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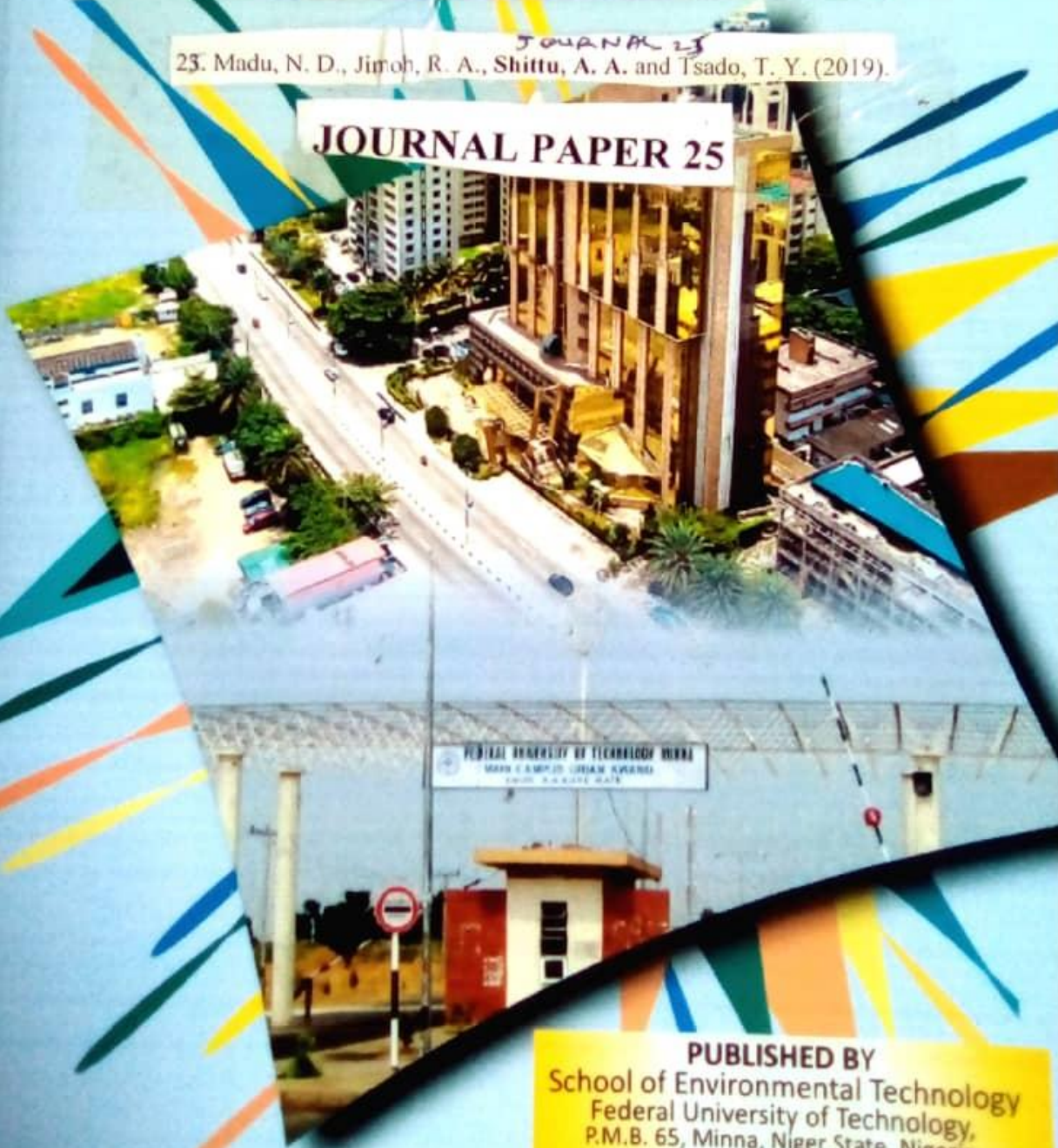


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The Environmental Technology and Science Journal (ETSJ) is devoted to the publication of papers which advance knowledge of practical and theoretical issues that daily plague our society. The aim of the journal is to provide an avenue for the dissemination of academic research findings from various disciplines of the environment, engineering, pure and applied sciences, arts and social science which have materials that emphasize on environmental issues.

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Editorial

This year's World Water Day theme was 'Changing the world: innovations and better life for future generations'. The situation in Africa is growing by itself, report has shown that an estimated 1.6 billion people will be added to urban areas and it is expected that 70% of this growth will be in Africa and Asia. It will exacerbate the cities in Africa and expected to be the hub for driving the economic growth resulting in poverty reduction. However, Africa is yet to tap maximally from the benefits of rapid urbanisation experienced in developed countries. Instead we are plagued down by inadequate infrastructures, climate change, housing deficit, spiralling unemployment, myriad health challenges among other issues. Welcome to volume 14, issues 1 and 2 December 2013 edition of Environmental Technology & Applied Journal (ETAJ). There are 11 articles in this issue where diverse and topical issues are interrogated by our contributors. We may not be able to detect *eureka* yet but the narrative is changing.

Adegbile *et al.* in the 1st paper on the influence of Housing Attributes on Housing Satisfaction in Selected Residential Areas of Ogun State recommended that policy makers, housing developers and the professionals should put these attributes into consideration while providing housing for the people.

In the 2nd paper by Adediji *et al.*, it assessed the operational energy performance of three administrative office buildings in tertiary institutions in Niger State. The need for effective monitoring of energy consumption by sub-metering and auditing of buildings in tertiary institutions and orientation was advocated.

Fajana *et al.* affirmed that adequacy of hostel facilities affect the academic performance of students residing in hostel according to Fajana *et al.* in the 3rd paper. Adequacy of hostel facilities is determined by inadequate hostel facilities. This study was conducted to assess the effect of availability and accessibility of hostel facilities on students' academic performance at the Federal University of Technology, Akure, Ondo State campus. The study recommended that the institution should ensure that adequate student accommodation facilities are provided in accessible condition to further enhance student learning and good performance.

An experimental study was carried out by Ayan *et al.* in the 4th paper to investigate the flexural strength characteristics of grades M20 and M30 concrete prepared using the BPI mix design method. It was concluded that there will be significant reduction of reinforcements in tension of structural members subjected to bending with the modified concrete, especially where light weight is desired.

The 5th paper by Amuda-Yusuf *et al.* identified the barriers to e-tendering adoption leaning upon Technology, Organisational, and Environment (TOE) framework and innovation diffusion theory. The authors stated that the findings will enable policy makers and other industry players to understand the barriers to the implementation of e-tendering adoption and develop strategies to overcome them.

Ali *et al.* in the 6th paper appraised the financial investment in knowledge management (KM) practices with a focus on Quantity Surveying (QS) firms. QS firms were urged to adopt knowledge management (KM) practices because the level of financial investment on KM practices in QS firms was moderate.

Water supply to most communities in most parts of the world has suffered serious setbacks as a result of human activities. Based on this, Awaisu *et al.* in the 7th paper assessed the water quality from different water sources for domestic use during the rainy season in Nasarawa Local Government Area Nasarawa State. The paper suggested that open wells should be lined with cement with level of cover above ground level to avoid surface runoff of pollutant especially during the rains.

The concept of enhancing the efficiency of traditional buildings using a conceptual design approach was discussed by Alao and Ogunbode with particular emphasis on redirecting load paths, moment redistribution and eliminating design flaws in the 8th paper. The paper showed that conceptual design and re-design can improve the efficiency of designs and was therefore encouraged.

Ineffective application of cost control techniques from inception through execution of infrastructural projects, especially dam projects, is a major cause of poor project delivery as stated by Madu *et al.* in the 9th paper. The paper reported the pilot study of the drivers and challenges of the use of cost control techniques in dam project delivery in Nigeria with a view to suggesting strategies for improved delivery of dam projects. Major recommendation from the study was that most severe challenges of cost control techniques application should be identified as a major threat to be addressed in order to mitigate the causes and effect of poor delivery of dam projects in Nigeria.

Dahiru and Kofarbai assessed the performance of PPP arrangement as a viable option for the procurement of infrastructural facilities in Nigeria in the 10th paper. The paper recommended that

effort should be made to create enabling environment such as security, reliable power supply, good roads, reliable source of funding and formulation of policies that will guarantee the sustainability of PPP agreement as well as protect the interest of parties to the agreement.

Fabi and Awolesi in the 11th paper assessed the factors impeding implementation of public-private-partnership highway project in Nigeria. The paper advocated that the impeding factors must be confronted headlong in order to bring about desired economic growth and development.

This 12th paper by Bashir *et al.* analysed the land use/land cover change in Gusau Zamfara State, Nigeria. The paper concluded that urbanization is reducing land availability for other uses and needs to be properly planned for environmental sustainability.

The last paper by Idris *et al.* evaluated the potential risk factors associated with civil engineering projects with a view to achieving overall project objectives. The study recommended that project team should identify and quantify project related risks at the initial stage and allocate the risks to party/parties suitable to control them.

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Let us do it again, peace!

R. A. Jimoh
Managing Editor

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Assessment of Drivers and Challenges of the Use of Cost Control Techniques in Dam Project Delivery in Nigeria

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A project is bound to fail due to its nature and size, as projects increase in size, planning, budgeting and cost control become complex and problematic. This consequently leads to cost and time overruns that hinder effective project delivery. Ineffective application of cost control techniques from inception through execution of infrastructural projects, especially dam projects, is a major cause of poor project delivery. This paper presents the result of pilot survey aimed at assessing the drivers and challenges of the use of cost control techniques in dam project delivery in Nigeria with a view to suggesting strategies for improved delivery of dam projects. Questionnaires were sent to twenty (20) respondents purposively selected from the identified population for the larger study. Findings from the study indicated that technical know-how, the need to train people to implement cost control techniques and desire to complete the project within cost envelope were the major drivers in the use of cost control techniques. The size and technical requirement of the project, non-availability of skilled manpower, and the cost of applying the techniques were revealed as the major challenges to the application of cost control techniques in the delivery of dam projects in Nigeria. It was however concluded that the most effective strategies for cost control techniques application for improved project delivery of dam projects are Bench-marking new projects to a reference class of similar completed projects (Reference class forecasting); enhanced project management capability; and Computer-aided cost estimating and forecasting models. Major recommendation from the study was that most severe challenges of cost control techniques application should be identified as a major threat to be addressed in order to mitigate the causes and effect of poor delivery of dam projects in Nigeria.

Keywords: Dam; Project Delivery; Driver; Challenge; Strategy; Nigeria

Introduction

The construction industry is of strategic importance to all nations due to the role it plays in the economy (Ogunsemi, 2015; Stasiak-Betlejewska & Potkany, 2015). The industry worldwide accounts for a sizeable proportion of national economic activities, accounting for about 6 - 10% of the world's economy (Heme *et al.*, 2011; Sanni & Hashim, 2013; Chikara, 2004; Ibrahim, 2014; Stasiak-Betlejewska & Potkany, 2015; Adewumi, 2018). Based on the magnitude and nature of the works the construction industry executes, it has been established that it is a major consumer of

capital resources. However, improving cost performance and project delivery have been some of the chronic challenges confronting the industry worldwide (Chigara *et al.*, 2013). The Nigerian construction industry is dotted with many cases of failed, abandoned or uncompleted projects. Dam construction is one of such projects despite its contributions to the socio-economic growth of the nation. In fact, Adewumi (2018) pointed out that even though the number of large dams in Nigeria is insignificant on a global scale, the role of dams in the economic development of the country is important. Dams create reservoirs

for storing surplus water during wet periods which can be utilised during lean periods (International Committee on Large Dams [ICOLD], 2016). Anecdotal report by the researcher at the start of this study showed that dam sub-sector of the Nigerian construction industry is the worst hit by the phenomenon of projects failures and or abandonment. For instance, Jagboro and Babalola (2005) revealed that an interim report of the Presidential panel on contracts at the wake of the present democratic government in Nigeria in 1999 confirmed a staggering amount of over four hundred and fifty billion Naira (N450b) for dam and other infrastructural projects that can be classified as failed contracts spanning from 1979 to 1998. The Committee's report regarding the projects cited poor funding, poor conception of projects, policy somersault, inefficient procurement methods, poor cost control and cost management as the reasons for the poor delivery of the projects. The effects of project abandonment include disappointment to the populace users, low living standard, wastage of resources, reduction in employment opportunities, decrease in tempo of construction activities, decrease in revenue accruing to government, difficulty in attracting foreign loans (Ayodele & Alabi, 2014). The socio-economic effect of failed/abandoned dam projects in Nigeria is overwhelming considering the huge amounts of money invested (Olalusi & Otunola, 2012). The frequently faced consequences of poor projects delivery are reduction in profit margin and induced loss of belief of citizens in government funded projects (Le-Hoai *et al.*, 2008).

However, construction projects failure manifest as inability to deliver a project within stipulated time, cost and quality specifications, or inability to satisfy consumer expectations (Nzekwe *et al.*, 2015). Dissanayaka and Kumaraswamy (1999) revealed that projects generally have tendencies to fail the larger the project size and complexity, the more problematic the construction planning, budgeting, and cost control and defective planning would

ultimately lead to cost and time overruns which hinder effective project delivery. Alinaitwe *et al.* (2013) therefore concluded that ineffective application of cost control techniques from inception through execution of infrastructural projects, especially dam projects, is a major cause of poor project delivery.

In the same vein, Olawale and Sun (2010) observed that despite the availability of various cost control techniques and project control software, many construction projects fail to achieve their cost and time objectives. Olateju (1991) pointed that contractors that could not control construction costs would not make profits and contractors that cannot make profit would be out of business. It is therefore imperative to conduct further studies on how cost control techniques could be used specifically improve the delivery of dam projects in Nigeria. This is believed would provide some useful insights and information towards forestalling the current challenges plaguing effective delivery of dam projects (abandoned/failed projects), and consequently help in improving project performance within the construction industry.

Literature Review

Dams and the Nigerian Water Sector

Nigeria has a population of over one hundred and eighty (180) million people, a land area of 923,000 square kilometres, with a water resources potential of about 374 billion cubic metres. 244 billion cubic metres is surface water, 88 billion cubic metres are inflows from upstream countries, while 42 billion cubic metres is underground water (Federal Ministry of Water Resources [FMWR], 2013; Adewumi, 2018). The useful part of the surface water is stored in lakes or reservoirs created by the construction of dams. Adewumi (2018) noted that huge investments in dam construction in Nigeria were aimed at improving the economy and welfare of citizens. Despite the huge potential and investments, the national access to water supply is only 69%. This implies that about 31% or 55.7 million

Nigerians lack access to water supply due to reasons which include ineffective projects delivery / failed or abandoned water infrastructure projects (FMWR, 2013).

FMWR (2013) indicated that Nigeria has potential of 3.14 million Hectares (Ha) of irrigable land, 440,000Ha has been planned; 130,000Ha has been developed and only 70,000Ha is actually being irrigated. The country has a hydropower potential of about 12,220 MW of which, only about 1,930 MW has been developed at Kainji, Jebba and Shiroro dams (FMWR, 2013). Also, a potential of over 830 MW are under construction (Zungeru, Gurara 1 and Kashimbilla dams). Whilst, over 3250MW potentials are in dams whose construction programmes have not progressed as planned (Mambilla, Otukpo multi-purpose, Qua Falls, Datsin Hausa dams). The massive flood of 2012 which destroyed property across the country could have been mitigated if there were sufficient dams and reservoirs to hold the water and regulate the releases. Adewumi (2018) further noted that even though dams have social and environmental concerns, its beneficial impact on food security, energy production, creation of employment and poverty alleviation contribute immensely to sustainable economic development. Accruable benefits in timely completion of the construction of the dam projects include increase in access to water supply, increased irrigation cultivation and food security, improved access to hydro-electricity supply and flood mitigation (FMWR, 2013).

Construction Cost Control

Ikegwuru (2006) opined that cost is an important concern in any construction project and to control costs within an acceptable level so as to achieve effective project delivery requires appropriate and accurate identification of various project-related determinants as well as an understanding of the magnitude of their effects. Ikegwuru (2006) also posited that in order for a project to be effective, any cost control system employed in its construction should be proactive. The study further opined that the response time in the control

of a construction project is too slow to be effective with only a feedback system and therefore concluded that the cost control systems used in Nigerian construction industry are mainly based on the principle of feedback after either a project or an element of the project has been completed. Such cost control systems are characteristically reactive and after the effect. The major cause of the poor state of construction infrastructure projects delivery is limited understanding and lack of application of cost control techniques or cost management at every stage of the project delivery, from inception to design and to construction (Henesy, 1993; Mansfield *et al.*, 1994; Frimpong, 2003; Chan, *et al.*, 2004; Doloi, 2011).

Causes of Ineffective Construction Project Delivery

The problem of project delivery schedule failure is an old but recurring problem in the construction industry. Project delivery schedule failure or slippage are notorious for their inability to deliver according to plan and in Nigeria, the problem is severe and is a major cause of cost overrun or project abandonment (Annoa, 2014). Project cost control is the application of economic principles to the construction project. It examines not only the costs appropriate to specific project, but also the factors and influences of the determinants of this cost according to Ashworth and Perera (2010).

Mansfield *et al.* (1994) in the analysis of most important factors responsible for project delays and cost overrun in Nigerian construction projects found that poor contract management, financing and payment for completed works, change in site conditions, shortages of materials, design changes, subcontractors and nominated suppliers, price fluctuation, inaccurate estimates, delays and additional works are responsible for project delays, cost overrun and poor projects delivery.

Enshassi (2009) found that construction projects located in the Gaza Strip, Palestine, suffer from many problems and complex

issues such as unavailability of competent staff, material shortage, waste rate of materials, escalation and fluctuation of material prices, delay in progress payment, cash flow of project, cost variation order, cost of rework, cost control system, poor site management, conformance to specification, project complexity, planned time for construction, inadequate planning and scheduling, mistake and discrepancies in design documents, late reviewing and approving design document by consultant and client and ranked them accordingly.

Drivers of the use of Cost Control Techniques

Cost control is the process where the construction cost of a project is managed through the best methods and techniques so that the contractor does not suffer losses when carrying out the activities of the project (Ayodele, 2005; Ayinde, 2018). Project cost control aims at controlling changes to the project budget, it provides management with cost related information for making decisions with a view to complete the project with specified quality, on time and within budgeted costs (Chitkara, 2005). Ayodele and Alabi (2014) revealed that Bill of Quantities (Cost control technique) is utilized in all government projects and this resulted into high quality jobs, this was not the same with private projects developments who are reluctant to use the Bill of Quantities for control. This position is in consonance with the finding of Chinwokwu (1999) who found that building collapse is more rampant on sites of private developers as compared with government developments.

Familiarity with available cost control techniques increases the chances of its application in projects delivery, MS Project and Earned Value Analysis were the most important techniques available for cost controlling and the contractors who had adopted the these techniques said that ease of monitoring and user friendliness were the factors that most influenced their use (Malkanathi *et al.*, 2017). A project cost control system for effective implementation, as far as feasible, should be

easy to understand and simple to implement, without creating any interdepartmental and interpersonal conflicts. The system should have least response time, thus enabling quick monitoring and prompt decisions based on simple cost reports initiated at regular frequency by cost incurring centers (Chitkara, 2005). Familiarity, simplicity and ease of its application is a major driver in the use of a cost control technique.

Cost control can be achieved by choosing the appropriate professional, equipment and tools for the work, practitioners are more comfortable with conventional method of cost control with limited involvement in information technology, or any form of computer software for cost control therefore practitioners should constantly attend workshops and seminars that will refresh and broaden the required knowledge and skill for controlling costs of their project as it has been established that lack of practices and lack of expertise are the main barriers that prevent contractors from using the cost control techniques (Ayinde, 2018; Malkanathi *et al.*, 2017 and Dhawadker, 1989).

Challenges of the use of Cost Control Techniques

Barriers are the impediments to the implementation of effective cost control practices in Nigerian construction industry and one of the top critical barriers among the challenges that affect construction cost control practices in Nigeria is lack of research and innovation (Sanni and Hashim, 2013). Adjei *et al.* (2018) listed the challenges of project cost control practice to include: using obsolete methods and concepts, lack of knowledge on the use of available tools and technology, overemphasizing on results while ignoring the cost control process, lack of project cost control process and systems suitable to the enterprise, abandonment of complicated strategies, lack of consistency in cost management by managers, serious decision failure, exorbitant marketing expenses, poor attitude towards information communication technology usage, difficulty in monitoring different sources of day-to-

day cost data, variations in contract and lack of financial commitment in the projects.

Ademola (2012) and Adjei *et al.* (2018) opined that using manual and paper-based means for cost control is where site managers, cost engineers or quantity surveyors prefer the use of calculators and notebooks or writing pads to arrive at cost control analysis instead of using appropriate tools and technology available. The challenge is that these outdated cost management practices cannot be used to solve real-world situation of cost variances. Akeem (2017) revealed that cost control has a positive impact on organizational performance, therefore to achieve success, there is a need for organization to apply cost control scheme in their operation and workers should be carried along.

Yismalet and Patel (2018) noted that construction firms, being organisations, have to develop their project management capacity in order to accomplish firm and project objectives successfully hence contractors need to focus on project cost management process. The major shortcomings of construction projects cost management practice can be attributed to ineffective approaches to identifying, managing and controlling client needs, project scope and cost, incompetent competition in tendering, incomplete design, poor project management, poor coordination of site and poor communication (Yismalet & Patel, 2018).

Strategies for improving the use of Cost Control Techniques and Project Delivery

Cost control can be achieved by choosing the appropriate professional, equipment and tools for the work, practitioners are more comfortable with conventional method of cost control with limited involvement in information technology, or any form of computer software for cost control, therefore practitioners should constantly attend workshops and seminars that will refresh and broaden the required knowledge and skill for controlling costs of their project as it has been established that lack of

practices and expertise are the main barriers that prevent contractors from using the cost control techniques (Ayinde, 2018; Malkanthi *et al.*, 2017 and Dhawadker, 1989).

Contractors should be encouraged to use cost controlling techniques by attending training and awareness programs (Malkanthi *et al.*, 2017). Competency of the essential personnel in the contracting organisation should be high in construction cost control practices and activities because the more efficient the staff, the better for the progress and growth of the company (Sanni & Hashim, 2013). Pries *et al.* (2004) concurred with Sanni and Hashim (2013) noting that business of today is about fulfilling client satisfaction through efficient production, therefore, if the contractor's personnel are very efficient in the discharge of their work, this may result in the efficient production in the organisation. Ayodele and Alabi (2014) opined that the Federal Government of Nigeria should make laws to compel private developers to adopt the use of cost control techniques in building development as this will drastically reduce the rate of building collapse in Nigeria and will make them ultimately spend less on the projects.

Research Methodology

This paper reported the pilot study carried out before the larger study through the self-administration of 20 questionnaires. Pilot study allows the testing of the questions with few participants before the questionnaires are sent out to the field (Omotayo, 2017; Gakure & Uloko, 2013; Panneerselvam, 2013). In order to avoid any misunderstanding during the data collection process, it was necessary to check the wording, layout and style of writing with few respondents before it was sent out (Omotayo, 2017; Saidu, 2016; Oyewobi, 2014; De Vaus, 2013). Feedbacks from the pilot study usually help in adjusting the questions for better understanding and irrelevant questions expunged. The constructs for the study were obtained from the works of authors such as Ademola (2012), Sanni and Hashim (2013), Ayodele

and Alabi (2014), Akeem (2017) and Adjei *et al.* (2018).

In this study, copies of the questionnaire were sent to twenty (20) respondents from the identified population for the larger study. The respondents on the pilot survey were chosen based on their knowledge, experience in handling of projects of this type and the proximity of their location to Abuja for easy access. Five (5) to contractors' project managers involved in the projects, five (5) to the consultants, five (5) to members of the Nigerian Committee on Large Dams (NICOLD) and five (5) to members of Nigerian Institute of Water Engineers (NIWE). The respondents were given three weeks to complete the questionnaires and return. The questionnaires were self-administered, multiple phone calls and visits were made to the respondents to improve response rate. Fifteen of the respondents returned the completed questionnaires. All the questionnaires were substantially completed and were considered valid for the analysis which is presented subsequently. The paper was therefore based on quantitative methodology using questionnaire survey with closed ended questions on professional practitioners. Morenikeji (2006) cut-off points were used in taking decisions from the results obtained as shown below; the decisions formed the basis for the conclusion reached and the recommendations made.

- 1.0– 1.49 = No influence/Not important
- 1.50 – 2.49 = Little influence/Slightly important
- 2.50 – 3.49 = Moderate influence/Moderately important
- 3.50 – 4.49 = High influence/Highly important
- > = 4.50 = Very high influence/Very highly important

Results and Discussion

Demographic analysis of respondents

Table 1 below gives the details on the people and organisations surveyed in the pilot study. Analysis of the demographic data showed that all the respondents were male (100%), a strong indication that this aspect of human endeavour is a male

dominated enterprise. Majority of the respondents were mature individuals who were older than 45 years. The dominant educational qualification possessed by respondents was Master's degree; however, all of the respondents had obtained at least a Bachelor's degree or its equivalent. More than three quarters of the sample had worked in the responding organisation for up to 10 years, and for more than 15 years in the construction industry generally.

4.2 Drivers and Challenges of Application of Cost Control Techniques in Achieving Effective Project Delivery of Dams in Nigeria

This section focused on the drivers, challenges and strategies that could be employed to improve the application of cost control techniques in the project delivery of dams in Nigeria.

Drivers of application of cost control techniques

The result of analysis of data enabled the identification of the three most influential drivers of increased application of cost control techniques on dam projects, based on a general consensus opinion of all respondents. In order of influence, the three drivers were 'Availability of skill or technical know-how', 'The need to train people to implement cost control techniques' and 'Desire to complete the project within cost envelope'. This agrees with Charoengam and Sriprasert (2001) conclusion that contractors perceive cost control as a prerequisite towards profit maximization and effective project delivery. That the most important function that facilitates construction organisations to accomplish profit maximization is cost control and that absence of a well-established cost control system has caused failures to many Thai contractors. The analysis further revealed that about two-thirds of the sample has an active policy on cost control which was reviewed at varying intervals. Such intervals ranged from quarterly (7% of the sample), annually (13% of the sample), and frequently (27% of the sample); in one firm the cost control policy was reviewed at the end of every project

meeting, however, there was no information on how frequently such meetings take place. The results also supported the supposition that cost control techniques applied in previous jobs are reviewed for application to current jobs; 67% of the sample concurred with this.

All of the respondents agreed that continuous review of the application of cost control techniques could improve the cost control process. Only about half of the sample utilise special templates for managing construction cost (47% of the sample). The respondents were however

enthusiastic about trying new approaches that might lead to cost reduction on their dam projects; 87% of the sample agreed with this position. Akeem (2017) found that cost control has a positive impact on organizational performance, therefore to achieve success, there is a need for organization to apply cost control scheme in their operation and workers should be carried along in doing so. Table 2 shows the ranking of the drivers of the use of cost control techniques.

Table 1: Demographic Features of Respondents

Demographic parameter		Frequency	Percent
Category of respondent	Consultant	4	26.7
	Contractor	5	33.3
	NICOLD	3	20.0
	NIWE	3	20.0
	Total	15	100.0
Gender	Male	15	100.0
Age	18 -30 years	1	6.7
	30 - 45 years	1	6.7
	45 - 60 years	9	60.0
	More than 60 years	4	26.7
	Total	15	100.0
Educational qualification	HND	1	6.7
	BSc	3	20.0
	MSc	8	53.3
	PhD	3	20.0
	Total	15	100.0
Length of service employment	0 - 5 years	2	13.3
	5 - 10 years	1	6.7
	10 - 20 years	7	46.7
	More than 20 years	5	33.3
	Total	15	100.0
Length of service construction industry	0 - 5 years	1	6.7
	More than 15 years	14	93.3
	Total	15	100.0

Table 2: Drivers of application of cost control techniques

Driver	Mean score	Decision of Respondents
Availability of skill or technical know-how	4.73	Very high influence
The need to train people to implement cost control	4.73	Very high influence
Desire to complete cost envelope	4.53	Very high influence
Desire to complete project on schedule	4.33	High influence
Experience of the contracting company	4.33	High influence
Need to achieve best quality of project	4.33	High influence
Desire to maximize profit	4.20	High influence
Complexity of the project	4.07	High influence
Size/technical requirement of the project	4.00	High influence
The cost of applying the techniques	3.67	High influence
Client requirement or influence	3.60	High influence
Cumbersomeness of applying some of the techniques	3.20	Slight influence

Challenges of use of cost control techniques

The study also examined twelve circumstances as shown in Table 3 below that could serve as challenges to the application of cost control techniques in dam projects delivery. Based on respondents' opinions, the three most influential circumstances were identified as challenges. The three top challenges, according to general opinion of the entire sample were: 'Availability of skill or technical knows-how'; 'the need to train people to implement cost control techniques' and 'Experience of the contracting company'.

Consultants and members of the professional association had slightly different perceptions of the challenges that projects face in the application of cost control techniques. Consultants believed that 'Experience of the contracting company' was the most important challenge facing the application of cost control techniques on dam projects. The professional association on the other hand opined that the most important challenge was actually a double challenge; these were 'Desire to complete the project on schedule' and 'Need to achieve best quality of project'. Adjei *et al.* (2018) listed the challenges of project cost control practice to include; using obsolete methods and concepts, lack of knowledge on the use of available tools and technology, overemphasizing on results while ignoring

the cost control process, lack of project cost control process and systems suitable to the enterprise, abandonment of complicated strategies, lack of consistency in cost management by managers, serious decision failure, exorbitant marketing expenses, poor attitude towards information communication technology usage, difficulty in monitoring different sources of day-to-day cost data, variations in contract and lack of financial commitment in the projects. This study examined twelve circumstances that could serve as challenges to the application of cost control techniques in dam project delivery and found the need to train people to implement cost control ranks very high, this directly corroborates with and affirms lack of knowledge as expoused by Adjei *et al.* (2018). Malkanthi *et al.* (2017) noted that lack of practices and lack of expertise are the main barriers that prevent contractors from using the cost control techniques and suggested that contractors should be encouraged to use cost controlling techniques by attending training programmes and awareness programmes.

Strategies for improving the use of cost control techniques

Table 4 below shows the general opinion of the entire sample with respect to the strategies that could be applied for improving the use of cost control techniques on dam projects was that three strategies were the most important. These included 'Bench-marking new projects to a reference class of similar completed projects

(Reference class forecasting), 'Enhanced project management capability' and 'Computer-aided cost estimating and forecasting models'. This selection of strategies underscores the importance that respondents attached to the ability to forecast project cost with a reasonable degree of accuracy.

Analysis of the opinions of employers and the professional association of water engineers however both felt that 'Enhanced project management capability' should rank as the most important strategy for improving cost control techniques application on dam projects. Yismalet and Patel (2018) concluded that construction firms, being organisations, have to develop their project management capacity in order to accomplish firm and project objectives successfully hence contractors need to focus on project cost management process.

Conclusion and Recommendations

The most severe challenges of cost control techniques application are Availability of skill or technical know-how; The need to train people to implement cost control

techniques; and Experience of the contracting company.

It can finally be concluded that the most effective drivers of cost control techniques application are Availability of skill or technical know-how; the need to train people to implement cost control techniques; and Desire to complete the project within cost envelope. In addition, the most effective strategies for cost control techniques application are Bench-marking new projects to a reference class of similar completed projects (Reference class forecasting); enhanced project management capability; and Computer-aided cost estimating and forecasting models.

In view of the conclusion of the study, it is recommended that in order to improve on the availability of skilled manpower, seminars and workshops are needful to enable the staff update knowledge and skills. In addition, most severe challenges of cost control techniques application should be identified as a major threat to be addressed in order to mitigate the causes and effect of poor delivery of dam projects in Nigeria.

Table 3: Challenges of the use of cost control techniques

Challenge	Mean score	Decision of Respondents
Availability of skill or technical know-how	4.33	High influence
The need to train people to implement cost control	4.07	High influence
Experience of the contracting company	4.07	High influence
Complexity of the project	3.67	High influence
Size/technical requirement of the project	3.60	High influence
Client requirement or influence	3.40	Slight influence
Need to achieve best quality of project	3.36	Slight influence
The cost of applying the techniques	3.20	Slight influence
Desire to complete project on schedule	3.14	Slight influence
Desire to complete cost envelope	3.14	Slight influence
Desire to maximize profit	3.00	Slight influence
Cumbersomeness of applying the techniques	2.80	Slight influence

Table 4: Strategies to improve use of cost control techniques

Strategy	Mean score	Decision of Respondents
Enhanced project management capability	4.79	Very highly important
Bench marking new projects to a reference class of similar completed projects. (Reference class forecasting)	4.53	Very highly important
Computer aided cost estimating and cost forecasting models	4.33	Highly important
Pre-qualification of contractors	4.27	Highly important
Risk and contingency planning	4.07	Highly important
Use of public-private-participation models	4.07	Highly important

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