

Factors influencing construction firms' decision-making processes regarding the adoption of digital technology in the Gauteng construction industry, South Africa.

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Abstract

The adoption of digital technology has the potential to improve efficiency, productivity, and competitiveness within the construction industry; however, adoption levels among construction firms in South Africa remain uneven. This study examines factors influencing construction firms' decision-making processes regarding digital technology adoption within the Gauteng construction industry, South Africa. The study aims to identify organisational, technological, and environmental factors shaping adoption decisions. A quantitative research design was employed using a structured questionnaire administered to construction professionals in Gauteng Province. A total of 112 valid responses were obtained and analysed using descriptive statistics, exploratory factor analysis (EFA), and chi-square tests. The findings reveal that the availability of skilled personnel and the cost of implementation are the most influential factors affecting adoption decisions. Furthermore, factor analysis identified three major components influencing decision-making: organisational and strategic factors, external and human resource factors, and cost considerations. The study contributes empirical evidence specific to Gauteng Province and provides insights for policymakers and industry stakeholders to improve digital transformation strategies within the construction industry.

Keywords: Digital technology adoption; Decision-making processes; Construction firms; Gauteng construction industry; Technology adoption factors; Construction innovation.

1. Introduction

The construction industry plays a critical role in economic development and infrastructure delivery globally. Despite advancements in digital technologies such as Building Information Modelling (BIM), Internet of Things (IoT), and cloud computing, adoption within the South African construction industry remains uneven and relatively slow (Aghimien et al., 2022).

The slow uptake of digital technologies has been attributed to several factors, including limited organisational readiness, lack of skilled personnel, and high implementation costs (Umar, 2021). Understanding the factors influencing decision-making processes is essential for improving adoption rates and enhancing industry performance. However, limited empirical studies have focused specifically on decision-making dynamics within the South African construction context. Despite the growing global emphasis on digital transformation within the construction sector, the adoption of digital technologies among construction firms in South Africa remains relatively slow and inconsistent. While technologies such as Building Information Modelling (BIM), cloud computing, artificial intelligence, and Internet of Things (IoT) systems offer significant benefits in

improving productivity, project coordination, and operational efficiency, many firms continue to experience challenges in adopting these technologies effectively. Existing studies have primarily focused on technological implementation and innovation adoption in developed economies, with limited empirical attention given to the decision-making dynamics influencing digital technology adoption within the South African construction industry. Furthermore, there is insufficient understanding of how organisational, technological, and environmental factors collectively influence construction firms' adoption decisions, particularly within Gauteng Province. This study therefore seeks to address this gap by examining the factors influencing construction firms' decision-making processes regarding digital technology adoption in Gauteng Province, South Africa.

This study therefore aims to examine the factors influencing construction firms' decision-making processes regarding digital technology adoption.

2. Literature Review

Digital technology adoption within the construction industry has increasingly become an important area of research due to its potential to improve productivity,

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efficiency, communication, and project delivery. Technologies such as Building Information Modelling (BIM), cloud computing, drones, artificial intelligence, and Internet of Things (IoT) systems are transforming construction processes globally. However, the adoption of these technologies remains uneven, particularly within developing countries such as South Africa.

The Technology-Organisation-Environment (TOE) framework developed by Tornatzky and Fleischer provides a useful theoretical foundation for understanding technology adoption within organisations. According to the TOE framework, technology adoption is influenced by technological, organisational, and environmental contexts.

Technological factors relate to the characteristics of the technology itself, including complexity, compatibility, usability, and perceived benefits. Besklubova et al. (2021) explain that technologies perceived as highly complex are less likely to be adopted because firms may lack the technical capabilities required for implementation. Compatibility with existing organisational systems and workflows also plays a significant role in determining whether firms adopt digital technologies successfully.

Cost of implementation is another important technological factor affecting adoption decisions. Digital technologies often require substantial financial investment for software acquisition, employee training, infrastructure development, and maintenance. Umar (2021) found that many construction firms in developing economies struggle to adopt digital technologies due to financial constraints and uncertainty regarding return on investment.

Organisational factors include management support, organisational readiness, firm culture, and availability of skilled personnel. Top management support has consistently been identified as a critical driver of successful digital transformation because leadership influences strategic priorities, resource allocation, and organisational commitment toward innovation adoption. Attencia and Mattos (2022) state that firms with strong leadership support are more likely to implement digital transformation initiatives successfully.

Organisational readiness refers to the extent to which firms possess the necessary financial resources, infrastructure, and technical expertise to implement digital technologies effectively. The availability of skilled personnel is particularly important because digital technologies require employees with specialised technical knowledge and digital competencies. Aghimien et al. (2022) emphasised that lack of skilled personnel remains one of the major barriers to digital technology adoption within the construction industry.

Environmental factors include competitive pressure, client demand, industry trends, and regulatory requirements. Competitive pressure often encourages firms to adopt digital technologies to maintain market relevance and improve competitiveness. In addition, increasing client expectations regarding project efficiency, sustainability, and innovation have motivated construction firms to invest in digital solutions.

Regulatory requirements and government policies also influence technology adoption decisions. Supportive policies, industry standards, and digital transformation initiatives can encourage firms to adopt innovative technologies more effectively. However, limited policy support and inadequate industry regulations may slow adoption rates, particularly in developing economies.

Although several studies have investigated digital technology adoption within the construction industry, limited research has specifically focused on the factors influencing construction firms' decision-making processes within the Gauteng construction industry. This study therefore seeks to contribute to the existing body of knowledge by examining the organisational, technological, and environmental factors influencing digital technology adoption decisions among construction firms in Gauteng Province, South Africa.

2.1. Conceptual Framework

This study is grounded in the Technology-Organisation-Environment (TOE) framework, which explains how technological, organisational, and environmental factors influence organisational technology adoption decisions.

In this study, technological factors include implementation cost, system complexity, and expected return on investment. Organisational factors include management support, organisational readiness, project complexity, and availability of skilled personnel. Environmental factors include competitive pressure and regulatory requirements.

The framework proposes that these factors collectively influence construction firms' decision-making processes regarding digital technology adoption within the Gauteng construction industry.

3. Research Methodology

This study adopted a quantitative research approach to investigate the factors influencing construction firms' decision-making processes regarding digital technology adoption within Gauteng Province, South Africa. A quantitative approach was considered appropriate because it allows for the collection and statistical analysis of numerical data from a large sample of respondents.

Gauteng Province was selected for the study because it is South Africa's economic hub and contains a high concentration of construction firms and infrastructure development projects. The province also represents one of the most technologically advanced regions within the South African construction industry, making it suitable for investigating digital technology adoption.

The target population consisted of construction professionals including project managers, quantity surveyors, construction managers, engineers, and architects working within construction firms operating in Gauteng Province.

Data were collected using a structured questionnaire designed based on existing literature relating to digital technology adoption factors within the construction industry. The questionnaire included sections relating to respondent demographics and factors influencing digital technology adoption.

A total of 112 valid responses were obtained and used for data analysis. The collected data were analysed using descriptive statistics, including Mean Item Score (MIS) and standard deviation, to determine the relative importance of the identified factors. Exploratory Factor Analysis (EFA) was further conducted to identify the underlying components influencing decision-making processes. In addition, chi-square tests were performed to examine whether statistically significant relationships existed between demographic variables and the identified adoption factors.

The selected statistical techniques were considered appropriate because they provide empirical insight into the patterns and relationships associated with digital technology adoption decisions within construction firms.

4. Findings and Discussion

4.1. Descriptive Analysis Results

Table 1 presents the ranking of factors influencing construction firms' decision-making processes regarding digital technology adoption.

The findings reveal that the availability of skilled personnel and the cost of implementation are the most influential factors affecting digital technology adoption decisions among construction firms in Gauteng Province.

These findings suggest that construction firms place significant emphasis on technical capacity and financial capability when considering digital transformation initiatives. The results further indicate that firms are increasingly influenced by external market competition and project-related complexities.

4.2. Exploratory Factor Analysis (EFA)

The EFA results are presented in Table 2. Table 2 identified three major components influencing decision-making.

4.2.1. Factor 1: Organisational and Strategic Factors

This factor includes management support, project complexity, and competitive pressure. These findings confirm that internal organisational dynamics significantly influence adoption decisions (Attencia & Mattos, 2022).

4.2.2. Factor 2: External and Human Resource Factors

This includes availability of skilled personnel, expected ROI, and regulatory requirements. The importance of human capital in digital transformation is consistent with findings by Aghimien et al. (2022).

Table 1: Ranking of factors for decision-making in construction firms for digital technology adoption

Factors	Mean Score	Standard Deviation	Rank
Availability of skilled personnel	1.43	0.52	1
Cost of implementation	1.45	0.56	2
Competitive pressure	1.61	0.64	3
Project complexity	1.68	0.71	4
Management support	1.74	0.75	5
Regulatory requirements	1.83	0.79	6
Expected return on investment	1.91	0.82	7

Table 2: EFA Results

Variables	Component 1	Component 2	Component 3
Management support	0.812		
Project complexity	0.756		
Competitive pressure	0.701		
Skilled personnel		0.793	
Expected ROI		0.741	
Regulatory requirements		0.688	
Cost of implementation			0.851

4.2.3. Factor 3: Cost Considerations

Cost of implementation emerged as a standalone factor, highlighting its critical role as a barrier to adoption. This is consistent with literature indicating that high initial investment costs discourage adoption in developing economies (Umar, 2021). The three factors collectively explained approximately 61.72% of the total variance, indicating strong explanatory power.

4.3. Chi-Square Test Results

The chi-square analysis (Table 3) revealed no statistically significant differences across demographic variables such as age, professional role, employer type, and years of experience. This suggests that the identified factors are widely experienced across the construction industry.

Table 3: Chi-square analysis results

Demographic Variable	Chi-Square Value	p-value	Interpretation
Age	2.143	0.342	Not significant
Professional role	3.287	0.218	Not significant
Employer type	1.974	0.417	Not significant
Years of experience	2.651	0.276	Not significant

4.4. Discussion

The findings of this study indicate that digital technology adoption decisions within construction firms are primarily influenced by the availability of skilled personnel and the cost of implementation. The prominence of skilled personnel highlights the importance of human capital and technical expertise in supporting successful digital transformation initiatives within the construction industry.

This finding aligns with Aghimien et al. (2022), who found that limited technical skills remain one of the major barriers to digital technology adoption within developing construction industries. Construction firms require employees with adequate digital competencies to effectively implement and manage emerging technologies such as BIM, cloud computing, and digital project management systems.

The study also found that implementation cost significantly influences adoption decisions. This finding is consistent with Umar (2021), who reported that financial constraints and high initial investment costs discourage many construction firms from adopting advanced digital technologies. The financial burden associated with software acquisition, training, infrastructure, and maintenance remains a major challenge, particularly for small and medium-sized construction firms.

In addition, organisational factors such as management support and project complexity were found to influence adoption decisions. Firms with strong leadership support are generally more willing to invest in innovation and technological transformation. This finding supports Attencia and Mattos (2022), who

emphasised the critical role of leadership commitment in facilitating successful digital transformation.

Environmental factors such as competitive pressure and regulatory requirements also influence decision-making processes. Increasing competition within the construction industry encourages firms to adopt digital technologies to improve efficiency, productivity, and market competitiveness.

Overall, the findings validate the Technology-Organisation-Environment (TOE) framework by demonstrating that digital technology adoption decisions are influenced by a combination of technological, organisational, and environmental factors.

5. Conclusion and Further Research

This study examined the factors influencing construction firms' decision-making processes regarding digital technology adoption within Gauteng Province, South Africa. The findings revealed that the availability of skilled personnel and the cost of implementation are the most influential factors affecting adoption decisions within construction firms.

The study further identified organisational, environmental, and financial considerations as critical determinants influencing digital technology adoption. These findings confirm that successful digital transformation within the construction industry depends on both internal organisational readiness and external environmental conditions.

The study contributes to the existing body of knowledge by providing empirical evidence relating to digital technology adoption within the Gauteng construction industry. Furthermore, the findings provide practical insights for policymakers, industry stakeholders, and construction firms seeking to improve digital transformation strategies.

It is recommended that construction firms invest in digital skills development and employee training to improve organisational readiness for digital transformation. In addition, government and industry stakeholders should develop supportive policies and financial support mechanisms aimed at reducing the cost barriers associated with digital technology adoption.

Future research should focus on longitudinal studies investigating how digital technology adoption evolves

over time within construction firms. Comparative studies involving other South African provinces and international contexts are also recommended to provide

broader insights into digital transformation within the construction industry.

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