Modelling Cost Control for Effective Dam Projects Delivery in Nigeria

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Delays in delivering construction projects, abandonment of construction projects, poor quality works and cost overruns are common features in the Nigerian construction industry due to inappropriate application of cost control techniques in the implementation of the projects among other reasons. Over the years, billions of Naira have been sunk into projects that have not benefited anticipated users. Worried by the phenomenon of poor infrastructural projects delivery particularly in the water sector of the Nigerian economy thus, this research aimed at developing a cost control model for effective Dam projects delivery. The research investigated the causes of poor projects delivery and the linkage between application of cost control techniques and effective project delivery of Dams in Nigeria. The quantitative approach used survey questionnaire administered to a carefully chosen group of practitioners cutting across construction companies, Engineering consultants and members of professional bodies. The Partial Least Square Structural Equation Modelling (PLS-SEM) technique was used in analysing and establishing the relationships between the various constructs in the study. The findings revealed that the most significant contractor related causes of poor dam projects delivery were unrealistic tenders and technical incompetence. The non-application of cost control techniques in the delivery of the Dam projects adversely affect the cost, completion time and quality of the project. The result shows that there is a positive relationship between the challenges in the use of cost control techniques and the effects of use of cost control techniques on dam projects delivery. There is also a significant positive relationship between causes of project failure and cost control technique. The study concluded that cost related, and client related issues were major causes of poor dam projects delivery in Nigeria. Based on this conclusion, the study recommends a need to have a mechanism that will detect cost and budget overruns in enough time and correct them, while the project is still underway. It also recommends the isolation of the cost control system of projects at site level from oversight systems controlled at the head offices.
Keywords: Cost control, project delivery, earned value theory, dam, Nigeria

Introduction

The value of the construction sector in development of nations across the world due to the amount of resources it consumes in the economy is enormous (Ogunsemi, 2015; Stasiak-Betlejewska & Potkany, 2015). Measured against the overall global economic activities, undertakings within the construction industry is valued to 6 - 10% (Iheme *et al.*, 2011; Sanni & Hashim, 2013; Chitkara, 2004; Ibrahim, 2014; Stasiak-Betlejewska & Potkany, 2015; Adewumi, 2018). Studies by Ikegwuru (2006) and Adewumi (2018) revealed that construction investments have been found to be the bedrock of the advancement of national developments specifically in the aspect of infrastructural facilities. This industry is described by the nature of its activities and products to include those that engage in building works, civil engineering works or the likes (Stasiak-Betlejewska & Potkany, 2015). Dam projects are examples of civil engineering infrastructural projects.

Adewumi (2018) pointed out that even though the number of large dams in Nigeria is insignificant, on a global scale, the importance of dams in the development of the countries is very significant. Infrastructural facilities are the physical foundation upon which all nations' developmental efforts and improved living conditions are established (Ikegwuru, 2006). Olalusi and Otunola (2012) revealed that construction activities in Nigeria are extremely diverse in nature, size and complexity. In a related development, Adindu (2012) concluded that the sector has played a vital part in the growth of this country since after the civil war. Based on the volume and economic importance of the activities of the industry, it has been established that construction attracts a good portion of every capital budget. However, improving cost performance and project delivery has been a challenge confronting the sector worldwide (Chigara *et al.*, 2013).

There are a lot of failed construction projects in Nigeria. Some of the failed construction projects cause disappointments, loss of confidence and poor economic activities within the populace (Ayodele & Alabi, 2014). The failure of construction project manifest when it is not concluded within stipulated schedules (Nzekwe *et al*., 2015). The nature and size of a project determine to a large extent if a project will fail. That is, as projects increase in size, planning, budgeting and cost control become complex and problematic (Dissanayaka & Kumaraswamy, 1999). This consequently leads to cost issues which end up preventing project delivery at the expected time and projected cost. Alinaitwe *et al.* (2013) therefore concluded that ineffective application of cost control is a cause of poor project delivery.

In the mid1990s, a study by the United Kingdom government concluded that over 25% of its construction works exceeded initial proposed costs at completion (Jackson, 2002). Moris (1990) and Aljohani *et al.* (2017) having found that 90% of the projects failed on cost projections concluded that the industry must improve on its records in projects delivery. One universally acclaimed construction activity that faced serious cost failure was Channel Tunnel construction works in the United Kingdom. The construction cost rose from £2600 million to £4650 million an increase of more than 80%**.** Humber bridge works in the United Kingdom had a 175% increase in cost (Flyvbjerg *et al.*, 2003; Aljohani *et al.,* 2017). More than two decades after some of these studies, the situation has not improved significantly as cost overruns, inefficient use of cost techniques and failed projects remain universal problems. Countries in the developing world like Nigeria are most severely affected (Olawale & Sun, 2010). Anecdotal report by the researcher at the start of this study showed that dam construction is the worst hit by the phenomenon of projects failures and or abandonment in Nigeria.

The negative economic effects of failed dam constructions in Nigeria is very far reaching due to the enormous amounts of resources invested in them (Olalusi & Otunola, 2012). The frequently faced consequences of poor projects delivery are, reduction in contractor's profit and induced criticism of government's inability to provide services (Le-Hoai *et al*., 2008). Several researchers including Liang (2005) have investigated how cost control technique can be adopted in projects implementation to overcome failure or improve delivery, the study concluded that some of the major shortcomings occasioned by poor projects delivery on the part of the contractors include non-availability of materials and inability to gather cost data. In addition, Olawale and Sun (2010) revealed the existence of numerous types of cost control methods including computer software, and noted that despite that, a lot of projects still fail to meet delivery desires. As a consequence of poor projects delivery, Olateju (1991) pointed out that contractors that could not control construction costs will not make profits and contractors that cannot make profit will be out of business. How to effectively operate a construction project within a specified budget has attracted considerable research attention (Ikegwuru, 2006; Anyanwu, 2013; Ayodele & Alabi, 2014; Ogunsemi, 2015). However, construction projects including dams still fail because of how the costs are controlled (Ogunsemi, 2015). Therefore, in this study, the point presented as research problem is that lack of application of techniques for cost management at various stages of construction implementation, for example, at the conception and design stage by the client, during construction by the contractor and the absence of a cost control model hampered effective dam projects delivery in Nigeria.

Cost Control Theories

Theory "is a systematic phenomenon to have a deeper understanding that will be able to predict future phenomenon behaviour under consideration (Anvuur, 2008; Oyewobi, 2014). This study centred on cost control model for effective dam projects delivery. Control is the mechanism that directs an operation towards a predetermined objective, therefore, it determines whether an activity is achieving the desired result or not (Lockyer & Gordon, 1996; Ikegwuru, 2006; Nunnally, 2007; Ayodele & Alabi, 2014).

In certain definitions, construction cost management subsumes construction resources allocation, this includes calculation, budgeting, management of resources for the successful execution of projects within the budget and the accepted time frame (Ogunsemi, 2002; Omotayo, 2017; Adjei *et al*., 2017; Ayinde, 2018). The aim of a cost control management system involves development of project cost mitigation strategies (Kerzner, 2001; Ogunsemi, 2002; Ikegwuru, 2006)

The literature indicates that there is no particular cost control principle, a process or methodology for project cost control. Variations can be implemented based on complexity, peculiarities and so on. However, literature has presented some of the more commonly used cost theories as management of value received, index to total, forecasts, computation of variances, economic analysis, work plan, cost control cycle of projects. Only earned value management theory that the study is hinged on is described below:

The earned value management theory

Out of the cost control systems espoused in literature, EVM has tremendous application/advantage over other concepts in different construction projects (Malkanthi *et al*., 2017; Ariel & Li, 2003; Brinke *et al.,* 2004). A key to project success is management actions with regards to efficiency and control expense (Hernandez *et al.,* 2013; Chigara *et al*., 2013; Wilkens, 1999). Managing the value earned is a methodology which integrates efficient resource management. This study on cost control model for effective dam projects delivery seeks to integrate proper and complete design of projects, proper scoping, tendering and cost of delivering the project. Generally, EVM measures periodically achievements along life of the project. Hernandez *et al*. (2013) established that project progress on cost is measured by evaluating these indices, planned value (PV), actual value (AV) and earned value (EV). Figure 1 is a diagrammatic expression of the relationships. The EVM enables the monitoring of those factors that affect project delivery such as poor conception, poor design, procurement methods, contractor's lack of capacity or cost management methods or techniques, faulty estimation of quantities, price fluctuation and contingency provisions, these enable the project managers to address the variances early enough in other to achieve effective project delivery.

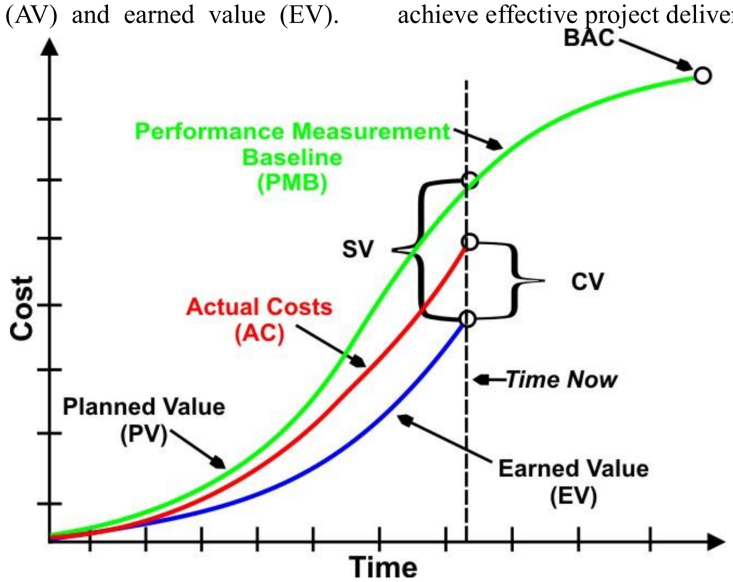

Figure 1: Key parameters of earned value management
Source: Hernandez *et al.* (2013)

Wilkens (1999); Scileanna (2012) and Chigara *et al.* (2013) all agreed that the main purpose of EVM is to provide data that will enable an effective evaluation of project progress, provide a platform to forecast cost of completing a project, predict time, support effective utilisation of the available resources, and provide ways of managing change, these are the steps that summarizes the positive effects of using cost management techniques to enhance project delivery and herein lies the advantage of EVM over the other theories. EVM as a cost control theory enables the establishment of a firm theoretical base which other earlier discussed techniques/theories are deficient. Hence the theoretical framework for effective dam projects delivery in Nigeria is presented in Figure 2.

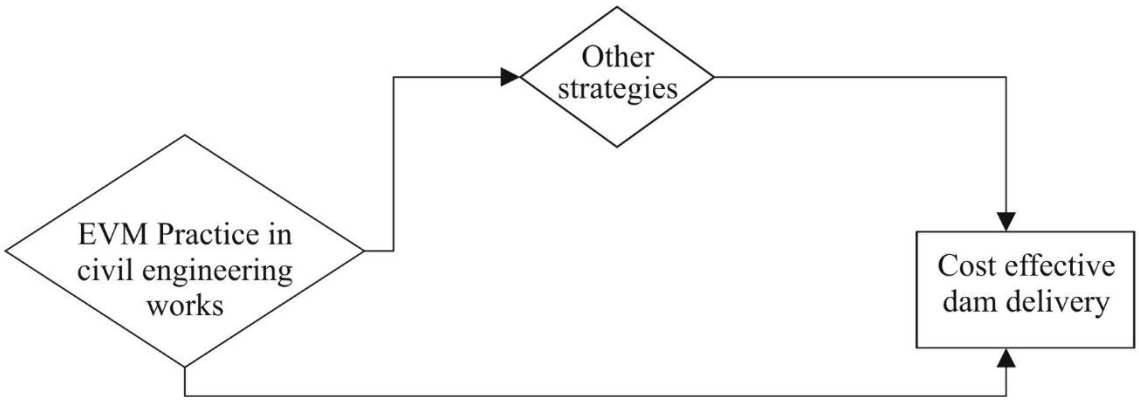

Figure 2: Theoretical model for cost effective project delivery of dams
Source: Authors (2019)

Conceptual Framework for Effective Dam Project Delivery

Miles and Huberman (1994), Vaughan (2008), Jabareen (2009) and Adom *et al*. (2018) defined conceptual framework of a study as a visual or written proposal that illustrates the core challenges to be investigated in graphical form or narratively; the major elements, ideas or variables and the presumed interrelations. It aims to link all aspects of the investigation, such as problem description, intent, analysis, approach, selection, and study of past works (Svinicki, 2010; Simon & Goes, 2011; Adom *et al*., 2018). The purpose of a conceptual framework is to categorize and define concepts which are essential for studying and mapping their relationships. The conceptual structure is an interpretation of the researcher on the essence of the research which can be diagrammatically interpreted (Ibrahim, 2014; Ravitch & Carl, 2016; Aina, 2017). The conceptual framework, therefore, gives direction, rationale, and basis for undertaking the subsequent stage (methodology) of the research process (Adom *et al*., 2018). Figure 3 is a framework for a model for effective dam projects delivery. The relationships among the constructs in the conceptual framework are further explained subsequently.

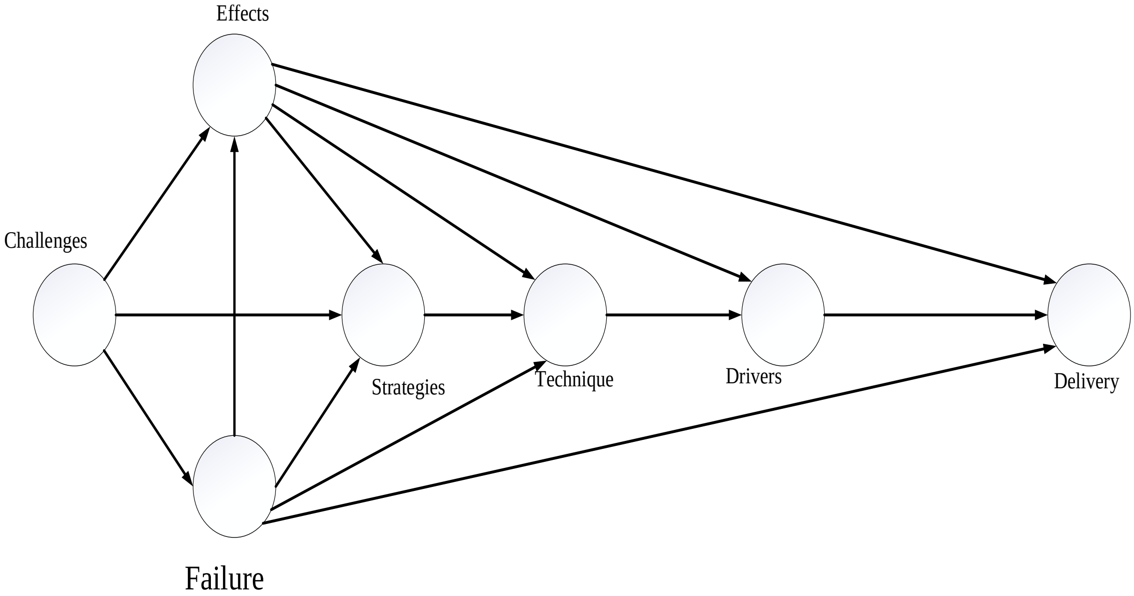

Figure 3: Conceptual framework for effective project delivery of dams in Nigeria
Source: Authors (2019)

Literature revealed the challenges in project delivery and the effects of non-application of cost control systems. It also revealed drivers and strategies to enhance or improve application of cost techniques in dam projects delivery. The cost control model for effective project delivery framework was developed based on the theoretical structure presented in Figure 4, it is the interactions of the various constructs and relationships between the variables indicated in Figure 3 and further explained in Figure 4, the framework shows that the challenges in application of cost control techniques corelates directly with relationship between effects of the use of the techniques and failure or non-application and other relationships. According to Stasiak-Betlejewska and Potkany (2015), the economic effect of an excess in construction costs is a potential failure of the project's economic rationale. This therefore implies that possible challenges of cost control in project implementation must be curtailed otherwise the project will lose its economic justification. Therefore, the effect of use of cost control techniques must be amplified to effectively address the challenges and lead to effective project delivery with its attendant benefit of economic justification.

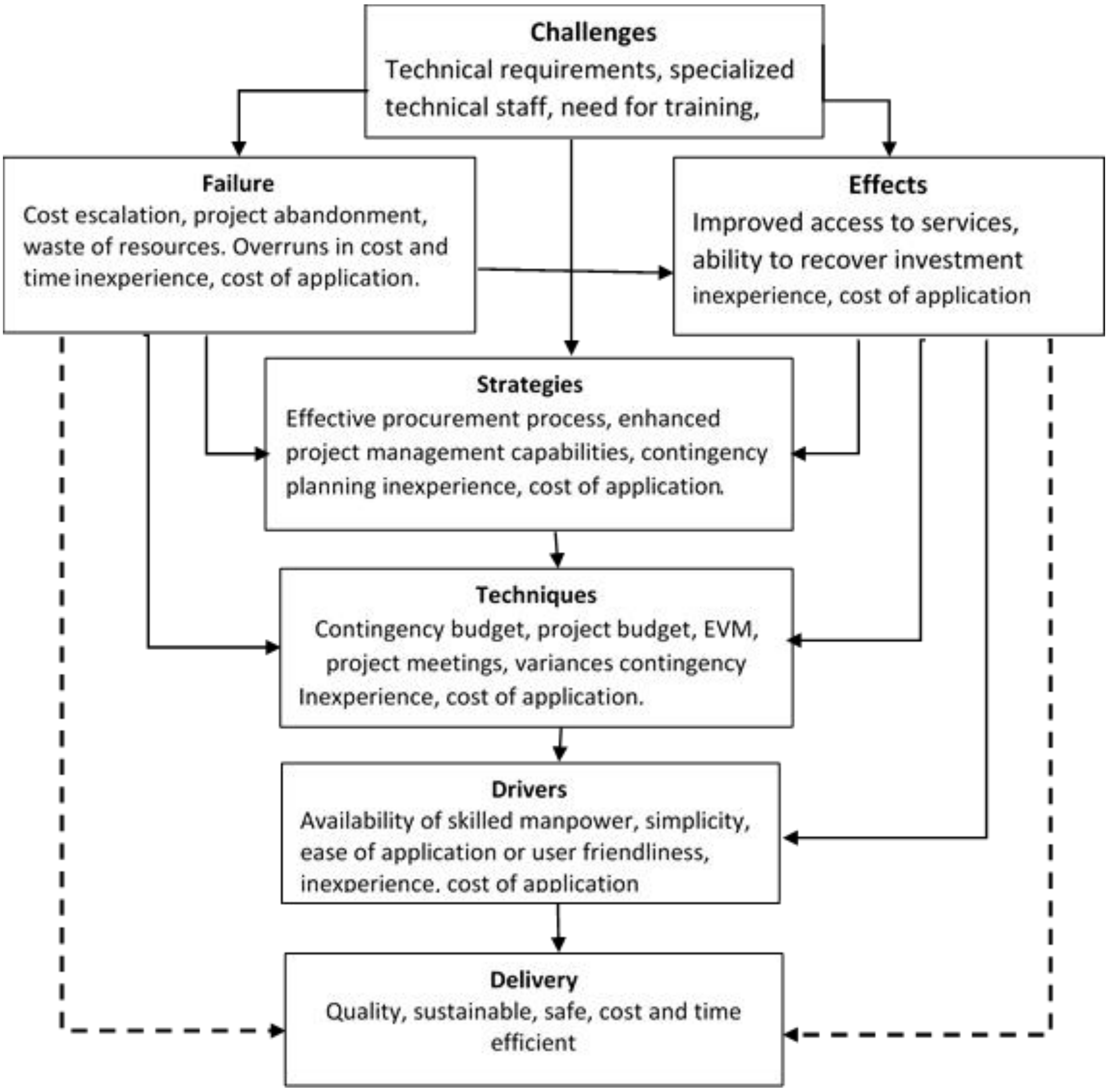

Figure 4: Variables of the different constructs in the conceptual framework
Source: Authors (2019)

From literature it is evident that familiarity and level of usage, drivers and strategies all depend on training and technical proficiency of the staff applying the cost control techniques, training provides for efficient information gathering and ability to manage the information in decision making. This is further justified by Sanni and Hashim (2013) who stressed that the competence of essential staff in contracting firms should rank high in cost control practices as the more proficient they are, the better for progress and growth of the company.

The framework indicates that diligent practice of earned value management principles as construction cost control technique is a sure way to achieve cost effective project delivery. The traditional method of dam construction in the study context has led to problems such as cost and time overruns, and poor or inefficient projects delivery (Figure 5). These have consequently caused a reduction in productivity of the construction industry. Therefore, to improve on project delivery, there is a need to improve on the traditional methods of dam construction in Nigeria. These improvements may come in a way that mitigates the elements in the traditional methods that works against effective or efficient project delivery such as dealing individually with the current problems enunciated in the independent variables listed in Figure 5.

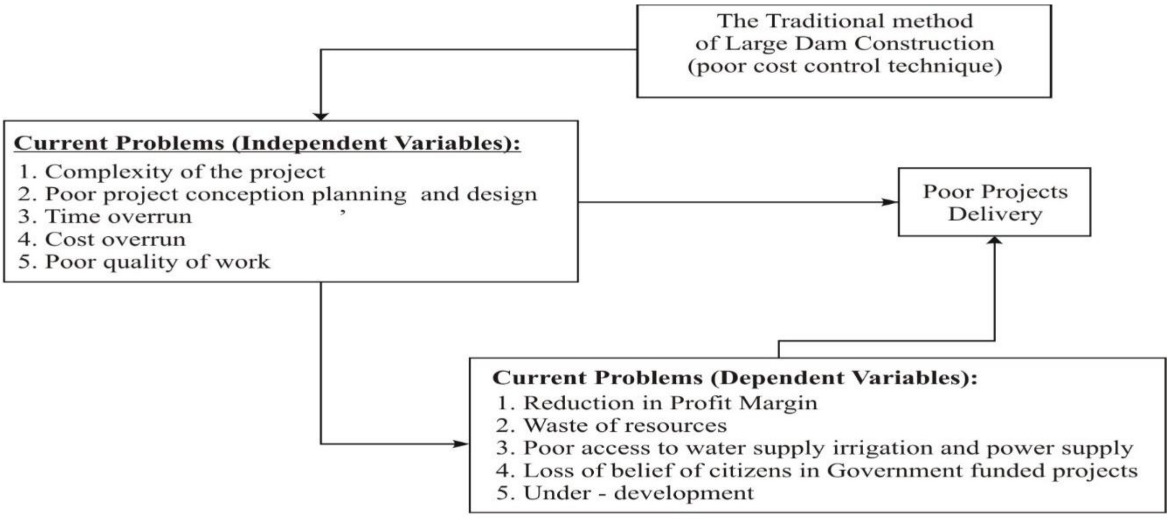

Figure 5: Challenges in traditional method of projects delivery process
Source: Authors (2019)

The flow chat of the challenges in the traditional method of dam projects delivery is further improved upon by considering how the sources of dam projects failures, challenges of dam projects development, cost control techniques and stakeholders perception affect dam projects delivery in Nigeria, this is summarized in Figure 6

The figure indicates that the negative effects of stakeholders' perceptions, the identified sources of project failures and challenges of traditional dam projects development will be overturned to head towards effective project delivery if appropriate methods of cost control are applied in the implementation or delivery of the construction projects.

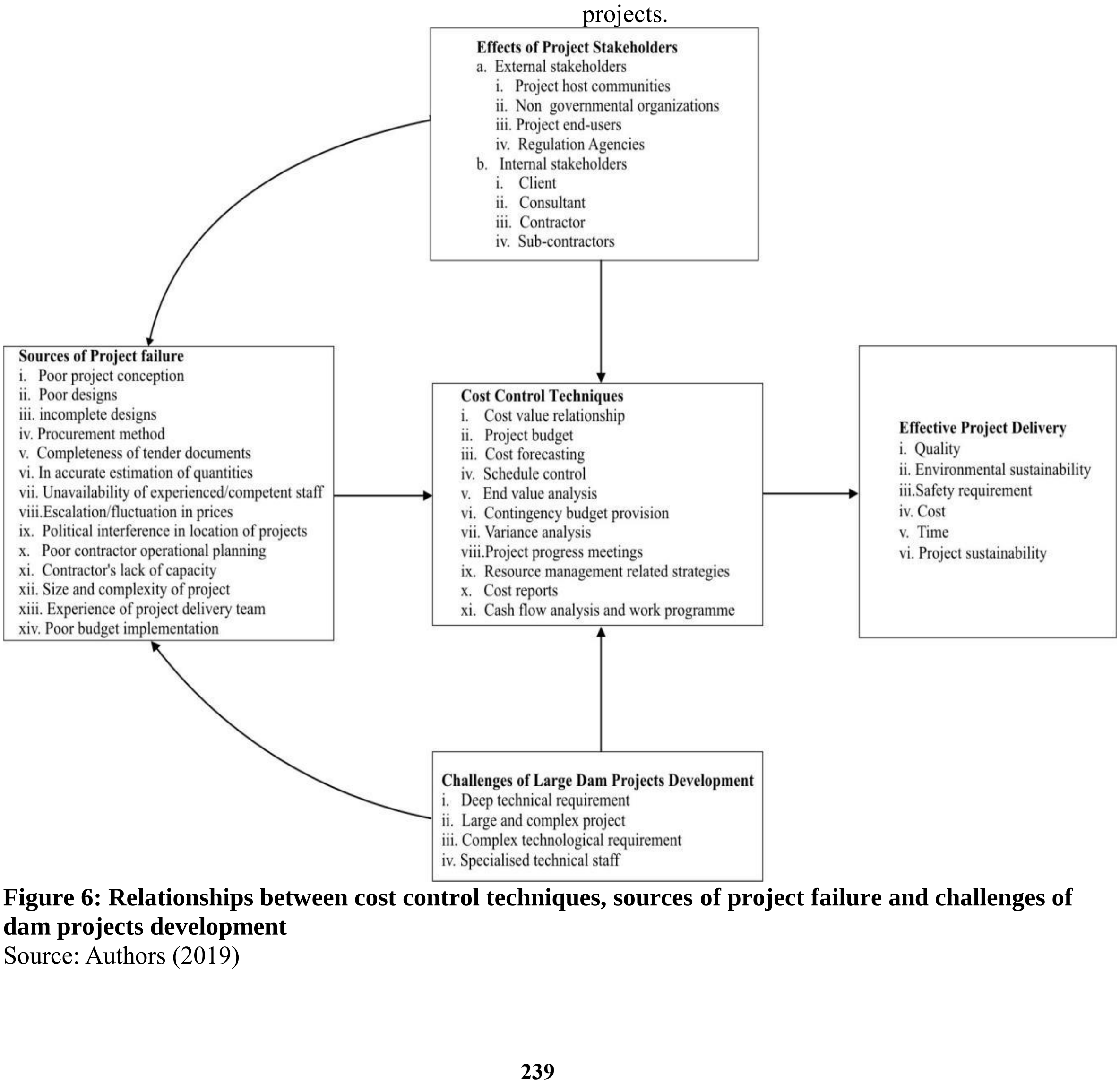

Figure 6: Relationships between cost control techniques, sources of project failure and challenges of dam projects development
Source: Authors (2019)

This outcome is further illustrated in the Figure 7 which captures the various inputs and the sequence to achieve effective project delivery. It shows that effective conception, planning and detailed designs of the components of the project is the very first and a very important step towards achieving effective project delivery

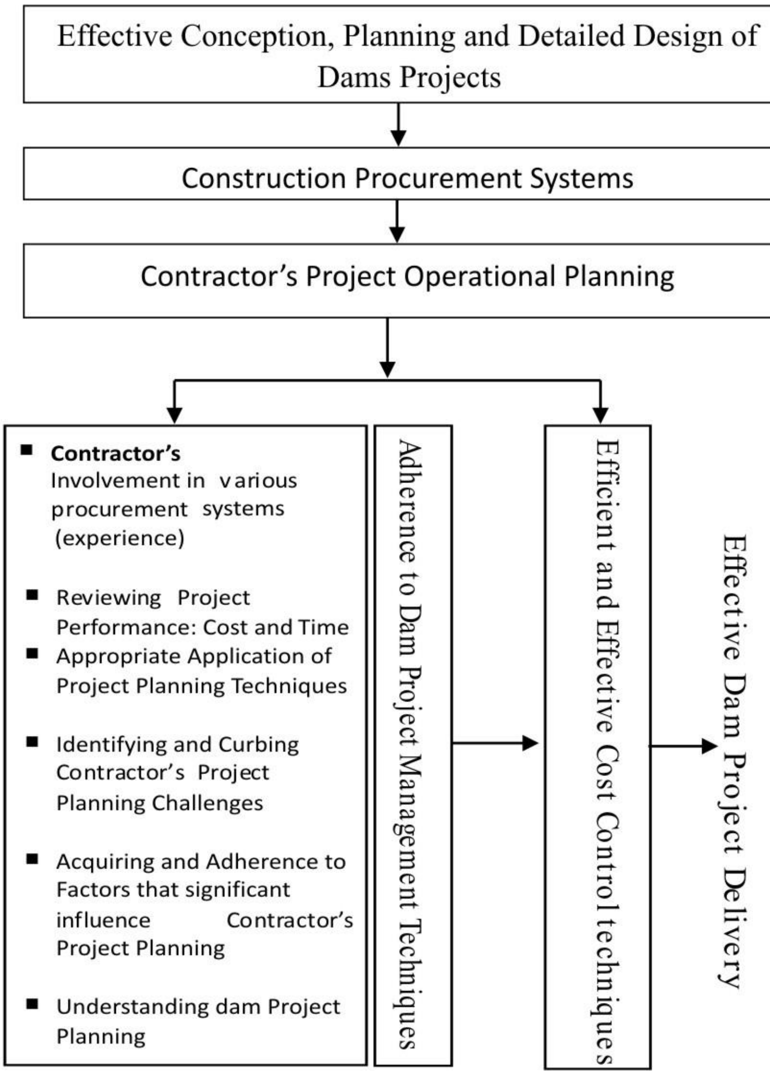

Figure 7: Ingredients of effective project delivery of dams
Source: Adapted from Wiess and Wysocki (1992)

The importance of choosing the most competent contractor through a procurement process that is sincere, open, thorough, and diligent in combination with capacity and experience of the chosen contractor cannot be over emphasised. If all these are complemented with the application of effective and efficient cost control techniques, there will be high chance of the project succeeding in terms of cost, time and quality requirement.

Research Methodology

The main study adopted mixed methods methodology, however, only the quantitative strand is reported here using questionnaire survey. Twenty carefully chosen practitioners were involved in piloting the questionnaire in order to ensure compatibility with the frameworks and all items were retained for further study. The reliability of the internal consistency was measured using alpha value of Cronbach. All the variables were certified accurate with Cronbach's alpha higher than 0.6 suggested for this kind of exploratory research. The main study questionnaire was created and implemented on organizations and practitioners involved in dam projects after reviewing the pilot study questionnaire to ensure it was free from any ambiguities that may influence the responses from the sample size determined.

Creswell and Plano Clark (2011) revealed that validity definition is different in both quantitative

and qualitative studies. Nevertheless, validity is used in the two approaches to test the data quality, the findings and their interpretation. Punch (1998) emphasised that validity determines how accurately a measure reflects the idea it aims to measure. Internal validity is the extent to which an effect measured and observed is due to an established causal relationship rather than a spurious relationship between variables (Fellows & Liu, 2008; Yin, 2009). Parveen (2014) stated that internal validity determines the motivations for the study's outcomes and helps to minimize certain, sometimes unpredictable explanations for such outcomes.
The questionnaires were sent to 254 individuals, 152 of them were returned which showed a response rate of 59.8% and were found suitable for analyses. The responses were coded and transferred to IBM SPSS 23.0 to carry out analyses like descriptive analysis, normality tests and exploratory factor analysis (EFA). Key analysis used the Partial Least Square (PLS) method, and analysis was carried out using program SmartPLS 2.0. The inner and outer models were evaluated with PLS process.

Data analysis
Inner model was assessed as a first stage by evaluating the factor loading, reliability of the composite, average variance extracted (AVE), and discriminating validity. Objects having loading factor values higher than 0.5 reflected highly important (Hair *et al.*, 2012). The test results revealed therefore that all items were loaded and retained for further analysis. Outcome of composite reliability constructs were greater than 0.6 within the commonly accepted range (Bagozzi, Yi & Nassen, 1998), and AVE was higher than 0.5 (Henseler & Chin, 2010). Reliability construct and convergent validity thresholds were attained. Furthermore, distinguishing validity was compiled following the criterion that factor loading of each item was higher than cross loading items from other structures, and the square root of AVE for each structure was higher than inter-correlations with other constructs. Discriminating validity was achieved. Next was to test the structural model that was evaluated with R^2 value, the path coefficients and the effect size. It showed R^2 value is 0.978 for dependent variables and that the control technique drivers are 0.88 which was considered mild. Second, the findings of the path coefficients and subsequent bootstrapping t-values showed support for ten out of 13 assumptions.

Results and Discussion
Table 1 presents the reliability indicators and their internal consistency. The results suggested that for all constructs the α value is above 0.7 save roughly the cost control technique steps. The α value was 0.93 for cost control construct drivers for which the measures were produced. Project cost management challenges reached α value of 0.73 while effects reached α value of 0.88. Failure value was 0.83, while project performance metrics obtained a value of 0.88. Finally, the importance of strategies for enhancing the technique of cost management achieved an α importance of about 0.70. These results indicated that the questionnaire used in this study was a good measuring device, which indicated reasonable internal consistency and reliability of measuring of the scale.

Table 1: Reliability values of the measures

Latent Variable	Cronbach's Alpha	No of items	No of items retained
Challenges	0.73	3	2
Drivers	0.93	3	2
Effects	0.88	6	5
Failure	0.83	4	3
Performance	0.88	3	3
Strategies	0.69	6	3
Technique	0.62	3	2

Respondents socio-economic profile
Respondents Socio-economic profile is presented in this section and findings on gender, age, highest qualification, years in employment and years in the construction industry. Table 2 gives detailed pattern of the findings for each of the four categories of the respondents. On age of the respondents, majority (more than 90%) were of at least 30 years of age. At least six out of every ten of them were between 30 and 45 years old while one quarter were between the ages of 45 and 60 years. This implies that actors in the industry are mature and in active age bracket. The table shows that a good number of interviewees had at least a BSc degree in relevant fields while more than 5 per cent of them also had a PhD. The pattern is the same across all the four categories of respondents. This implies that these categories of respondents had good knowledge of various problems discussed.
Furthermore, there is the likelihood that the respondents had adequate experience of the issues around the study theme as the table reveals that majority of them, at least six out of every ten of them, had spent 15 years or more in employment.

Table 2: Socio-economic Profile of Respondents

	NIWE		Contractors		Consultants		NICOLD		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Age (Years)										
18-30	2	2.9	0	0.0	0	0.0	2	3.6	4	2.7
31-45	55	8.09	7	53.8	2	14.3	37	67.3	101	67.3
46-60	11	16.2	6	46.2	9	64.3	12	21.8	38	25.3
Above 60	0	0.0	0	0.0	3	21.4	4	7.3	7	4.7
Total	68	100.0	13	100.0	14	100.0	55	100.0	150	100.0
Highest Educational Qualification										
OND	0	0.0	0	0.0	1	7.1	1	1.8	2	1.3
HND	4	6.0	0	0.0	0	0.0	4	7.1	8	5.3
BSc	25	37.3	4	30.8	1	7.1	16	28.6	46	30.7
MSc	32	47.8	7	53.8	7	50.0	26	46.4	72	48.0
PhD	3	4.5	1	7.7	2	14.3	6	10.7	12	8.0
Others	3	4.5	1	7.7	3	21.4	3	5.4	10	6.7
Total	67	100.0	13	100.0	14	100.	56	100.0	150	100.0
No of Years in Employment										
0-5	1	1.5	0	0.0	0	0.0	0	0.0	1	0.7
6-10	9	13.6	1	8.3	1	7.1	12	21.1	23	15.4
11-15	13	19.7	1	8.3	1	7.1	10	17.5	25	16.8
Above 15	43	65.2	10	83.3	12	85.7	35	61.4	100	67.1
Total	66	100.0	12	100.0	14	100.0	57	100.0	149	100.0
Years of practice										
0-5	2	3.1	0	0.0	0	0.0	1	1.8	3	2.1
6-10	5	7.8	0	0.0	0	0.0	4	7.3	9	6.2
11-15	10	15.6	1	8.3	0	0.0	8	14.5	19	13.1
Above 15	47	73.4	11	91.7	14	100.0	42	76.4	114	78.6
Total	64	100.0	2	100.0	14	100.0	55	100.0	145	100.0

Partial least squares
The model created was checked with Partial Least Squares (PLS) modelling method based on variance structural equations (Henseler *et al*., 2009), applying SmartPLS 2.0 software to validate measurements and check hypothesis. This method was chosen because it has the capacity to enable both measurement and structural models to be evaluated (Roldán *et al*., 2012). PLS enables the analysis of latent variables as predictive or formative structures (Chin *et al*., 2003). This study used a variance-based approach for two key reasons: to estimate the dependent variable that is the product of the project (Chin, 2010) by developing a generic model to improve efficiency of construction through cost control and analyse intensity and total effects of the project. However, data were also evaluated before testing the model using PLS-SEM to search for common variance in the process. According to Podsakoff and Organ (1986), when a factor account for many of the described variances, traditional method variance becomes an issue. The study used exploratory factor analysis to investigate whether the prejudice exists according to Podsakoff *et al*. (2003). The results showed that common system variance was not a concern.

Measurement model assessment
This study evaluated measuring platform by exploring all possible structural relationships among the latent variables showing predictive indicators to obtain results. This was done by determining the inner weighting using the PLS algorithm (Chin, 2010). The reliability of latent constructs and their validity were examined for assessment of measurement model. Internal accuracy and reliability of the measurements were evaluated using composite reliability while the reliability of the indicator was evaluated considering the external loads. The model was further tested by evaluating the convergent validity by means of an average variance extracted (AVE) in the model (Hair *et al*., 2017). Table 3 shows that composite reliability of all latent constructs was higher than appropriate threshold of 0.7 (Gefen *et al*., 2000) and all AVE was higher than cut-off value of 0.5 (Bagozzi & Yi, 1988). According to Chu *et al*. (2004), the outer loadings of products in Figure 8 which have below 0.7 were excluded as indicators.

Table 3: Results for Reflective Exterior frameworks

Factors	Indicators	Loadings	Indicator Reliability (i.e., loadings2)	Composite Reliability	AVE
Challenges	CC_1	0.9028	0.815	0.881	0.788
	CC_2	0.8719	0.760		
Drivers	DR_1	0.9689	0.939	0.968	0.937
	DR_2	0.9671	0.935		
	EF_CS	0.8506	0.724		
	EF_HC	0.8547	0.731		
Effects	EF_Quality	0.8165	0.667	0.912	0.874
	EF_Time	0.7874	0.620		
	EF_WS	0.7934	0.629		
	FL_CL	0.8638	0.746		
Failure	FL_CT	0.8491	0.721	0.895	
	FL_PR	0.8664	0.751		0.739
	PRJ_1	0.9304	0.866		
Performance	PRJ_2	0.8141	0.663	0.928	0.912
	PRJ_3	0.9519	0.906		
	ST_3	0.8334	0.695		
Strategies	ST_4	0.7609	0.579	0.826	0.614
	ST_5	0.7537	0.568		
Technique	FM_1	0.9016	0.813	0.836	0.720
	FM_2	0.7916	0.627		

This study tested measurement model by examining all possible structural relationships between the latent variables, using predictive indicators to obtain results. This was achieved by using the PLS algorithm to evaluate the internal weighting (Chin, 2010). Evaluation of the measuring pattern, reliability and validity of latent variables were examined. The internal accuracy and reliability of the measurements were evaluated using composite reliability when considering the external loads, the reliability of the indicator was assessed. The model was further evaluated by testing convergent validity using an average variance extracted (AVE) in the model (Hair *et al.*, 2017). From Table 4, composite reliability of all latent factors was higher compared with acceptable threshold of 0.7 (Gefen *et al.*, 2000), AVE was higher than the limit value of 0.5 (Bagozzi & Yi, 1988). As Chu *et al*. (2004) suggested, the outer loadings products, in Figure 8 which are below 0.7 were omitted as indicators.

Table 4: Fornell-Larcker Standard Review for Discriminant Validity Tests

Latent Variable	Challenges	Drivers	Effects	Failure	Performance	Strategies	Technique
Challenges	**0.89**						
Drivers	0.402	**0.97**					
Effects	0.443	0.831	**0.94**				
Failure	0.436	0.304	0.378	**0.86**			
Performance	0.420	0.952	0.902	0.330	**0.96**		
Strategies	0.463	0.325	0.384	0.240	0.372	**0.78**	
Technique	0.381	0.938	0.833	0.289	0.931	0.338	**0.85**

Measurement model provided by this study showed adequate and sufficient internal consistency and convergent validity, meaning all items used in the questionnaire were accurate measurements of various latent variables centred on predictions and statistical importance of the parameters.

Structural model

Bootstrapping performed to evaluate hypothetical route analysis after evaluating the discriminant validity, reliability and analysing specific process bias of the measures used. The structural model shown in Figure 8 provided the explained variance (R^2) to indicate the degree of power in explaining the specific endogenous construct (i.e. success of the project). Overall, the model showed R^2 value of 0.974 suggesting that the independent variables of task, impact, drivers of cost management strategy, and strategies can explain 97.4 per cent of the variance in construction project results. In addition to the generated R^2 values, the study looked at the predictive relevance Q^2, developed and suggested by Stone (1974) and Geisser (1975). The Q^2 is also a model fit evaluation criterion to assess how well data were excluded from the model. Model has predictive significance, as suggested by Chin (2010) when $Q^2 > 0$. After the partial least square (PLS) blindfolding test, it was discovered that the value of Q^2 for project success was .71, this was larger than zero. Therefore, model showed a highly predictive and acceptable fitness. The results are shown in Table 5.

Table 5: Assessment of Structural Model

Latent Variable	R Square	Cronbachs Alpha	Communality	Redundancy
Challenges		0.732	0.788	
Drivers	0.888	0.933	0.937	0.223
Effects	0.238	0.880	0.674	0.127
Failure	0.190	0.825	0.739	0.137
Performance	0.974	0.883	0.812	0.710
Strategies	0.254	0.686	0.614	0.126
Technique	0.695	0.620	0.720	0.499

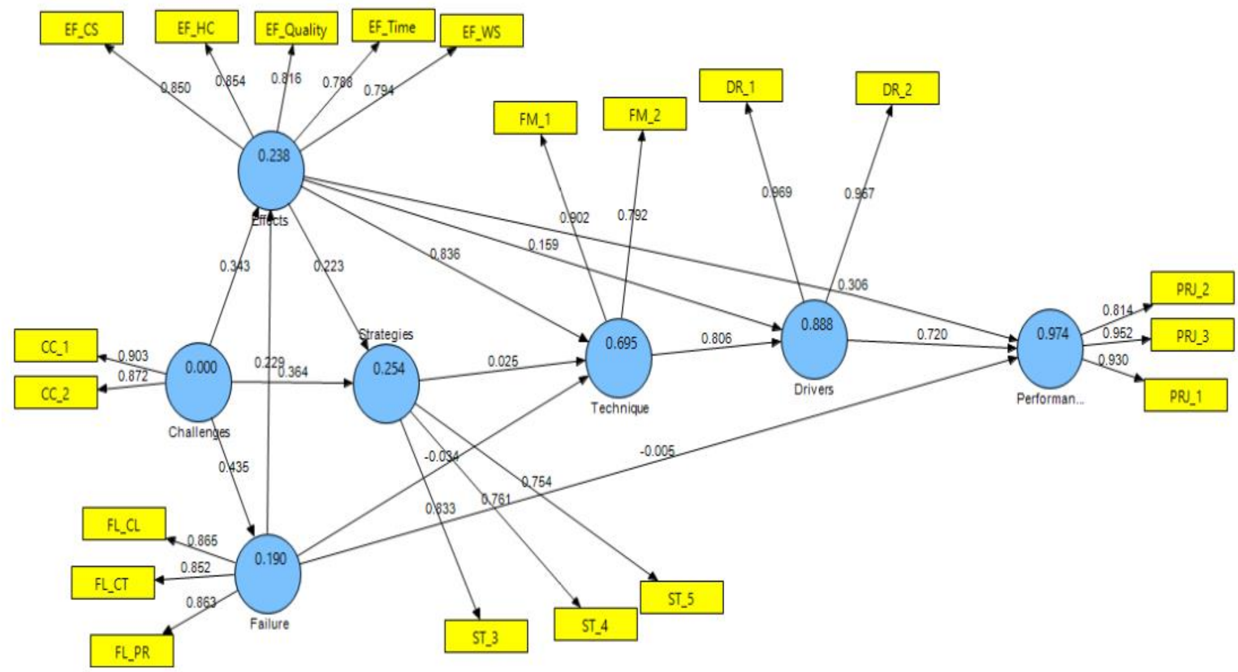

Figure 8: Path coefficient structural model and R^2 values

Following Chin (2010) suggestion, the study used a re-sampling bootstrapping technique to analyse the statistical significance of the structural model. This procedure produced results on t-statistics for all coefficients of the path. Thus, the model's path coefficients (β) and t-statistics are then used to determine the relationship between external and internal factors. This inevitably results in use of path coefficient and the t-value to analyse whether the data obtained endorse the hypothetical paths displayed in the model. Within this analysis, if it falls below these thresholds, a route is deemed not significant*: p < .01 (2.57), p < .05 (1.96), p < .10 (1.645)* for a 2-tailed test.

The research findings on the structural model are presented in Table 6. It has been revealed that the results of the failure to implement cost control measures (β = .837, p < .01) are the most powerful indicator of an effective cost control strategy. There was another clear link between cost management methods and the drivers of cost control measures (β = .805, p < .01), while the drivers also show significant relationship with construction project performance as the most significant predictor (β = .719, p < .01). All the hypothetical paths were significant except the relationship between failure and performance, failure and cost control techniques and strategies and cost control technique. For these three hypothetical paths, no significant relationships were revealed.

Table 6: Coefficients for the path and testing hypotheses

Hypotheses	Beta (β)	Standard Error	T-Statistics	Decision
Challenges -> Effects	0.4426	0.070	6.327	Enabled
Challenges -> Failure	0.4362	0.074	5.860	Enabled
Challenges -> Strategies	0.364	0.119	3.065	Enabled
Drivers ->Delivery	0.719	0.016	46.492	Enabled
Effects -> Drivers	0.160	0.041	3.917	Enabled
Effects -> Performance	0.307	0.017	18.299	Enabled
Effects -> Strategies	0.223	0.097	2.297	Enabled
Effects -> Technique	0.837	0.032	26.002	Enabled
Failure -> Effects	0.229	0.097	2.348	Enabled
Failure ->Delivery	-0.005	0.012	0.389	Not Enabled
Failure -> Technique	-0.033	0.047	0.717	Not Enabled
Strategies -> Technique	0.025	0.041	0.609	Not Enabled
Technique -> Drivers	0.805	0.035	23.168	Enabled

****p < .01 (2.57), **p < .05 (1.96), *p < .10 (1.645) SE = Standard Error*

Discussion of model effects and hypothesis testing

This study established a cost management model for successful implementation of dams. Research model based on various theories described and discussed in the conceptual framework was built to give some detailed comprehension of latent constructs impact used in the model. The aim of this study is to expand understanding on how successful project cost management could bring about efficient project delivery within the budget by enabling project stakeholders to formulate strategies to counteract the causes of project failures through the development of cost control model.

The study included seven latent variables in the model to evaluate direct as well as indirect linkages between the constructs. The structural models tested from the results of the models discussed in the preceding sections suggest that ten of the hypothetical paths are important. The R^2 value varies from 19 per cent to 97.4 per cent, which Elbanna *et al*. (2013) indicated is at an appropriate 10 per cent level. The two of the three insignificant directions, however, showed negative relationship with use and project execution of techniques for cost control. Results and descriptions of hypothesis testing are described next.

Results of structural model show that some of the links previously tested (such as the connection between drivers and project delivery, and between techniques and drivers) were significant. This suggests that within the context of this analysis, the model had high predictive ability. The R^2 value was also above the recommended 10 per cent threshold recorded at the aggregate data level (Elbanna *et al*., 2013) and this aligned with Fornell and Cha (1994) who argued that a model indicates predictive relevance if Q^2 value is larger than 0. The Q^2 value in this study as depicted by the model and shown in Table 5.62 (redundancy) are higher than 0. Hence, the model presented in the study has been able to explain approximately 97.4% of the variation in the paths model. This high explanatory capacity may be attributed to three factors identified by Oyewobi (2014), namely sample adequacy; relevance of the psychometric attributes of the measures involved in the study and the use in the questionnaire of adapted or validated objects. PLS-SEM is referred to as a 'simple technique' because it makes no distributional assumptions, places minimum sample size requirements and typically achieves high predictive potential (Reinartz *et al*., 2009) as shown in this current study.

Based on the conceptual structure as shown in Figure 3, built in this thesis, the hypothesis paths shown in the experiment were investigated using the Smart PLS structural model, and a description of the causal links as tested is provided in Table 6 and summarised in Table 7.

Table 7: Summary of the hypotheses tested in the PLS-SEM path model

Path Label	Path Relationship	Corresponding hypothesised causal path	Beta (β)	T-Statistics	Decision
PCE	Challenges -> Effects	*H1: The challenges of using techniques for cost control and effect of using techniques for cost control on project execution are positively related.*	0.4426***	6.327	Supported
PCF	Challenges -> Failure	*H2: The difficulties of using techniques for cost control and the inability to use techniques for cost control in project execution are positively related.*	0.4362***	5.860	Supported
PFE	Failure -> Effects	*H3: Outcome of use of techniques for cost control and inability to use techniques for cost control in project execution are strongly positive.*	0.229**	2.348	Supported
PET	Effects -> Technique	*H4: Positive association exist between results of dam cost control and degree of techniques for cost control used.*	0.8365***	26.002	Supported
TFT	Failure -> Technique	*H5: Positive relationship exist between failure causes and cost management techniques.*	-0.033	0.717	Not Supported
PTD	Technique -> Drivers	*H6: The relation between techniques for cost control and cost control drivers is significantly positive.*	0.8051***	23.168	Supported
PED	Effects -> Drivers	*H7: Results of use of techniques for cost control and drivers of techniques for cost control have a strong positive relationship*	0.1596***	3.917	Supported
TST	Strategies -> Technique	*H8: Relationship between degree of use of techniques for cost control and approaches to increase use of techniques for cost control is strongly positive.*	0.025	0.609	Not Supported
PCS	Challenges -> Strategies	*H9: A major positive relationship between cost-control problems and approaches to make better use of them.*	0.3637***	3.065	Supported
PES	Effects -> Strategies	*H10: The results of using cost management methods and approaches to enhance their use have a strong positive relationship.*	0.2234**	2.297	Supported
PDP	Drivers ->Project delivery	*H11: The drivers of the use of cost management strategies and project execution have a strong positive relationship.*	0.7191***	46.492	Supported
PEP	Effects ->Project delivery	*H12: There is a major positive association between the results of the cost management strategies and the execution of projects.*	0.3068***	18.299	Supported
TFP	Failure ->Project delivery	*H13: There is a major negative association between the failure to implement cost management strategies and the execution of projects.*	-0.005	0.389	Not Supported

****p < .01 (2.57), **p < .05 (1.96), *p < .10 (1.645) SE = Standard Error*

Conclusion

This study aimed at developing a cost control model for dam projects for efficient project execution and concluded based on analysis from examined literature and empirical results from the study's mixed methods approach: The study established that the poor dam projects delivery is caused by several factors, top most of these factors were client related and they included poor conception and incomplete designs at award, delays in payment for works, and technical omissions at design stages. Contractor related issues also contributed to poor dam projects delivery, chief among the issues included technical incompetence and unrealistic tenders. Non-application of methods to manage costs in implementation of projects also contributed to poor projects delivery. These issues have created major setbacks leading to abandonment of some dam projects. Poor dam projects delivery affects all stakeholders negatively. The effect of poor project delivery was said to be direct if it led to inability of government to provide services or loss of revenue and indirect if it led to waste of resources or poor access to water supply and hydroelectricity. The study showed that espousing an appropriate cost control model will improve dam projects delivery, thus, the model was developed to bring about effectiveness in the process. From results and inferences, the following recommendations are made to provide guidance to all stakeholders involved in major infrastructure projects such as dam construction to enhance the effective delivery of projects. Stakeholders should spend enough time at the conception stages of the projects in order to properly understand the concepts, achieve proper and complete designs before proceeding to tender. Contractors should update their technical knowledge from time to time and use competent professionals during tendering to avoid unrealistic tenders. Adopting cost-control methods in project delivery is dependent on familiarity with, simplicity and ease of application of the cost control technique, contractors should endeavour to expose themselves and staff to some of the techniques available in the industry. Availability of requisite skilled manpower and know-how is a major driver for the use of a cost control technique; therefore, it is imperative to develop and maintain the know-how needed to implement cost management techniques. The challenge for the application of cost control techniques could be overcome by training and re-training staff. The model has established that challenges of poor dam projects delivery can be overcome by the adoption of appropriate strategies and application of appropriate cost management techniques in conjunction with appropriate incentives in the name of drivers.

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