication and collaboration tools. This cutting-edge strategy allows project managers and stakeholders to effectively monitor construction projects from remote sites, thereby reducing the requirement for on-site presence (Rabida, 2020). This method of managing construction projects leverages various technologies to effectively coordinate and supervise projects from multiple locations. These technologies encompass drone technology, cloud-based applications, building information modeling (BIM), virtual reality (VR), augmented reality (AR), and other related technologies (Elabd et al., 2020; Gontier et al., 2021). Utilizing these innovative technologies in construction project management can assist in addressing some of the issues linked to traditional project management approaches. Despite the growing discourse on digital transformation within the construction sector, there is a lack of research focused on the drivers of the deployment of remote construction management in the context of South Africa. Although studies highlight the challenges, yet there is no identification of the factors that influence successful project delivery outcomes. In light of this, the objective of the study is to assess the drivers of implementing remote construction management for successful project execution in South Africa.

2. REVIEW OF RELATED LITERATURE

Weippert et al. (2022) characterized remote construction management as the use of technology to oversee construction projects from afar, eliminating the need for a physical presence at the construction site. Conversely, Wolfram (2023) explained remote construction management as the supervision and administration of construction projects from a distant location through digital technology, communication, and collaborative tools. This innovative method allows project managers and stakeholders to effectively monitor construction endeavors from remote sites, reducing the necessity for on-site attendance (Rabida, 2020). Nevertheless, remote construction management depends on a variety of technologies to successfully coordinate and manage construction projects across different distances. These technologies encompass drone technology, cloud-based applications, building information modeling (BIM) software, information communication technology (ICT), as well as virtual reality (VR) and augmented reality (AR) systems (Ahmed et al., 2017).

A key driver of the use of remote construction management is the rising need of the digital transformation of processes in construction project delivery. The integration of innovative technologies enables real-time monitoring and management of construction activities remotely. These technologies permit project stakeholders to manage construction data continuously, hence helping to improve decision-making and project coordination (Zhu et al., 2022). The visualisation and digital representation of real-time data of projects enables project teams to make informed decisions while enabling efficient management of complex construction projects. Furthermore, the need for improved monitoring and performance in construction projects drives the use of remote construction management (Islam, 2020). Traditional construction monitoring often relies heavily on frequent site visits, which can be time-consuming, costly, and sometimes ineffective in detecting emerging problems early. The technologies associated with the deployment of remote management of construction projects provides continuous oversight of project activities aided by sensors, digital dashboards, and other automated data capture systems. Alaloul et al., (2022) noted that the use of remote monitoring systems for construction projects demonstrates resource optimisation when compared to conventional site supervision methods. The need for cost efficiency serves as a need for the deployment of remote construction management. Construction projects are often attributed to cost overruns which is antithetical to the pursuit of effective project performance. Remote management technologies facilitate improved coordination among stakeholders, enabling faster problem identification and more effective resource allocation. Through continuous monitoring and predictive analysis of construction processes, organisations can reduce operational inefficiencies and minimise unnecessary site visits, which ultimately lowers project management costs (Kehinde, 2025).

Moreover, the increasing sophistication and complexity of construction projects further drives the need for the deployment of remote construction management (Dagou et al., 2025). The project team formation of construction projects predominantly features numerous stakeholders, which sometimes are geographically dispersed. Remote construction tools allows project team members to access project information simultaneously regardless of location. These systems enhance collaboration and communication among project team members, which leads to improvement of the project during its lifecycle. Also, the safety considerations serves as a major instigator for the use of remote construction management. Construction sites are inherently hazardous environments, and frequent physical inspections can expose project managers and supervisors to safety risks. Remote monitoring technologies enables project team members to follow up with progress and milestones being made on site without being physically present, hence eliminating the exposure to hazardous environments while maintaining effective oversight of site activities (Harris et al., 2020). According to Sharma (2024), automated monitoring systems can help trigger safety risks alert and operational anomalies. One of the drivers of remote construction management is the increasing demand for data-driven decision-making and real time information in project delivery. The deployment of digital systems for construction project delivery enables continuous capture and integration of onsite data, which can be used for forecasting and scheduling when analysed. The availability of real-time project data allows project managers to make informed decisions quickly and respond proactively to emerging issues (Rahaman et al., 2024).

3. METHODOLOGY

A quantitative research method was utilized in this study to assess the drivers of the deployment of remote construction management in the South African construction industry. The quantitative method follows a deductive approach, where phenomena are observed in an attempt to maintain an objective stance (Kumar, 2011). A questionnaire survey was employed in eliciting responses from the study's respondents. The research instrument comprised of two sections. The former focused on the demographic details of the respondents, while the latter focused on the drivers of remote construction management in the South African construction industry. The study employed a purposive sampling due to the nature of the study, which sought for construction professionals with knowledge of the use of digital technologies. A total of eighty-four responses were received and deemed appropriate for analysis. The target respondents were architects, quantity surveyors, construction managers, construction project managers, and engineers. The analysis method used for the data was exploratory factor analysis (EFA), which helps to reveal the relationships among a set of variables. The extraction method employed was principal component analysis (PCA), as demonstrated by Ikuabe et al. (2022). Pallant (2007) notes that PCA is performed to assess the uni-dimensionality of the factors, thereby determining their suitability for analysis. Additionally, the reliability and validity of the questionnaire were evaluated using Cronbach's alpha test, which resulted in a value of 0.883, confirming the research instrument's reliability and validity (Tavakol and Dennick, 2011).

4. FINDINGS

4.1 DEMOGRAPHIC INFORMATION OF RESPONDENTS

The results from the analysis of the respondent demographics for the study indicate that 46% of the respondents are connected to contracting firms. In contrast, 34% are linked to consulting agencies, while 20% are employed by governmental organizations. Additionally, regarding the respondents' years of work experience, 70% have been working for 6-10 years, 20% have 11-15 years of experience, and 8% have worked for 1-5 years. Moreover, concerning the highest level of academic achievement among the respondents, 54% hold an honour's degree, 18% possess a bachelor's degree, and 12% have a master's degree.

4.2 EXPLORATORY FACTOR ANALYSIS

The findings from the exploratory factor analysis (EFA) revealed the grouping of variables into clusters with similar underlying dimensions. This process allowed for a reduction in the number of variables, presenting them within a clearly defined and more comprehensible framework. To accomplish this, an evaluation of the dataset's suitability was performed using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy alongside Bartlett's test of sphericity. These tests were employed to determine whether the dataset utilized in this study was suitable for factor analysis. According to Pallant (2007), a dataset must show significant results in Bartlett's test of sphericity ($p < 0.05$) to be considered appropriate for analysis. As demonstrated in Table 1, the outcome of Bartlett's sphericity test is significant, with a p-value of 0.000. Additionally, the KMO should exceed a value of 0.6 to be deemed suitable for factor analysis, in accordance with previous research (Aghimien et al., 2021; Ikuabe et al., 2020). The analysis revealed a KMO value of 0.853. These findings provide guarantee regarding the appropriateness of the dataset for the EFA.

Table 1: KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.853
Bartlett's Test of Sphericity	Approx. Chi-Square	1278.115
	Df	86
	Sig.	0.000

A principal component analysis with varimax rotation was conducted to evaluate the underlying structure of thirteen (13) items. The assumption of independent sampling was satisfied. The conditions of normality, linear associations between pairs of variables, and moderate correlation levels among the variables were examined. This analysis identified three (3) factors with eigenvalues greater than 1, specifically: Factor one - improved project performance and operational efficiency, which explained 56.37% of the variance and having a factor loading ranging from 0.654 – 0.912. Factor two - enhanced health & safety and workforce wellbeing, which explained 10.11% of the variance explained and having a factor loading ranging from 0.533 – 0.721. Factor three - optimised organisational operations, which explained 6.72% of the variance explained and having a factor loading of ranging from 0.509 – 0.736.

Table 2: Rotated component matrix

Drivers	**Component**			**Extracted Communalities**	**% of Variance**
	1	**2**	**3**		
Improved Project Performance and Operational Efficiency					
Improved project monitoring and control	0.912			0.692	
Enhanced decision-making through real-time information	0.826			0.507	
Productivity and efficiency improvement	0.805			0.883	56.37
Management of geographically dispersed projects	0.778			0.616	
Integration of digital and physical monitoring systems	0.654			0.538	

Drivers	**Component**			**Extracted Communalities**	**% of Variance**
	1	**2**	**3**		
Enhanced Health & Safety and Workforce Wellbeing					
Improved health and safety management		0.721		0.777	10.11
Reduced exposure to high-risk construction environments		0.629		0.581	
Enhanced remote collaboration among project teams		0.594		0.825	
Workforce flexibility and mobility		0.533		0.794	
Optimised Organisational Operations					
Cost reduction in project management operations			0.736	0.645	6.72
Improved digital integration across project stakeholders			0.618	0.827	
Increased organisational competitiveness			0.565	0.522	
Improved resilience to disruptions			0.509	0.731	

5. DISCUSSION

The findings of the study reveal that the deployment of remote construction management is primarily driven by the need to achieve improved project performance and operational efficiency, enhanced health and safety and workforce wellbeing, and optimised organisational operations. The importance of improved project performance and operational efficiency implies that construction organisations identify the value of remote management of construction projects using innovative technologies, which helps in reinforcing the project control and decision making. This is supported by (Zhu et al., 2022) which noted that digital monitoring systems significantly enhance project controls and drives more responsive management of construction processes. The provision of real-time data assists project stakeholders to make better informed decisions and respond proactively to emerging project risks. Furthermore, the findings highlight enhanced health and safety and workforce wellbeing as a significant driver of remote construction management. The use of remote construction management reduces the need for physical onsite oversight activities therefore reducing the exposure to harmful construction environment (Kehinde, 2025). By enabling supervisors and consultants to monitor site activities remotely, organisations can improve safety oversight while protecting personnel from potential risks. Also, a key finding from the study is identification of the role of optimised organisational operations in motivating the adoption of remote construction management. Past studies noted that the use of digital technologies for construction project delivery instigates improved coordination for construction projects, even if they are geographically dispersed (Islam, 2020). These findings suggest that the adoption of remote construction management is motivated not only by technological advancements but also by the broader pursuit of improved project delivery, safer working environments, and more efficient organisational processes.

6. CONCLUSIONS AND RECOMMENDATIONS

The study assessed the instigating factors for the deployment of remote construction management for project delivery in South Africa. Using a quantitative methodology, data was collected from the study's target population. The analysis from the retrieved data shows three derived constructs serving as the drivers of remote construction management. These are improved project performance and operational efficiency, enhanced health & safety and workforce wellbeing, and optimised organisational operations. The findings portrays the potential for construction management to drive the transformation of the supervision and management processes engaged in during project execution. Findings from the study can assist contractors, consultants, and policymakers in developing digital strategies, enhancing project implementation efficiency, improving coordination across dispersed project locations, and building resilience and competitiveness. Based on these findings, the study recommends that construction organisations invest in digital technologies which aids remote monitoring of construction projects and ultimately drives effective project management. Also, construction organisations should strive to develop the requisite competence required among personnel to drive the espousal of remote construction management. Furthermore, policymakers and industry stakeholders should promote the integration of remote construction management practices through supportive regulatory frameworks and industry guidelines, thereby encouraging broader adoption across the construction sector. It is worthy to note that the study was conducted in Gauteng province in South Africa. Future studies can be conducted in other provinces of the country to give a broader perspective from the geographical context. Also, a mono methodological method was employed in the current study, other studies can deploy a multi or mixed methods.

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