



MODELLING CHALLENGES HINDERING THE IMPLEMENTATION OF COST-REDUCTION TECHNIQUES ON PUBLIC TERTIARY INSTITUTION PROJECTS

Akinola, G. A.¹, Fagbenle, O. I.², and Ogunde, A. O.³

^{1,2,3}*Department of Building Technology, College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria.*

¹*Department of Quantity Surveying, The Federal Polytechnic Ilaro, Ogun State, Nigeria.*

¹*gbemisola.akinolapgs@cu.edu.ng; gbemisola.akinola@federalpolyilaro.edu.ng*

²*olabosipo.fagbenle@covenantuniversity.edu.ng*

³*ayodeji.ogunde@covenantuniversity.edu.ng*

ABSTRACT

Purpose: This study examined the interconnections between cost-reduction techniques and the challenges affecting their implementation in public tertiary institution building projects in Nigeria.

Design/Methodology/Approach: The study employed a quantitative research approach using a structured questionnaire. Quota purposive sampling was used to select 138 construction professionals who have worked on construction projects completed between 2012 and 2022 in public tertiary institutions in Ogun, Lagos, Osun, and Oyo states. SPSS 23 was used to analyse the demographic data, while SmartPLS v4.0.9.8 software was used to model the relationship.

Findings: The study indicated that the challenges hindering the implementation of cost-reduction techniques are intertwined.

Research Limitation: The study is limited to public tertiary institution building projects; care should be taken in generalising to other project types.

Practical Implication: The model developed by the study will serve as a helpful guide for implementing preventive measures and addressing the challenges that hinder the implementation of cost-reduction techniques.

Social Implication: The model will be useful to public institution managers and construction experts in achieving cost savings and environmental sustainability in public tertiary education building projects.

Originality / Value: This study bridges the knowledge gap by modelling the relationship between cost-reduction techniques and the challenges hindering their implementation in public tertiary-institution projects.

Keywords: *Challenges. construction. cost-reduction. modelling. public institutions*

ISSN: 2408-7920

Papers were presented at the 3rd International Conference on Sustainable Infrastructural Development, held at Covenant University, Ota, Ogun State, Nigeria, September 2-4, 2024.

Copyright © African Journal of Applied Research

Arca Academic



INTRODUCTION

The Nigerian construction industry, and the construction industry globally, faces poor cost performance, resulting in cost overruns, unaffordable construction, and budget constraints for clients (Oladiran & Njoku, 2026; Inuwa et al., 2015; Rahman et al., 2013). This is considered a menace by studies (Amusan et al., 2018; Olatunde & Alao, 2017; Ogunde et al., 2017) and requires specialised interventions to effectively reduce costs in executing construction projects.

Public tertiary institutions are funded and operated by the government and often construct educational buildings with funding from the government, its agencies, internally generated revenue, or donations (World Bank, 2021). These projects play a vital role in providing infrastructure for higher education, which is essential to the development of societies and nations (Chankseliani & McCowan, 2021). However, due to limited financial resources, these projects often face the challenges of delivering quality infrastructure (Ise et al., 2018).

Studies have shown that implementing cost-reduction techniques improves project performance and delivery (Akinola et al., 2024a). For instance, Himme (2012) and Akeem (2017) noted that the cost performance of construction projects depends mainly on the type or combination of cost-reduction techniques adopted. Selecting one or more cost-reduction techniques has been shown to improve cost performance, provide value for money, and ensure client satisfaction at the end of project delivery (Osumanu et al., 2022; Gopalan & Venkataraman, 2015). Likewise, Anuradha et al. (2022) reported that cost-reduction techniques encourage synergy among quality, performance, and reliability, thereby improving the value of public-sector construction projects. At the same time, Wong and Ahmed (2018) argued that implementing cost-reduction techniques will significantly reduce process variation and improve performance in complex projects.

While the study assesses these barriers, a relationship model is necessary to show the constructs' interaction. This is necessary to create efficient ways to overcome them and ensure the successful delivery of public tertiary education building projects. Hence, the study aims to bridge the knowledge gap using a Structural Equation Model (SEM) to explicate the relationship between cost reduction techniques and the challenges hindering their implementation on public tertiary institution projects. Understanding the model will assist decision-makers undertaking public institution projects in selecting cost-reduction techniques for construction.

ISSN: 2408-7920

Papers were presented at the 3rd International Conference on Sustainable Infrastructural Development, held at Covenant University, Ota, Ogun State, Nigeria, September 2-4, 2024.

Copyright © African Journal of Applied Research

Arca Academic



CONCEPTUAL MODEL FOR THE STUDY

Cost reduction techniques are methods and strategies that aim to reduce construction costs without compromising quality (Akinola et al., 2024b; Oyewobi et al., 2018). These techniques include value engineering, design optimization, material selection, construction management improvements, supply chain management, target value design, budget control, cost-benefit analysis, onsite project resource control technique, earned value analysis, target costing, market research, simplification and standardization of units, standard costing, activity-based costing, kaizen costing, material and process substitution, automation, and circular economy (Akinola et al., 2023; Kim & Alseadi, 2021; Tohidi, 2011).

These 16 techniques were further grouped into four categories, as shown in Table 1.

Table 1: Classification of Cost Reduction Techniques

Cost reduction techniques (CRT)
(CRT_G1)
Circular Economy
Standard Costing
Market Research
Kaizen Costing
Material and Process Substitution
Automation
Activity Based Costing
(CRT_G2)
Supply Chain Management
Onsite Project Resource Control
Budget Control
(CRT_G3)
Simplification and Standardisation of units
Cost Benefit Analysis
(CRT_G4)
Value Analysis/Engineering
Target Value Design
Target Costing
Earned Value Analysis

ISSN: 2408-7920

Papers were presented at the 3rd International Conference on Sustainable Infrastructural Development, held at Covenant University, Ota, Ogun State, Nigeria, September 2-4, 2024.

Copyright © African Journal of Applied Research

Arca Academic



However, despite their potential benefits, various challenges frequently hinder their implementation (Akinola et al., 2023). Hafez et al. (2015) mentioned that these challenges include change orders, design errors and material price fluctuations. Akhil and Das (2018) emphasised proper project planning, skilled labour allocation, and efficient material management as essential elements for reducing project costs. Hafez et al. (2015) added that implementing the techniques requires overcoming obstacles such as lack of knowledge, poor management, and inadequate site supervision.

Previous studies explored the challenges associated with implementing cost-reduction techniques in construction projects, presented in Table 2. The table presents the six (6) classifications of challenges identified in the literature. However, most of these studies have focused on construction projects in general, with limited attention to public tertiary education building projects (Akinola et al., 2024). Despite the researchers' contributions to implementing cost-reduction techniques in the industry, no research has effectively created a model that analyses the relationship between the techniques and challenges hindering its implementation, particularly in addressing public tertiary institution projects.

Table 2: Challenges Associated with Cost Reduction Techniques.

	Challenges	Authors
ACP	Ambiguity in contract award and project execution	
ACP1	Ambiguity in contract documentation	Alsuliman et al., (2012); Ewa, (2013)
ACP2	Cash flow problems	Kadiri & Shittu (2015) ; Dougherty (2016)
ACP3	Non-adherence to professionalism and ethical practice	Khadim et al., (2021)
ACP4	Budget padding on educational projects	Damoah et al. (2021)
ACP5	Inexperience of project stakeholders	Owusu et al., (2019); Khadim et al., (2021)
ACP6	Practices of assigning contracts to the lowest bidder	Wells (2013) ; Asiedu & Adaku (2020)
ACP7	Shortage of materials	Alsuliman et al. (2012); Osawaru et al. (2018); Bashir & Bello (2022)
ACP8	Stakeholders' corrupt practices	Owusu et al. (2019); Khadim et al. (2021)
ACP9	Design errors	Asiedu & Adaku, (2020)

ISSN: 2408-7920

Papers were presented at the 3rd International Conference on Sustainable Infrastructural Development, held at Covenant University, Ota, Ogun State, Nigeria, September 2-4, 2024.

Copyright © African Journal of Applied Research

Arca Academic



ACP10	Lack of communication among parties	Wells (2013); Asiedu & Adaku (2020)
LCM	Lack of Control from The Management	
LCM1	Construction disputes	Wells (2013)
LCM2	Incorrect planning and scheduling by contractors	Owusu et al. (2019); Khadim et al. (2021)
LCM3	Lack of support and commitment from management	Aje (2012); Larson & Gray (2018)
LCM4	Lacks of control from the management of tertiary institutions	Aje (2012); Larson & Gray (2018)
LCM5	Imposition of fixed-priced contracts for contracts exceeding one year	Isofia et al. (2023)
PIP	Perceived political influence in procurement	
PIP1	Inaccurate estimates	Aghimien & Aigbavboa (2018); Asiedu & Adaku (2020)
PIP2	Politics	Owusu et al. (2019)
PIP3	Poor procurement strategies utilized	Asiedu & Adaku (2020)
PIP4	High construction claims	Olanrewaju & Anavhe (2014)
PIP5	Complexity of tertiary education projects	Isofia et al. (2023); Kadiri & Shittu (2015);
UCC	Unrealistic contract requirements and change orders	
UCR1	High cost of building materials	Alsuliman et al. (2012)
UCR2	High construction changes	Alsuliman et al. (2012)
UCR3	Unrealistic contract duration and requirements imposed	Isofia et al. (2023)
UCR4	Acceptance of meagre bidding rates	Wells (2013)
NAI	Non-prioritised automation integration	
NAI1	Incompetent project team	Aje (2012); Isofia et al. (2023)
NAI2	Payment challenges	Isofia et al. (2023); Olayisade et al. (2023)
NAI3	Lack of automation	Aghimien & Aigbavboa (2018); Damoah et al. (2022);
NAI4	Variation order	Alsuliman et al. (2012)

ISSN: 2408-7920

Papers were presented at the 3rd International Conference on Sustainable Infrastructural Development, held at Covenant University, Ota, Ogun State, Nigeria, September 2-4, 2024.

Copyright © African Journal of Applied Research

Arca Academic



NAI5	Insufficient time for estimate	Aghimien & Aigbavboa, (2018); Asiedu & Adaku (2020)
DCC	Deficiencies in contract documents and costing	
DCC1	Deficiencies in cost estimates prepared by public agencies	Owusu et al. (2019); Khadim et al. (2021)
DCC2	Lack of experience of project type	Owusu et al. (2019); Khadim et al. (2021)

Source: Akinola et al.(2024b)

As presented in Tables 1 and 2 above, the study identified 16 cost-reduction techniques and 31 associated challenges from the literature. These variables were then grouped respectively as described. Assessing the challenges associated with cost-reduction techniques in public tertiary education buildings is critical to addressing the institutional infrastructure shortage. According to Oyewobi et al. (2018), these associated challenges influence the project's overall cost. Hence, understanding their relationship is unavoidable for effectively implementing cost-reduction techniques.

Each technique and challenge was coded by group to facilitate variable identification. Cost reduction techniques were tagged CRT_G1, CRT_G2, CRT_G3, and CRT_G4, as indicated in Table 1. Challenges tagged ACP1-ACP10 represent “Ambiguity in the contract award and procurement”; LCM1-LCM5 indicate a lack of control by management; and PIP1-PIP5 indicate perceived political influence in procurement. Other challenges are UCC1-UCC4, NAI1-NAI5, and DCC1-DCC2, representing unrealistic contract requirements and change orders, non-prioritised automation integration, and deficiency in contract documents and costing.

Hence, the underlisted hypotheses were proposed in the study and depicted in the conceptual model shown in Figure 1.

H1- Ambiguity in contract award and project execution challenges significantly influence the implementation of cost-reduction techniques in public tertiary institution projects.

H2- Lack of management control significantly influences the implementation of cost-reduction techniques in public tertiary institution projects.

H3- Perceived political influence in procurement challenges significantly affects the implementation of cost-reduction techniques in public tertiary institution projects.

ISSN: 2408-7920

Papers were presented at the 3rd International Conference on Sustainable Infrastructural Development, held at Covenant University, Ota, Ogun State, Nigeria, September 2-4, 2024.

Copyright © African Journal of Applied Research

Arca Academic



H4- Unrealistic contract requirements and change-order challenges significantly influence the implementation of cost-reduction techniques in public tertiary-institution projects.

H5- Non-prioritised automation integration challenges significantly influence the implementation of cost-reduction techniques in public tertiary institution projects.

H6- Deficiencies in contract documents and costing challenges significantly influence the implementation of cost-reduction techniques in public tertiary institution projects.

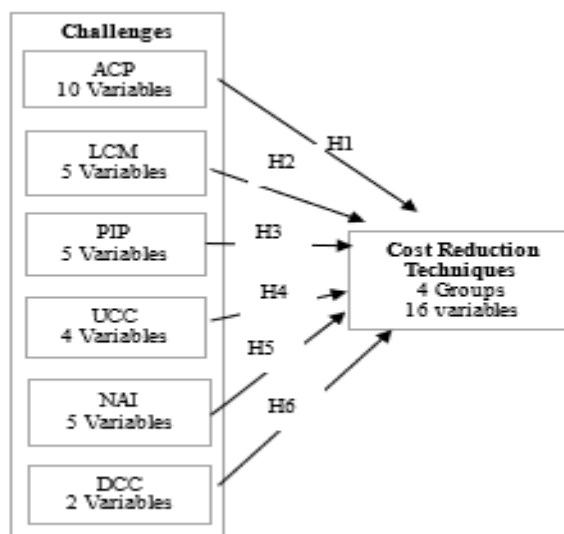


Figure 1: Conceptual model

METHODOLOGY

This study employed a quantitative approach, using a well-structured questionnaire to gather data to test the proposed hypotheses. According to Saunders et al. (2023), this approach is suitable for describing, generating, or testing hypotheses, thus making it ideal for this investigation. The study employed a quota-purposive sampling technique, in which construction professionals involved in projects at public institutions in Ogun, Lagos, Osun, and Oyo states were considered, provided the projects were completed between 2012 and 2022.

The study identified 138 building projects across 15 public institutions in the four states that were completed within the specified year. The construction professionals' details were

ISSN: 2408-7920
Papers were presented at the 3rd International Conference on Sustainable Infrastructural Development, held at Covenant University, Ota, Ogun State, Nigeria, September 2-4, 2024.

Copyright © African Journal of Applied Research

Arca Academic



extracted from the project files, targeting at least one respondent per project. Of the 138 questionnaires distributed, 133 responses were received, yielding an impressive response rate of 96%.

This study used SmartPLS v4.0.9.8 software to evaluate the PLS-SEM (Partial Least Squares Structural Equation Modelling) model. The model evaluations aimed to estimate the structural model and validate the measurement model. The measurement model describes each unobserved construct's relationship to indicators or observed measurements. The structural model, in turn, explains and predicts the connections (both direct and indirect) among the latent factors in the study's model (Hair et al., 2022). Before estimating the structural model, various statistical analyses were employed to evaluate and reflect the measurement models.

Mathematical calculations were performed by applying the PLS algorithm and computing the estimated latent parameter values after the path models were created in SmartPLS. This allowed the algorithm to calculate every load and index in the structural and measurement models over the range -1 to +1. All calculations performed using the bootstrapping technique were configured to "no sign changes, 5000 bootstrapping samples", considering the 133 valid observable samples in the data collection.

RESULTS AND DISCUSSION

Demographic Characteristics of Respondents

The background information obtained from the respondents revealed the highest qualifications, professional background, years of experience, and categories of respondents' organisations. Based on the findings, Figure 2 below shows that 50% of the 133 respondents reported obtaining an MSc/MBA/MPM degree. At the same time, the profession most represented was quantity surveying, at 32%, as shown in Figure 3. Figure 4 also revealed that the respondents have considerable years of experience in the construction industry, as evidenced by the whopping 68.4% in the 11-30 years experience range. The background analysis also shows, in Figure 5, that most respondents (80%) are from public tertiary institutions. This feat aligns with the study's focus on collecting data from relevant professionals at the selected public institutions.

ISSN: 2408-7920

Papers were presented at the 3rd International Conference on Sustainable Infrastructural Development, held at Covenant University, Ota, Ogun State, Nigeria, September 2-4, 2024.

Copyright © African Journal of Applied Research

Arca Academic

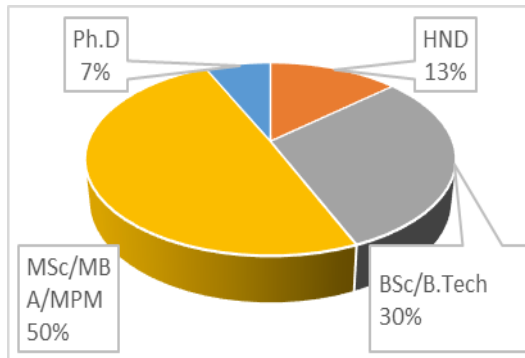


Figure 2: Highest academic qualification

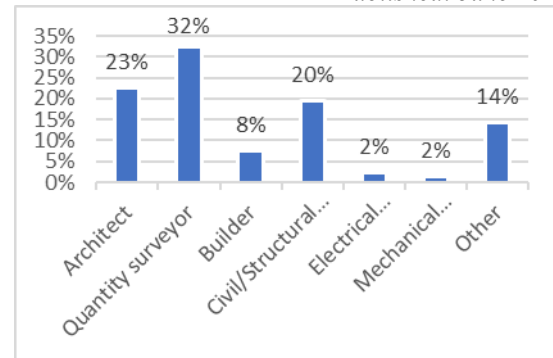


Figure 3: Respondents' professional background

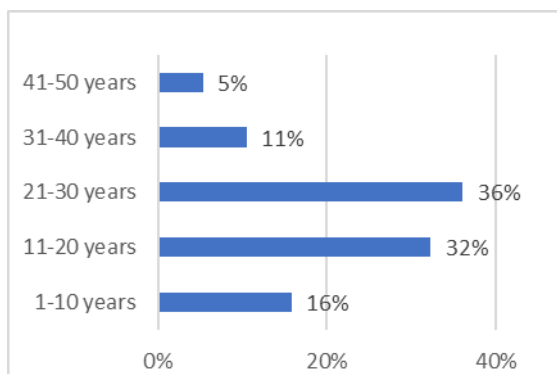


Figure 4: Respondents' years of experience

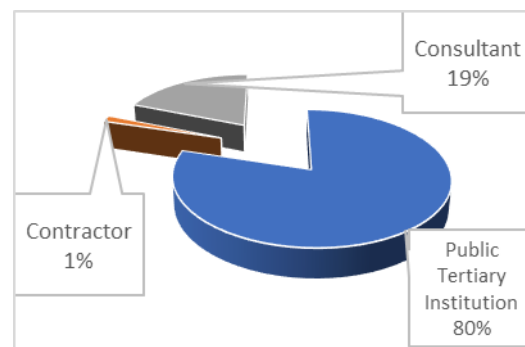


Figure 5: Respondents' organisation

Evaluating the Measurement Model

Seven reflecting constructs, including ambiguity in contract awards and project execution, lack of management control, perceived political influence in procurement, unrealistic contract requirements and change orders, non-prioritised automation integration, deficiencies in contract documents and costing, and cost reduction techniques, make up the proposed measurement approach. The measuring model was validated using the evaluation standards for the reflective model.

As ascertained by Hussain et al. (2018), a reflective assessment framework can be evaluated by examining the model's validity and reliability, including convergent validity via indicator reliability and average variance extracted (AVE), dependability of intrinsic consistency using Cronbach's alpha, as well as discriminant validity via the Fornell and Larcker criterion, cross-

ISSN: 2408-7920

Papers were presented at the 3rd International Conference on Sustainable Infrastructural Development, held at Covenant University, Ota, Ogun State, Nigeria, September 2-4, 2024.

Copyright © African Journal of Applied Research

Arca Academic



loading pattern and the Heterotrait-Monotrait Ratio (HTMT). As Cronbach explains, alpha and composite reliability scores above 0.70 indicate internal consistency.

The internal consistency reliability of the assessment framework used in this study was deemed satisfactory, as evidenced by the combined accuracy and Cronbach's alpha values for every component above 0.70. Cronbach's alpha scores ranged from 0.728 to 1.000, and composite reliability scores ranged from 0.836 to 1.000, as shown in Table 3. The model's convergent validity was also evaluated to assess how well the constructs explain the variance in their indicators.

Each construct's Average variance extracted (AVE) value was examined to evaluate convergent validity. As a general rule, an AVE of 0.50 or higher indicates that the construct, on average, accounts for over 40% of the variability in its metrics (Fornell & Larcker, 1981). On the other hand, if the AVE is below 0.5, the construct's convergent validity is in doubt. The result indicated that all constructs possess AVE values greater than 0.50. As a result, all constructs showed commendable convergent validity, as shown in Table 3.

Table 3: Reflective Measurement Model Assessment

Latent Variables	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
ACP	0.922	0.924	0.935	0.594
LCM	0.924	0.93	0.942	0.766
PIP	0.93	0.931	0.947	0.781
UCC	0.728	0.836	0.822	0.545
NAI	0.875	0.887	0.909	0.666
DCC	0.919	0.921	0.961	0.925
CRT	1.000	1.000	1.000	1.000

To demonstrate how dissimilar the constructs in the measurement model are, discriminant validity was also assessed using the Fornell and Larcker criterion, cross-loading patterns, and the Heterotrait-Monotrait Ratio (HTMT), as recommended by Ramayah et al. (2017). The results of these tests are presented in Tables 4, 5, and 6. As indicated in Table 4, the square root of the construct's AVE (the highest value in each column, bolded diagonally) exceeds the intercorrelations with other constructs. Table 5 revealed the cross-loading pattern from the PLS-SEM method and demonstrated that the item loadings are higher with the constructs that it is designed to measure. It shows that each item differed from the other constructs and loaded more heavily on its corresponding construct. The Heterotrait-Monotrait Ratio (HTMT) values

ISSN: 2408-7920

Papers were presented at the 3rd International Conference on Sustainable Infrastructural Development, held at Covenant University, Ota, Ogun State, Nigeria, September 2-4, 2024.

Copyright © African Journal of Applied Research

Arca Academic



in Table 6 are below 0.85 (stringent criteria) to further confirm the discriminant validity. Therefore, the Fornell and Larcker criterion, cross-loading pattern and HTMT support and validate the discriminant validity of the model's constructs. The results of the reflecting measurement model satisfy the assessment conditions, indicating its validity, reliability, and suitability for calculating the structural model.

Table 4: Discriminant Validity using Fornell and Larcker Criterion

	ACP	LCM	PIP	UCC	NAI	DCC	CRT
ACP	0.771						
LCM	0.039	0.875					
PIP	0.222	-0.127	0.884				
UCC	-0.15	0.15	0.036	0.738			
NAI	-0.056	0.5	-0.202	0.261	0.816		
DCC	0.243	0.374	0.335	-0.073	0.189	0.962	
CRT	0.501	0.48	0.33	0.249	0.372	0.55	1.000

Table 5: Discriminant Validity using Cross-loadings

Latent variables	ACP	LCM	PIP	UCC	NAI	DCC	CRT
ACP1	0.854	-0.136	0.219	-0.044	-0.119	0.1	0.388
ACP10	0.645	0.041	0.128	-0.052	0.074	0.266	0.408
ACP2	0.835	0.052	0.105	-0.142	-0.009	0.231	0.41
ACP3	0.837	0.02	0.145	-0.177	-0.098	0.161	0.361
ACP4	0.795	-0.016	0.145	-0.068	-0.081	0.13	0.35
ACP5	0.815	0.017	0.188	-0.148	-0.078	0.181	0.437
ACP6	0.77	0.024	0.142	-0.184	-0.05	0.157	0.322
ACP7	0.76	0.071	0.311	-0.152	-0.003	0.248	0.394
ACP8	0.696	0.095	0.21	-0.164	-0.09	0.189	0.389
ACP9	0.667	0.129	0.1	-0.02	0.021	0.187	0.361
CRT_G1	0.501	0.48	0.33	0.249	0.372	0.55	1.000
CRT_G2	0.501	0.48	0.33	0.249	0.372	0.55	1.000
CRT_G3	0.501	0.48	0.33	0.249	0.372	0.55	1.000
CRT_G4	0.501	0.48	0.33	0.249	0.372	0.55	1.000
DCC1	0.232	0.35	0.327	-0.092	0.167	0.96	0.518
DCC2	0.236	0.369	0.317	-0.049	0.196	0.964	0.54
LCM1	0.031	0.891	-0.155	0.083	0.447	0.277	0.395
LCM2	-0.001	0.901	-0.062	0.184	0.442	0.419	0.461

ISSN: 2408-7920

Papers were presented at the 3rd International Conference on Sustainable Infrastructural Development, held at Covenant University, Ota, Ogun State, Nigeria, September 2-4, 2024.

Copyright © African Journal of Applied Research

Arca Academic



LCM	0.062	0.883	-0.065	0.173	0.393	0.332	0.468
LCM4	0.068	0.868	-0.147	0.13	0.43	0.317	0.403
LCM5	0.008	0.832	-0.146	0.066	0.494	0.273	0.36
NAI1	-0.06	0.307	-0.119	0.177	0.844	0.188	0.261
NAI2	-0.041	0.382	-0.138	0.224	0.814	0.166	0.305
NAI3	0.054	0.442	-0.21	0.161	0.85	0.189	0.372
NAI4	-0.132	0.392	-0.186	0.282	0.785	0.085	0.258
NAI5	-0.086	0.498	-0.161	0.242	0.786	0.131	0.297
PIP1	0.118	-0.029	0.897	0.064	-0.192	0.316	0.28
PIP2	0.171	-0.107	0.901	0.046	-0.149	0.3	0.289
PIP3	0.153	-0.131	0.888	0.021	-0.13	0.331	0.286
PIP4	0.225	-0.175	0.868	0.002	-0.256	0.256	0.284
PIP5	0.302	-0.117	0.863	0.028	-0.17	0.278	0.315
UCC1	-0.116	0.041	0.062	0.779	0.212	-0.048	0.144
UCC2	-0.157	0.15	-0.042	0.78	0.108	-0.096	0.175
UCC3	-0.093	0.133	0.07	0.856	0.317	-0.02	0.264
UCC4	-0.099	0.119	-0.017	0.483	0.021	-0.1	0.086

Table 6: Discriminant validity using HTMT criterion

Latent variables	ACP	LCM	PIP	UCC	NAI	DCC	CRT
ACP							
LCM	0.099						
PIP	0.236	0.146					
UCC	0.192	0.178	0.092				
NAI	0.128	0.555	0.221	0.291			
DCC	0.262	0.401	0.363	0.13	0.207		
CRT	0.518	0.496	0.341	0.264	0.391	0.574	

Evaluating the Structural Model

Regression analysis, a method similar to that used to evaluate formative measurement models, is utilised to assess multicollinearity among the constructs (Ramayah et al., 2017). When two variables believed to be causally connected measure the same construct, multicollinearity occurs (Ojelabi et al., 2023). All six independent variables in Table 7 have VIF values below 3.3, which rule out collinearity. The significance of the route coefficient is tested using the bootstrapping tool in the SmartPLS v4.0.9.8 software (Ramayah et al., 2017). In this investigation, the path coefficients ranged from 0.199 to 0.427, with empirical t-values and P-values at the 95% confidence level. Cohen (1988) deemed the R^2 for the cost reduction

Papers were presented at the 3rd International Conference on Sustainable Infrastructural Development, held at Covenant University, Ota, Ogun State, Nigeria, September 2-4, 2024.

Copyright © African Journal of Applied Research

Arca Academic



technique substantial ($R^2 > 0.26$), with a value of 0.683. It accounts for 68.3% of the variation in the cost reduction technique.

Table 7: Lateral collinearity assessment

Challenges	VIF
ACP -> CRT	1.115
LCM -> CRT	1.563
PIP -> CRT	1.340
UCC -> CRT	1.153
NAI -> CRT	1.471
DCC -> CRT	1.508

Next, the effect size to R^2 (f^2) value of 0.515 shows that ACP has a substantial effect on cost reduction technique, while f^2 values of 0.137, 0.108, 0.148, 0.185 and 0.138 show that LCM, PIP, UCC, NAI and DCC challenges, respectively, also have a medium effect on cost reduction technique. The Stone-Geisser Q^2 value was evaluated last and is sometimes referred to as predictive relevance. The Q^2 value of 0.196 (greater than 0), obtained using the blindfolding procedure in SmartPLS 4.0, indicates that predictive relevance is established in this model.

Table 8 presents the results of the structural model's validation, using standardised *p-values* and *t-values*. Table 8 presents the results of the hypotheses formulated in this study to assess whether a significant relationship exists between cost-reduction techniques and the associated challenges. All the challenges analysed show a significant relationship with the cost-reduction techniques, as indicated by the T-values and p-values obtained. The lowest and highest T-values are 2.959 for G5 and 7.569 for G1, both below the recommended minimum of 1.96. In addition, the p-values obtained range from 0.0000 for G1, G2, G3 and G6 to 0.0010 and 0.0030 for G4 and G5, respectively. These findings indicate that the challenges are significantly related to cost reduction techniques, especially GI (ambiguity in contract award and project execution), which has the highest T-value (7.569). Hence, the hypotheses are accepted.

Table 8: Structural model standardised T statistics and P value

	Path	T	P	Decision
H1	ACP -> CRT	7.569	0.0000	Accept
H2	LCM -> CRT	4.333	0.0000	Accept
H3	PIP -> CRT	3.817	0.0000	Accept
H4	UCC -> CRT	3.337	0.0010	Accept
H5	NAI -> CRT	2.959	0.0030	Accept
H6	DCC -> CRT	4.019	0.0000	Accept



The final model based on the analysis is presented in Figure 6.

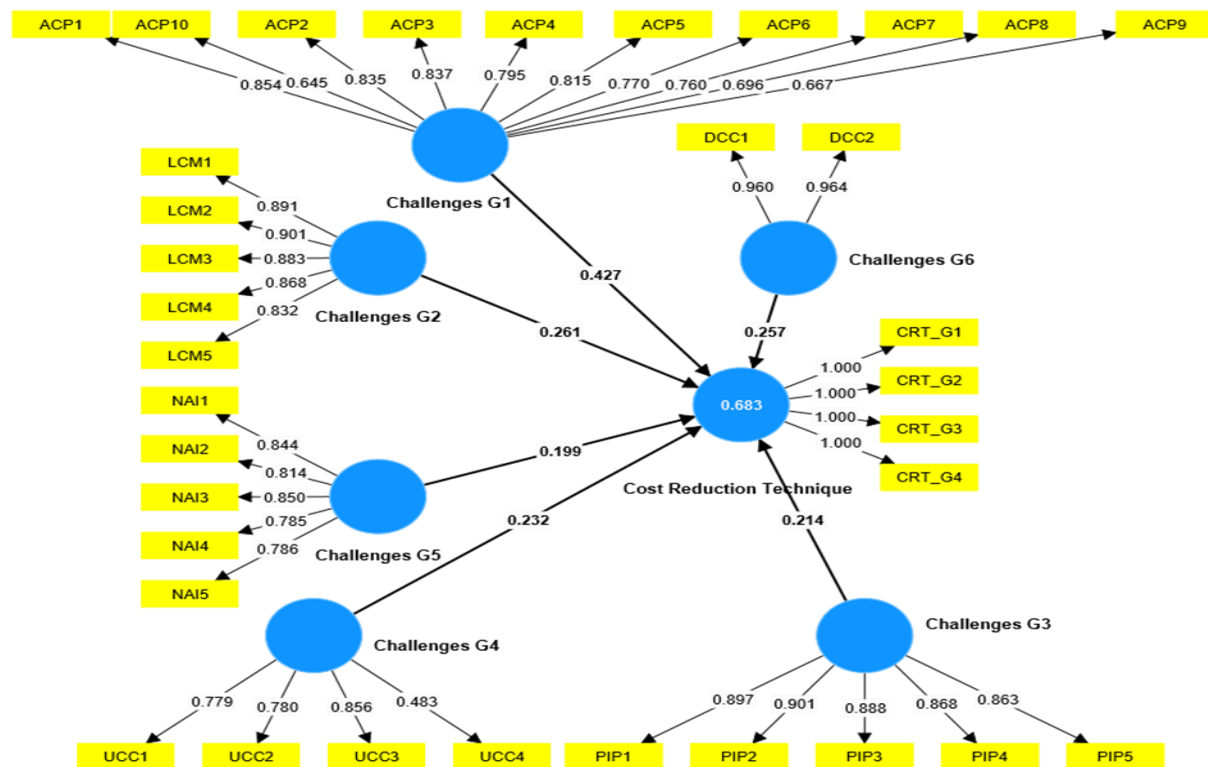


Figure 6: Structural Path Model

Discussion

The model's validity and reliability were established through rigorous assessments of convergent validity, internal consistency reliability, and discriminant validity, aligning with best practices recommended by scholars (Hair et al., 2022; Ramayah et al., 2017). Notably, the category "ambiguity in contract awards and project executions" (G1) exhibited the most substantial effect on cost reduction techniques, as indicated by its effect size ($f^2 = 0.515$).

This underscores the importance of effective project administration, in which contractors and clients can easily understand the contract terms and conditions. This finding corroborates previous research highlighting the detrimental impact of ambiguous contracts and project execution processes on cost management (Koc & Gurgun, 2021). The remaining constructs, including lack of management control (G2), perceived political influence in procurement (G3),

ISSN: 2408-7920

Papers were presented at the 3rd International Conference on Sustainable Infrastructural Development, held at Covenant University, Ota, Ogun State, Nigeria, September 2-4, 2024.

Copyright © African Journal of Applied Research

Arca Academic



unrealistic contract requirements and change orders (G4), non-prioritised automation integration (G5), and deficiencies in contract documents (G6), also exert some influence. However, the analysis revealed that the effects of cost reduction techniques are moderate. These findings align with previous studies identifying these factors as potential challenges in construction projects, often leading to cost overruns and ineffective cost management practices (Oyewobi et al., 2018).

In addition, the substantial coefficient of determination ($R^2 = 0.683$) for cost reduction techniques indicates that the proposed model explains a considerable portion (68.3%) of the variation in cost reduction techniques, recognising that the multifaceted nature of cost management in construction projects and the influence of various organisational, contractual, and project-related factors are multidisciplinary and should be considered for further exploration (Koc & Gurgun, 2021; Memon et al., 2014).

CONCLUSION

The study revealed that cost reduction is significantly hindered by various factors. Therefore, the study developed and validated a comprehensive model that captures the key challenges affecting cost-reduction techniques.

A robust assessment of the measurement model, including convergent validity, internal consistency reliability, and discriminant validity tests, evaluated six reflective constructs: ambiguity in contracts, lack of management control, political influences, unrealistic requirements, automation integration gaps, and contract documentation deficiencies. The model revealed that ambiguity in contracts and project execution had the most substantial influence on cost-reduction techniques, followed by other challenges that had medium effects.

The model demonstrates high explanatory power and predictive relevance, indicating its potential for forecasting and for developing effective cost-reduction strategies. Hence, to create a conducive environment for implementing practical cost-reduction techniques, there must be unambiguous contracts, robust administration, collaboration, training, and continuous improvement.

In conclusion, the development of clear and straightforward contract administration is critical to managing construction project costs and depends significantly on the priorities that organisations give it.

ISSN: 2408-7920

Papers were presented at the 3rd International Conference on Sustainable Infrastructural Development, held at Covenant University, Ota, Ogun State, Nigeria, September 2-4, 2024.

Copyright © African Journal of Applied Research

Arca Academic



Therefore, it is recommended that the management of public tertiary institutions implement robust contract administration processes and foster collaboration and effective communication among stakeholders involved in institutional projects. Management should also provide specialised training in contract management and project administration and continuously improve processes based on lessons learned.

Acknowledgement

The Covenant University Centre for Research Innovation and Discovery (CUCRID) supported this publication, for which the authors are grateful.

REFERENCES

- Aghimien, D., & Aigbavboa, C. (2018). Performance of Selected Funding Schemes Used in Delivering Educational Buildings in Nigeria. In Proceedings of the International Conference on Industrial Engineering and Operations Management held in Washington DC, USA, 108-110.
- Aje, I. (2012). The impact of contractors' prequalification on construction project delivery in Nigeria. *Engineering, Construction and Architectural Management*, 19(2): 159–172.
- Akeem L. B. (2017). Effect of Cost Control and Cost Reduction Techniques in Organizational Performance. *International Business and Management*, 14(3):19–26. <https://doi.org/10.3968/9686>
- Akhil, R., & Das, B. B. (2018). Cost Reduction Techniques on MEP Projects. In *Sustainable Construction and Building Materials: Select Proceedings of ICSCBM*, 495–517. Engineering.
- Akinola, G. A., Fagbenle, O. I., & Ogunde, A. O. (2024). Assessing the Level of Implementation of Cost Reduction Techniques on Educational Building Projects in Public Tertiary Institutions in Southwestern Nigeria. In *E3S Web of Conferences* (Vol. 589, p. 03010). EDP Sciences.
- Akinola, G. A., Fagbenle, O. I., & Ogunde, A. O. (2024). Exploring stakeholders' perspectives on the barriers to the application of cost-reduction techniques in public higher educational building delivery. *Buildings*, 14 (2551). <https://doi.org/10.3390/buildings14082551>.
- Akinola, G. A., Fagbenle, O. I., Ogunde, A. O., & Akerele, A. O. (2023). Cost Reduction Techniques in Public Higher Educational Buildings in Southwestern Nigeria: Awareness Among Project Participants. *E3S Web of Conferences*, 437, 04001–04001. <https://doi.org/10.1051/e3sconf/202343704001>.

ISSN: 2408-7920

Papers were presented at the 3rd International Conference on Sustainable Infrastructural Development, held at Covenant University, Ota, Ogun State, Nigeria, September 2-4, 2024.

Copyright © African Journal of Applied Research

Arca Academic



- Alao, O. O., Jagboro, G. O., Opawole, A., & Kadiri, D. S. (2019). Assessment of resuscitation strategies of abandoned projects: A case study of public tertiary education institutions' buildings in Osun State, Nigeria. *Acta Structilia*, 26(1), 167–200. <https://doi.org/10.18820/24150487/as26i1.7>
- Amusan, L. M., Afolabi, A., Ojelabi, R., Omuh, I., & Okagbue, H. I. (2018). Data exploration on factors that influence construction cost and time performance on construction project sites. *Data in brief*, 17, 1320-5.
- Anuradha, I., Ambagala, A., Dharmarathne, P. D., Liyanage, S., Halwatura, R. U. & Devapriya, K. A. (2022). Value Engineering as a Pragmatic Value Enhancing Tool for Public Sector Construction Projects. 2022 Moratuwa Engineering Research Conference (MERCon), 1-6.
- Asiedu, R. O. & Adaku, E. (2020). Cost overruns of public sector construction projects: a developing country perspective. *International Journal of Managing Projects in Business*, 13(1), 66–84. <https://doi.org/10.1108/IJMPB-09-2018-0177>.
- Babalola, A. J., Aderogba, A. M., & Adetunji, O. O. (2022). Inflation and Cost Overrun in Public Sector Construction Projects in Nigeria. *ECS Transactions*, 107(1). <https://doi.org/10.1149/10701.16137ecst>.
- Bashir, A. S., & Bello, A. S. (2022). Assessment of Factors Influencing the Costs of Building Materials in Housing Development in Nigeria. <https://www.researchgate.net/publication/371562392>.
- Chankseliani, M., & McCowan, T. (2021). Higher Education and the Sustainable Development Goals. In *Higher Education*. Vol. 81, Issue 1). Springer Science and Business Media B.V. <https://doi.org/10.1007/s10734-020-00652-w>.
- Cohen J. (1988). *Statistical power analysis for the behavioural sciences*. New Jersey: Lawrence Erlbaum Associates Hillsdale.
- Damoah, O., Peprah, A., & Osei, K. B. (2021). Does higher education equip graduate students with the employability skills employers require? The perceptions of employers in Ghana. *Journal of Further and Higher Education*, 45, 1–14. <https://doi.org/10.1080/0309877X.2020.1860204>.
- Dorrah, D. H., & McCabe, B. Y. (2023). Construction Payment Problems: A Critical Review of Payment Problems, Prompt Payment Legislation, and Challenges. *Lecture Notes in Civil Engineering*, 363 LNCE. https://doi.org/10.1007/978-3-031-34593-7_22.
- Enshassi, A., Mohamed, S. & Abushaban, S. (2009). Factors affecting the performance of construction projects in the Gaza strip. *Journal of Civil Engineering and Management*, 15(3): 269-280. <https://doi.org/10.3846/1392-3730.20009.15>.



- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39–50. <https://doi.org/10.2307/3151312>.
- Gopalan, K., & Venkataraman, M. (2015). Affordable housing: Policy and practice in India. *IIMB Management Review*, 27(2), 129–140. <https://doi.org/10.1016/j.iimb.2015.03.003>.
- Hafez, S. M., Aziz, R. F., & Elzebak, H. M. (2015). Optimal techniques for cost reduction and control in construction sites. *Journal of Human Resource Management*, 3, 17–16.
- Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, 3rd ed., Sage, Thousand Oaks, CA.
- Hasan, R., Chowdhury, S. A., & Akter, J. (2021). Construction Project Monitoring: The Cost and Schedule Control by Earned Value Method (EVM). *Journal of Technology Management and Business*, 8(1). <https://doi.org/10.30880/jtmb.2021.08.01.001>.
- Himme, A. (2012). Critical success factors of strategic cost reduction: Results from an empirical survey of German cost reduction projects. *Journal of Management Control*, 23(3), 183–210. <https://doi.org/10.1007/s00187-012-0157-8>.
- Hussain, S., Fangwei, Z., Siddiqi, A., Ali, Z., & Shabbir, M. (2018). Structural equation model for evaluating factors affecting quality of social infrastructure projects. *Sustainability*, 10(5):1415–14.
- Ibraheem, R. A. R., & Mahjoob, A. M. R. (2022). Facilitating claims settlement using building information modeling in the school building projects. *Innovative Infrastructure Solutions*, 7(1). <https://doi.org/10.1007/s41062-021-00646-2>.
- Ikechukwu, F. U. (2021). Investigation on the Influence of Building Materials Price Fluctuation on Cost of Building Products in Nigeria. *Current Journal of Applied Science and Technology*. <https://doi.org/10.9734/cjast/2021/v40i231265>.
- Inuwa, I. I., Napoleon Daniel Usman, N. D., & Dantong, J. S. (2015). The effects of unethical professional practice on construction project performance in Nigeria. *African Journal of Applied Research*, 1(1).
- Ise, O. A., & Elohor, O. H. (2018). Cost-Saving and Internally Generated Revenue in Tertiary Educational Institutions: The Role of Cloud Computing. *International Journal of Education and Information Technology*, 3(2), 7–16. <http://www.aiscience.org/journal/ijeithhttp://creativecommons.org/licenses/by/4.0/>
- Isofia, L.A., Ibem, E.O., Uzewgbunam, F.O., & Iloeje, A.F. (2023). Causes of time overrun in fixed price contracts of tertiary education trust fund (TETFund) building projects in Enugu State, Southeast Nigeria. *International Journal of Construction Management*.



- Khadim, N., Taseer, S., Jaffar, A., Musarat, M. A., & Ilyas, U. (2021). Effects of Corruption on Infrastructure Projects in Developing Countries. *International Journal on Emerging Technologies*, 12(1), 284–295. www.researchtrend.net
- Kikwasi, G. J. (2023). Claims in construction projects: how causes are linked to effects? *Journal of Engineering, Design and Technology*, 21(6). <https://doi.org/10.1108/JEDT-06-2021-0312>.
- Kim, Y. W., & Alseadi, I. (2021). Identification and Evaluation of the Influencing Factors in Target Value Design Process through an Industry Survey, *Journal of Civil Engineering and Construction*, 10(2), 75–83. <https://doi.org/10.32732/jcec.2021.10.2.75>.
- Koc, K., & Gurgun, A. (2021). Ambiguity factors in construction contracts entailing conflicts. *Engineering Construction & Architectural Management*, ahead-of-print. <https://doi.org/10.1108/ECAM-04-2020-0254>.
- Larson, E., & Gray, C. (2018). *Project Management: The Managerial Process*; McGraw Hill Education: New York, NY, USA.
- Memon, A. H., Rahman, I.A., Abdullah, M. R. & Azis, A. A. A. (2014). Factors affecting construction cost performance in project management projects: Case of MARA large projects. *International Journal of Civil Engineering and Built Environment*, 1(1), pp.30-35.
- Ogunde, A. O., Olaolu, O., Afolabi, A., Owolabi, J., & Ojelabi, R. (2017). Challenges confronting construction project management system for sustainable construction in developing countries: Professionals perspectives (a case study of Nigeria). *Journal of Building Performance* ISSN, 8(1).
- Ojelabi, R., Afolabi, A., Oyeyipo, O., & Ogunrinde, O. (2023). Modelling client and construction firm barriers hindering social client relationship management system implementation in the built environment. *Architectural Engineering and Design Management*, 20(1), pp. 102-119.
- Oladiran, O. J., & Njoku, O. (2026). Compatibility of The Nigerian Construction Industry's Regulations with Disruptive Technology. *African Journal of Applied Research*, 12(2), 408-422.
- Olatunde, N. A., & Alao, O. O. (2017). Quantitative appraisal of cost and time performance of construction projects in public and private universities in Osun State, Nigeria. *Journal of Engineering, Design and Technology*, 15(5), 619–634. <https://doi.org/10.1108/JEDT-11-2016-0081>.
- Olayisade, O., Oluyinka, I., Kolawole, A., & Adebolanle, A. (2023). Accountability Process Analysis in the TSA Policy Implementation, the Perception on the Public Sector



- Financial Performance in Nigeria. *Research Journal of Finance and Accounting*.
<https://doi.org/10.7176/rjfa/14-17-01>.
- Olupitan, A. L., Ajator, U. O., & Nzeneri, O. P. (2021). The Critical Causes and Effects of Cost Overruns in Public Sector Construction Projects in Port Harcourt, Nigeria. *International Journal of Scientific and Research Publications (IJSRP)*, 11(10), 304–317.
<https://doi.org/10.29322/ijssrp.11.10.2021.p11835>.
- Osawaru, F., Amusan, L., Awotinde, O., Akanya, C., Asiyanbola, O., & Akinbo, F. (2018). Planning materials supply for construction works, in IOP Conference Series: Earth and Environmental Science, 173(1), IOP Publishing.
- Osumanu, I. S., Aigbavboa, C. O., & Thwala, D. W. (2022). The impact of lean thinking on organizational learning. *African Journal of Applied Research*, 8(2), 315-321.
- Owusu, E. K., Chan, A. P. C., & Ameyaw, E. (2019). Toward a cleaner project procurement: Evaluation of construction projects' vulnerability to corruption in developing countries. *Journal of Cleaner Production*, 216, 394–407.
<https://doi.org/10.1016/j.jclepro.2019.01.124>.
- Oyewobi, L. O., Jimoh, R. A., Suleiman, B., & Sheu, M. T. (2018). Cost Reduction Strategies for Building Construction Projects in Minna. In USEP: Journal of Research Information in Civil Engineering (Vol. 15, Issue 1).
- Rahman, I. A., Al Ameri, A. E. S., Memon, A. H., Al-Emad, N., & Alhammadi, A. S. A. M. (2022). Structural Relationship of Causes and Effects of Construction Changes: Case of UAE Construction. *Sustainability (Switzerland)*, 14(2).
<https://doi.org/10.3390/su14020596>.
- Rahman, I. A., Memon, A. H., & Karim, A. T. A. (2013). Examining Factors Affecting Budget Overrun of Construction Projects Undertaken through Management Procurement Method Using PLS-sem Approach. *Procedia - Social and Behavioural Sciences*, 107, 120–128. <https://doi.org/10.1016/j.sbspro.2013.12.407>.
- Ramayah, T., Cheah, J. H., Chuah, F., & Ting, H. (2017). PLS-SEM using SmartPLS 3.0: Chapter 12: Assessment of Mediation Analysis.
<https://www.researchgate.net/publication/341250748>.
- Saunders, M., Lewis, P., & Thornhill, A. (2023). Research Methods for Business Students. In *Pearson Education Limited* (9th ed.). Pearson Higher Ed, 2023.
- Tembo, M., Mwanaumo, E. M., & Kahanji, C. (2023). Improving Procurement Selection Criteria for Managing Construction Tender-Price Volatility on Public Projects. *European Journal of Logistics, Purchasing and Supply Chain Management*, 11(1).
<https://doi.org/10.37745/ejlp SCM.2013/vol11n1125>.



- Tohidi, H. (2011). Review the benefits of using value engineering in information technology project management. *Procedia Computer Science*, 3, 917–924. <https://doi.org/10.1016/j.procs.2010.12.150>.
- Wong, L. S., & Ahmed, M. E. A. M. (2018). A critical review of lean construction for cost reduction in complex projects. *Jordan Journal of Civil Engineering*, 12(4).
- World Bank (2021). Tertiary Education Overview – World Bank Group. Available online at: <https://www.worldbank.org/en/topic/tertiaryeducation#1>. Accessed on April 20, 2023.
- Yap, J. B. H., Lim, B. L., Skitmore, M., & Gray, J. (2022). Criticality of project knowledge and experience in the delivery of construction projects. *Journal of Engineering, Design and Technology*, 20(3). <https://doi.org/10.1108/JEDT-10-2020-0413>.