

Leveraging Innovative Technologies for Construction Cost Management in South Africa

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Abstract

One of the attributes of a successful construction project is its adherence to effective cost management as anticipated ex-ante. Using innovative technologies can help achieve the aforementioned, as opposed to the traditional approach used for construction management, which has proven ineffective. Hence, this study seeks to evaluate the drivers for the uptake of innovative technologies for construction cost management in South Africa. The study employed a quantitative methodological approach, which necessitated the collection of data from the target respondents via a questionnaire. The elicited data was analysed using appropriate methods of data analysis. Findings from the analysis showed that the most significant drivers are reduced overruns, complexity of modern construction projects, and client expectations. The study's findings contribute to the body of knowledge by providing insights that can help in aiding cost management using innovative technologies. Also, the research outcome would benefit stakeholders in the South African construction industry by giving perceptions on the propelling measures for effective construction cost management.

Keywords

Construction Costs, Cost Management, Innovative Technologies, Optimisation, South Africa.

1. Introduction

The construction industry plays a vital function in the economic development of any nation through the supply of infrastructure needed for nation-building, both at the national and sub-national levels (Ikuabe et al., 2021). Key to the industry is the delivery of construction projects that come in different sizes, complexity, uniqueness, resource intensity, interdependency of tasks, etc. (Boadu et al., 2020). According to Oh and Choi (2020), the methodical complexities characterised by the execution of construction projects in accordance with completion mandates are aligned with the client's demands driven by dynamic technical competencies and the innovative skills of the executor. Delivering construction projects requires financial expenses spanning inception to completion. Hence, the effective management of financial resources during construction project delivery is a fundamental yardstick for assessing project success (Ikuabe and Oke, 2019). Moreover, project cost management is among the knowledge areas specified by the Project Management Institute (PMI). This pertains to planning the project's financial administration, estimating the costs of resources required to undertake the project, creating a budget for the project, setting up a financing strategy and funding, and managing and controlling the project's costs (Burke, 2013). Consequently, the optimisation of costs associated with construction project delivery is germane. One effective approach for attaining the aforementioned is the deployment of innovative technologies.

The use of innovative technologies for construction project delivery has been touted to proffer solutions to some of the challenges encountered using traditional methods (Adekunle et al., 2024; Otasowie et al., 2022). Other sectors such as aviation, healthcare, manufacturing, and banking have showcased evidence of optimised service delivery resulting from the espousal of innovative technologies (McKinsey, 2017). The use of digital technologies such as building information modelling (BIM), virtual reality, blockchain technology, cloud computing, and the Internet of Things, amongst others, for project delivery is fast gaining attention among scholars and industry experts.

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Implementing these innovative technologies for construction cost management would aid in improving the competitive advantage of organisations, inform precise estimation of construction projects, and collect real-time data for cost control (Smith, 2016). Furthermore, this would lead to improved transparency of financial dealings and aid in risk mitigation through predictive analytics, resource optimisation, and expounding data-driven insights (Ibem and Laryea, 2014). On this basis, this study intends to assess the drivers of implementing innovative technologies for construction cost management in South Africa. This is to contribute to the knowledge on the digital transformation of construction project delivery for optimised service delivery.

2. Review of Related Studies

Methodologies for construction project cost management entail tasks that inform the optimal utilisation in the management process for achieving expected outcomes. According to Doloi (2013), the cost management process comprises a group of interlaced techniques specifying the management of cost activities. The development of this procedure considers the project charter, the project management plan, market trends and prices, resource costs and productivity rates, and organisational process assets (historical data, cost estimating policies and financial control processes) (Burke, 2013). Overall, these procedures ensure a well-defined outlay of managing the project's financial resources under execution. Using innovative technologies is seen as a revolutionary tool for optimising cost management practices for delivery projects as planned ex-ante (Smith 2016). This aids in the planning, controlling, and executing of the financial resources required for putting up construction projects from inception to completion. The uptake of innovative technologies for construction cost management is driven by several parameters. Ozorhon and Kutluhan (2016) emphasised innovation policy as stated in an organisation's innovation strategy, which encompasses the innovation culture of tolerance and supportiveness as essential for digital transformation.

Moreover, the efficient use of resources has been a long-standing motivation for innovativeness (Delmas and Pekovic, 2015). This is premised on the need to improve resource utilisation to attain project success. Furthermore, Roomi (2024) opined that the call for enhanced collaboration and communication among project stakeholders induces innovativeness in cost management. Instituting seamless communication among project parties, who are economic actors, contributes to the project's overall success. Also, due to market pressure faced by economic actors, the need for innovation to institute cost management cannot be overemphasised (Gualandris and Kalchschmidt, 2014). The increasing demand for clients, the rapid sophistication of construction project concepts and ideas, and the complexities associated with project execution are some factors instigating this market pressure. Chien et al. (2014) opined that the need for project risk mitigation is a significant driver for employing digital technologies for construction cost management. These innovations seek to aid in the abatement of consequential risk outlays that can potentially impact project success. Due to the complexity of construction projects, budget overruns are often expected during project execution. Reducing cost overruns associated with construction delivery is a mandate driving the uptake of digital technologies for project execution (Scott and Bommu, 2024; Ikuabe et al., 2020).

3. Methodology

The study aims to evaluate the instigating measures for the uptake of innovative technologies for construction cost management in South Africa. A quantitative approach was employed, necessitating a questionnaire survey for data collection from the study's target population. The target population comprised construction professionals in the Gauteng province of South Africa. These included quantity surveyors, architects, project managers, engineers, and construction project managers. The sampling techniques employed were the purposive and snowball sampling techniques. Sixty-three questionnaires (63) were collected from the respondents and judged proper for analysis. For the data analysis methods, mean item score, standard deviation and one-sample *t*-test were used. Furthermore, Cronbach's alpha test was employed to ascertain the reliability and validity of the study's instrument for data collection. The result gave an alpha value of 0.857, thus affirming that the research instrument is credible since the alpha value is closer to 1.00 (Tavakol and Dennick, 2011).

4. Results

The derived drivers from existing literature were rated by the target population based on their significance. The retrieved data was subject to analysis using a one-sample *t*-test, necessitating the formulation of the study's hypothesis. The formulated hypothesis had a null hypothesis stating that a driver for using innovative technology for construction

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cost management is insignificant if the mean value is less than or equal to the study's population ($H_0: U \leq U_0$). The alternate hypothesis states that a driver for using innovative technology for construction cost management is significant if the mean value is greater than the population mean ($H_a: U > U_0$). The current study adopted 3.50 as its population mean (U_0). Hence, a driver must have a mean value greater than 3.50 to be statistically significant. Meanwhile, a driver with a mean value less than or equal to 3.50 is portrayed as statistically insignificant. Furthermore, the outcome of the analysed data portraying the identified drivers and their accompanying two-tailed p -values is presented in Table 1. The result indicates that all the identified drivers of the uptake of innovative technologies for the management of construction cost all have a p -value less than 0.05 at a 95% confidence level, indicating that they are all significant.

Table 1. One-Sample Test

Drivers	Test Value = 3.50					
	95% Confidence Interval of the Difference					
	T	df	Sig. (2-tailed)	MD	L	U
Competitive advantage	2.781	62	0.000	0.601	0.4287	1.4782
Reduced overruns	3.665	62	0.000	0.227	0.3874	1.5590
Market pressure	7.092	62	0.000	0.543	0.3695	1.3624
Risk mitigation	5.857	62	0.000	0.444	0.4993	1.5575
Client expectations	4.333	62	0.000	0.289	0.2086	1.3964
Complexity of modern construction projects	5.008	62	0.000	0.174	0.3939	1.4783
Enhanced collaboration and communication	4.793	62	0.000	0.350	0.4268	1.2975
Resource efficiency	6.698	62	0.000	0.186	0.3775	1.4182
Technological advancements	1.374	62	0.000	0.235	0.2218	1.3361
Demand for greater accuracy	2.448	62	0.000	0.116	0.4003	1.2985
Improved accountability	5.869	62	0.000	0.391	0.4275	1.4026
Effective cost monitoring	4.522	62	0.000	0.138	0.3614	1.3088

N.B: MD=Mean Difference; L=Lower Limit; U=Upper Limit

The ranking of the identified drivers of the uptake of innovative technologies for construction cost management in South Africa is shown in Table 2. The results indicate that all the drivers have a mean score above the cut-off set for the study, which is 3.50. Consequently, this affirms the study's alternate hypothesis for all the identified drivers ($H_a: U > U_0$). This states that a driver for using innovative technology for construction cost management is significant if the gotten mean value is greater than the population mean. Also, the derived p -value of the drivers at a 95% confidence level is given to be less than 0.05, which outlines that they are significant. From the findings, the most significant drivers for the espousal of innovative technologies for construction cost management are reduced overruns ($MIS=4.89$, $sig.=0.000$), complexity of modern construction projects ($MIS=4.75$, $sig.=0.000$), client expectations ($MIS=4.66$, $sig.=0.000$), effective cost monitoring ($MIS=4.66$, $sig.=0.000$), and technological advancements ($MIS=4.59$, $sig.=0.000$).

Table 2. Summary of *t*-test showing rankings of the identified drivers

Drivers	Mean	Std. Deviation	Sig. (2-tailed)	Rank
Reduced overruns	4.89	0.638	0.000	1
Complexity of modern construction projects	4.75	0.771	0.000	2
Client expectations	4.66	0.205	0.000	3
Effective cost monitoring	4.66	0.784	0.000	3
Technological advancements	4.59	0.328	0.000	5
Resource efficiency	4.52	0.488	0.000	6
Competitive advantage	4.41	0.597	0.000	7
Demand for greater accuracy	4.38	0.216	0.000	8
Improved accountability	4.22	0.295	0.000	9
Market pressure	4.22	0.633	0.000	9
Risk mitigation	4.09	0.617	0.000	11
Enhanced collaboration and communication	3.86	0.845	0.000	12

5. Discussion of Findings

Stakeholders' viewpoints were obtained to evaluate the drivers of employing innovative technologies for construction cost management in the South African construction industry. Results from the analysed retrieved data indicate that the reduction in cost overruns of construction projects is a key driver. This is corroborated by Scott and Bommu (2024) and Ikuabe et al. (2020), who affirmed that reducing cost overruns associated with construction delivery is a mandate driving the uptake of digital technologies for project execution. Since one of the cardinal yardsticks for assessing the success of a construction project is cost optimisation, reducing cost overruns by using innovative technologies would significantly drive its uptake. Moreover, due to the complexity of modern construction projects, there is a need to infuse innovative technologies to manage costs. Due to market pressure faced by economic actors, the need for innovation to institute cost management cannot be overemphasized (Gualandris and Kalchschmidt, 2014). The increasing demand for clients, the rapid sophistication of construction project concepts and ideas, and the complexities associated with project execution are some factors instigating this market pressure. Also, Chien et al. (2014) opined that the need for project risk mitigation is a significant driver for employing digital technologies for construction cost management. These innovations seek to aid in the abatement of consequential risk outlays that can potentially impact project success.

5. Conclusions

The need for construction cost optimisation resulting from the conventional challenges plaguing the effective delivery of projects calls for systematic approaches. Innovative technologies for construction cost management are touted to proffer solutions to some of these challenges. The study assessed the drivers of using innovative technologies for construction cost management in South Africa. The identification of the drivers was aided by the review of extant literature and used to frame the study's research instrument. Data retrieved from the target respondents was analysed appropriately. The findings showed that the most significant drivers of using innovative technologies for cost management are reduced overruns, the complexity of modern construction projects, and client expectations. The study's findings bring to the fore the measures that can help propel the espousal of innovative technologies for effective cost management of construction projects. The study's findings will benefit stakeholders in South African construction as it unravels propelling measures for employing innovative technologies for managing construction costs optimally. Conclusively, it is pertinent to note that the study was conducted in the Gauteng province of South Africa. Future studies can be conducted in other provinces to portray a wider reach of the viewpoints of construction professionals in the country.

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