COST CONTROL MODEL FOR EFFECTIVE DAM PROJECTS DELIVERY IN NIGERIA

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PhD/SET/2015/787

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FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

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DECLARATION

I hereby declare that this thesis titled "**Cost Control Model for Effective Dam Projects Delivery in Nigeria**" is a collection of my original research work and it has not been presented for any other qualification. Information from other sources (published or unpublished) has been duly acknowledged.

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CERTIFICATION

The thesis "**Cost Control Model for Effective Project Delivery of Dams in Nigeria**" by Madu, Nicholas Dumebi (PhD/SET/2015/787) meets the regulations governing the award of the degree of PhD of the Federal University of Technology, Minna and it is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

This work is dedicated to God Almighty for His mercy and grace, to my late mother Victoria Uchenna Madu who toiled and sacrificed to get me going, my dear uncle Prof. A.U. Uwandulu who supported my foundation and keeps inspiring me and to my loving family, Ifeanyi, Nonso, Uche and Tobechukwu for support and understanding, if not for you I would not have come this far.

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ABSTRACT

Construction investments contribute significantly to the development and growth of national economies. Delays in delivering construction projects, abandonment of 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. Over 450 billion Naira has been sunk into projects that have not benefited anticipated users. Worried by the phenomenon of poor 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. This research aligned with pragmatic paradigm which allowed the use of both quantitative and qualitative methodologies. 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. In-depth interview was used to obtain qualitative data from construction companies operating in Nigeria. A great deal of data was also obtained from archival records that existed in the client's offices. Data analysis was by descriptive and inferential statistics, content and thematic analysis. 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 most significant finance related causes of poor dam projects delivery were payment delays, variations and rework during construction and accuracy of estimates at tender. The study further revealed that clients also contributes to poor dam projects delivery by payments delays, technical omissions at design stage as well as incomplete design at tenders. The study revealed also that the most significant direct effects of poor dam projects delivery were inability of government to provide services to the people. While the most significant indirect effects of poor dam projects delivery are waste of resources, poor access to water supply. Also, 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 study revealed that project budgets and meetings were the most familiar cost control techniques while contingency budgets and project budgets were the most frequently used techniques. 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 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.

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LIST OF ABBREVIATIONS

AVE	Average Variance Extracted
BCIS	Building Cost Information Service
CBSEM	Covariance Based Modelling Equation
COREN	Council for the Regulation of Engineering in Nigeria
EFA	Exploratory Factor Analysis
Eq	Equation
EVA	Earned Value Analysis
FCT	Federal Capital Territory
FMBNP	Federal Ministry of Budget and National Planning
FMWR	Federal Ministry of Water Resources
GWhr/year	Gigawatt Hour per Year
Ha	Hectares
ICOLD	International Commission on Large Dams
IDI	Index Interview
KRI	Key Respondent Interview
MDGs	Millennium Development Goals
MW	Megawatt
NICOLD	Nigeria Committee on Large Dams
NIWE	Nigerian Institution of Water Engineers
NSCD	National Sub-Committee on Dams

PLS	Partial Least Square
PLS-SEM	Partial Least Square Structural Equation Modelling
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
RETC	Revised Estimated Total Cost
WBS	Work Breakdown Structure

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

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 & Rothengatter, 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).

The population of Nigeria has multiplied over the years, 37,859,748 in 1950, 63,374,633 in 1975 and 200,936,599 in 2019 (Varrella, 2020) and so has the demand for water supply, water for agriculture (irrigation) and hydropower generation, leading to the need for developing additional water supplies and more efficient utilisation of funds allocated to this sector of the national economy. It is therefore essential to note that a dam is an engineering structure of important dimensions across a River, stream or a flow course for storing or harnessing water for multi-purpose use (McMillan, 2007; Youdeowei *et al*., 2019). 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 construction is the worst hit by the phenomenon of projects failures and or abandonment in Nigeria.

Jagboro and Babalola (2005) and Anyanwu (2013) revealed that a report by Presidential panel on contracts in Nigeria in 1999 showed that over ₦450 billion is trapped in dams and other infrastructural projects that failed over 18 years between 1979 and 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 construction cost management is described as the measure involved in controlling expenditure in the process of implementation of the works from starting till completion (Liang, 2005).

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. It is therefore imperative to conduct further studies on construction cost methods specifically in dam projects which will provide some useful insights and information towards managing the discovered problems (abandoned/failed projects), and consequently help to improve project delivery.

1.2 Statement of the Research Problem

Despite the huge potential and huge investments in water infrastructure, the national access to water supply is only 69%. This implies that about 31% or 52.7 million Nigerians do not have access to water supply due to many reasons which include ineffective projects delivery/failed or abandoned water infrastructure projects (FMWR, 2013).

Nwachukwu *et al*. (2010) noted that the rate of failure or abandonment of infrastructure development caused slow progress of the economy. Ayodele and Alabi (2011) asserted that the sight of abandoned projects spread across Nigeria's is troubling. According to Kontagora’s (1993) study, there are about 4,000 unfinished projects estimated to cost over 300 billion Naira and more than three decades to actualise given government's construction ability. The 2011 report of the former President Jonathan's abandoned Projects Audit Commission revealed that over the last four decades the Federal Government abandoned about 11,886 construction projects (Ayobami, 2016).

Umoru and Eruke (2016), however, reported that there were 19,000 Government projects abandoned in the country. A recent survey conducted by Nigeria's Chartered Institute of Project Management found that some 56,000 abandoned projects in Nigeria were worth more than 12 trillion Naira (Ebatamehi, 2019; Aluko, 2019). An analysis of the major reason for this pointed to improper planning and implementation of the infrastructural projects mainly as a result of poor cost control systems adopted (Ayodele & Alabi, 2014; Hafez, 2001).

The massive flood of 2012 which destroyed property across the country could have been mitigated if there were enough dams and reservoirs to hold the water and regulate the releases. Adewumi (2018) stated that in spite the fact that dams have social and environmental concerns, their beneficial impact on food security, energy production for industry, creation of employment and poverty alleviation contribute immensely to sustainable economic development. Accruable benefits in timely completion include increased availability of water, increased food cultivation, improved hydro-electricity supply and flood mitigation (FMWR, 2013).

Furthermore, the 2015 fourth quarter and consolidated budget report of the Federal Government indicated that construction of Kashimbilla dam project had created employment opportunities for over 1000 skilled and unskilled indigenes of Benue and Taraba States as well as other Nigerians (FMBNP, 2015). Access roads had opened to a lot of communities and boosted commercial activities around Kashimbila, Jato-Aka and other neighbouring communities. This has led to the development of the area through the provision of social amenities. It is anticipated that timely completion of the project will create over 39,000 jobs for the immediate communities, provide irrigation scheme for 2000Ha of farmlands, aid fishery development, provide 40 megawatts of power and boost tourism (Federal Ministry of Budget and National Planning (FMBNP), 2015). However, this project remained uncompleted owing to many reasons such as cost escalation, poor funding, poor cost control and poor project delivery (FMWR, 2016).

Ikegwuru (2006) noted the significance of construction cost and that managing costs at an appropriate level requires an adequate and reliable description of the various determinants relevant to the project and an appreciation of the magnitude of their impact. The study further pointed out that, for a construction process to be effective, any cost regime employed should be proactive. However, the response time is too slow to be effective with only a feedback system and therefore concluded that the cost control systems used in Nigerian mainly rely 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, responding only after that aspect of the project has been concluded. It has been argued in many literatures that the major cause of the poor state of construction infrastructure projects delivery is poor understanding and lack of application of cost management principles at the various stages of implementation (Henesy, 1993; Mansfield *et al.*; 1994, Frimpong, 2003; Chan, *et al*., 2004; Doloi, 2011).

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.

Based on the research problem identified, this study sought answers to the following questions:

i. What are the causes of poor dam projects delivery in Nigeria?

ii. What are the effects of poor dam projects delivery in Nigeria?

iii. What is the level of familiarity with the techniques to manage costs and how frequently are the techniques used in dam projects the delivery in Nigeria?

iv. What are the drivers and difficulties in the use of cost management techniques to achieve effective dam projects delivery in Nigeria?

v. How can cost control model be developed for effective dam projects delivery in Nigeria?

1.3 Aim and Objectives of the Study

The study aimed at developing a cost-control model for effective dam projects delivery in Nigeria with a view to improving dam projects delivery. The following objectives are set for achieving the aim:

i. Determine causes of poor delivery of dam projects in Nigeria.

ii. Assess the consequences of poor delivery of dam projects in Nigeria.

iii. Determine level of familiarity with techniques for cost management and how frequently the techniques are used in dam projects delivery in Nigeria.

iv. Assess the drivers and difficulties in the use of cost management techniques to achieve effective dam projects delivery in Nigeria.

v. To develop a cost control model for effective delivery of dam projects.

1.4 Justification for the Study

Ogunsemi (2015) reported that the construction sector in Nigeria, like others worldwide is faced with the problems of inefficient product development, given the huge capital expenditure. There are many reports documenting factors leading to delays and inefficient production. For example, Mansfield *et al*. (1994) carried out an inquiry in Nigeria and discovered important variables causing project delays included conditions of the site, design changes and delayed payments for approved works. Ikegwuru (2006) established that the cost management systems employed in the country by construction companies are based on historical evidence. This denotes that information concerning the cost status of a project operation is collected long after completion of the activity in question. In other words, the existing systems look only at historical cost records incurred in a project.

Hafez (2001), Koushki and Kartam (2004) and Ayodele and Alabi (2011) found that inadequate project planning, inadequate funds, variation of project scope, inefficient control of cost, faulty designs and untimely payments were the most contributing factors of projects failure. Study by Olalusi and Otunola (2012) on causes of projects abandonment, identified ineffective control of cost as the principal responsible factor for poor execution of works. Ojedokun *et al.* (2012) concluded that early preparation of cost control of projects is very critical in project delivery. In a related development, Olalusi and Otunola (2012) studied potential causes of project abandonment, its effect on the local society, contribution to decadence of infrastructure and degradation of the environment and concluded that lack of adequate control in monitoring resources contributed significantly to project abandonment.

Furthermore, Monyane (2013) found that poor cost management methodology was the main cause of significant cost overruns, insufficient project scheduling/ planning and additional work that the owner demanded also contributed. There are few published materials related to the implementation of cost management techniques or models about dams in Nigerian. Dikko (2002) reported the existence of cost model based upon quantities and single unit/space cost model but concluded that project promoters need early decisions to avoid future variation otherwise execution of the projects would render it unworkable and that the models are too simple and unrealiable**.** Anyanwu (2013) conducted an analysis and found that most of the abandoned construction projects were due to weak cost management controls. Ayodele (2005), Elinwa *et al*. (1993) and Olawale and Sun (2010) are some of the few attempts to study the cost control phenomenon in Nigeria, many of the studies concluded that, efforts of contractors to manage project costs are based on project resource management and that the planning of the project is also of importance. Nonetheless, these studies failed to address effectively the cost management techniques issue in dam delivery. Empirical work on this subject is therefore limited in Nigeria.

The literature studies above indicate that lack of cost management strategies in major construction schemes hindered successful execution of projects. Despite the existence of all these studies, comprehensive research is still needed, which provides detailed examination of effects of techniques for cost management in the Nigeria dam project delivery. This study thus aimed at examining impacts of cost management strategies in effective delivery of dam construction and create system of cost management technique for efficient delivery of dams. The study's guidelines will produce the highest value for money in project execution, if properly implemented. The number of abandoned dams will reduce as there will be an increase in the effective project delivery of dams in Nigeria. The study will also improve water resources projects delivery which will consequently improve access to water supply, food sufficiency, access to hydro-power and general well-being of Nigerians.

An efficient control system will concentrate on potential costs and operational problems, but the conventional systems currently in use do not factor in construction complexities as already spent funds reflects sunken costs that cannot be reversed in the potential and may or may not be important in the future. It is therefore imperative to establish some means of forecasting a project's future path, if control would be successful (Ikegwuru, 2006). Fifteen years later, no much progress has been made due to the cost control related challenges plaguing the industry especially in dam projects, hence the main thrust of this study.

1.5 Scope and Limitation of Study

The scope covered were large dam construction projects in Nigeria from 1990 to 2015. This period was chosen because there was an upsurge in dam construction projects as Nigeria struggled with its developmental needs and efforts to fulfil the United Nations' Millennium Development Goals (MDGs) set out in the UN agenda on access to water supply and food security (FMWR, 2016). The MDGs are series of eight-time based development goals aimed at addressing poverty, employment, gender equality, health and the environment and water being one of the bases of life was emphasised in the millennium declaration.

This study centred on dams classified as large dams according to Dams Sub-Committee and Large Dams Committee of Nigeria [NSCD/NICOLD] (1995) definitions (see pages 13 and 14). The dam projects selected were made up of five projects defined as completed projects, five abandoned projects and eight on-going construction projects distributed in all the six geopolitical zones of the country and located in 13 States namely; Kaduna, Sokoto, Ogun, Osun, Delta, Katsina, Ekiti, Oyo, Enugu, Plateau, Niger, Cross River and Benue.

Selection of dam projects from all current or under construction dams for the study, selection of experts or questionnaire respondents, and interviews reduced the degree of aggregation or generalization of study results. Interviewees may not be a complete representative of the sector. For this analysis, the records or archival data sources such as contract agreements, bills and construction firms' financial statements were gathered and formed part of the evaluated realities. The accuracy of the results depends on the consistency of the answers, and this may have been constrained by some respondents' inability to share confidential details about the Organizations they serve.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Dam Construction in History

Nigeria has a land mass covering 923,000 km^2 and over 160m people live within this space. The water resources potential is about 374 billion cubic metres (bm^3) and of this volume, the water that flows on the surface amounts to 244 bm^3 while the volume of water flowing into the country from outside amount to 88 bm^3 are inflows from upstream countries, while 42 billion cubic metres is underground water (Adewumi, 2018 & Federal Ministry of Water Resources (FMWR), 2013). The useful part of the surface water is stored in lakes or reservoirs created by the construction of dams. Adewumi (2018) noted that huge investment in dam construction in Nigeria was targeted to boost citizens' prosperity and welfare.

Federal Ministry of Water Resources [FMWR] (2013) indicated that Nigeria has potential of 3.14 million Hectares (Ha) of irrigable land. Out of this, 440,000Ha has been planned; 130,000Ha has been developed and only 70,000Ha is 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) added that there are 17 dams with combined potential hydropower capacity of over 2000MW that are yet to be exploited. Also, a potential of over 830 MW are under construction (Zungeru, Gurara 1 and Kashimbilla dams). Whilst, over 3250MW potentials in dam's construction programmes that have not progressed as planned (Mambilla, Otukpo multi-purpose, Qua Falls, Datsin Hausa dams).

Dams are man-made structures to store water. They can be constructed for one or many purposes to include flood control, water supply for both domestic and industrial uses, irrigation (agriculture), hydroelectric power generation, recreation, tourism, wild life development, ground water recharge and inland navigation (Ezugwu, 2013; Adewumi, 2016 & Youdeowei *et al*., 2019). Dams have a history that goes back several thousand years. Dams have provided safe sources of water for people's survival for more than 5000 years (Ezugwu, 2013). In ancient Mesopotamia, dams primarily served the purpose of controlling the water level of important rivers, such as the Euphrates. History has it that the first known dam was originally constructed around 3,000 BCE in Mesopotamia and was used for agriculture. Since construction of early dams over 5000 years ago, dam technology has evolved tremendously. Today there are thousands of existing dams of various sizes throughout the world, and the ever-increasing needs for water, food and power means that dams will continue to make significant impact on mankind (Ezugwu, 2013). In the 20th century, political, economic and hydrological factors shaped the building of large dams (Van de Giesen, 2010). Generally, dams are constructed to foster national or regional developments. In the last three decades, Nigeria has experienced an upsurge in dam construction and more than 323 dams constructed country wide, with many more under construction (Ezugwu, 2013). Dam projects are vital for hydroelectric power supply which is essential for economic development (Youdeowei *et al.*, 2019).

2.2 Categorisation of Dams and Dam Projects in Nigeria

The scope of this study covered only dams constructed from 1990 to 2015, and those dams classified as large dams by Dams Sub-Committee and Large Dams Committee of Nigeria (NSCD/NICOLD, 1995) the discussion in this section and subsections centre only on those classes of dams. Adewumi (2018) noted that Nigeria has built several large dams during the past four decades. Nigeria boasts of different categories of dams that are classified based on size, function or purpose, material, style of construction. Under the size category, dams are classified as small, medium or large dams. Size is mostly seen in term of the reservoir capacity except for hydropower dams where generating capacity comes into play (International Committee on Large Dams (ICOLD) 2016. According to Youdeowei *et al*. (2019) dams are usually categorized as small or large dams based on whether or not the crest level [H] above the waterbed level is lower or higher than fifteen metres, that is for small dams, $H \leq 15$ metres, and for large dams $H > 15$ metres.

Dams Sub-Committee and Large Dams Committee of Nigeria defined large dams as all dams with heights of 15 metres or more taken from the base area to the top or dams with heights of 10 to 15m if it complies with one or more of the criteria below:

i. Crest length equal to 500m or more

ii. Volume of storage created must be greater than 1.0 MCM

iii. Spillway must be able to discharge 2000 m^3/s or more at its peak.

iv. Dams with complex or unique fundamental problems

v. Dams with unusual configurations (NSCD/NICOLD, 1995).

Dams Sub-Committee and Large Dams Committee of Nigeria also define medium dams as all dams with heights between 8 and 10 metres or dams which do not meet the criteria for large or small dam classification. Small dams are said to be all dams of 8 metres and below and impounding not more than 5 million cubic metres of water (NSCD/NICOLD, 1995).

Table 2.1: List of large dams and Rivers in Nigeria

River	Dam	Location	Reservoir capacity Mm^3	Year of establishment
Niger	Kainji	Niger State	15000	1968
Niger	Jebba	Niger State	3880	1983
Kaduna	Shiroro	Niger State	7000	1989
Gurara	Gurara I	Kaduna State	880	2007
Challawa	Challawa	Sokoto State	930	1992
Ogun	Ikere gorge	Ogun State	690	1991
Oyan	Oyan	Oyo State	270	1983
Kampe	Omi	Kogi State	250	1999
Sokoto	Bakolori	Zamfara State	450	1978
Kano	Tiga	Kano State	1968	1975
Gongola	Dadin Kowa	Taraba	2855	1988
Gada	Jibiya	Katsina	142	1990

Source: (NSCD/NICOLD, 1995)

Table 2.1 shows a list of large dams in Nigeria, their locations, the reservoir capacities, the years that the dams were constructed and the Rivers on which the dams were built. Table 2.2 shows a list of on-going dam projects in Nigeria, selected for this study. The table also indicate the States in Nigeria where the dams are located. Tables 2.3 and 2.4 show the list of abandoned dam projects with their locations and the list of completed dam projects respectively.

This classification is not commonly used to designate dams in literature. It should be noted that status of implementation of a project can change over time. Some dams can be classified as on-going, abandoned or completed depending on the status of construction stage (FMWR, 2016). This research focused on the following dams that are classified under the on-going project, abandoned project and completed project categories as presented in Tables 2.2 - 2.4.

Table 2.2: On-going projects

Dam Project	Location
Ogwashi-uku Multipurpose dam	Delta State
Jare dam	Katsina State
Ingawa Dallaje dam	Katsina State
Ogbesse dam	Ekiti State
Irawo dam	Oyo State
Adada dam	Enugu State
Mangu dam	Plateau State
Otukpo multi-purpose dam project	Benue State

Source: (FMWR, 2016)

Table 2.3: Abandoned projects

Dam Project	Location
Kagara dam project	Niger State
Qua falls dam project	Cross River State
Ile-Ife dam project	Osun State
Kontagora dam project	Niger State
Jada multi-purpose dam project	Adamawa State

Source: (FMWR, 2016)

Table 2.4: Completed projects

Dam Project	Location
Shagari dam project	Sokoto State
Gurara dam project	Kaduna State
Owiwi dam project	Ogun State
Ilesha dam project	Osun State
Gimi earth dam project	Kaduna State

Source: (FMWR, 2016)

Large dams are selected for the study because of their complexities in planning, construction, huge costs, technical and managerial requirements.

2.3 Stages in Construction Project Delivery

The stages involved when carrying out infrastructure projects construction can distinctly be broken into four namely; the design phase, tender phase, construction phase and the final account/handover. For a construction project to succeed, proper cost and time control measures must be taken at each stage such that final account does not exceed budget at conception (Wak & Ibbs, 2002). A few scholars have categorized the stages of project delivery to include the following five stages, Initiating, planning, executing, and controlling and completion stages. Following the above categorization, Wak and Ibbs (2002) noted that cost control is method of managing construction project spending at all stages within the approved budget, and the management of project costs includes scoping, definition of scope, resource planning, estimation and financial planning.

2.3.1 Conception and design stage

In many definitions the design stage encompasses the conception phase. This period or phase range from the time the owner or investor decides to invest into a given facility, briefs the designer, through all the preliminary considerations and studies to the final design and production of tender documents. The design team leader obtains the brief from the owner. The design team leader may be an Architect or an Engineer, the team leader is determined by the type of project. Dam construction is substantially a civil engineering concern, therefore usually the team is led by a Civil Engineer. According to Scileanna (2012), the responsibilities of the team leader include entire project program management and coordination. In all projects, comprehensive site investigations are needed to fully assess the cost consequences for each conceptual design alternative. At the earliest possible stage, the design team must conduct comprehensive project preparation, at least before going to tender and carrying out cost management procedures in the design process and documentations.

They must remember that cost limits must not be exceeded, and they must ensure the completeness of the project's design, documents, drawings and correct scope to ensure that the tender document contains all the details required to complete the construction (Scileanna, 2012). Anyanwu (2013) stressed that the designer may typically not know the contractor's methods and tools that might ultimately build the project at the design stage. Many researchers agree that a good designer should have a fair knowledge of types and limits of equipment available to the contractors, this will usually inform some of the decisions the designer would make while designing the projects (Anyanwu, 2013; Ayinde, 2018). Responsibility of team leader is to successfully oversee the contract to achieve high-quality construction and to carry the project to a satisfactory completion on schedule and within the budget, all in compliance with the contractual terms and the job specifications. Cost control is a continuous process during the construction stage process determined in part by the consistency and completeness of the owner's design and tendering documentation; the other actions are the actions of the contractor (Oyedokun *et al*., 2012; Akeem, 2017).

Clients need to prepare for adequate financing before awarding the project; and consultants will perform comprehensive due diligence audits during the tendering process to guarantee the chosen contractor is financially capable with requisite skills. Using management driven procurement approach could also reduce issues with teamwork and decision-making (Annoa, 2014). Bahaudin *et al*. (2012) analysed cost management practices in Malaysia and found out that, technically, the time during which substantial cost savings can be achieved is during the pre-construction process, no major cost expenditure has been achieved. This underlined the importance of proper conception and complete designs of projects. It also alerts us to the need for developers to engage qualified and well experienced professionals at this stage of the project development.

Nhat (2009) concluded that the promoter failed to properly identify project scope set achievable goals. Imperatively the owner needed to initiate the cost management process from the onset by determining and clearly defining scope using well qualified professionals and cost managers. It is also important to curtail and manage the owner's expectations. According to Bahaudin *et al*. (2012) designs have impact on cost and the design environment is impacted by several factors. Cost innovations come from many different paths, from designers, builders and manufacturers, it is therefore at the design stage of the project that best efforts are made to explore the advantages that this knowledge confers. Ashworth and Perera (2010) noted that the designer would also be familiar with the production process, as well as knowing construction process. Managing building costs within a defined value during the design process is an application of cost control (Seeley, 1979; Alvey, 1996). It includes making an initial estimate to which the project must be committed and adjusting the cost as the specifics of the design evolve (Seeley, 1979).

Project expertise should be available to the proprietor throughout the project's design process to achieve optimum cost-effective savings. Consequence of effective, practical designs can be seen in the role of construction management in the design (Bell & Stukhart, 1987). Simon (2000) revealed that full knowledge contributes to more reliable estimates of the budget and that client-driven adjustments in design are the greatest risk. Simon (2000) recommended that more time should be spent on the scope and complexity of a project. Once the construction begins changes by the client would most likely induce a review of parts or sections as both the designers and the contractor would be required to alter already agreed programme to accommodate the alterations. The effect of alterations would depend on the degree or extent of the change compared to the initial programme.

2.3.2 Tendering and construction stage

The design team must ensure that all items are priced at tendering. If the tender price exceeds the pre-tender budget accepted, the design team must identify any potential savings that might be required to bring the cost into budget. This implies that experienced designers must understand costing; they must have full knowledge of construction machines and equipment that are available in the market for use and therefore design with the knowledge of possibilities and cost effectiveness. At the tendering stage, very little cost-effective decision can be expected of the designer.

The bulk of cost decisions at tender stage fall on the bidding firms. The firms' understanding of the project and his internal organization and experience will aid him in submitting a tender that is competitive and will also enable him to execute the job and make reasonable profits if the tender becomes successful. The owner must pay attention and ensure that preparations are made during the tendering and building stages to contain the overall cost within acceptable limit. Stoke and Akram (2008) concluded that successful cost control involves ensuring implementation projections do not alter the overall cost estimate.

Charoenngam and Sriprasert (2001), in a study in Thailand, found that contractors view cost management as a prerequisite for optimizing income. At the construction stage the owner must grant the project management team, contractor and consultants some authority and duty to behave fairly on his behalf instead of requesting the owner's approval for change orders. Bidding will decide the price of successful bidder, while the contract price for successful bid is decided based on the demand. If anything goes wrong during bidding, then it can result in price increases for winning bid, so it is not possible to have accurate cost control foundations, and this can even lead to a loss of cost control (Li, 2009). It is widely understood that tender rates are likely to be higher in the absence of some form of competition than when other firms might be pursuing the contract. This therefore means that an open and competitive tender will obtain the lowest tender amount possible for a project. Under normal conditions, negotiated tenders were found to be usually 50 per cent higher than a comparable competitive tender. Bahaudin *et al*. (2012) noted that construction is one of the phases in project execution that theoretically has the greatest capacity to raise the expected budgeted cost.

2.3.3 Construction stage

During the construction process, the primary objective is effective delivery which involves spending within plan, on accepted standards and other technical requirements. Li (2009) opined that construction is a phase that needs the most assets in the entire project delivery cycle and is also a critical stage for the transformation of pecuniary capital into building entities. Cost control at the implementation level relates to confining construction costs within a planned scope of control through a theory and method of scientific cost control on condition that the quality and time limit of the project are guaranteed. Dandago and Adah (2013) indicated that cost management is for efficient use of resources to achieve an organization's target. The cycle of creating a building or constructing a dam is irreversible, and if successful automated monitoring and pre-control over construction costs cannot be performed then economic damage that cannot be compensated for may be induced. On completion of the works the contractor notifies the client's representative that the works are substantially completed and requests for certification. If work is unfinished or defects remain uncorrected at the end of the period of defect liabilities, the representative of the client will extend the duration of defects until the job is finished and verified to be completed. At this stage really, not much decision is left as relates to the cost of the project. Major items that have serious cost implications must have been executed before the project can be said to be substantially completed. However, it is the final phase of works before handing over to the owner for use.

2.4 Construction Project Failure

A project, regardless of the completion time or cost, is a failed one unless it supports its investment and the profit derivable from its use (Pinto & Mantel, 1990). Nwachukwu and Nzotta (2010) pointed out that the inability of many projects to fulfil the end user's needs and expectations generally is also an indication of failure. In a study aimed at evaluating the importance of customer satisfaction as project success measure. Baker *et al*. (2010) reported that project success means more than just satisfying cost and efficiency goals, noting that the degree of customer satisfaction is a very good predictor of project failure or success.

2.5 Cost Management Process

According to Owler and Brown (1982) and Dandago and Adah (2013), the basic theoretical aim of cost analysis is to demonstrate to the management any area of inefficiencies and the extent of various types of waste, whether in terms of money, energy, expense or the use of machinery, equipment and instruments. Cost management as established by Institute of Project Management (PMI) (2004) is the procedures involved in preparing, estimating, budgeting and tracking the costs to complete the project within the approved budget. In effect, the three most important elements as mentioned in PMBOK are defined as:

i. Cost estimation; this involved generating forecasts and calculating resources required for tasks.

ii. Cost budgeting; this included integrating estimates to create benchmarks and

iii. Control; this deals with the monitoring and control of variables that change or influence the budget.

Managers strive to efficiently achieve cost, time and quality objectives (Owens *et al*., 2007). The position of a project manager and/or cost engineer is very critical in the creation and execution of successful and productive dam projects, in the sense that such professionals are responsible for implementing appropriate cost management techniques that are necessary for successful project management (Johnson, 2006; Ogunsemi, 2015).

As the need to deliver projects on time as well as maximise profits increase, cost control of the project become crucial. Nhat (2009) noted that construction cost control is in three levels: at design, tender and construction levels.

2.6 Causes of Ineffective Construction Projects Delivery

Failure to deliver construction projects on schedule is common occurrence. Project delivery schedule slippage often leads to cost overrun or abandonment (Annoa, 2014). Control of cost implies applying economic principles to construction project. It explores not only the costs necessary for a specific project, but also the causes and effects of these cost determinants (Ashworth & Perera, 2010).

Nhat (2009) concluded from a study on Vietnam's building projects three factors induce schedule slippage namely: incomplete plan drawings, owner's criteria and contractor changes. Inadequate funding, delay in paying for finished works, shortages of materials, changes in plan drawings, price fluctuations, incorrect forecasts, delays and additional works lead the way in the most important reasons for projects delivery slippage in Nigeria (Mansfield *et al*., 1994)

In Thailand, resource supply inadequacy, client and consultant deficiencies, and incompetence were high on the reasons for implementation delays (Ogunlana & Proumkunting, 1996). Kaming *et al*. (1997) found that seven items including rise in material costs due to inflation, incorrect estimates, poor knowledge of project area, inexperience cause inefficient project delivery. Problems that caused delays and subsequent budget failure in Uganda included: adverse weather, poor resource efficiency, site workers' illness, lack of supplies, owner order to postpone the work due to no funds (Otim *et al*., 2011). There are several significant causes of delay related to owner involvement, contractor capability and early project preparation and design among these are financial problems, changes in design and scope, delays in owner decision-making and approval, difficulties in securing work permits and scheduling (Al-Ghafly, 1995). According to Bahaudin *et al.* (2012) in Malaysia, to manage expenditure to avoid expenses that reduces profit is the aim of cost management. According to Elinwa and

Buba (1993) resource shortages, variations, commodity prices, are causes of project delays and eliminating on-site contact issues would help minimize construction costs and enhance the execution of projects. Enshassi (2009) concluded that Gaza Strip, Palestine lack qualified personnel, also, shortages, material wastage, escalation and fluctuation, materials delays and project costs are the main issues and ranked them accordingly. Table 2.5 factors according significance in influencing cost overrun and projects delivery.

Table 2.5: Most significant causes of poor project delivery

The Various Factors	Rank in order of Prominence
Shortage of materials	1st
Labour shortage	2nd
delayed arrival of machinery and supplies	3rd
Incompetent staff	4th
Labour inefficiency	5th
Equipment standard and the raw material	6th
Delayed payments	7th
Contractor's financial problems	8th
Poor site management	9th
Rising and fluctuating commodity prices	10th
Lack of contact and cooperation between the owner and others	11th

Source: (Enshassi, 2009)

From Table 2.5, it is evident that overrun of costs occurs universally though factors inducing it vary slightly from country to country depending on local peculiarities.

2.6.1 Public sector projects

Most dams in Nigeria are financed with public funds and owned by the government. The reasons for cost, time overruns and poor projects delivery in the Nigerian public sector projects are as complex as they are diverse. Method of procurement, personal interests, poor budget implementation, very unstable fiscal policies, man- know-man, and public service bureaucracy are some of the reasons that can be easily noticed (Ewa *et al.*, 2013). Alinaitwe *et al*. (2013) studied Ugandan public sector projects and concluded the major causes of inefficient delivery were work variations, contractor's payment, inadequate control. Projects in the public and private sectors show somewhat similar trends of cost overruns and delays (Koushki *et al*., 2005).

2.6.2 Cost control and public construction projects

Jahren and Ashe (1990) illustrated connection between size of project and cost schedule slippages, pointing out a direct correlation between the two. As one increases the other equally goes up too. Shrestha *et al*. (2013) corroborated the finding in an analysis of 363 public works, the larger the works the more significant the costs and time overrun. The scale of the project is characterized in terms of its expensiveness, physical appearance and effect on society, resulting in increased public interest.

2.7 Improving Construction Projects Delivery

Delay is a causal event that makes the completion of a project to take extended time (Sanders & Eagles, 2001). Ahmed *et al*. (2003) determined that the internal and or external issues are responsible for delays, internal relating to parties to the contract while external relate to issues outside the parties to the contract, for example, material suppliers. Frimpong (2003) found that construction projects failed to act as planned, as owner's unjustified expectations pushed contractors into unrealistic games, corner-cutting or unrealistic commitments. Slippage of the production timeline directly affect project completion time and cost.

Aibinu and Jagboro (2002) noted that delay also causes tension between parties and if not amicably resolved will lead to more delays and disturbances. To minimize slippages, enough time should be spent on project preparation to properly identify the needs of clients, ensure adequate project scope, minimize design incompleteness, reduce design errors and thus reduce construction variations (Annoa, 2014). Mansfield *et al*. (1994) described major issues that led to slippages in Nigeria to include funding and payment systems and unreliable forecasts. Henesy (1993) determined that material resources and manpower were key variables that caused extension of time but what is of utmost importance is an evaluation of how cost control methods applied from inception stage through design up to implementation can mitigate on these two negative phenomena. Kaming *et al.* (1997) revealed that delivery times in Indonesia is mostly affected by shortages of skilled labour.

Kumaraswamy and Chan (1998) conducted interviews in Hong Kong and found that, delayed design, long approval process and supervision errors contributed the most. Frimpong *et al*. (2003) conducted studies in Ghana, Assaf and Al-Hejji (2006) in Saudi Arabia and Al-Momani (2000) in Jordan all found that changes in designs, owner requirements, environment, location conditions, late deliveries, economic factors were key issues that caused delays. Inclement weather resulted in at least 15 – 20 per cent overrun time in Hong Kong (Yogeswaran *et al.*, 1998). Noulmanee *et al*. (1991) studied highways in Thailand and revealed key issues to include subcontractors, inadequate resources, ambiguous scopes and contractor shortcomings had the most effects on delivery. In their report, Odeh *et al.* (2002) stated that client involvement, insufficient expertise, funding, labour efficiency, sluggish client responses and ineffective preparation led to delays and poor execution of projects in Jordan. It is evident that causes of projects delays are numerous and diverse. A lot of local factors also come into play.

Major delay factors to include inadequate preparation by contractors, contractor sloppiness, financing and payment for finished work, problems with subcontractors and shortages of equipment (Sambasivan and Soon, 2007). Fugar and Agyakwah-Baah (2010) studied delivery delays and found that in Ghana issues of significance include underestimation of quantities and materials, access to loans, and poor contractor organisation.

Mezher and Tawil (1998) evaluated construction delays in Lebanon found that consultants were more concerned with project management problems as major cause of delays. Aibinu *et al*. (2006) examined the factors leading to delays in Nigeria and found funding and banks very stringent construction loan conditions as major sources. Abd El-Razak *et al*. (2008) found that in Egypt design changes was the principal cause of delivery delays.

Elinwa and Joshua (2001) found that in Nigeria time overrun is high, that the client and contractor contribute to the time overrun, the phenomenon is severe in public funded projects and finally, it occurred on all types and sizes of projects. Doloi *et al*. (2011) examined factors influencing delays in India using regression analysis and found weak contractor organisation, weak scheduling, inappropriate preparation is most significant. Regression model suggested slow owner decision, poor labour productivity, inability of designers to alter designs significantly affect project delivery. The major causes of delay reported by researchers from different countries are detailed in Table 2.6.

Table 2.6: Major causative factors of delay reported by researchers

Investigators	Locations	Causative factors
Nhat (2009)	Vietnam	Incomplete specifications, incomplete designs, owner's conditions and contractor adjustments.
Mansfield *et al.* (1994)	Nigeria	Poor management, site change, product shortages, design changes, fluctuating prices, erroneous estimates, variations.
Ogunlana and Proumkunting (1996)	Thailand	Insufficient services availability, shortcomings and negligence of clients and consultants
Otim *et al.* (2011)	Uganda	Poor weather, low productivity of resources, staff illness, materials shortages, owner interventions**.**
Enshassi (2009)	Gaza Strip, Palestine	Competent workers unavailability, shortage of materials, rate of waste, prices of commodities, materials delays, variations and price differential of currency.
Alinaitwe *et al.* (2013)	Uganda	Changes in nature of work, slow contract payments and inadequate supervision.
Abd El-Razak *et al.* (2008)	Egypt	Financing, delays in contractor payments, design adjustments, incomplete designs, poor construction methods.
Doloi *et al.* (2011)	Indian	No dedication to duties, inefficient methods, inappropriate scheduling, poor preparation, slow owners' decisions, poor productivity of labour, architects' reluctance to alter and rework due to construction errors.
Aibinu and Odeyinka (2006)	Nigeria	Financing projects, funding and uncertainty in policies, and developers' poor access to loans, banks have very strict construction loan conditions.

Source: Researcher, 2020

2.7.1 Controlling time delays in public projects

Arditi *et al*. (1985) surveyed contractors in Turkey implementing public projects. Researchers found that some of the variables are affected by national economic policies, while the public agencies and contractors can regulate others.

2.7.2 Time delays and sustainability of construction projects

Gilchrist and Allouche (2005) reported that time delays have a direct effect on project sustainability as an increase in development time is associated with traffic congestion, accidents, disruptive economic activities, increased emissions, disruption to ecosystems and impacts on existing infrastructure. Mukuka *et al*. (2014) observed that arbitration, lawsuits, conflicts and complete project abandonment were the results of schedule slippages. According to Assaf and Al-Hejji (2006), schedule overruns to clients means loss of revenue due to reliance on existing order, to contractors it means increased costs. In summary, the above studies show corresponding negative effects of schedule overruns which can ultimately contribute to complete project abandonment.

2.8 Construction Cost Management

Projects are planned by combining cost estimates into a budget and by setting the tasks, anticipated costs are specified, and the schedules indicate time to incur cost. Therefore, projects require mechanisms for managing the costs, showing when a task is required to be active and the accompanying costs. A benchmark used to control expenditures (Ayodele & Alabi, 2014). Otim *et al.* (2011) inferred that cost management strategies include preliminary estimates, cost schedule, valuation of variances and final accounts preparation.

Ogunsemi (2000) discovered that the lack of cost-control resulted in the persistent building collapse in Lagos. Otim *et al.* (2011) in their analysis of cost control techniques used in Uganda established seven commonly used cost control techniques which include: schedules, budget, inspection, meetings, reports, records and monitoring and evaluation. Chigara *et al*. (2013) carried out overview of cost managing strategies in Zimbabwe, the study revealed that efforts to reduce costs are focused on managing project resources. The study concluded that among the other approaches are also monthly expense analyses, risk control, project budgets, and cash flow forecasting. Some of the methods, tools and techniques contractor uses to control costs include calculation of cost-value, analysis of benefit obtained, analysis of variances (Charoenngam & Sriprasert, 2001; Staley & Jones 2007; Olawale & Sun 2010). Cash flow forecasting (Sanni & Hashim, 2013; Potts, 2008; Staley & Jones 2007). Others are, schedule and plan, estimates combination and schedule, status report of project, valuation of profit and loss at given dates or overall (Staley & Jones 2007; Olawale & Sun, 2010). Monthly cost reports (Hendrickson & Au, 2000) pointed out that these tools or techniques may be used singularly or in combinations.

Studies by Charoenngam and Sriprasert (2011) identified that in addition to these methods, software for cost control like project Microsoft, Astra Project Soft Ware (Microsoft Excel are also used for cost control. Dharwadker (1989) and Chigara *et al.* (2013) concluded that methods used by contractors in Zimbabwe to control cost include reports of costs, budget and cost estimation, analysis of variances, managing resources and project meetings. They also reported that a study in Uganda indicated that programmes of work, cost reports, project budget and inspection of works among others were the methods used to manage cost of projects (Otim *et al.*, 2011).

In Nigeria, budgeting was commonly used method, next to that was monitoring of labour and cost of materials respectively. At this point it is apt to look at literature of some of the most prominent or widely used cost control techniques in much more details, to enhance the understanding of how they aid in the control of project costs (Sanni & Durodola, 2012).

2.8.1 Cost value relationship

An analysis of the value derived from a cost. Cost value reconciliation or analysis goes beyond measuring of planned against actual cost, it equally focuses on generation of values. It helps contractors to evaluate the volume by which profit is changing as a project progress (Chigara *et al.*, 2013). Analysis of cost-value of projects enables estimation of the expense and benefit of the project at completion or at the point of reconciliation. Cost value reconciliation systematically assesses and records the profit by contrasting costs with revenues at a given date, the discrepancy between the total benefit and loss on a project can be noted. Because of the expense and technical expertise needed for its use, this technique is often used by large contractors in major construction projects (Chigara *et al*., 2013).

2.8.2 Project budget

Most contractors produce budget on receipt of contract documents and other contract information. The document will usually include bill of quantities (BOQ). These budgets used as cost benchmarks as the project progresses. The use of budgets and estimates of cost agree with the conclusions of Kwakye (1997) and Selver (2009), whose works showed that to manage project costs effectively, one will need to know what the overall project budget amounts to.

Building plan with accompanying benchmark expenditure estimates provide corresponding reference controlling costs in a given project, therefore, final estimate also evaluates financial progress. If final cost is within cost estimates, the project is under financial control. The estimate is then converted to budget of the project and used for control and guide. Consequently, costs incurred during project execution are reported in different accounts and compared with original estimates (Selver, 2009).

2.8.3 Cost forecasting

In project management and monitoring, it is necessary to recognize and take into account upcoming costs and resources requirement. More attention is given to projected costs, future expenses and technical problems. Past spending reflects sunken costs which cannot be reversed (Ikegwuru, 2006; Scileanna, 2012). To be able to predict upcoming events or activities with resources requirement is necessary necessary for control.

2.8.4 Schedule control

Many researchers agree that monitoring of schedules is important in the control of cost. Production of building requires timelines for start and finish of the job, therefore, legal arrangements may require attention to schedules. One of the many detrimental consequences of construction delays is the increased costs arising from late occupancy or use of the facility. In schedule management, the length of the operation can be compared with the planned period, and in this phase, it will be necessary to estimate the time for completion of the activities.

2.8.5 Analysis of earned value

Analysis of earned value is a method of project management which uses current work achieved to forecast the project progress in the future. Analysis of earned value (EVA) points out upcoming distress in good time to enable management take appropriate actions. Before Analysis of earned value is carried out, some fundamental project management activities must take place. These are listed as follows:

i. The project must be divided into manageable parts known as structure for job breakdown (WBS).

ii. It is necessary to ensure that the sections are well specified and that the time of each operation is allocated as well as the cost to complete it.

iii. Establishing a baseline for allocating resources to sections, an example of how earned value is used is indicated in Figure 2.1 (Wilkens, 1999). This shows a graph of cost against time indicating the relationships between both at various times during the implementation of the project.

After completing steps one to three above, the Earned Value Analysis can then begin. The steps involved are:

i. Using current development, review the schedule

ii. Update the actual costs of the current progress

iii. Main values, variance, and ratios measure and graph

iv. Analyse result and act.

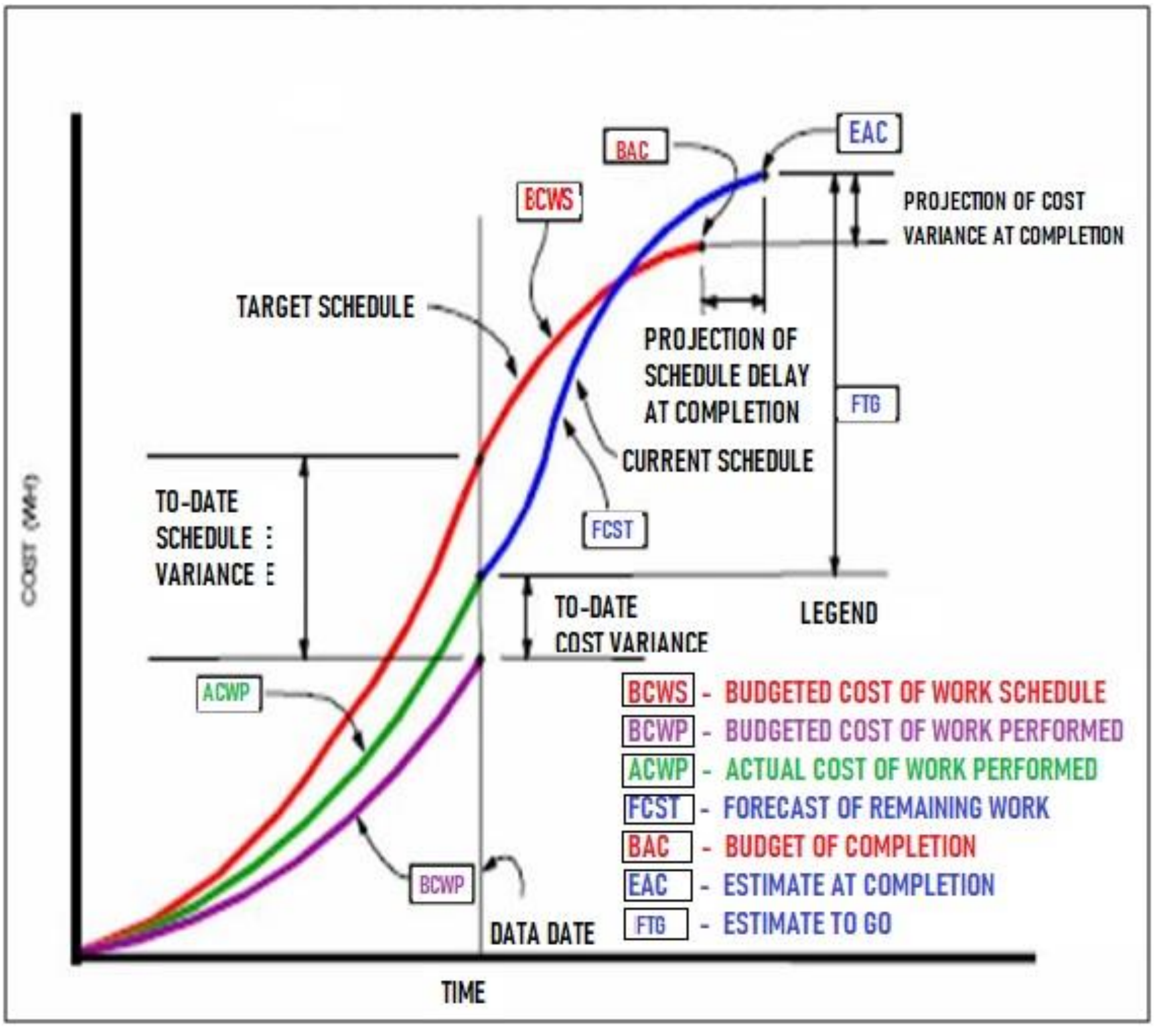

Figure 2.1: Earned Value Example

Source: (Wilkens, 1999)

Some of the key values in Figure 2.1are explained as follows:

i. Cost of work designed for a budget (BCWS): original job plan reference

ii. Interest earned, or work cost achieved (BCWP): share of work finished multiplied by original estimate. BCWP = performing percentage of work x original estimated cost.

iii. Real Cost of Work (ACWP): cost of completing the work.

iv. Variance Schedule (SV): difference between Budgeted Work and Budgeted Work Rate. SV = BCWP - BCWS.

v. Variance of Cost (CV): difference between planned labour cost and actual work cost. CV = BCWP - ACWP.

If the amount in Naira of Budgeted is less than the amount in Naira of Performed, then the value of Cost Variance in Naira will be negative indicating that the project team has overspent for the work performed. On the other hand, if the amount in Naira of Budgeted is less than the amount in Naira of Budgeted Scheduled, then the Schedule Variance SV will be negative indicating that the project is behind in schedule (Wilkens, 1999).

It is a method of calculating efficiency. A technique in project management that uses innovative research to suggest or predict the future. An improvement on conventional indicators of reporting progress. Scileanna (2012) indicated that conventional approaches are based on expected expenses and projected costs, but Earned Value goes a step further and looks at real achievements. It gives a clearer picture to project managers, and with that, managers can build risk reduction strategies based on real expense, schedule, and work progress. Analysis of Earned Value helps recognize problems early and permits effective and timely management of projects (Chigara *et al*., 2013).

2.8.6 Variance analysis

Variance Analyses in the construction projects contrast budgeted to actual expenditure on a project. Analysis of variance helps the contractor to note the presence of a variation in the project cost of labour, material or overhead and thereby provide an opportunity to determine the drivers of cost variance(s) to implement effective remedial steps. Analysis of variance is a method of budgetary control by performance evaluation (Chigara *et al*., 2013).

2.8.7 Contingency budget provision

Caruthers *et al*. (2008) and Monyane (2013) defined a contingency as a provision created to compensate unexpected items that may go wrong. Enshassi (2009) recommended that appropriate contingency provisions should be in place to cover fluctuations in material prices, and that the quality of materials should be of greater concern to contractors to maximize expense, time and efficiency. Jackson (2003) acknowledged that 'contingency for different people stand for different things.' To management, contingency is capital that it hopes at the end of the project will not be invested but then returned unused as income. To Contractor it covers extra expenses incurred because of delays or reduced efficiency. It is a fund for the cost engineer to use to cover specification and estimation errors. Contingency is a tool for managing risks (Jackson, 2003).

2.8.8 Project meetings

These scheduled meetings to review activities of the project provide avenues to evaluate progress of the project and cost performance and provide basis to identify areas that are not performing well to proffer workable progress solutions, meetings also help in early identification of problems and proposition of alternatives.

2.8.9 Resources management related strategy

Resource utilisation is an important cost item in the general cost regime of construction projects. The resources management include material management, labour management and plant and equipment management. Many studies in the past reported correlation between project cost and resources consumption. Emuze (2011) studied performance improvement and projects delivery in South African and reported the impact of cost control in elimination of unnecessary wastage of resources.

2.8.10 Cost reports

Reports of project costs provide progress details used to measure project success against goals set (Liang, 2010). While there is no law about the duration or frequency of reporting on project costs, Clough *et al*. (2000) noted that the reports should be prepared often enough to identify rising project costs when there is still adequate time for corrective action to be taken.

2.8.11Cash flow analysis and work programmes

Cash flow forecasting includes splitting the project budget against the construction job schedule to generate a cash flow for a project. It seeks to link the cash flow of projects to the period as expressed in the operation schedule, contractors use this system to track and monitor project costs at the same period as the project cash flow (Sanni & Durodola, 2012). Chigara *et al*. (2013) indicated that this method helps the contractor to link project cost output to the project plan, but schedule and the cash flow measurement level obtained in Zimbabwe is contrary to the arguments put forward by Sanni and Durodola (2012).

2.9 Performance Implication of Cost Overrun Occurrence

Azhar *et al*. (2008) analysed some construction problems and found that in Pakistan, leading cause of cost overruns is related to market and regulatory climate, promoting corner cutting and unsound construction methods, is Pakistani government's prevalent practice of enforcing its lowest bid price policy, this situation exists in Nigeria as well, but it involves built-in problems and does not provide the best value for money. The drawback with this approach is that the real price of the bid was 50% of the expected price, as contractors try to outdo each other in the bidding process. Aljohani *et al*. (2017) concluded that construction projects around the world have very poor records of being completed outside cost and time expectation. To minimize the impact of payment delay, government should be active in helping contractors find a middle way with the banks and other security groups (Aljohani *et al*., 2017).

2.10 Strategies for Cost Management

Chigara *et al.* (2013) conducted an evaluation on construction practices and found that in Zimbabwe, strategies employed by contractors are as varied as there are contractors; the summary of their finding is in Figure 2.2

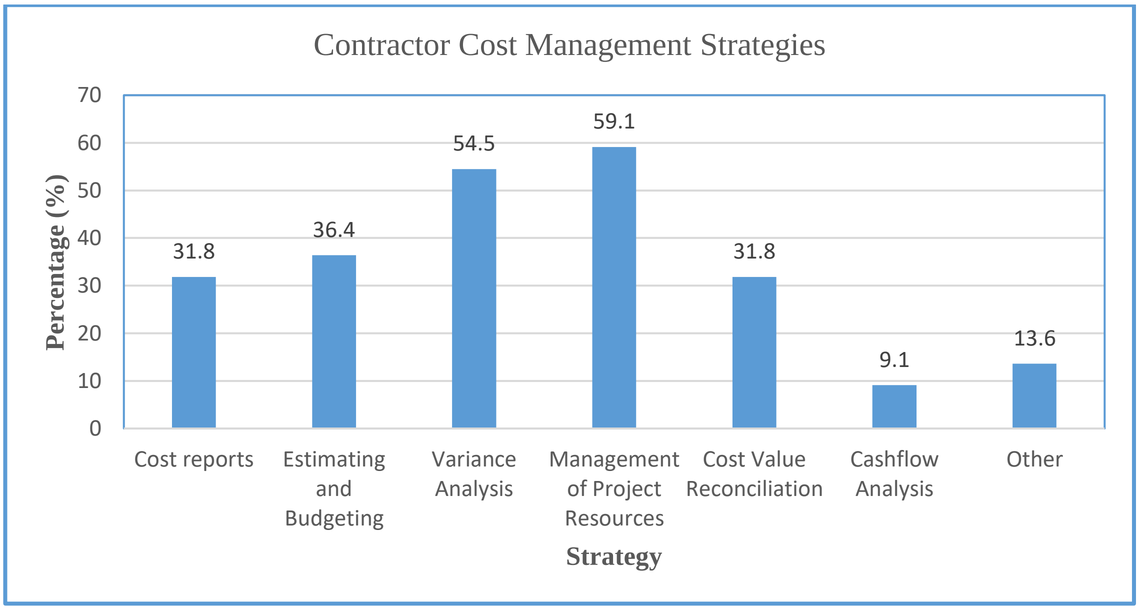

Figure 2.2: Cost Management Strategies on building projects

Source: (Chigara *et al.*, 2013)

The study found that 31.8% of the contractors surveyed employed cost reports as their strategy to manage cost, 36.4% employed cost estimating, 54.5% employed variance analysis,31,8% used cost value reconciliation while 18.2% employed cash flow analysis and work programme. The study clearly showed that common approaches were estimation of costs and budgeting, variance analysis and cost-value reconciliation. The study further concluded that while there is an increasing trend towards automating cost control systems as evidenced by increased use of such software as Microsoft Project, Microsoft Excel and other systems, over-reliance on the mechanistic Microsoft Excel and paper-based systems pose serious challenges, especially where real-time reporting is required. Similar research by Sanni and Durodola (2012) in Nigeria noted that project budget was the most frequently used method followed by labour and materials control, respectively.

2.11 Challenges of Managing Project Costs

Anyanwu (2013) pointed out that in Nigeria projects fail due to issues of cost and quality optimization. This position agrees with Jagboro and Babalola (2013) who concluded that the main reason for the failed projects includes the fact that most of the specialist organizations engaged in project management lack enough quantitative and qualitative management inputs; this position agrees with Iheme *et al*. (2011) who recommended that specialization with respect to the construction professionals should be the order of the day.

Sanni and Durodola (2012) reported that price increases, unreliable forecasts, design changes and material impact shortages are causes of project failures and concluded that, in addition to problems related to capital, variations also influence the efforts of contractors to control project costs. Variations interrupt system flow and over time affect cost. Chigara *et al*. (2013) concluded that the difficulties faced by contractors in controlling project costs could either be classified into exogenous factors (externally induced) to include resource-related difficulties such as manpower, materials facility, financing problems and variations or endogenous factors (internally induced) to include organizational, inadequate cost management structures and inaccurate estimates.

Sanni and Hashim (2013) summarized the challenges encountered by contractors to include poor documentation, engagement of cheap and unqualified personnel, volatile market situations, frequent changes in policies, selecting a contractor and lack of innovations.

2.12 Factors Affecting Construction Delivery

Chan *et al*. (2004) evaluated factors affecting success of construction projects by reviewing past efforts and identified actions of managers as key factor. Anyanwu (2013) believed that seeking advice of experts early in the process is crucial to overall success, therefore, professional management is important for project success.

Dissanayaka and Kumaraswamy (1999) asserted that construction team efficiency is very vital. Love *et al*. (2005) analysed relationships between team efficiency and cost efficiency and found that in Australian states, both correlated positively well and manifested in time efficiency.

2.13 Construction Delivery Failures

Execution time slippage in the construction industry is an ancient but recurring one. Delivery schedules for projects failure is especially serious in Nigeria and is a major cause of overrun costs. Elinwa and Jagboro (2002) found that time slippages extend construction period up to 420 per cent in some cases and the slippage of the implementation schedules manifest in increased completion cost. Haseeb *et al*. (2011) concluded that the general consequences of the delays include the loss of profit to contractor due to expenditure on recruitment of labour, while loss in income and the lack of availability of facilities for the owner.

To lessen project delivery plan failure, client must provide enough time for project planning to accurately capture the needs of the client, ensure adequate project scope, reduce design incompleteness, reduce errors and ultimately reduce modification during construction. Contractors need to know about their resource strength and obtain up-to-date machinery and new construction equipment to reduce delay in projects (Haseeb *et al*., 2011). To contractors, solving problem of delay, good cost control techniques practice is essential (Malkanthi, 2017)

2.14 Use of Cost Control Techniques

According to Le-Hoai *et al*. (2008) along with delay, cost overruns, failure and decreased citizens' confidence are the frequently faced consequences. Companies must complete project programs to achieve financial targets. Successful cost management strategies ensure that projects are executed within budgets or, for specific reasons, may surpass budgets in a controlled manner (Le-Hoai *et al*., 2008). It is well known that enforcing adequate cost controls for the project decreases the likelihood of project delays and provides all the expected benefits from prompt implementation and delivery of the project.

2.15 Divers, Barriers and Strategies to Improve Use of Cost Control Techniques

Hastak (1994) and Ikegwuru (2006) revealed that many of the current cost control methods do not assist management in designing a cost control strategy that includes monitoring of attributes to cut escalation of cost. Therefore, it is important to analyse the problems cost concerns that help encourage the use of the techniques in construction implementation.

2.15.1 Drivers of use techniques for cost management

Cost management is the mechanism in which a project's construction costs are controlled to avoid waste (Ayodele, 2005; Ayinde, 2018). Cost control of the project aims at monitoring adjustments in the project budget and providing decision tools to management (Chitkara, 2005; Madu *et al*., 2019). Ayodele and Alabi (2014) revealed that cost management techniques are 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 common 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 (Malkanthi *et al*., 2017; Madu *et al*., 2019). Familiarity, flexibility and ease of use are key drivers of using a cost management strategy (Chitkara, 2005; Madu *et al*., 2019). 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 knowledge and expertise are the main reasons that hinder contractors’ use of cost control techniques (Madu *et al*., 2019; Ayinde, 2018; Malkanthi *et al*., 2017; Dhawadker, 1989).

2.15.2 Barriers to use techniques for cost management

Barriers are impediments in implementing effective practices to use techniques for cost management. Absence of research with innovation is a critical barrier in Nigeria (Sanni and Hashim, 2013; Madu *et al*., 2019). Adjei *et al*. (2018) described the challenges of project cost management practices to include utilizing outdated approaches and principles, lack of information on the use of available resources and technologies, overemphasizing outcomes while ignoring cost control processes, lack of enterprise-appropriate project cost control processes and procedures, abandoning complex techniques, lack of cost consistency. Ademola (2012) and Adjei *et al*. (2018) agreed that using manual and paper-based cost control means is where site managers, cost engineers or quantity surveyors prefer writing pads rather than using appropriate tools and available technology. The challenge is that these obsolete cost management practices cannot be used to address cost variances in real-world situations. According to Akeem (2017) and Madu *et al*. (2019), cost control leads to organizational efficiency, so companies need to implement cost control to achieve success.

Yismalet and Patel (2018) noted that construction companies need to improved abilities to effectively achieve client and project goals and thus should concentrate on management control processes. Major deficiencies of cost management practices in construction projects include tendering, incomplete design, inefficient coordination and communication (Yismalet & Patel, 2018; Madu *et al*., 2019).

2.15.3 Strategies to improve use of cost control techniques

Choosing the appropriate professional would enhance achievement of cost control in projects, practitioners relate more with familiar management strategies, 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 expertise prevent contractors from using the cost control techniques (Malkanthi *et al*., 2017; Ayinde, 2018; Dhawadker, 1989).

By completing training and awareness programs, contractors will be motivated to use cost management strategies (Malkanthi *et al*., 2017; Madu *et al*., 2019). The expertise of the necessary staff in the contracting organization should be strong in construction cost management procedures and activities because the more productive the workers are, the better for the company's success and development (Sanni & Hashim, 2013). Pries *et al*. (2004) agreed with Sanni and Hashim (2013) that today's business is about customer satisfaction by efficient production, thus, if the employees of the contractor are very effective in discharging their jobs, this may lead to efficient production within the organisation.

2.16 Cost Control Models in Other Climes

Modelling is the method of creating a framework for forecasting project costs (Hastak, 1994, Dikko, 2002; Pettang *et al*., 2016). Construction cost control models incorporate all the techniques used in the development of construction costs, cash flow forecasting and cost management.

There are several types of cost models for new infrastructure projects of varying complexities. These models help provide accurate budgeting forecasts and help promote effective resource allocation. They reduce the occurrence of abandoned projects resulting from budget allocation explicitly for projects in the public sector. It provides versatile, accurate estimates, and responsive to alterations in variables. Dikko (2002) identified existing models to include:

2.16.1 Single unit / space cost model

Used to predict potential project costs. Adjustments should then be made to consider variations in project timing, scale and requirements while preparing future projects.

Single unit/space model examples:

(a) Buildings ---------------------------- Cost/m^2

(b) Roads------------ -------------------- Cost/Km

(c) Hospital ---------------------------- Cost/Bed Space

(d) Markets ---------------------------- Cost/Stall

(e) Electricity Supply ----------------- Cost/Kw

The obvious downside of these cost models is that they are too simple, incredibly unadaptable. Nevertheless, at the early planning stage of projects where the plans are yet to end, they are very useful (Dikko, 2002).

2.16.2 Cost plan based on elements

Predictions based on Building Information Service (BCIS) system based on the elementary cost planning. Originally the method was built for use only to construct projects with distinct components. It uses Gross Floor Area (GFA) cost / m^2 for every building element. The general method for using the model is to pick up a past project's cost analysis and produce similar character changes (Dikko, 2002). Typical elementary arrangement is shown in Table 2.7 for a building project:

Table 2.7: Cost plan based on elements examples

Number	Element	Estimated cost/m^2 (GFA)
1	Substructure	cost/m^2
2	Frame	cost/m^2
3	Upper floors	cost/m^2
4	Staircases	cost/m^2
5	Doors	cost/m^2
6	Windows	cost/m^2
7	Wall finishes	cost/m^2

Source: (Dikko, 2002)

While the basic cost plan model was primarily designed for the construction of roads, its general concepts could be applied to other developments (Dikko, 2002).

2.16.3 Cost models based upon quantities

A modeling method that Quantity Surveyors have available and commonly rely upon. The downside, designers need early decisions to avoid future variations otherwise execution of the project will render it unworkable. The technique is to establish accurate (though approximate) measurements of all work products. Its separations of each element, it is easy to make modifications if required (Dikko, 2002; Singh, 2007).

2.16.4 Computer aided cost modelling

The existence of computer software enables cost modeling through input of key parameters to be carried out easily. Most applications are designed for different types of projects but have the potential to adapt to the needs of the user (Hastak, 1994; Dikko, 2002).

2.16.5 Multi-discriminant analysis

Computer technology also has the potential to carry out multi-discriminatory cost evaluations. Multi-Discriminate evaluations enables simultaneous estimate and effect at the same time many key factors change. Single way sensitivity analysis on individual variables may also be performed to assess their responsiveness to changes (Dikko, 2002).

2.16.6 Cost management planning support system (COMPSS)

Many of the current cost management approaches are established only after a line item has undergone a cost increase, which means that attempts are being made to recognize and monitor symptoms rather than to seek and recognize and regulate the cause (Hastak, 1994; Ikegwuru, 2006). COMPSS is a computerized decision support system that assists management before and after the start of the project, defining characteristics that may cause possible cost escalation of the project and formulating a cost control plan for the project (Hastak 1994).

2.16.7 Input, integration and output model

This model adopts bill of quantities, resource list, work breakdown structure (WBS) and activities programme as model inputs which are integrated with planning and estimating, interconnection and forecasts for quantities usage and deadlines which gives updates for production control and cost variances analysis report as outputs (Amaral-Lopes, 2013; Adjei *et al*., 2016). In this model, any change in the resource cost or in its consumption in any bill item, is reflected dynamically in all the reports (Adjei *et al*., 2016)

2.16.8 Model based on input, process and output

This model of cost management model focus on principle of value gained, which consists of real performed work (ACWP), budget for performed work (BCWP) and scheduled budget work (BCWS) and focused on these parameters, cost variances and time variances are determined to assess the efficiency of work used (Azhar *et al*., 2003; Adjei *et al*., 2016).

2.16.9 Framework, functions and information model

This model has sections: the structure, functions, and knowledge of cost techniques (Charoenngam & Sriprasert, 2001). It seeks reliable cost information to ensure efficient decision making (Charoenngam & Sriprasert, 2001; Adjei *et al*., 2016)

2.17 Project Implementation Stages as Components of a System

System in engineering terminology is used to mean a set comprising interdependent elements known as subsystems acting or working together to carry out a predetermined function (Ikegwuru, 2006). The definition of set occurs in all mathematics branches, so it is described as listing or collecting objects or items that are connected to one another (Omezi, 2012; Oluwasanmi, 2013). Mbamali (1997) noted that a proper evaluation of any engineering system is contingent upon a thorough understanding of its components or parts, operating conditions and maintenance requirements and therefore defined system analysis as an in-depth study of a group of interrelated things that work together for the sole purpose of attaining a desired goal. System approach in solving problem is characterized of the relevant system and its objectives, generation and evaluation of alternatives for meeting the objectives and selection of alternatives (Mbamali, 1997).

Control is a process of making situations behave according to the performance standards wanted and therefore cost control is taking positive action during the execution of a project to ensure that costs budgeted for the different activities that make up a project are not exceeded (Ikegwuru, 2006). Discussing the components or subsystems of cost control, Wak and Ibbs (2002) asserted that a project structure directly influence cost control method and concluded that all projects go through four stages of conceptualization, design, tender or procurement and execution and these make up the components or subsystems of the cost control system. Each stage has its peculiarities, yet all are interlinked and affect the final cost of the project (Wak & Ibbs, 2002; Ikegwuru, 2006). For this study, the phases or stages of project delivery is consolidated into three namely: the design stage, the tendering or procurement and implementation phase. Each stage is viewed as a sub-system or subset working together to achieve the goal of the system.

Asiru *et al*. (2012) described a set as a collection of clear and well-defined objects or a collection of objects called the set elements or members but none of the set objects can be the set itself. The principle of sorting all objects into similar groupings or sets is the most basic concept in modern mathematics, since it was developed, the theory of sets has in fact been the unifying principle for all mathematics (Asiru *et al*., 2012; Omezi, 2012 & Oluwasanmi, 2013).

Successful projects must achieve multiple objectives of timely completion within cost and quality targets (Waks & Ibbs, 2002). Delay in completion time of the project, cost overruns and poor-quality standards delay the time by which investments is recovered. Construction projects vary in size, scope and complexity this underlines a need for application of systems approach in construction delivery (Ikegwuru, 2006). The systems approach views the cost control process as a total system that is open to the environments from which it receives inputs and discharges outputs. The fundamental assumption of the systems theory is that of inter-relatedness. According to Ikegwuru (2006), (Omezi (2012) and Oluwasanmi (2013), all phenomena are connected and that a change in one part of the system will result in changes in other parts therefore systems approach is holistic in that it assumes that behaviours of the parts of the system can only be explained by the system as a whole and also systems approach will enable all participants in cost control process to adapt easily to changes in their environment.

2.18 Gap Analysis

Projects can fail or be abandoned for reasons which include designs, procurement or contractor related issues, project complexities, inability to use cost control techniques could also have the same effects (Ayodele & Alabi, 2011). Literature also show that improving construction projects delivery is essential to achieving the government's goals of power supply, water supply as well as food sufficiency. It is also inferred from literature that contingency budget provisions help to ease some of the cost issues causing poor construction projects delivery.

Delays in project delivery problem affects project expense. Abdul-Rahman *et al*. (2009) acknowledged the delay was injurious to project promoter. Delivery components can be viewed as sub-systems, wherein all the sub-systems function ultimately to ensure effective project delivery.

Most of the previous efforts by researchers indicated above, to an extent have provided the basis to understand some of the issues associated with cost, time overruns and poor project delivery (Basak, 1996; Haseeb *et al*., 2011; Aljohani., 2017; Adjei *et al*., 2017 and Ayinde, 2018) however, many of them are over 10 years ago (Elinwa and Joshua, 2001; Jackson, 2002; Abdul-Rahman *et al*., 2009; Ayodele and Alabi, 2011; Otim *et al* ., 2011). There is need for more recent effort is very well noted. Majority of the efforts were carried out outside the shores of Nigeria (Frimpong *et al*., 2003; Alaghbari *et al*., 2007; Emuze, 2011; Chigara *et al*., 2013); the need to evaluate how some of the findings reflect on Nigeria is therefore established. Again, it was noted that most of the studies focused on building construction, very few of them concentrated on heavy civil engineering projects such as dams with their unusual complexities in planning, design and construction. Majority of the studies just identified influencing factors that cause poor projects delivery, not many of them looked at the way cost control techniques applied by the various owners and contractors affect both the costs of the projects and the times of delivery, these therefore underline the essence of this study. This study is aimed at evaluating significance of techniques for cost control on delivery cost using construction of large dams as the focus of the study with the final aim of developing cost control model for effective dam projects delivery in Nigeria.

Time overrun causes severe negative effect on organisations in terms of schedule, cost and quality. Researchers in this field have collectively identified about seventy-five factors that influence project delivery, evaluation of these factors show that thirty of them are resource related factors. Poor projects delivery caused additional resources and loss of profit, therefore delayed or inefficient delivery is costly to both client and contractor (Rahman *et al*., 2013) Existence of control models developed in other climes particularly with building construction projects gives a clear indication that development of cost control models to aid dam projects delivery is possible, modelling project variables to ensure efficient dam projects delivery in Nigeria is a key deliverable.

CHAPTER THREE

3.0 THEORETICAL AND CONCEPTUAL FRAMEWORKS

3.1 Theoretical Framework

Theoretical framework is an interrelated logical set of ideas and models which are based on theory (Trochim, 2006; Gay & Weaver, 2011). In a research, theoretical framework presents the theory that explains why the research problem exist and paves way for the development of the research conceptual framework (Ogolo, 1996; Gay & Weaver, 2011; Oyewobi, 2014; Ijaola, 2017). Adom *et al.* (2018) revealed that a researcher must tactfully choose the appropriate theory or theories underpinning the knowledge base of the phenomenon under study and is required to use the chosen theory in a specific manner to explain the theoretical concept. Theoretical structure assists researchers in deciding study theory reference, and this places their studies on academic and scholarly level (Ravitch & Carl, 2016). To make a proper selection of a theoretical background, the researcher must find the study's guiding principles and situate the question in relation to it (Adom *et al.,* 2018). It was based on the above assertions that cost theories were considered in locating a theoretical framework for this study. The cost control theories considered are discussed in subsequent sections.

3.2 Cost Control Theories

Theory "is a systematic phenomenon to have a deeper understanding that will be able to predict future phenomenon behavior 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. These are explained in the headings below:

3.2.1 Economic analysis theory

To achieve this primary objective of effective project delivery defined by economic justification, timeliness and agreed or designed quality, the probable economic result of the planned construction project must be both identified and measured (Stasiak-Betlejewska & Potkany, 2015). The review for project competing proposals will be needed. Analysis can be measured in the following terms: achieving full productivity from the project in question; minimizing costs parameters set; optimizing social advantages; minimising insecurity and optimizing health, efficiency and public image (Stasiak-Betlejewska & Potkany, 2015; PMBOK, 2017). PMBOK (2017) emphasised that the following procedures must be followed for effective cost control of construction projects: i. Preparation that involves recognizing the mission, identifying the client's priorities and gathering all data;

ii. Study involving the analysis of available evidence and for formulating alternative solutions;

iii. Assessment, which is a mixture of evaluating the proposed solutions and finding the optimal solution, and

iv. Decision, to continue with identified solution.

The problem or weakness of economic theory is that most economic models depend on multiple assumptions that are not necessarily realistic; thus, any study of the results of an economic model must consider the degree to which inaccuracies in these assumptions undermine the results (Stasiak-Betlejewska & Potkany, 2015).

3.2.2 Theory of cost control cycle

Control is a critical element in ensuring the achievement of company and project goals by supplying reliable and efficient information to promote informed decision-making (Basak, 2006). Basak (2006) and Ogunsemi (2002) further observed that project management involves tasks related to planning, scheduling and cost management. The basic procedures in the project cost-control process theory can be summarized as follows, according to the PMBOK (2017) and Basak (2006); establish a baseline, accumulate / gather data, review and analyse results, forecast and recommend (to help decision). Basak (2006) indicated that these tasks are cyclical in nature and are regularly carried out during each step of construction. First move is creating a baseline which is a collection of reference baselines to bring the cost management of the project into practice. Next, as the work progresses, data is gathered for identifying variances and their triggers. Finally, various options are considered for estimating costs at completion and compared to the existing estimate if appropriate to bring the project back on track including budget changes and revisions to contingency allocations (PMBOK, 2017; Basak, 2006). According to Basak (2006), project cost management process theory suggests that project monitoring is critical to the achievement of company objectives by supplying reliable and productive information to facilitate informed decisions. The major limitation of this theory is because it is not easily adaptable to extremely complex tasks and climates. It performs perfect for well-defined projects that are unlikely to alter much as project progresses (Koskela & Howell, 2002; Cobb, 2020).

3.2.3 To-complete index theory

A significant cost efficiency metric for project managers (PM) is the application of the received value management (EVM) to-complete efficiency index (TCPI) (Fleming *et al*., 2009; Lipke, 2015). The TCPI defines the cost-efficiency needed to attain planned cost for project remainder (Lipke, 2015). TCPI's importance can affect very effectively how a project manager decides when and how to quickly react to developing issues. Described as a fraction of remaining undone work against unspent funds (Project Management Institute, 2011; Lipke, 2015). The TCPI is useful in that it can be calculated at completion using cost values other than the estimate, as shown in equation 3.1.

$$TCPI = \frac{Work\ remaining\ to\ be\ accomplished}{Amount\ of\ unspent\ funding} \tag{3.1}$$

Likpe (2015) stated that the remaining work should be measured in relation to overall project expenditure and deferred value earned, and that the available funds should be estimated based on the total cost. In summary, to complete the performance index model has limited use in planning.

3.2.4 Cost forecasting theory

Iheme *et al.* (2011), Anyanwu (2013), Chigara *et al*. (2013), Adeagbo (2014), Shabniya and Dilruba (2017), Malkanthi *et al*. (2017), and Cooray *et al.* (2018) reported the importance of construction to strategic national progress, cost forecasting process is a vital component of the industry which adds up to the most significant aspects for the appropriate functioning of any construction company. Accurate cost estimation of a project will prevent failure. Poor forecasts will certainly lead to poor project delivery. There are mainly two classification for forecasting namely traditional or non-traditional systems of predicting construction costs of projects. The traditional method centred around quantity - rate - analysis, the project is divided into discrete work items and unit rate is mapped for each discrete work item (Shabniya & Dilruba, 2017). A multiplication of both and a final summation gives the estimated total construction cost of the project (Shabniya & Dilruba, 2017). In addition to the traditional methods, few methods based on either algebraic or based on artificial intelligence have been developed (Bayram & Al-jibouri, 2016). Realistic assessment of construction costs is crucial for efficient delivery (Shabniya & Dilruba, 2017 & Enshassi *et al.*, 2009). The short coming of this model is, forecasts depend on past performance; therefore, there is no guarantee that the future will replicate the past (Cobb, 2020).

3.2.5 Variance Analysis theory

Cost control is a continual mechanism practised by management to achieve its fundamental objective of reducing costs below the specified effective level (Ogunsemi, 2002; Dandago & Adah, 2013). Analysis of variances are effective strategies as they expose management to underlying issues (Ogunsemi, 2002; Dandago & Adah, 2013). If practical performance expectations are set in place and it deviates from expected performance rates, then there will be a question of why cost variation (Nigeria Chartered Accountants Institute (ICAN), 2006; Dandago & Adah, 2013).

Analysis of variances is a contrast between planned project results and actual cost results. This analysis helps to explain the causes of the variance. Corrective measures are calculated from analysis of variances. In summary, variance analysis as a cost management philosophy of a project dictates that costs be regulated at point of occurrence, variances should be removed as soon as possible to create incentives for adjustment (Dandago & Adah, 2013).

Major disadvantage of the theory is that variances are only considered when they are material, and many disputes occur because of the various decisions involved in agreeing the limit of materiality. In addition, the whole budget is planned by collecting estimated data based on the financial statements for the current year. Variations of wide margins may occur if the budget has been poorly planned, more because the workers can exploit variances for their own use. The management can take incorrect steps to obtain a favourable variance or to prevent a negative variance. For example, the business could only purchase higher units of low-quality material at a cheaper price, so the variation in material usage will be favourable (Dandago & Adah, 2013).

When the length of the accounting period increases, the budgeted data becomes less important and more useless. It is because the estimates are calculated at the end of the year and the longer the delay, the staler would be the data and fewer the opportunities for correction, and it is worth remembering that variance analysis helps to retain leverage over costs and spending (PMP Training, 2020).

3.2.6 Management of value received theory

Management of value received (EVM) is a method of recovering cost, while evaluating progress, enables alignment of goals and development of performance assessment yardsticks. It can refer to projects of different sizes, scopes and durations (Project Management Association, 2006). Wilkens (1999); Scileanna (2012) and Chigara *et al*. (2013) noted that it is imperative to create a performance measurement baseline (PMB) to conduct an effective EVM consisting of adequate scope and assumptions, reasonable sequence operation schedules and time-phased resources / costs (labour and materials).

Therefore, EVM's main goal is to provide data that will facilitate accurate project status assessment, provide yardstick to estimate final cost, and estimate period when to complete, promote efficient management of available resources, and provide a means of managing and monitoring change (Anjum, 2016). According to Wilkens (1999), Ariel and Li (2003), Brinke *et al*. (2004) and Liang (2005), the basic steps in the application of EVM theory in a project are to break work items into approved pieces using work breakdown mechanisms (WBSs) which must be in place. The next steps are to identify work items, for its completion period and to assign costs and resources create a reference base. EVM drawbacks include that the exact calculation of received value not reliable because 'risks evaluation can differ (Anjum, 2016).

3.2.7 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 3.1 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.

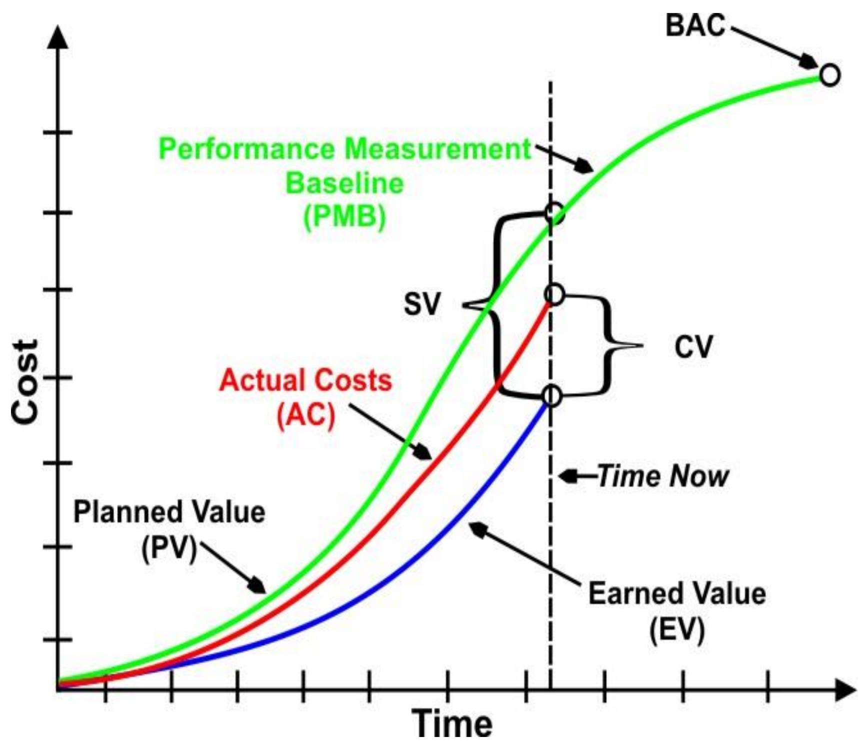

Figure 3.1: Key parameters of earned value management
Source: Hernandez *et al.* (2013)

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. Based on the benefits of EVM over other cost control techniques, the researcher believes that the approach can be better adopted in this study. 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 3.2.

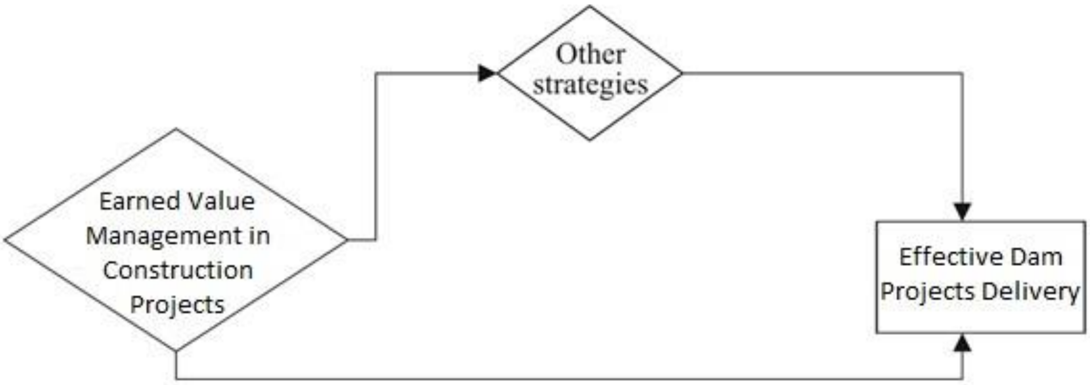

Figure 3.2: Theoretical model for cost effective project delivery of dams
Source: Researcher, 2019

3.3 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).

A concept is a plan, vision, or a symbolic expression of an abstract idea or thinking (Jabareen, 2009). A conceptual framework in a research therefore, shows the position, problem and direction to the study, it further shows relationships between different constructs that the study is investigating (Oyewobi, 2014, Ravitch & Carl, 2016; Saidu, 2016). The conceptual framework, therefore, gives direction, rationale and basis for undertaking the subsequent stage (methodology) of the research process (Adom *et al*., 2018). Figure 3.3 is a framework for a model for effective dam projects delivery. The relationships among the constructs in the conceptual framework are further explained subsequently.

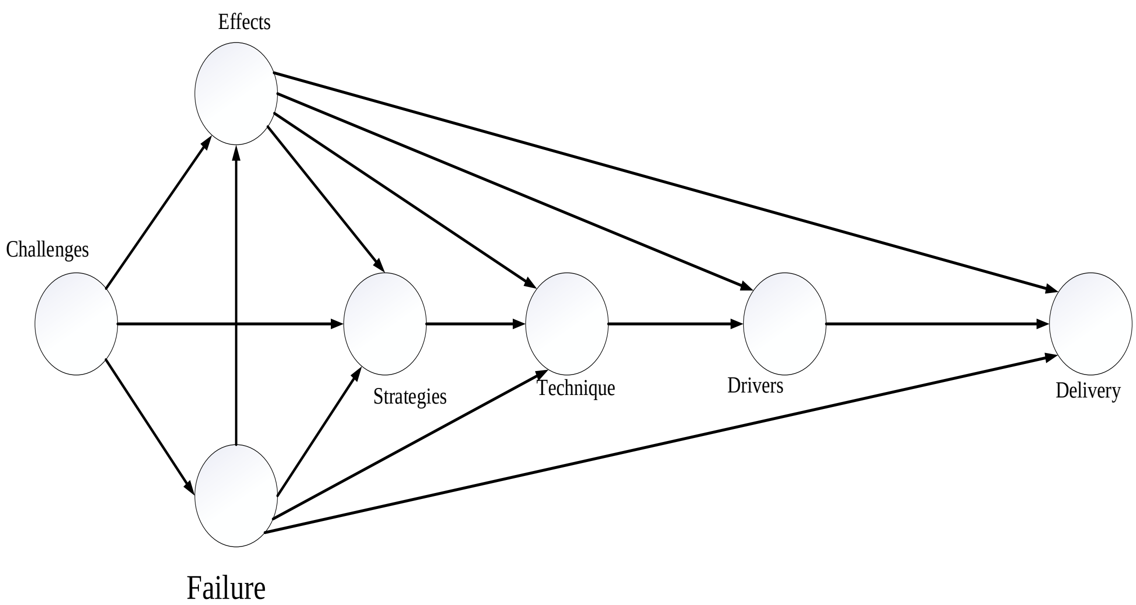

Figure 3.3: Conceptual framework for effective project delivery of dams in Nigeria
Source: Researcher (2019)

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.

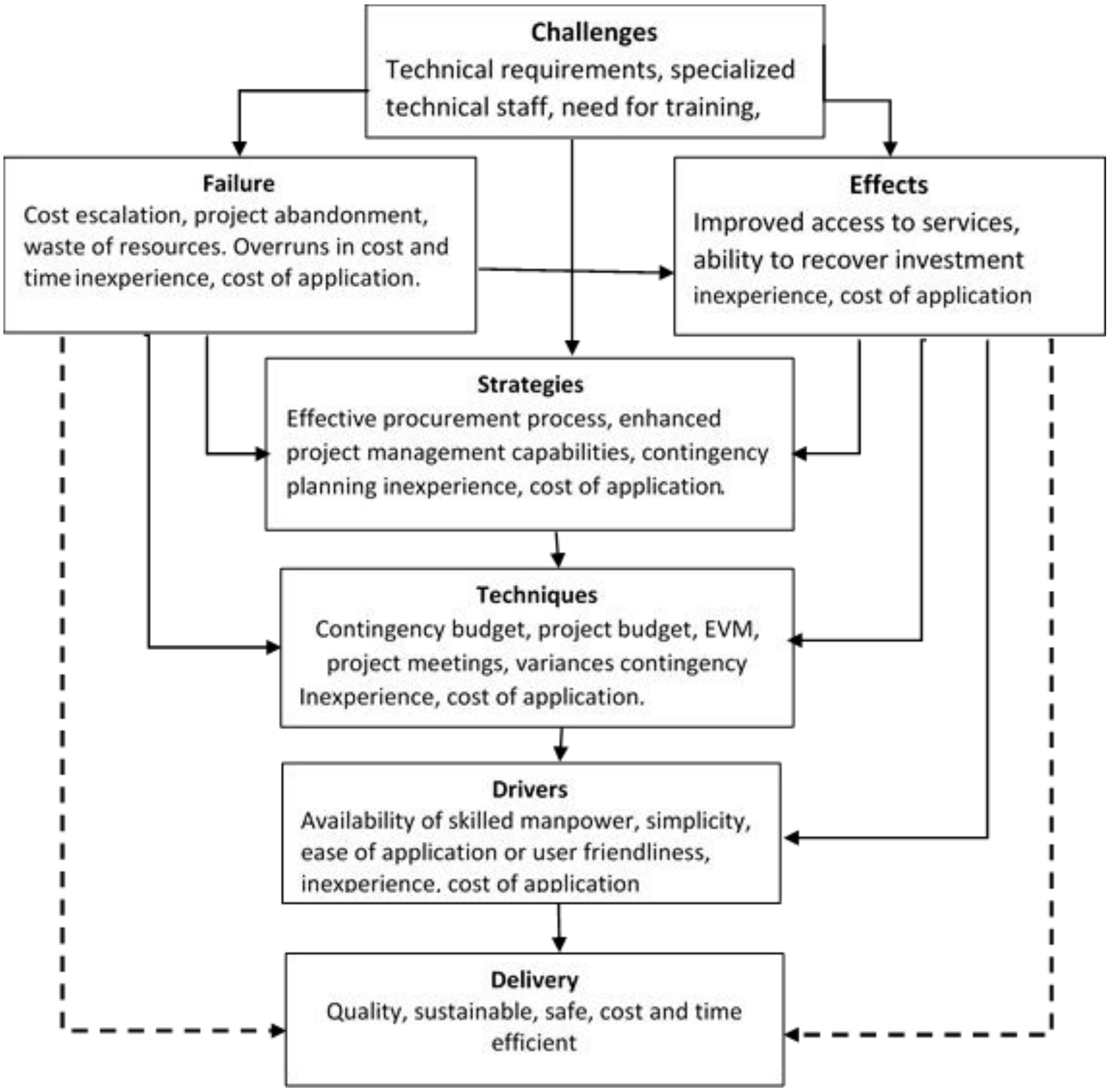

Figure 3.4: Variables of the different constructs in the conceptual framework

Source: Researcher, 2019

The cost control model for effective project delivery framework was developed based on the theoretical structure presented in Figure 3.4, it is the interactions of the various constructs and relationships between the variables indicated in Figure 3.3 and further explained in Figure 3.4, 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.

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 3.5). 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 3.5.

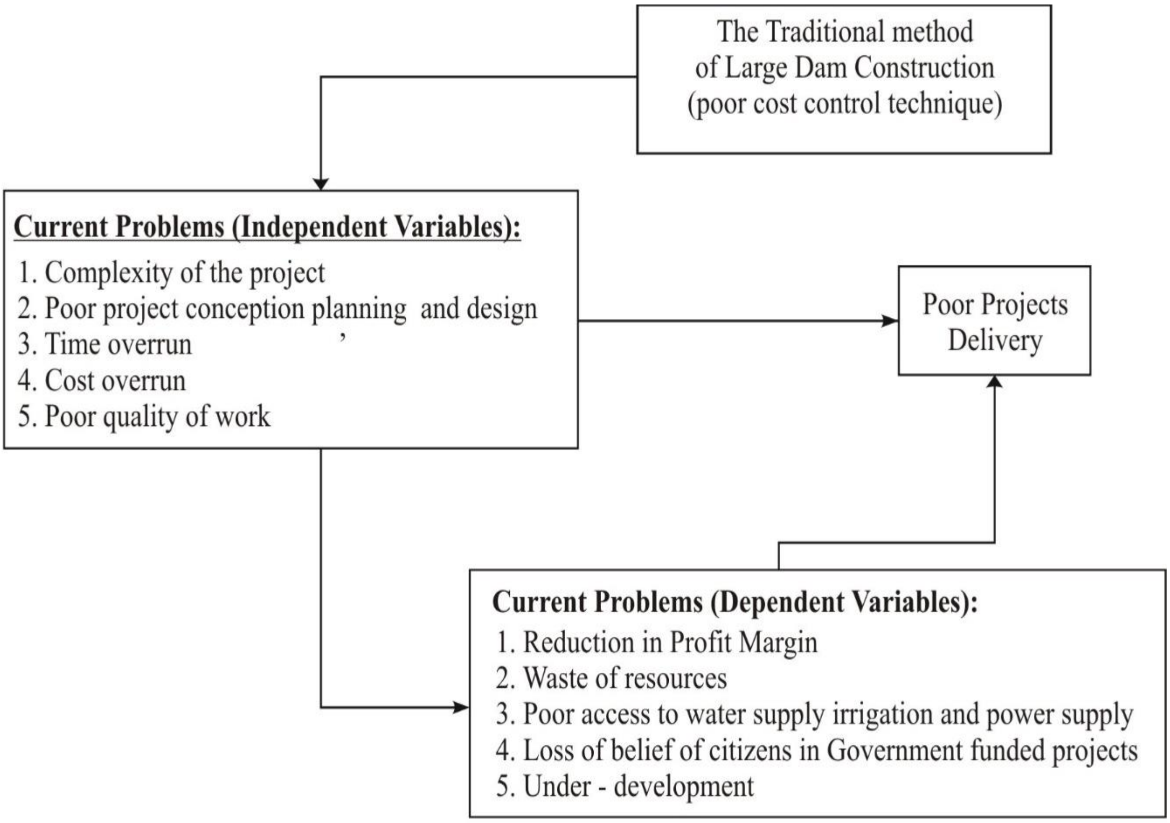

Figure 3.5: Challenges in traditional method of projects delivery process.

Source: Researcher (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 3.6

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 3.6: Relationships between cost control techniques, sources of project failure and challenges of dam projects development

Source: Researcher (2019)

This outcome is further illustrated in the Figure 3.7 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.

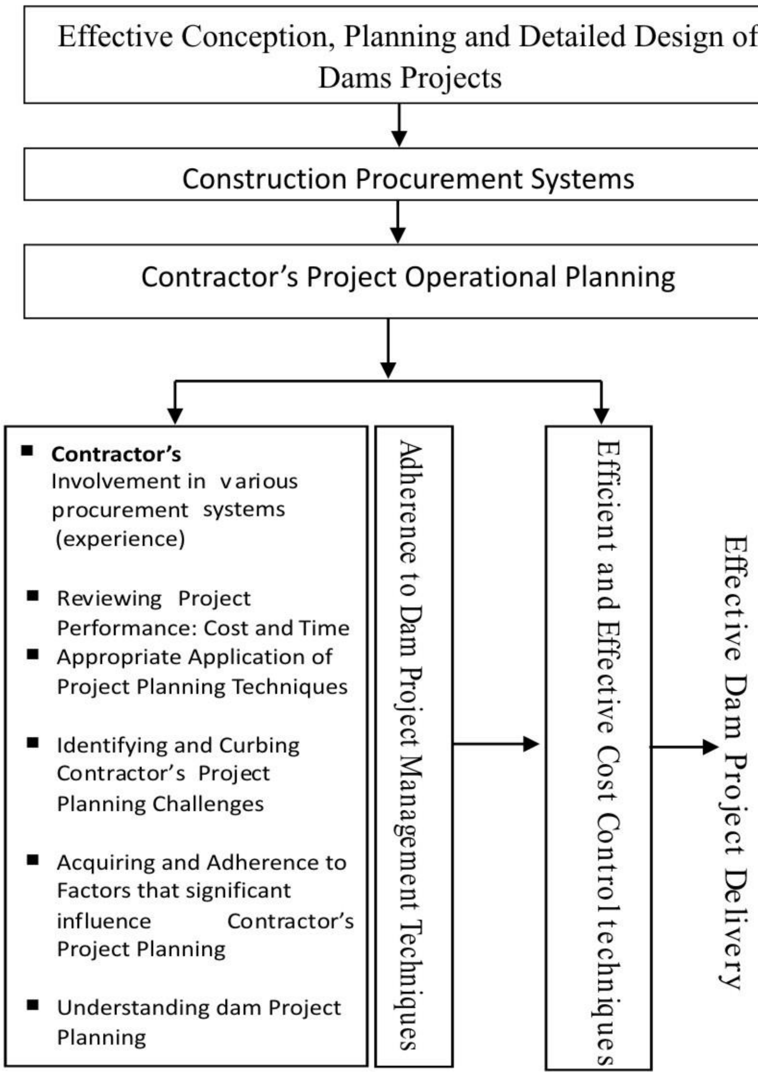

Figure 3.7: Ingredients of effective project delivery of dams

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. Different constructs of the conceptual framework are further examined subsequently, and hypotheses formulated based on the relationships.

3.3.1 Challenges and effects of the use of techniques for cost control

Adjei *et al*. (2018) highlighlighted the challenges in the use of techniques for cost control or management practices to include utilizing outdated approaches and principles, lack of information on the use of available resources and technologies, overemphasizing outcomes while ignoring cost control processes, lack of enterprise-appropriate project cost control processes and procedures, abandoning complex techniques, lack of cost consistency.

Ademola, (2012) and Adjei *et al*. (2018) thought that using manual and paper-based cost control means is where site managers, cost engineers or quantity surveyors prefer old method or writing pads rather than using modern software and available technology. The challenge is that the outdated methods cannot address variances in real-world situations. Figure 3.8 details the pathways of the hypotheses developed for the study and it suggested that: -

H1: The complexities of using techniques for cost control and the results of using techniques for cost control are positively related.

3.3.2 Challenges of use of techniques for cost control and failure to use

Many company managers merely ignore the cost management system in the process of project construction (Song, 2014). On the other hand, most contractors are not willing to invest in methods of cost reduction or are unwilling to pay specialists to handle cost problems for the company, others find it a waste of money, although it could have saved the company considerable money loss with cost control practice while enhancing project delivery records (Song, 2014; Adjei *et al*., 2018). Failure to apply techniques for cost control cost correlates negatively with project delivery according to Ashworth *et al*.

(2002) cited in Sanni and Hashim (2013), some contractors experienced insolvency not that their job was economically unviable but due to short-term cash flow problems. This study therefore proposes that:

H2: A strong positive correlation exist between the complexities of using cost management strategies and inability to use them in the execution of projects.

3.3.3 The effects and failure to use cost control techniques in project delivery

Yismalet and Patel (2018) noted that the majority of national contractors in India showed failure to manage the projects effectively which resulted in insolvency that weakened their organizational ability. The high rate of failure is not due to contractors not knowing construction techniques, but because they failed to learn requisite construction cost techniques. Charoenngam and Sriprasert (2001) concluded in their evaluation of cost control systems that most vital function which enhanced construction organizations profit maximization is cost control, but weak control system has caused many Thai contractors to fail. Miscalculation and inadequate on-site financial control contributed to high cost of construction (Okpala &Anieku, 1998; Ibrahim, 2011).

Failure to implement or apply cost management strategies leads to failures in decision making which involves misallocation of funds or loss of opportunities resulting from delays in decision taking. This can indirectly affect organizational cost expenditure and ultimately its ability to deliver the project effectively (Song, 2014; Adjei *et al*, 2015). Lockey (2002) and Akeem (2017) stated that companies need control of costs in order not to surpass their budget and not run at a loss, as well as not to decrease the quality of their goods. Cost control makes policy decisions very easy to manage. The construction sector will blossom if cost management is strictly adhered to as a mechanism designed to monitor project costs (Anyanwu, 2013). Ayodele and Alabi (2014) noted that Bill of

Quantities (Cost Control Technique) has been used in all government projects and this has resulted in high-quality jobs, this is not the same with developments in private projects that are reluctant to use the Bill of Quantities for control. This status is in line with Chinwokwu's (1999) report, which found from a study in Lagos that building collapse is more rampant on private developer sites compared with government projects. Hence, it is reasonable for this study to conclude that projects with an appropriate cost management strategy are more likely to perform well. It is proposed that:

H3: A strong positive association exist between the results of cost management strategies and the failure to use them in the execution of projects

3.3.4 Effects, familiarity with and level of usage of techniques for cost control

Most contractors do not use the expertise gained from their previous projects to ensure the quality of their current projects because most of them do not use project management systems, and they cannot record past experiences and view all projects as new (Yismalet & Patel, 2018; Adjei *et al*., 2015). Many Nigerian contractors do not consider cost management strategies, this is corroborated by Ogunsemi (2002), who discovered that failure to adopt cost strategies led to the incessant collapse of buildings in Lagos State of Nigeria. The cost control problem is lack of awareness and inadequate implementation preparation combined with poor management of construction resources (Yismalet & Patel, 2018). Hence, it is hypothesized that:

H4: A strong positive association exist between the results of dam project cost control and degree of techniques for cost control used.

3.3.5 Familiarity with and level of usage against failure of the use of techniques for cost control

Cost control is a vital ingredient for project success (Yismalet & Patel, 2018). In their report, Malkanthi *et al.* (2017) concluded that cost control techniques have been established as a tool to reduce overrun costs, however, most contractors are fully aware of the available techniques of cost control in the construction sector, but their use is limited. There are strategies to reduce cost overruns, but because of a shortage of capital, contractors are not likely to execute them properly. Yismalet and Patel (2018) concluded that most contractors plan their budgets, but only a few uses the plan to promote process of cost control. Ayodele and Alabi (2014) and Chinwokwu (1999) concluded that private developers could reduce the rate of collapse of buildings by using cost control techniques, especially the bill of quantity. Cost control of the project aims at monitoring adjustments in the project budget, providing information for decision making (Chitkara, 2005). Familiarity with available cost control techniques increases the chances of its application in projects delivery and therefore diminishes chances and negative effects of non-application of the techniques. The study therefore proposes that:

H5: A strong positive relationship exist between project failure causes and cost management techniques.

3.3.6 Familiarity with and level of usage against drivers of cost-control methods used

Malkanthi *et al*. (2017) found that majority of the contractors in their survey were generally conscious of the cost management methods that are available in the construction industry, but effective use was not evident. The study revealed that contractors agreed that most common techniques available were Project MS and Analysis

Value Gained, and contractors who used them cited ease of monitoring and simplicity influenced their use (Malkanthi *et al*., 2017).

A cost control programme for project execution, to the extent possible, without causing interdepartmental and interpersonal disputes should be easy to understand. It should have rapid response time, allow for quick monitoring and prompt decision-making based on simple cost reports initiated by cost centres at regular frequency (Chitkara, 2005). Familiarity, usability, and ease of use is a major driver of using a cost control technique. It is therefore proposed that:

H6: A significant positive relationship exists between the degree of use of cost control strategies and the drivers of their use

3.3.7 Effects of use of cost control methods and usage drivers

Cost management is the mechanism where a project's construction costs are controlled using the best approaches to avoid losses on the part of the contractor (Ayodele, 2005; Ayinde, 2018). Sanni and Hashim (2013) revealed that it is critical to monitor cost to reduce unnecessary resource wastage. In a study conducted in Thailand, Charoenngam and Sriprasert (2001) reported that contractors perceive cost control as a prerequisite for maximizing revenue. Spedding (2005) cited by Sanni and Hashim (2013) concluded that little productivity improvement would generate additional jobs and contribute more to the economy, since the construction industry is a huge employer of labour. Chen and Chen (2011) indicated that since the profit margins for the construction industry are small, contractors should build frameworks for the management of uncertainties which may arise during construction. When management strategies are properly used such a scheme is highly likely to be within the target cost. Therefore, this study proposed that:

H7: A significant positive correlation exist between the utilization results of cost control strategies and the drivers.

3.3.8 Drivers of use of techniques for cost control and strategies to improve use

Sanni and Hashim (2013) found that barriers are impediments to control practices and lack of research or innovations is one of the top critical barriers in Nigeria. Yismalet and Patel (2018) stated that construction entities, need improved ability to effectively achieve firm and project goals, so, contractors need to concentrate on cost management. Key shortcomings of cost management practices in construction projects is inadequate approaches to defining, addressing and monitoring client demands, project scope and expense, inept tendering competition, incomplete design, weak project management, weak site planning and poor communication (Yismalet & Patel, 2018). Familiarity with available cost control techniques increases the chances of its application by contractors, also, familiarity, simplicity and ease of its application are drivers in use of techniques (Chitkara, 2005; Madu *et al.*, 2019). Based on these challenges and shortcomings, it is believed that:

H8: An important positive relationship exists between the level of use of cost control methods and user improvement strategies.

H9: A strong positive relationship exist between cost-control issues and approaches to enhance its use.

3.3.9 Effects of use of techniques for cost control and strategies to improve use

Malkhanti *et al*. (2017) revealed that the issue is not approaches employed but poor management of the techniques used. Construction is capital intensive, to improve cost management professionals such as Quantity Surveyors should obtain more training in cost management art (Anyanwu, 2013). Effective control mechanism involves staff in the achievement of the aim, hence involvement of well-trained site personnel in cost control would lead to efficient project delivery (Charoenngam & Sriprasert, 2001). Skitmore and Marston (2005) cited by Adjei *et al*. (2018) concluded that a good understanding of cost control concepts is crucial for effective planning which ensures improved projects delivery. Contractors should be familiar with cost control strategies and how to use the techniques to reduce cost overruns (Malkanthi *et al*., 2017). This can be examined empirically by stating the hypothesis as:

H10: A significant positive relationship exist between the cost-control techniques and strategies used to enhance their application.

3.3.10 Strategies to improve use of techniques for cost control and project delivery

Construction practitioners are more comfortable with traditional cost control approaches with minimal participation in information technology, or any form of cost control computer software. Therefore, practitioners should constantly attend workshops and seminars that will inform them, refresh and broaden the required knowledge and skill for controlling costs of their project as it has been established that inadequate practices and low expertise are the main reasons why contractors are not using cost control techniques (Ayinde, 2018; Malkanthi *et al*., 2017; Dhawadker, 1989).

Contractors should be motivated to use cost-control strategies by their involvement in training programmes and education programmes (Malkanthi *et al*., 2017). The expertise of the critical workers in the contracting organization should be strong in construction cost management practices and activities because the more effective they are, the better for the company's success and development (Sanni & Hashim, 2013). Sanni and Hashim (2013) agreed with Pries *et al*. (2004) that today's business is about satisfying customer by efficient production, thus, if the employees of the contractor are very effective in discharging their duties, this may lead to efficient production within the organisation.

Ayodele and Alabi (2014) were of the opinion that laws to compel developers to use cost management strategies in construction would be appropriate, it would dramatically mitigate building collapse and improve project delivery in Nigeria. Thus, the study postulated that:

H11: A strong positive relationship exist between the drivers of cost control and project delivery techniques

3.3.11 Effects of use of techniques for cost control and project delivery

Sector's core objective of delivering project within a given time, good quality and occupant protection has highlighted the need for efficient cost management (Chitkara, 2005; Nunnally, 2007; Ayodele & Alabi, 2014). Akeem (2017) studied cost-control impacts on organizational performance and found that cost-control had a positive impact on corporate efficiency. Akeem (2017) further argued that cost control prevents inefficient use of valuable resources and encouraging cost understanding and efficiency. Avoiding wasteful use of resources has a direct positive relation with productivity or delivery.

Wastage is unavoidable during construction, according to Chitkara (2005), but excessive wastage adversely affects efficiency, it results in additional costs. In a study evaluating techniques for cost control in Nigeria, Ayinde (2018) revealed that practitioners in the construction industry agreed that wasted materials on sites influenced the choice of cost control techniques.

Efficient management of construction costs is the most critical activity for effective completion of a project (Malkhanti *et al.*, 2017). Anyanwu (2013) concluded that the increasing cost of construction materials and the resulting exponential rise in cost, demands proper cost control principles to minimize or eliminate project costs increase.

Akeem, (2017) found that cost management has a significant effect on organizational efficiency, thus, to achieve success, organisations need to implement cost control strategies. The study thus proposed that:

H12: A major positive relationship exist between the cost-control strategies and project execution results.

3.3.12 Failure of use of techniques for cost control and project delivery

It is essential to manage and reduce unnecessary expenditures in an enterprise, and it also helps to increase market demand in competitive market terms. Akeem (2017) contended that any business organization that is successful in using cost control can sell its products at a lower rate than competitors without reducing its quality. Sanni and Hashim (2013) reported that for failure to manage construction costs of their projects, contractor would go bankrupt, then the projects in some instances would be abandoned. Cost overrun (poor project delivery) makes the profit less secure (Malkanthi *et al*., 2017). Furthermore, cost management practices are necessary to mitigate cost overruns. If project managers fail to keep a handle on the real costs when the project is under way, it might not be possible to complete the project within budget (Susana, 2012). Akindoyeni (1988) and Ogunsemi (2002) opined that projects seldom complete at the scheduled time and cost in Nigeria, to reduce this problem, implementing cost management strategies is advised. Thus, it is proposed:

H13: A major negative connection exist between failure to use cost management strategies and completion of projects.

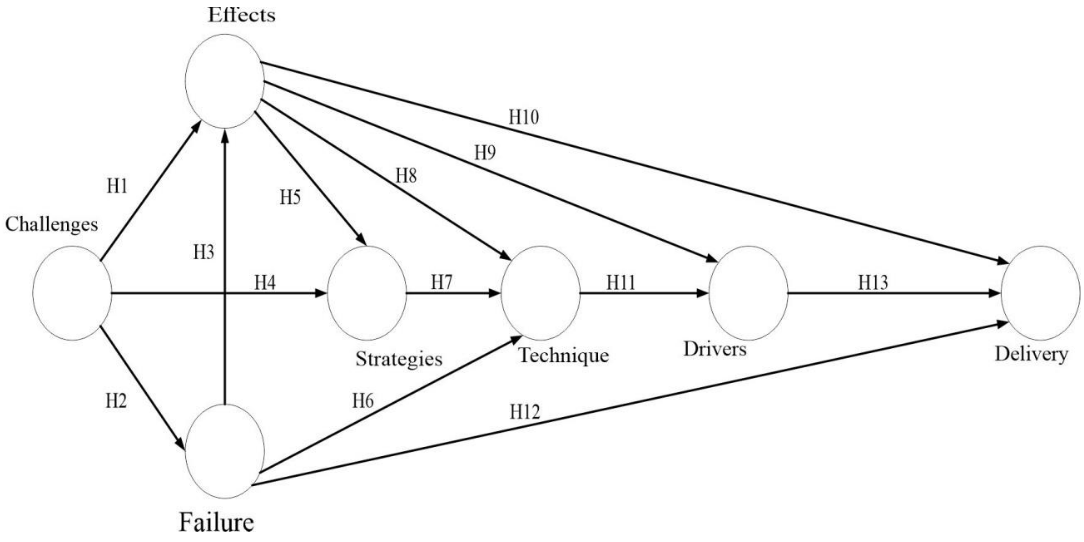

Figure 3.8: Constructs of the conceptual framework showing hypotheses developed based on the relationships Source: Researcher (2019)

3.4 Summary

The conceptual structure for this study as shown in Figure 3.3 demonstrates how the variables or constructs in the model are linked to each other or influence each other to provide a deeper understanding of the fundamental concepts enshrined in that model. The relationships are helpful in the analysis and understanding of cost management system for successful execution of projects in spite the fact that the conceptual framework was yet to be validated. However, attempts were made to ensure that enough attention was provided to all constructs to represent factor that could support the model. The linkages between challenges of implementing techniques for cost control, consequences and failure to implement them have been identified. Also, the relationships between familiarity and usage of cost control methods and the failure to use or effects of usage in project delivery was also established and discussed. The effects of use of techniques for cost control in relation to drivers for usage as well as strategies to the usage were also discussed and finally the relationships between the effects of usage, failure of application, strategies for usage and project delivery were established and discussed. The theoretical and conceptual frameworks have however provided the ground work for the research methods and methodology adopted for this study as discussed in the next chapter.

CHAPTER FOUR

4.0 RESEARCH METHODOLOGY

4.1 The Research Onion

Study frameworks provide a clear description of the research methods and explain step by step procedures that must be followed with each study (Saunders *et al*., 2019; Al Zefeiti & Mohamad, 2015; Omotayo, 2017). The onion, according to Saunders *et al*. (2019), describes and demonstrates relations between the research methodology, the research philosophy, the approaches, the options, the time horizons and the techniques and procedures. Saunders *et al*. (2019) and Omotayo (2017) noted that research onion begins with the philosophy of research which specifies the steps to be taken by researcher based on ontology, epistemology, and axiology which are the main ways to think about the philosophy of science. The linkages are described in Figure 4.1.

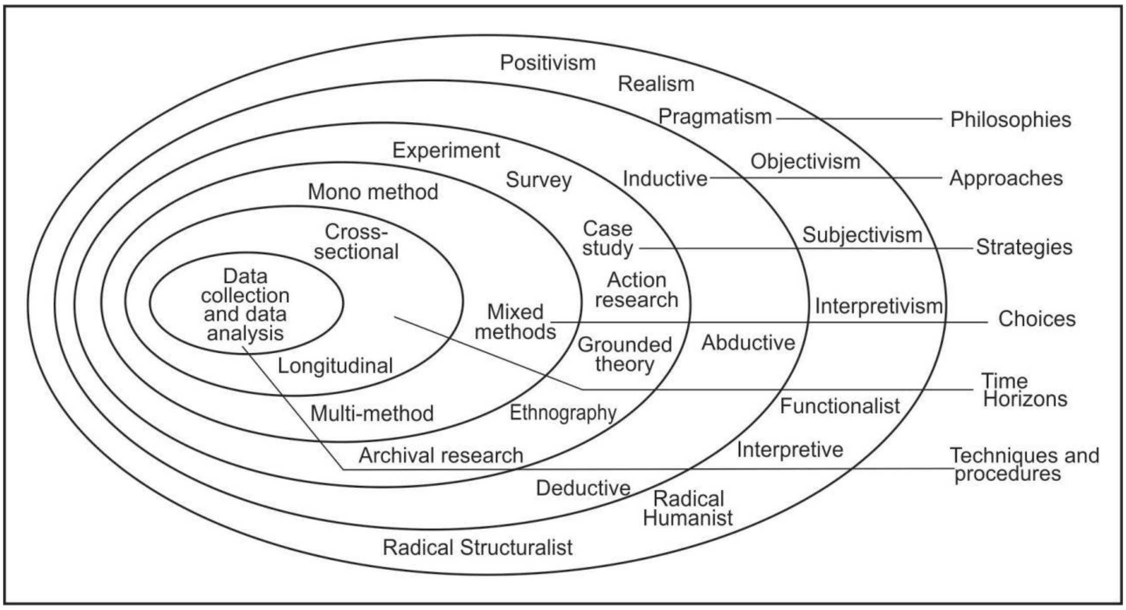

Figure 4.1: The research onion (Saunders *et al.*, 2019)

Guba and Lincoln (2005) maintained that the choice of techniques for data gathering and analysis strategies are the core of research onion in any study and, before reaching this central point, there are essential layers of the onion that need to be removed.

4.2 Research Philosophy

Philosophy of study is a structured methodology developed based on researcher's interpretation of issue under investigation (Al Zefeiti & Mohamad, 2015; Odediran, 2016; Ijaola, 2017; Saunders *et al*., 2019). It is mainly concerned with the comprehensive creation, supervision and improvement of investigative methods in all fields of academic endeavour (Al Zefeiti & Mohamad, 2015; Omotayo, 2017; Saunders *et al*., 2019). Philosophy concerns creation of knowledge and the essence of that knowledge. Easterby-Smith *et al*. (2002) and Saunders *et al.* (2019*)* emphasised that research philosophy includes fundamental hypotheses about the way the universe is seen. The assumptions underpin research plan and methodologies selected as part of that strategy. Saunders *et al.* (2019) also pointed out that based on the assumptions that underpin research philosophy, there are three main viewpoints of philosophy of science: ontology, epistemology and axiology, each containing important differences that will affect how one thinks about the study process. These are explained in the following headings:

4.2.1 Ontological assumptions

Ontology investigates the essence of fact or how reality is viewed. Ontology is about whether we assume that there is one verifiable truth or whether many socially constructed realities exist (Patton, 2002; Chilisa & Kawulich, 2012; Rehman & Alharthi, 2016). To a greater degree than epistemological concerns, ontology addresses beliefs that researchers have about commitment to the reality of the world and to unique views (Saunders *et al*., 2007; Saunders *et al*., 2019). It explains human views, the essence of existence, and precisely whether there is an objective truth created in human minds, or only a subjective fact (Flowers, 2009; Rehman & Alharthi, 2016). It is defined on the basis of objectivism and subjectivism, objectivism represents the notion that social objects remain in fact beyond social actors, while subjectivism is concerned with social phenomena arising from the expectations and effects of those social actors concerned with their lives (Thakurta, 2015). When human actions are based on beliefs and consequent actions of social actors involved life, it is said to be subjectivism.

4.2.2 Epistemological assumptions

It is mainly about what constitutes appropriate information within a field of study. Epistemology considers the best ways to examine the essence of the world (Easterby-smith *et al.*, 2002; Rehman & Alharthi, 2016). According to Girod-Seville and Perret (2001) cited by (Ijaola, 2017) and Rehman and Alharthi (2016), epistemology answers the questions about the nature of knowledge to be generated through research, ways of generating scientific knowledge and the value and status of this knowledge. Thakurta (2015) asserted that epistemology is about the appropriate awareness of a study field and are of two aspects, namely the resource researcher who deals with the data from the viewpoint of a natural scientist or emotional researcher who is worried with workers' thoughts and attitudes to their supervisors. Asset researcher is involved in positivist philosophy development while researcher of feelings is based on interpretive philosophy. The main epistemological issue is whether the approach to social environment study, including management and the approach to business, is the same as that to natural science research. Hatch and Cunliffe (2006) and Saunders *et al*. (2019) summarized epistemology as' how information is produced, what parameters distinguish true knowledge from bad one, and how to reflect or explain truth. Eriksson and Kovalainen (2008) and Saunders *et al*. (2019) inferred that epistemology can be viewed under two perspective which are objective or subjective. The objective epistemology presumed that world exists in a neutral or external form, whereas the subjective epistemology believes that there is no outside world connection beyond our own experiences and it is possible to interpret these.

4.2.3 Axiological assumptions

Axiology is a scientific branch that studies value evaluation. It holds that the role played by the principles of the researcher at every stage is very significant if the researcher wishes the findings of the study to be reliable. Many scholars argue that the underlying motive for all human behaviours are individual values. The axiological assumptions describe the role values play in science. Investigators express their beliefs in the analysis and regularly disclose their beliefs and prejudices, as well as the value-laden essence of field-gathered knowledge (Creswell, 2007). Creswell (2007) noted that the axiological conclusions can be either objectivistic or subjectivistic. Objectivist viewpoint shows that work is value-free and not subjective while subjectivist viewpoint applies to the value-laden and subjective work.

4.2.4 Philosophical position of this study

In this study, with the need for partnership and extensive social interaction and collaboration with groups of civil engineers, water engineers, professionals in dam construction and project managers for realisation, and acquisition of knowledge through the research questions highlighted in the first chapter, the researcher perceived this research to be ontologically objective (exists independently of human views and thoughts), the research tends towards subjective epistemological views, which believe that because there is no access to the outside world outside our own experiences and perceptions, only measurable events can provide reliable knowledge and truth. Axiologically, it is value-bond. Hence the philosophical position of this study is objective/subjectivism and value bond as shown in Table 4.1.

4.3 Research Paradigm

A paradigm for research is a set of fundamental assumptions and convictions about how the world is understood, acting as a basis for thinking that directs the actions of researchers (Jonker & Pennink, 2010; Wahyuni, 2012; Makombe, 2017; Kivunja & Kuyini, 2017, Saunders *et al*., 2019; Kankam, 2019). A paradigm is considered as the main belief system and theoretical framework with assumptions on ontology, epistemology, methodology and methods (Rehman & Alharthi, 2016). It is our way of knowing, and learning the truth of the universe (Rehman & Alharthi, 2016). In a thesis that addresses research questions and fixes research problems, a research framework offers a philosophical and conceptual context and methodological guidance (Creswell & Plano Clark, 2011; Abdulkareem *et al*., 2017; Kumar, 2019). Kankam (2019) observed that pragmatism, interpretivism, positivism and post-positivism are the four most commonly used paradigms in science. Five fundamental paradigms provide direction for study, which are positivism, post-positivism, interpretivism, pragmatism, advocacy and participatory (Johnson & Onwuegbuzie, 2004; Creswell & Plano Clark, 2011; Creswell, 2014; Saunders *et al*., 2019). Distinctions are set in Table 4.1.

Table 4.1: Fundamental Science Paradigms values

	Research Paradigms				
Fundamental Creeds	*Positivism (Naive realism)*	*Postpositivism (Critical Realism)*	*Interpretivism (Constructivism)*	*Pragmatism*	*Advocacy and participatory*
Ontology: Place on reality's origin	Outside, objective and separate from the social actors	Goal Exists independently of human beliefs, or awareness of actual reality, but is viewed by social pressures (critical realism).	Socially constructed, subjective, can alter, multiple	External, multiple views selected to better address a research issue	Nominal structure, socially rich built by power structures concepts, perceptions, facts are dominated and silenced by others
Epistemology: an interpretation of what constitutes reasonable information	Only measurable phenomena can provide evidence, facts, with credibility. Emphasis on causality and generalisation according to statute, reducing anomalies to simplest elements	Measurable evidence, with credibility. Concentrate on describing in sense and meaning	Subjective significances and anomalies in culture. Concentrate on the facts of the situation, the reality behind these facts, their subjective significance and motivating acts	One or both quantifiable and subjective phenomena, based on research questions interpretations may provide appropriate information. Focuses on realistic applied analysis, incorporating different viewpoints to help understand the data	What is appropriate for "fact" and "truth" is defined by the dominant views based on absences, silences and oppressed / repressed meanings, expectations and voices.

Based on Saunders *et al*. (2009); Guba and Lincoln (2005) and Hallebone and Priest (2009) - Source: Wahyuni (2012)

Table 4.1: Fundamental Science Paradigms values (Cont'd)

	Research Paradigms				
Fundamental Creeds	*Positivism (Naive realism)*	*Postpositivism (Critical Realism)*	*Interpretivism (Constructivism)*	*Pragmatism*	*Advocacy and participatory*
Axiology: The value role in attitude of researchers	Value-free and etic Work performed in a value-free way, researcher is independent of evidence with impartial position	Value-charged and etic Work is laden with value; influenced by world views, cultural views, experiences and education	Value bond and emic study are value bonds, researchers are part of the project, are not isolated and will therefore be subjective.	Value-bond and etic-emic concepts play an important role in the interpretation of results, with researchers taking both objective and subjective views	Scientists and scholars rooted in power relations Many of the study theories are repressed and suppressed at the expense of other. Radically instinctive researcher
Research Methodology: The concept of research process	Quantitative	Qualitative Quantitative or	Qualitative	Qualitative and Quantitative (mixed or multi-method)	Deconstructive-reading texts and evidence against themselves In-depth investigations of events, silences and absences Different sources of data, usually qualitative methods of research

Based on Saunders *et al*. (2009); Guba and Lincoln (2005) and Hallebone and Priest (2009) - Source: Wahyuni (2012)

4.3.1 Positivist paradigm

Use natural science lens to apply to the social sciences. Ontologically holds an external and realistic view of social reality. Axiologically, it preserves the isolation of the investigator from the observed by taking an etic or outsider approach viewpoint stance (Wahyuni, 2012; Rehman & Alharthi, 2016; Saunders *et al*., 2019). Positivist supports, epistemologically, the use of a statistical method by designing empirical measures to produce suitable information (Rehman & Alharthi, 2016; Rahi, 2017).

4.3.2 Postpositivist paradigm

As with the positivists, postpositivists extend the human sciences lens to social sciences. They hold the view, ontologically, that social truth is intrinsic and objective, and axiologically, it preserves researcher's independence from research using etic or outsider approach viewpoint stance (Wahyuni, 2012; Saunders *et al*., 2019). Postpositivists promote, epistemologically, usage of a systematic methods through the creation of analytical measures to generate correct knowledge. A major difference between positivist and postpositivist is that the latter questions the belief in this actual fact, especially concerning the reality of human behavior in the social sciences (Wahyuni, 2012; Kivunja & Kuyini, 2017). The philosophy still believes in aggregation, but accept that intelligence comes from social pressures, referred to as essential realism (Rehman & Alharthi, 2016).

4.3.3 Interpretivist paradigm

In the far end of postpositivism, interpretivists adhere to constructivism. They claim that reality is constructed by social actors and the people's perception of it. They understand those people with their own diverse cultures, beliefs and perceptions contributing through social interaction to ongoing truth building that exists within the society (Hennink *et al*., 2011; Saunders *et al*., 2019). In a nutshell, interpretivists deny objectivism as suggested in postpositivism, and a single reality. Interpretivists prefer dialogue and discussion with studied participants, as well as working with qualitative data offering vivid explanations of social structures, using a narrative method of study to explain clear comprehensive reports of a social environment under study, called an idiographical approach (Neuman, 2011; Wahyuni, 2012). Truth is context-dependent, and methodology can be qualitative; phenomenology; ethnography; symbolic interaction; naturalistic, though data are gathered primarily through interviews, observations of participants, photographs, diaries and documents.

4.3.4 Paradigm of activism and participatory intervention

According to activism and participatory intervention worldview, there is a clear narrative for this system aimed at change according to Creswell (2009), Levitan (2013) and Rahi (2017) which needs to blend with the policy agenda. Crewell (2009) claimed that social issues important at the time are discussed in a study using this structure such as dominance, injustice, exploitation, control, repression, and alienation are really the subject of the research. Its main attribute is that it gives participants a voice and the ability to form a reform agenda.

Kemmis and Wilkinson (1998) and Levitan (2013) presented four key characteristics of the advocacy / participatory inquiry framework:

i. Participatory activities focus on bringing about progress, and the researchers build an action plan for change at the end of this type of study;

ii. It focuses on liberating individuals from social constraints, which is why the study starts with an important issue in society now;

iii. It aims at creating a political debate to bring about change, and;

iv. Finally, it is a collaborative process as advocacy / participatory researchers involve participants as active contributors to the study.

4.3.5 Pragmatist paradigm

Tashakkori and Teddlie (1998) and Wahyuni (2012) emphasised that pragmatism is a research paradigm that declined to enter 'paradigm battle' between paradigms of positivism and interpretivism. Rather than challenging epistemology and ontology as starting point, pragmatists begin with problem of analysis to establish structure. This community stresses that research philosophy be perceived as continuous instead of a choice opposing one another. They conclude that objectivist and subjectivist viewpoints do not exclude one another, and epistemology, ontology and axiology can be mixed appropriately for interpreting social physical events (Wahyuni, 2012; Saunders *et al*., 2019). Pragmatist prefer blending qualitative and quantitative data as it allows greater social reality understanding. Methodological foundation of pragmatism encourages researchers using mixed methods to use a variety of approaches to respond to research questions that cannot be answered using a single tool. The goal of this technique is to identify and reinforce the weaknesses in the analysis by using the methodology of mixing methods (Johnson & Onwuegbuzie, 2004; Rahi, 2017; Saunders *et al*., 2019). Pragmatists argued that the philosophical approaches of positivism and constructivism can be mixed effectively. The explanation or basis for the research approach to mixed methods is the essential assumption of the information or experience and analysis approach (Johnson & Onwuegbuzie, 2004; Rehman & Alharthi, 2016; Kumar, 2019).

4.3.6 The research paradigm for this study

One paradigm may correlate with a given methodology. Positivitic paradigm usually correlates with quantitative methodology. Constructivist generally use qualitative methodology, this is not always the case, and yet there are occasions when an interpretative analysis can be carried out using a quantitative methodology (Chilisa & Kawulich, 2012; Creswell *et al*., 2006). Rubin and Babbie (2009) revealed that although, social constructivist researcher typically uses qualitative methods, there are exceptions. Positivist researchers for example occasionally conduct qualitative studies when they think the problem they are investigating calls for such and when they do, however, they will typically be more concerned with assessing the objectivity of their qualitative observations than social constructivist researchers are when they conduct qualitative investigations.

Having clearly explored the research paradigms available in literature and considering the foundation elements or assumptions of each of the paradigms with reference to research on cost control model for effective dam projects delivery, the researcher aligns this research with the pragmatic paradigm. Pragmatism allows researchers to participate in things of interest and meaningful, to analyze problems according to their understanding (Tashakkori & Teddlie, 1998; Oyewobi, 2014). Ontologically, this is the viewpoint on the essence of truth, it is external, numerous and the views chosen to get the best response to the problem of the study. Epistemologically, that is the view of what constitutes appropriate knowledge, it is one or both measurable and subjective phenomena, definitions may provide appropriate knowledge depending on the research question (Wahyuni, 2012; Kumar, 2019). Axiologically it is value-bond, as noted in Table 4.1. Beliefs play a significant role in evaluating results with objective and subjective views taken by the researcher (Wahyuni, 2012). Oyewobi (2014) and Wahyuni (2012) contended that the philosophical basis for an orientation to mixed approaches is widely known as pragmatics. Pragmatists employ various principles, using 'what works' (Creswell & Plano Clark, 2011; Oyewobi, 2014). Pragmatism thus enables pluralistic strategies to research, diverse worldviews as well as various ways to collect and interpret data in one analysis (Choi, 2014).

4.4 Research Methodology

Some researchers often confuse methodology and methods, but Jonker and Pennink (2010) and Wahyuni (2012) highlighted that research methods and research methodology are different terms, methodology (the process) is analogically a globe, whereas the method (tool) implies several moving measures between two points on the globe. A methodology corresponds to a system-like research model, it contains a number of underlying beliefs which guide a researcher in the selection of one set of study methods over others.

Methods of science are the methods and concepts used to perform a study (Creswell, 2014; Saunders *et al*, 2019). Research method differs from research methodology in that technique is the discipline, or body of knowledge that uses the techniques, while method is the path that aims towards a systematically pursued target (Kumar, 2019). The path means that such information can be gained by learning and study.

Methodology lays out the procedure for analysis, and it begins with the selection of a paradigm which informs the study (Chilisa & Kawulich, 2012). A method is a functional implementation of research while a technique is the theoretical and philosophical foundation of a method. Chilisa and Kawulich (2012) concluded that methods are the medium and an essential part of the techniques used to collect data. Methodology refers to research design, processes, techniques and procedures used to discover something in a well-planned investigation (Kivunja & Kuyini, 2017). Many academics have interchangeably employed research methodology and study strategy, which means one and the same thing (Choi, 2014; Oyewobi, 2014). However, according to Morgan (2007), Rehman and Alharthi (2016) and Kivunja and Kuyini (2017), paradigms as positions on epistemology, ontology and axiology have tremendous influence on the methods to be used in a study, since choosing a paradigm means near certainty as to the methodologies that flow from such a paradigm.

4.4.1 Qualitative research methodology

According to Greener (2011) and Saunders *et al*. (2019), qualitative researchers or interpretivists assume being unable to reach the outside world directly, but still by men's constructions. This stance is in accordance with Stiles (2003) who argued that perception relies on the idiosyncratic perception of available data, as it is assumed that environment is socially influenced by people's perception of it. Creswell (2014) identified qualitative study to investigate and analyse the relevance of a social or human problem, and research involves emerging problems and procedures. Information gathered in environment of the participant inductively constructs data analysis from unique to core questions, researchers interpreting significance of data. Qualitative data are obtained through direct experiences such as interviews or observations, which are very time-consuming (Westat, 2002; Choi, 2014).

4.4.2 Quantitative research methodology

Quantitative analysis allows testing analytical hypotheses by comparing relationships among variables, these variables may be calculated in turn, on equipment normally, in order to evaluate numerical data using statistical procedures (Creswell, 2007; Choi, 2014; Khaldi, 2017). Quantitative work refers to findings and measurements which other researchers may make objective and replicate (Westat, 2002; Creswell, 2007). It is also assumed that data obtained by quantitative approaches provide more reliable and accurate information as it is obtained using structured methods that can be repeated (Westat, 2002; Choi, 2014). Quantitative work is related to a post positivist view of the world (Creswell, 2014; Saunders *et al*., 2019). A quantitative analysis methodology promotes the use of the questionnaire to collect data, as well as using accurate, reliable methods, testing hypotheses, and producing representative data by random sampling (Stiles, 2003; Oyewobi, 2014; Choi, 2014).

4.4.3 Mixed Methods research methodology

This is a framework for a systematic scientific analysis method consisting of a qualitative or quantitative vital part that directs the theoretical pulsion, with additional qualitative or quantifying components that can be carried out separately or in combination to improve definition (Morse, 2003; Chen, 2006; Khaldi, 2017; Saunders *et al*., 2019). Study on mixed methods is both a theory and a process, involving the selection, analysis and mixing of approaches in one or a number of studies (Creswell *et al*., 2006; Saunders *et al*., 2019). Johnson and Onwuegbuzie (2004); Yin (2006) and Saunders *et al*. (2019) stated in a related development that mixed methods is a form of research in which researcher blends research techniques, processes, strategies, principles into one analysis. Mixed methodology research incorporates the philosophies of quantitative and qualitative methodology in a study, integrating the strengths of each approach to balance the shortcomings of individual methods and improving the legitimacy and reliability of research findings (Love *et al*., 2002; Easterby-Smith *et al*., 2012; Creswell, 2014; Choi, 2014; Kumar, 2019). Guba and Lincoln (2005) inquired whether it was possible to mix attribute of a method into another method in such a way that resulting research presents best attributes of the two world views? They noted that the response has to be a cautious yes from their perspective, particularly if the models share similar or strongly resonating axiomatic elements between them.

When researching a phenomenon, the mixed approach incorporates the strengths of both quantitative and qualitative approaches. Many researchers benefit from this because it draws on the strengths of both approaches to achieve the research goals. The researcher collects and analyzes the data in this process, incorporates the results and draws inferences in a single analysis using both qualitative and quantitative methodologies (Creswell, 2007; Choi, 2014). Mixed analysis obeys principles of intellectual rigour, and the value of the combined abilities of both methods while compensating for both approaches' limitations. According to Khaldi (2017) and Choi (2014), the added benefit of the mixed approaches is the possibility it gives the data triangulation work. Work on mixing methods may be descriptive, explanatory or exploratory.

Creswell and Plano Clark (2011) revealed three major decisions to be made by a researcher before selecting a specific form of mixed method design, the first relates to performing the qualitative and quantitative stages concurrently or sequentially, the second determines if both methods are given equal priority and the final issue is to determine where the mixing of qualities is concerned. By using mixed methods analysis, Creswell and Plano Clark (2011) and Saunders *et al*. (2019) identified six study techniques or approaches and concluded that the mixed methods techniques provide valuable frameworks for researchers. They are convergent parallel, sequential explanatory, sequential exploratory, embedded, transformative and multiple designs. The mixed approach used in a study depends on the research's theoretical perspective: whether the analysis is firmly based on a theory or indirectly based on a theory, the strategy's priority: whether equal, qualitative or quantitative, data collection sequence: whether qualitative first, quantitative first or no series, and finally the point at which the data are integrated: at data collection, analysis, interpretation or with a form of combinations (Terrell, 2012). The design adopted in this study was covergent parallel design, so it is clarified further.

4.4.3.1 Convergent parallel design

Covergent parallel design in literature has also been described as concurrent triangulation strategy, integrative research, parallel study (Tashakkori & Teddlie, 1998; Creswell *et* *al*., 2006; Johnson *et al*., 2007; Terrell, 2012). Under convergent parallel design, there are two simultaneous phases of data collection, and priority should be equal but either approach can be given. Data are incorporated during the interpretation process and the interpretation notices either a lack of convergence or convergence that enhances information statements (Terrell, 2012). The primary aim of triangulation within a single study is for clarification, corroboration, or cross-validation. One of its strengths is the fact that many researchers are familiar with the process, the other is that it enables shorter data collection times as opposed to sequential methods and balances limitations inherent in one design by using both. Researchers have found that its weakness is that it takes a great deal of skill and effort to research the phenomenon using two distinct methods and data types that can be difficult to compare to address differences when they occur (Terrell, 2012).

Creswell and Plano-Clark (2011) revealed four distinct stages in the implementation of the convergent concept:

i. Although qualitative and quantitative data are collected simultaneously during data collection period, they are collected separately, as one data set does not rely on the other's results;

ii. In the analysis, using traditional qualitative and quantitative analytical techniques two samples are independently and separately analyzed;

iii. This stage may involve comparing or converting results, it is the merging stage, ensuring that both sets of data are linked during further study. According to Plano-Clark *et al*. (2011), fusion may be achieved in one of the following ways:

a. Fusing into a discussion, especially in a section of the research conclusion;

b. Assembled with a matrix and

c. Fusion by transformation of the data.

Finally, the researcher interprets the data to assess the degree and manner in which the findings overlap, diverge or better yet refer to each other in order to establish an interpretation of the research problems.

4.5 Methodology Adopted for the Study

The study on cost control model for effective dam projects delivery in Nigeria adopted mixed methods methodology, this approach allows drawing from the inherent advantages in the mixed methods to enhance the quality of the outputs in this research. Mixed methods have been developed to enhance the trust and reliability of results; it also enhances its validity; it is successful in stepping up creativity and process innovation (Easterby-Smith *et al*., 2002; Kumar, 2019). To uncover the peculiarities and complexities around the construction industry, management analysis need to draw from the power of qualitative and quantitative study methods (Love *et al*., 2002; Dainty, 2008). According to Easterby-Smith *et al*. (2002) and Kumar (2019), by incorporating confirmatory and exploratory work at the same time, mixed approaches will assist in synthesizing and integrating hypotheses, thereby providing greater plurality of views and drawing stronger inferences. Terrell (2012) pointed out that the primary aim of covergent parallel design in mixed methods methodology is to confirm, corroborate or cross-validate within a single sample, therefore, this research also benefits from the advantage of mixed methods for verifying, corroborating and cross-validating performance.

Based on the philosophical position developed, the methodology and the advantages of both qualitative and quantitative methodologies and, more importantly, the advantages of using the best qualities of each to achieve the goal of the research and accepting the fact that the qualitative methodology better measures some aspects of the objectives of this research. The quantitative approach better matches certain other goals. Hence, this research adopted mixed methods methodology using covergent parallel as the strategy for data collection. Figure 4.2 details the procedure adopted in this research.

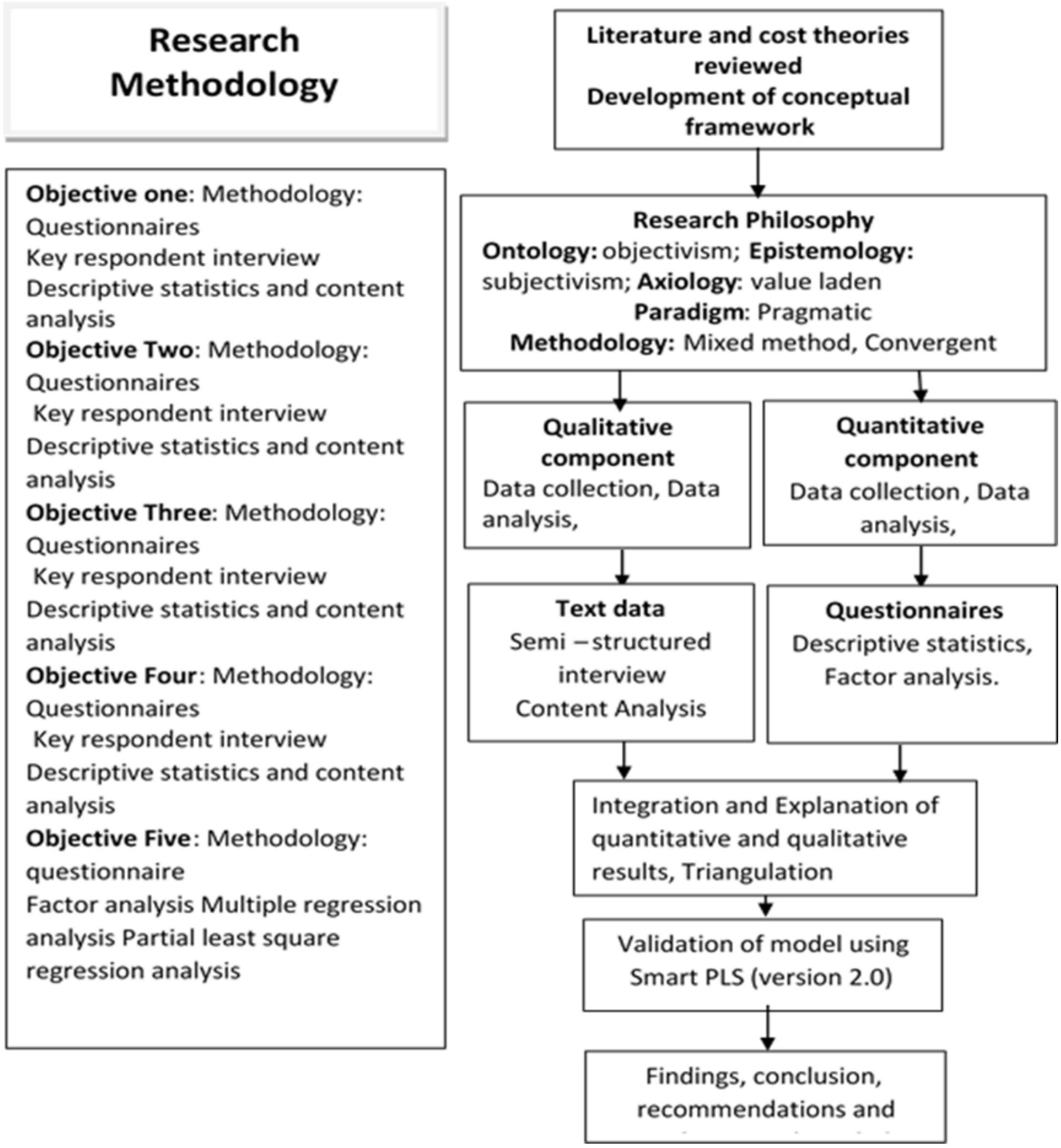

Figure 4.2: Flowchart of the stages in the implementation of a convergent design

Source: Researcher, 2019

Elements of both quantitative and qualitative data strands applied to this study came from the foregoing: -

i. Referring to the study objectives, quantitative data were produced from causes of poor delivery of dam projects in Nigeria, effects of poor delivery of dam projects, familiarity with and frequency of use of techniques for cost control, driver assessment and challenges of applying different cost control techniques found.

ii. Qualitatively, for the study to generate rich, reliable and subjective data was due to the degree of participation of the researcher in the data collection process. These were eminent from the data acquired by analyzing the causes of poor delivery of dam projects, the consequences of poor delivery of dam projects and the drivers' assessment and challenges in implementing the various cost management techniques found in literature.

4.6 Data Collection Procedure

Wahyuni (2012) and Kumar (2019) established that data for a research could be classified as primary or secondary data or at times combination of both, data could also come from archival records or documents. A critical look at the research problems of this study, it was evident that data would be generated from primary and secondary sources. Existing data which have been previously collected for a different purpose, or by a third-party researcher is called secondary data. They may be published or even unpublished (Patton, 2002). Primary data refer to those that are the original materials on which the research is based. Usually first-hand testimony or direct evidence derived, collected or observed by the researcher (Choi, 2014).

This study on cost control model for effective dam projects delivery in Nigeria was focused majorly on first hand or primary data obtained from questionnaire survey on professional practitioners, semi-structured interviews in addition to data from archival records such as contract agreements, drawings and specifications and projects progress reports. Due to the goals of this research, the following data collection methods were adopted. Instruments for data collection for this research are detailed in Tables 4.3 and 4.4.

4.6.1 Interviews conducted

Interview is a method of collecting qualitative data whereby a researcher asks question or questions orally and records the interviewee's response (Masejane, 2012; Wahyuni, 2012; Saidu, 2016; Saunders *et al.*, 2019). Interview schedule is a system of data gathering which allows an interaction between the interviewed and the interviewer on matters about the problems of a research, where the interviewer becomes an attentive listener (Saidu, 2016). Interviews were used in this research to explore perspectives because information was of a qualitative nature. The interest among researchers in using the interview is related to its versatility, as it ranges from formal to open-ended interviews (Saunders *et al*., 2019). Many researchers support the need for the interviewer to enter into a relationship with the interviewee so that accurate and relevant data can be obtained. Semi - structured interviews was adopted in this study. The questions were a collection of open-ended, research-based questions; which included some suggestions to support the interviewees. This approach allowed the researcher the right to seek out or pursue a new line of inquiry for the interviewee (Masejane, 2012; Saidu, 2016). The advantages of interview include that it generally offers the best data and fresh insights, it provides basis to explore the subject in detail, it permits face-to-face contact with respondents, however its drawbacks are it is time consuming and expensive; and its versatility can lead to discrepancies across interviews (Westat, 2002; Wahyuni, 2012). The interview was based on the 18 dams selected for the study. The contractor's project managers or their equivalent in rank and authority were the people interviewed. One project manager was interviewed per project or per contractor. The choice of projects for the study was based on purposive sampling technique. In recording the interviews, tape recorder was used as well as notes by the interviewer. Majority of the interviews did not exceed a duration of 30 minutes. A sample of the transcribed questions and answers are in appendix C.

4.6.2 Survey Questionnaire

Questionnaires are a very popular method of gathering data, particularly where large information is needed, where standardization matters, like this research on cost control model for effective project delivery of Dams in Nigeria, the questionnaire consisted of two parts: questions and answers (Westat, 2002; Wahyuni, 2012). Surveys are usually chosen when information is to be gathered from several individuals, or when responses to clearly identified questions are needed. Many scholars agree that surveys are useful for the inexpensive collection of descriptive data. Data collected can be analyzed with a variety of existing technologies, but its drawbacks include that data may offer a generalized image which lack specifics (Westat, 2002). A sample copy of the questionnaire used in this study is in appendix B.

4.6.3 Archival Records or Document Analysis

That refers to actual documents (as opposed to transcripts of research interviews). It comprised of newspapers, magazines, books, blogs, notes, conversation transcripts, and annual reports (Trochim, 2006). Sometimes existing documents provide insights into an environment that cannot be viewed or noticed in a different mode (Westat, 2002). Data collection from archival records was based on the 18 selected dams. Documents such as contract specifications, files, and progress reports on the implementation of the projects were collected and data extracted therefrom analysed to give insights and helped answer the research questions. From the contract documents for the projects data such as dates of award of contracts, duration, cost at award, revised costs, percentage completion of projects, time elapsed since award were extracted. From the documents available at the Budget Office of the Federation of Nigeria, data such as annual appropriation for each of the projects and annual releases were obtained for analysis. The advantages included that they were available locally, inexpensive, provided information on historical trends or sequences (Westat, 2002).

4.7 Study Population and Sample

This research adopted a problem-solving approach. Historical information was gathered from 18 large dams already discussed under the scope of the study in Chapter One. The locations of the various projects are shown in Figure 4.3. Five of the dams were categorized as completed, another five as abandoned or failed and eight categorized as on-going. Table 4.2 details the names of the projects, locations and status of implementation.

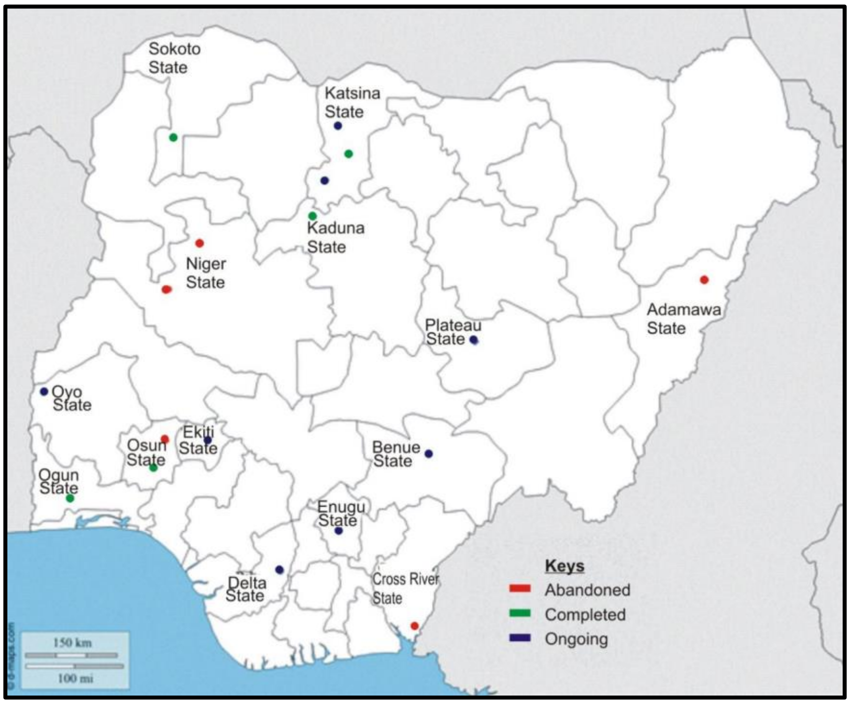

Figure 4.3: Locations of the dam sites

Source: d-maps.com (2016)

Table 4.2: Name of Project, Status and Location

Name of project	Status of implementation	Location
Ogwashi-Uku Multipurpose Dam	On-going	Ogwashi -Uku, Delta State
Jare Dam and Access Road	On-going	Jare, Katsina State
Ingawa Dallaje Dam	On-going	Ingawa, Katsina State
Ogbesse Dam	On-going	Ekiti State
Irawo Dam and Water Supply Project	On-going	Irawo, Oyo State
Adada Dam	On-going	Adada, Enugu State
Mangu Dam and Water Supply Project	On-going	Gindiri, Plateau State
Otukpo Multi-purpose Dam Project	On-going	Otikpo, Benue State
Kagara Dam	Abandoned	Kagara, Niger State
Qua Falls Dam	Abandoned	Calabar, Cross River State
Ile-Ife Dam	Abandoned	Ile-Ife, Osun State
Kontagora Dam	Abandoned	Kontagora, Niger State
Jada Multi-purpose Dam	Abandoned	Jada, Adamawa State
Shagari Dam	Completed	Shagari, Sokoto State
Gurara Dam	Completed	Kaduna State
Owiwi Dam	Completed	Owiwi, Ogun State
Ilesha Dam	Completed	Ilesha, Osun State
Gimi Earth Dam project	Completed	Gimi, Kaduna State

Source: FMWR (2016)

4.7.1 Research population

Asika (2009) viewed population to be all conceivable element, subject or observation relating to a phenomenon of interest. Population can be described as all individuals or things one wants to understand (Rahi, 2017). The sample population was a full collection of elements (persons or objects) that possessed certain specific and distinct characteristics according to the researcher's sampling criteria (Cassim, 2014; Saidu, 2016). It is often important to delineate the population of a research, from where the sample is to be drawn. A researcher is therefore, permitted to define a population in a way deemed appropriate, to effectively answer to the research questions created (Saidu, 2016). A subject is the individual items that make up the population, therefore the target population of this study was divided into four groups namely: dam construction projects commencing from 1990 going forward, spread across the country; the construction companies executing the construction processes (represented by the site managers or supervisors), dam professional who were members of the Nigerian Committee on Large Dams (NICOLD), members of the Nigerian Institution of Water Engineers (NIWE) and the Technical Officers of the dam projects promoters or clients. The population frame which was the source material from which sample was drawn comprised of all the large dam construction projects from 1990 from which eighteen projects were selected, spread across the country to fit into pre-determined categories of on-going projects, completed projects and abandoned construction projects. The number of dam construction projects selected was 18, the construction companies were eighteen (18), the number of consultants were eighteen (18), the membership of NICOLD was 240 professionals while that of the NIWE was 480 Engineers, giving a total population for the study to be 756 professionals. Majority of the clients' staff were pooled either as members of NICOLD or as NIWE members.

4.7.2 Research sample

The reason for a research is to provide answers to an existing problem with an aim to finding a principle that is universally applicable. Establishing a universally applicable principle requires a study of a targeted population or group (Taherdoost, 2016; Ijaola, 2017). Populations are often wide, expansive, extensive and numerous to cover within the study; therefore, the coverage of the entire population is usually not feasible during research, hence samples are chosen, and conclusion made by generalising from samples. The optimal sample is one which provides a perfect representation of the population with all the appropriate population characteristics (Saidu, 2016; Taherdoost, 2016). Cassim (2014) opined that a sample is a smaller study community of persons who must represent the whole population so that the data from the sample would accurately represent the target population. Sample units for this study are dam construction projects and construction companies while the sample elements were construction professionals working in projects and companies, members of professional organisations like NICOLD and NIWE.

4.7.3 Sample size determination

The sample dimension is the number of data sources chosen from the total population, and the basic concepts of statistical sampling suggest that the precision of an estimate from a probability sample is highly affected by the sample size itself (Taherdoost, 2016). The value of sample size in assessing results accuracy is the reason why larger samples produce more reliable estimates than smaller samples do (Taherdoost, 2016; Saidu, 2016). Increasing demand for research warrants an efficient method for determining the sample size required to be representative of a given population (Krejcie & Morgan, 1970). Krejcie and Morgan (1970) published a schedule to determine sample size from a given population. Total population for this study was 240 NICOLD members, 18 contractors, 18 consultants and 480 NIWE members totaling 756. Using the Krejcie and Morgan table, total test number was 254. This sample size of 254 was made up of 85 NICOLD members and 169 NIWE members summarised in Table 4.3 whereas the Krejcie and Morgan table for a given population is Table 4.4. Sampling is the tool for selecting population segment for analysis and there are many explanations for sampling including: improved data collection speed, accuracy of tests, and cost-effectiveness (Copper *et al*. 2003; Rahi, 2017). Types of sampling methods commonly available are, probability and non-probability sampling (Taherdoost, 2016; Rahi, 2017). Each component has equal odds of being picked in the sampling of probability approach, this strategy involves simple random, systematic random, stratified random, cluster and multi-stage sampling (Taherdoost, 2016; Rahi, 2017). In non-probability approach to sampling, likelihood of each unit chosen is not known or verified, and the method includes; purposeful, convenience, snowball, quota and sampling of decisions (Taherdoost, 2016; Rahi, 2017).

Table 4.3: Sample Size of the Respodents

	Population Frame	Test Size	Covered/ Retrieved	Coverage/ Retrieval rate (%)
Number of contractors	18	18	13	72.2
Number of consultants	18	18	14	77.8
Members of Nigerian Committee on Large Dams (NICOLD)	240	85	57	67.1
Members of Nigerian Institute of Water Engineers (NIWE)	480	169	68	40.2

Source: Researcher (2019)

Table 4.4: Test scale table from a given population

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note: N is population size; S is sample size.
Source: Krejcie and Morgan (1970).

4.7.4 Sampling technique

Morenikeji (2006) and Rahi (2017) defined sampling techniques in a research as a process of picking elements that are included in the population of study. Sampling is the assortment of a subgroup of persons from a population to provide population knowledge for statistical inferences (Black & William, 2004). A good sample of the population should be truly representative; leading to a small sampling error, the effects which can extend to a universe with a good degree of trust (Kothari, 2004; Rahi, 2017). As a rule, sample have similar characteristics with the community it was taken from.

This study was targeted at large dam construction projects in Nigeria. Under this circumstance, a non-probabilistic, purposive sampling technique was adopted in selection of dams for the interview and archival records. Purposive or judgmental sampling was a type of sampling technique, that subjects were selected depending on some characteristics (Saidu, 2016; Rahi, 2017). Judgmental sampling was used for selecting some cases of a type in the population (Blaikie, 2010; Rahi, 2017). The non-probability sample does not provide a chance for each population item to be selected, however the link between sample and population size is known as sampling ratio (Blaikie, 2010; Taherdoost, 2016). This choice was because the study was aimed at a specified group that could best answer research questions (Ibrahim, 2014; Rahi, 2017). According to Ibrahim (2014) and Rahi (2017), a case study may be used to generalize a research population if the set of cases is systematically selected. Guthrie (2010) emphasized that this would provide a high likelihood for a case study outcome to reinforce the population trend. In the selection of respondents from the professional groups of NICOLD and NIWE, simple random sampling (probability sample technique) was adopted. This ensured that each data set in the population has equal chances of being included in the study (Taherdoost, 2016; Saidu, 2016).

4.8 Data Collection Instruments

The research questions and goals were the basis of data collections strategies and instruments designed for the study. The data gathering strategies are detailed in Table 4.5 while the instruments for data collection are in Tables 4.6.

Table 4.5: Research design and data collection instruments

S/N	Study Goals	Purpose	Method
1	To determine reasons for poor dam projects delivery in Nigeria	Evaluate reasons for poor dam projects deliver in Nigeria.	Survey, interview and report review
2	To assess the effects of poor dam projectsdelivery in Nigeria.	Determined how poor dam project delivery affect stakeholders	Survey, review of records and an interview
3	To determine the familiarity and frequency of use of cost control techniques in dam projects delivery in Nigeria.	Determine how conversant the professionals were with the cost control techniques	Survey, review of records and an interview
4	To evaluate drivers and the problems of cost management methods applied in achieving effective dam projects delivery in Nigeria.	Exposed the enablers and challenges to use of cost management techniques in implementation of dam projects, as well as important performance factors	Survey and interview
5	To develop cost control model for effective dam projects delivery of large in Nigeria.	Model was developed for industry validation. Expert interviews with professionals required to produce ultimate cost control techniques	Interview and survey

Source: Researcher (2019)

Table 4.6 Data collection instruments

Objectives	What to examine(variables)	Research instrument	Respondents	Data Analysis	
1	Causes of poor delivery of dam projects in Nigeria:	Questionnaire	Project Managers and onsite workers	Descriptive Statistics	Measures of Frequency: Count, percent, frequency
	Causes include poor project conception; Poor designs Incomplete designs; Procurement methods; Incompleteness of tender documents; Inaccurate estimation of quantities; Unavailability of competent staff; Escalation of prices; Political interference; Poor contractor-operational planning; Contractors lack of capacity; Size and plan complexity; lack of expertise of project team; Poor budget implementation	Key Respondents Interview (KRI) Guide	Project Managers	Content and thematics analysis	Variable-oriented analysis of findings and verbatim quotations
		IDI Guide Index Interview (IDI) Guide	1 Senior supervisor	Content and thematics analysis	Variable and case-oriented analysis of findings and verbatim quotations
2	Assess the effects of poor delivery of dam projects in Nigeria Contractor's loss of profit margin/income, discord between the contractor and host community, loss of revenue by the client, unemployment, waste of client's resources, poor access to water supply, food scarcity, citizens 'loss of belief in government funded projects, stunts in economic growth of the nation	Questionnaire	Project Managers and onsite workers	Descriptive Statistics	Measurements of frequency: frequency, Central Trend Measurements: Mean, Median, and Mode. Measures of dispersion or variation: Size, variance, standard deviation
		KRI Guide	Project Managers	Content and thematics analysis	Variables oriented analysis of findings and verbatim quotations.
3	Familiarity and frequency of use of cost control techniques Traditional method, activity-based costing, cost value relationship, project budget, cost forecasting, schedule control, variation analysis, contingency budget provision, project meetings	Questionnaire IDI Guide Index Interview (IDI) Guide	Project Managers and onsite workers	Descriptive Statistics	Level measures: numbers, ratios, rates, measurements and bars

4	Drivers and Challenges of cost control methods in achieving effective project delivery of dams Deep technical requirement of projects, large and complex projects development, complex technological requirement, specialized technical staff requirement, use of cost control systems by unqualified staff may lead to poor project delivery, the size of the project affect prompt and effective delivery.	Questionnaire KRI Guide	Project Managers and onsite workers Project Managers	Descriptive Statistics Content and thematic analysis	Measures of frequency: Percent, Frequency Variable-oriented analysis of findings and verbatim quotations
5	Cost control model for effective project delivery of dams in Nigeria The model must develop institutional and organizational cost control techniques and structures to ensure timely completion of projects, within approved or accepted costs and quality. Ensure environmental sustainability, meet safety requirements, ensure stakeholders satisfaction.	Questionnaire	Project Managers and onsite workers	Descriptive Statistics	Frequency measurements: Count, percent, frequency. Central Tendency Measures: Variation measures: spectrum, variance, standard deviation, Partial Least Squares Structural Equation.

Source: Researcher (2019)

4.9 Procedures for analysing and handling data

Data analysis is the arrangement of raw data systematically into a coherent pattern involving data inspection, categorization, transformation and modelling, a phase where raw data is arranged or structured to extract useful information (Gakure & Uloko, 2013). Table 4.7 describes the study's data analysis strategy.

Table 4.7: Data analysis plan

Objectives	Quantitative data	Qualitative data
1 To determine causes of poor dam delivery in Nigeria	✓	✓
2 To assess the effects of poor delivery of dams	✓	✓
3 To evaluate familiarity with and frequency of use of the techniques in project delivery	✓	
4 To evaluate the drivers and challenges in achieving effective delivery of dams in Nigeria	✓	✓
5 To develop cost control framework for effective project delivery of dams in Nigeria	✓	

Source: Researcher (2019)

For this study, as indicated in Table 4.4, descriptive and inferential statistics, content and thematic analysis of data were deployed. Partial Least Square Structural Equation Modelling was employed to develop and validate the model proposed in Chapter 3.

4.9.1 Descriptive and inferential analysis

Descriptive statistical methods employed for data analysis included frequency measurements: count, percent, duration, bar charts. Centric tendency measures: mean, median, and mode. Dispersal measures: range, variance, standard deviation, student t-test.

4.9.2 Content and thematic analysis

The content and thematic analysis tools employed included variable-oriented analysis of findings and verbatim quotations, variable and case-oriented analysis of findings and verbatim quotations. In the social sciences, content analysis is an approach developed to turn verbal and nonverbal interactions into measurable data. Goal in qualitative content analysis is to turn large volume of text systematically into a highly structured and succinct description of key findings (Erlingsson & Brysiewicz, 2017). Content analysis was used to evaluate qualitative data by a systematic categorisation of data according to the emerging themes or categories, emerging themes were codified, and codes assigned numerical values which were eventually analysed through descriptive statistics (Gakure & Uloko, 2013). Analysis of content can be used to draw qualitative inferences by evaluating the context and contextual relationship of terms and concepts, it follows a structured process that other researchers can easily reproduce, yielding results of high reliability.

Thematic analysis provides qualitative researcher with the basic skills needed for qualitative data evaluation (Braun & Clarke, 2012). Thematic analysis is a method of recognizing, evaluating, arranging, explaining and reporting patterns identified in a set of data (Braun & Clarke, 2012; Nowell *et al*., 2017). The method is flexible, however, Nowell *et al*. (2017) revealed that this flexibility may bring in inconsistency and ambiguity in the production of research-derived themes. Nowell *et al*. (2017) also concluded that for a thematic data analysis to be trustworthy, the researcher must diligently adhere to the following six steps: familiarisation with the data; generate initial codes; search for themes within the data set; review themes; describe the themes and name them, and finally report.

4.9.3 Partial least square structural equation modeling

Structural Equation Modelling (SEM) is a multivariate tool for analysis of the data. It can check both straightforward and multiplicative causal trends which are theoretically validated (Wong, 2013; Statsoft, 2013). SEM is a mixed technique, involving confirmatory factor analysis, regression analysis and direction analysis (Parveen, 2014).

Just one-degree relationship between dependent variables and independent ones can be assessed at once by most first-generation techniques. However, SEM can handle a variety of interrelated research questions by simultaneously modelling links between many dependent and independent factors (Gefen *et al.*, 2000). There are just two SEM analytical methods, the covariance base analytical method and the variance based-partial least squares (PLS) method of analysis. Linear Structural Relations (LISREL), Equation Systems (EQS), and Analysis of a Moment Structures (AMOS) are statistical applications that uses study of covariances. Thus, applications such as the PLS graph and the SmartPLS is the statistical software based on least partial squares.

PLS is a family of alternating least square algorithms or" prescriptions" that extend the principal component and the analysis of canonical correlation. Wold (1974, 1982, and 1985) designed method for analysing high-dimensional data in an environment of low structure and underwent several extensions and improvements (Henseler *et al*., 2009). Henseler *et al*. (2009) noted that an ever-rising number of scientists from variety of fields have used PLS (e.g., Hulland, 1999), management information systems (Dibbern *et al*., 2004), e-business (Pavlou & Chai, 2002), marketing (Reinartz, Krafft, & Hoyer, 2004), and consumer behaviour (eg. Fornell & Robinson, 1983).

Popularity among scientists and practitioners of the PLS route modelling is based on four genuine features (Henseler *et al*., 2009). In place of using traditional reflective mode alone, the PLS path modelling algorithm enables unregulated measurement of cause-effect connection models using reflective and formative measuring models (Diamantopoulos & Winklhofer, 2001). When the sample sizes are small, PLS can estimate route models (Chin & Newsted 1999). Furthermore, PLS path models is quite complicated (consisting of many factors in latent and manifest form) but not causing issues with the estimation (Wold, 1985).

Modelling of the PLS direction is empirically beneficial for covariance-based modelling of structural equations (CBSEM) if incorrect or non-convergent results would occur (Krijnen *et al*., 1998). In comparison, with more complex structures, the number of latent and manifest variables in terms of observations can be large. Modelling of the PLS direction may be applied if distributions are highly skewed (Bagozzi, 1994), or when observation reliability is not guaranteed (Henseler *et al.,* 2009).

4.9.3.1 Various SEM-approaches

Many approaches to SEM exist. Most widely used technique is Covariance-based SEM (CB-SEM), where software packages like AMOS, EQS, LISREL and MPlus are employed. Second is Partial Least Squares (PLS), which emphasizes analysis of variance that can be conducted using PLS-Graph, VisualPLS, SmartPLS, and WarpPLS. “r” statistical software package is also used for modelling with PLS (Henseler *et al*., 2009).

(i) CB-SEM:

In the last few decades, CB-SEM has been widely used in social science and has remained favoured method of data analysis for confirmatory or rejection of theories by testing of hypothesis, mostly when size of sample is large. Also, CB-SEM requires that data to be used must be normally distributed, above all, the model is defined correctly. Specifically, appropriate constructs are identified and connected in a way that will convert a theory into a structural equation model (Hair *et al*., 2011; Hwang *et al*., 2010; Reinartz *et al*., 2009). Several industry professionals and analysts have acknowledged that finding a data set that satisfies such criteria is always difficult to achieve. Also, if the research is testing out or exploratory in nature, where there is a priori knowledge about the relationships that exist among the constructs; the use of PLS may be the best option (Oyewobi, 2014).

(ii) PLS-SEM:

PLS-SEM is a multivariate method that allows investigation of relationships between one or more continuous or categorical predicator variables and one or more outcome variables, either continuous or categorical (Oyewobi, 2014). It is also not based on distributional assumptions of data (Vinzi *et al*., 2010). Premise on these features, PLS-SEM is seen as a good alternative to CB-SEM particularly when a researcher is confronted with small sample size, accurate predictive capability desired and when a correct model dimensions cannot be guaranteed (Hwang *et al*., 2010; Wong, 2010; Wong, 2013):

However, it has been observed that PLS-SEM has its own weaknesses which makes it inadequate for all types of statistical analysis. These weaknesses are highlighted by Wong (2013) which includes:

i. PLS-SEM requires a higher value for the structural path coefficients for small sample size of data.
ii. Multicollinearity issues could constitute a major problem if not well handled.
iii. PLS-SEM can only model unidirectional correlation, since the arrows are always headed in single direction.

iv. Potential incomplete consistency of scores on latent factors can lead to biased prediction of components, loadings and pathway coefficients.

v. Estimating the path loading coefficient can cause large mean square inaccuracies.

Despite these shortcomings, PLS is useful in modelling structural equations in applied research, particularly with limited participants and data distribution distorted, such as surveying senior female executives or multinational CEOs (Wong, 2011).

4.9.3.2 Assessment PLS path models

In assessing PLS-SEM path models, researchers (Chin, 1998; Hulland, 1999; Bagozzi & Yi, 1988) have laid down some rules and procedures to be followed. For instance, Tenenhaus *et al*. (2005) suggested that PLS-SEM model path can be verified by using the consistency of the measuring model, the structural model and each structural regression equation on three levels. In examining outer or reliability and validity of measuring model as they affect both formative and reflective outer model according to certain criteria are the focus. However, this study only examined the reflective outer model as there were no formative indicators. Thus, the criteria presented in Table 4.8 was used in evaluating the form of measurement described herein.

Table 4.8: Assessing Reflective Measurement Model

Criterion	Description
Composite reliability	Reliability of the composites will be 0.7 or higher. If it is an exploratory study, it is appropriate at 0.6 or higher (Bagozzi & Yi, 1988)
Indicator reliability	It is recommended to square each of the outer loads to find the indicator reliability value of 0.70 or above. If it is exploratory work, it is appropriate at 0.4 or higher (Hulland, 1999)
Convergent validity	0.5 or above is acceptable (Bagozzi & Yi, 1988)
Discriminant validity	Fornell and Larcker (1981) proposed that each latent variable's "square root" of average variance extracted (AVE) be greater than correlations between the latent factors
Cross-loadings	Cross-loading provides another test for legitimacy which is discriminatory. If a predictor has a higher correlation with another latent variable than with its respective latent variable, it will rethink the appropriateness of the model.

Source: Henseler *et al*. (2009); Wong (2013)

4.9.3.3 Structural model evaluation

Importance of evaluating the structural model was to define variance addressed by a latent variable or more included in model, and also to determine the degree of significance of all estimates of the PLS direction (Chin, 2010; Lleras, 2005). Chin (2010) reported that R^2 values of the endogenous construct assess the predictive power of a structural model. However, if outer model follows the standards of reliability and validity, the structural model is simple to assess.

Hence parameters provided in this work for evaluating the structural model are given in Table 4.9. Structural model is also calculated using R^2 values and direction coefficients estimation. Henseler *et al*. (2009) proposed that the effect size f^2 and predictive significance Q^2 and q^2 could also be evaluated for a more in-depth analysis. The non-parametric bootstrap method (Davison *et al*., 2003; Efron & Tibshirani, 1993) can be used in PLS path modelling to provide confidence intervals for all parameter estimates, to provide the basis for statistical inferencing. The bootstrap technique typically offers an approximation of the form, spread and bias of the sampling distribution of a statistic. Bootstrapping considers sample being studied as though it reflects the population. The procedure creates many bootstrap samples, pre-specified (e.g. 5,000). Every sample on bootstrap should have same number of cases as initial sample. Bootstrap samples are generated by randomly drawing cases from the original sample with replacement (Henseler *et al*., 2009).

Following Chin (2010) suggestion, the study used a re-sampling bootstrapping technique to analyse the statistical significance of the structural model. This procedure generates results on t-statistics for all coefficients of the path. Path coefficient explains how strongly one variable influence another. Weight of the various path coefficients help the researcher rate their relative statistical significance (Wong, 2010). Thus, the model's path coefficients (β) and t-statistics are then used to determine the relationship between the exogenous variable and the endogenous variables. This invariably results in the use of the path coefficient and the t-value to examine how the data obtained support the hypothetical paths shown in the model. In this study, a path is considered significant if it falls within these thresholds: *$p < .01$ (2.57), $p < .05$ (1.96), $p < .10$ (1.645)* for a 2-tailed test. Table 4.9 displays the criteria for assessing a structural model.

Table 4.9: Evaluating Structural Model

Criterion	Description
R^2 of inner latent variables	Chin (1998) defined R^2 values of 0.67, 0.33, or 0.19 for endogenous latent factors within the inner path model as significant, moderate, or low.
Estimates for path coefficients	In structural model, estimated values for path relationships should be evaluated based on sign, magnitude and significance (latter through bootstrapping).

Effect size f^2	$F^2 = (R^2 \text{ included} - R^2 \text{ excluded})/ (1 - R^2 \text{ included})$; values of 0.02, 0.15, and 0.35 indicate that a latent predictor variable has a low, medium, or significant structural impact.

Source: Henseler *et al.* (2009).

4.10 Rationale for judging Research Design Standard

Yin (2009); Gakure and Uloko (2013) and Oyewobi (2014) defined four parameters used at different stages to assess consistency of a research design namely: construct, internal, external validity and reliability. In qualitative and quantitative research, definition of validity is different, however, it is used in both methods to ensure data quality, findings and their interpretation.

4.10.1 Validity of data for research

Creswell (2003) and Gakure and Uloko (2013) posited that validity is the strength of qualitative research, although other researchers preferred to replace validity with terms such as trustworthiness, credibility, transferability, reliability and conformability. Validity occurs when the desired information is obtained through explanations that require an understanding of the context and nature of experience (Castillo, 2009; Gakure & Uloko, 2013). Validity of research defines whether the study really tests what it was supposed to test, or how valid the study findings are (Golafshani, 2003; Omotayo, 2017). According to Creswell (2003) and Gakure and Uloko (2013), techniques for validating research results accuracy include collecting data from three separate sources or triangulation, member testing, including making study participants review the final reports to assess accuracy, and reporting using dense descriptions.

Nachmias and Nachmias (2008) and Gakure and Uloko (2013) concluded that the question "Am I measuring what I plan to measure?" concerns validity" And further revealed three basic validity types: validity of substance, empirical validity and validity of construct. The quality of the material refers to degree to which the questionnaire items embody all aspects of the measuring system (Oyewobi, 2014). In this analysis, care was taken to ensure validity of content through comprehensive literature review, from which the items to be included in the questionnaire were derived. Also, supervisors revised the questionnaire several times before and after the pilot study was performed. Piloting helped improve survey as it offered the opportunity to modify some of the questions or change them to ensure the interviewees understand the questions and answered appropriately. Construct validity defines how the items measured what they wanted to achieve (Creswell & Plano Clark, 2011; Oyewobi, 2014).

4.10.2 Reliability of the data

Reliability in research is defined as the ability of a collected data to be reliable, trustworthy, uniform, and repeatable in interpretation or analysis (Creswell & Plano Clark, 2011; Saidu, 2016). The degree to which the findings are consistent over time and an accurate reflection of the total population being studied is called reliability, and if the findings of a test can be replicated using similar methodologies, then the research instrument is considered reliable (Golafshani, 2003; Saidu, 2016). Reliability is defined, sought, measured and recognized in the quantitative field as an important factor for indicating a study's quality (Miller, 2008; Saidu, 2016). Quantitative research reliability implies that scores the respondents produced are consistent and reliable over time (Creswell & Plano Clark, 2011; Oyewobi, 2014). Gakure and Uloko (2013) concluded that the greater the degree of the repeatability of the measures, the greater the degree of reliability and that reliability can only be estimated and not measured.

A measure of reliability is the Cronbach alpha (Cronbach, 1951). The coefficient Cronbach Alpha is a measure of internal consistency (Monyane, 2013). Alpha is a lesser boundary for the survey's true reliability. Reliability is characterized mathematically as the proportion of variability in survey responses resulting from differences between respondents. Answers to a credible survey can vary because participants have different opinions, and not because the question is deceptive or has several meanings. Cronbach's alpha of 0.6 and above has become standard denoting an appropriate degree of reliability (Norusis, 2004). The alpha estimate of Cronbach is based on the number of items (k) in the sample, and the ratio of the average inter-item covariance to the average variance of items. Scale employed in the study is the questionnaire, which was designed with seven major sections. The first two sections were on the demographics of the respondents and responding organisations, while the last five parts addressed the objectives of the study. The result of reliability testing of each part of the study instrument is presented in Table 4.10

In general, there were only two parts of the research instrument that required detailed explanation, due to the value of Cronbach's alpha obtained. Alpha value for section A and B when combined was 0.042; closer inspection revealed that section A alone had a value of 0.791. The value for section B alone could not be computed, because most of the respondents failed to provide much of the required information. The extremely low value obtained for the two sections when combined is thus a reflection of this reality.

Table 4.10 Reliability test results

Part of scale tested	Cronbach's Alpha	N of Items	Valid cases	Excluded cases	df	F	Sig
Section A, B (Demographics)	0.042	16	2	13	1, 15	3.364	0.012
Section C (Objective 1)	0.976	61	12	3	11, 60	4.003	0.000
Section D (Objective 2)	0.970	91	12	3	11, 90	2.134	0.000
Section E (Objective 3)	0,934	30	10	5	9, 29	4.069	0.000
Section F (Objective 4)	0.665	34	9	6	8, 33	10.739	0.000
Section G (Objective 5)	0.881	21	15	0	14, 20	14.383	0.000

Source: Researcher’s Field Survey (2019)

The second part of the questionnaire that required explanation was section F, which dealt with Objective 4 of the research. The Cronbach's alpha of 0.661 was gotten; this was found to be because of the mixture of different types of scales in the section. A large portion of the section utilised Likert type measurements, while a few questions required Yes/No answers. Overall, however, the results of the section are still reliable, since the alpha value exceeds 0.6 (Norusis, 2004).

4.10.3 Generalisation in the data

External validity is linked to generalization, that is the degree the study results will remain valid in other locations and at other times with other persons (Gakure & Uloko, 2013; Omotayo, 2017). It refers to degree the research results may be applied to a broader sample environment under which study was carried out, this is an important quantitative research goal (Oyewobi, 2014). External validity may be ecological validity, or validity of the population. Fellows and Liu (2008); Yin (2009); Creswell and Plano Clark (2011) and Oyewobi (2014) noted that population validity is the degree to which results from the study population can be generalized to broader population, while ecological validity is the degree to which it is possible to generalize from the specific research setting to other contexts and environments. This research adopted a non-bias approach to ensure population validity. The questionnaire was designed to ensure no wrong or right answers, this was to ensure that the research conforms to ecological validity.

4.10.4 Ethical considerations

Ethical issues in research relate to privacy, consent, confidentiality, deceit and avoiding harm to the people involved in the research, these are the norms that differentiate between what can be considered a right or a wrong behaviour in research (Saidu, 2016). For this study, research ethics were followed in gathering data, storage, and evaluation. Identities of questionnaire respondents were not disclosed. The data collected was stored in a safe environment and kept secret. This study considered plagiarism; by acknowledging the works of other people used as materials, all sources were determined and appropriately acknowledged. Anonymity and confidentiality; all individuals privacy and confidentiality privileges were safeguarded in this research. Adherence to laws and norms; the study conformed under the Laws and Regulations of the Federal University of Technology, Minna with regards to research. Honesty and trust; the research reported the data, methods and results as they were without alteration, fabrication or misrepresentation. Integrity; the study was conducted with sincerity, strive for consistency of thoughts and actions and finally, informed consent; the consent of all participants in the study were sought and duly obtained.

CHAPTER FIVE

5.0 RESULTS AND DISCUSSION

5.1 Results Presentation and Analysis

This section presents the results of all three data modes collected for analysis. It discussed the results of the key informants' interviews conducted with the contractor's project managers or their equivalent in rank and authority on the issues relating to cost control techniques and project delivery in the Nigerian construction industry. The interviews were conducted among the construction companies involved in the dam projects. The chapter also presented the results of the archival records or document analysis conducted on the selected projects as well as field data on cost control techniques and effective project delivery.

Inferential statistics was used to evaluate the hypothesis postulated for the study. Tables, figures, and charts were used for the presentation of data, analysis and interpretation of results. The results of the interviews conducted were coded as: E01 to E13.

The responses on the causes of poor dam projects delivery, effects of poor dam projects delivery, familiarity with and frequency of use of cost control techniques as well as drivers of its use were rated based on the cut-off values stated by Morenikeji (2006) in a five-point Likert scale. The cut-off points ranged from less than 1.5 to 5 as shown in Table 5.1.

Table 5.1: Cut – off points for decisions on effects or relevance

No.	Cut-off (5 to 1)	Decision
1	> or = to 4.5	Most relevant
2	3.50 to 4.49	Very relevant
3	2.50 to 3.44	Relevant
4	1.50 to 2.49	Slightly relevant
5	< 1.50	Not relevant

Source: Adapted from Morenikeji (2006)

This study used PLS-SEM to develop and validate the conceptual model presented in Chapter Three. SEM enables researchers to test complete theories, concepts and complex models by estimating the composite relationships between variables (Chin, 2010). The model was validated using Partial Least Square Structural Equation Model (PLS-SEM). Smart PLS (version 2.0) application was used to evaluate PLS-SEM using the quantitative data collected. It also reported results of R^2 and f^2.

5.2 Key Informant Interview Results and Analysis

Semi-structured interview is among the instruments and techniques for data gathering. Interviews planned were 18 in number, one interviewee on each of the contractors involved in the 18 dam construction projects listed in this study, however, only 13 of the interviewees participated the rest failed to participate for reasons ranging from not convenient to unavailable and outright refusal to participate. The study established thematic areas, based on the respondents' knowledge. The 13 interviewees were coded as E1 to E13 and the key informants' responses on each of the thematic areas are presented in Table 5.2.

Table 5.2: Themes and Interviewees Responses

Themes and sub-themes	Organisations E1	E2	E3
Socio-economic/organizational			
Highest Education/Experience	I have B.Sc. in civil engineering and I have been practicing for 30years, male	B.Eng. in civil engineering. 22 years since graduation, male	I am a graduate. I have over 30 years of experience, male.
Communication model	We use top to bottom communication	In our company instructions come from above	From top to bottom
Procurement method	Competitive bidding	We prefer competition	Open and competitive
Causes of poor dam projects delivery in Nigeria			
Contractor related	Poor capacity of contractor	Inexperience and lack of knowledge	Contractor inexperience
Client related	Non-availability of funds is a major one	Not paying certificates on time	Payment delayed for work done
Effects of poor dam projects delivery in Nigeria			
Direct effects	Loss of profit by the contractor	The contractor would be out of job	Contractors not able to make profit
Indirect effects	Poor water supply to the population	Abandonment of projects	Poor water supply, and electricity
Familiarity/frequency of use of cost control techniques			
Familiarity	Very familiar some of the techniques	Yes, I am well familiar with them	Quite familiar with many of them
Frequency of use	Our company is not using any of them	Not very frequently	We use them frequently, depends on project
Drivers/challenges of use			
Drivers	Skilled manpower and training	Experienced personnel	Proper training and re-training of staff
Challenges	Use of old methods, no computers	Lack of good, qualified personnel	Lack of skilled staff
Cost control model for dam projects delivery			
Penalty for failure	It is proper in contracts	Would be good	The penalty should be for both contractor and client
Rewards for effective delivery	That will help too	Yes, very okay	Okay, that could work well.

Table 5.2a: Themes and Interviewees Responses

Themes and sub-themes	Organisations		
	E4	E5	E6
Socio-economic/organisational			
Highest Education/Experience	M.Sc. in Water Engineering, 28 years in the field. I am a project manager, male	HND, M.Sc. 27 years. I am the Site Agent and project coordinator, male	B.Sc. I have been in practice 33 years, male
Communication model	Communications come from Managing Director down	Top to bottom system of communication	From management to staff
Procurement method	We prefer competitive bidding	All methods are okay for us	Competitive process
Causes of poor dam projects delivery in Nigeria			
Contractor related	Contractor handling too many projects at a time	Bad machines, lack of loan facilities	Excessive quest to make profit
Client related	Poor funding by client	Nonpayment for certified work	Poor budgeting for the project. Bad releases
Effects of poor dam projects delivery in Nigeria			
Direct effects	Contractor would lose profit or cut corners	Project abandonment and waste of money	Resources and time wasted
Indirect effects	No food, no water, poor electricity	Government is unable to supply to the people	Loss of interest in government funded projects
Familiarity/frequency of use of cost control techniques			
Familiarity	Very much familiar. Yes	Quite familiar, we have a dept for it.	Yes, to an extent
Frequency of use	We use some, sometimes depending on our project	Very frequently	We often use them
Drivers/challenges of use			
Drivers	Available manpower or skilled staff	The technical know-how	Availability of skilled personnel
Challenges	Non-availability of skilled manpower	Need to train people specially	The need to train people for the use
Cost control model for dam projects delivery			
Penalty for failure	I will support that	That would discourage laziness. Yes	No problem provided the client is serious
Rewards for effective delivery	Yes, yes, yes.	That will encourage contractors	Great idea

Table 5.2b: Themes and Interviewees Responses

Themes and sub-themes	Organisations			
	E7	E8	E9	E10
Socio-economic/organisational				
Highest Education/Experience	B.Sc. I have been in practice since year 2000, male	M.Sc. Civil engineering. Project Engineer, Male, 30years	M.Sc. 19 years in dam construction, male	HND, been practicing for 31 years, male
Communication model	In our company it is top to bottom	Communication is from up to down	From top to bottom	Top to bottom
Procurement method	We are not particular about that	Competitive tendering	Any which way that we get the job	Open, competitive and transparent
Causes of poor dam projects delivery in Nigeria				
Contractor related	Cutting corners and use of poor-quality materials	Weak technical base, poor understanding of project	Laxity and poor technical ability	Engagement of unqualified people
Client related	incomplete design at tender. Poor funding	Not paying as at when due to contractors	Design deficiency and poor estimates	Multiple variations in the contract
Effects of poor dam projects delivery in Nigeria				
Direct effects	Waste of money and resources	Government cannot provide services	Litigations and waste of money	Abandonment of the project
Indirect effects	project abandonment and litigation	Poor supply of food and electricity	Citizens not trusting government anymore	Lack of development in the country
Familiarity/frequency of use of cost control techniques				
Familiarity	Yes, I am familiar with some of them	Quite familiar with many of them	Yes, I am familiar with some	Sure, very familiar with the techniques
Frequency of use	We use them frequently	Not too frequent	Project complexity	Very frequently
Drivers/challenges of use				
Drivers	Trained manpower	Simplicity of the technique	Skilled personnel would encourage its use	Trained staff
Challenges	Need to train people to use the techniques	Need to train staff for its use	It is too cumbersome to apply	Training requirements
Cost control model for dam projects delivery				
Penalty for failure	Sure, it will put everyone in check	Very okay	That can put pressure of the contractor, good	We welcome that
Rewards for effective delivery	That would be fantastic	Yes, the client will sit up and do the right thing	Yes, it would help	Good, it will encourage us

Table 5.2c: Themes and Interviewees Responses

Themes and sub-themes	Organisations		
	E11	**E12**	**E13**
Socio-economic/organisational			
Highest Education/Experience	B.Eng. in Agricultural Engineering, 15 years, male	B.Sc. and I have spent 25 years in the industry, male	M.Eng. in Civil engineering, this is my 29th year, male
Communication model	From up to down	Instructions from the management	Top to bottom
Procurement method	Transparent and competitive	Competitive tendering	Open and competitive
Causes of poor dam projects delivery in Nigeria			
Contractor related	inadequate experience of contractor	Complexity of the project	inadequate technical know-how
Client related	Most important reason is financing	Funding and design errors	Incomplete designs, poor estimates of quantities
Effects of poor dam projects delivery in Nigeria			
Direct effects	Project abandonment	Government cannot provide services	Loss of revenue by the client
Indirect effects	Poor services by government	Poor supply of food and electricity	Inability to deliver services to the people
Familiarity / Frequency of use of techniques to control cost			
Familiarity	Not too familiar	Familiar	Very familiar
Frequency of use	We use them just a bit	Yes, we use them	We do a lot
Drivers/challenges of use			
Drivers	Skilled and experienced staff	Ability of the staff to adapt and ease of use	Availability of kill and technical know-how
Challenges	Lack of skilled staff	The need to train people for the use	Non-availability of trained manpower
Cost control model for dam projects delivery			
Penalty for failure	It is welcome	Should be applied to both sides	No, we cannot support that
Rewards for effective delivery	That will push the contractor to do better	It is a welcome move. We support it	Good idea, it would help

Source: Field Survey by Researcher (2019)

5.2.1 Socio-economic and organisational set-ups

Tables 5.2 – 5.2c revealed the general trends of the socio-economic and organisational patterns, as shown. All representatives were male, all had university degrees in engineering which points to the fact that they were all very well educated. About 40% of the respondents had master's degrees. All the respondents were in the management cadre in the various organisations. The number of years of practice ranged from 15 to 33 years, which was another indication of being well experienced in the field and therefore, information given by them could be adjudged as reliable. As the participants E13 and E11 stated: -

I am a Civil Engineer by profession, I obtained my bachelor's degree in engineering in 1985, and Master of Science in Civil Engineering in 1987, am registered Engineer and have been working since then on various projects. I am the Deputy Project Manager **(E13).**

I am the Project Manager. I have a B.Eng. in Agricultural Engineering and so far, I have had 15 years post NYSC experience in construction projects and other machinery project that relate to construction **(E11)**.

All the respondents indicated the communications within the organisations came from management to the staff, meaning top to bottom approach. This is an indication that all the decisions were made by the management and passed on to the staff. Majority of the respondents indicated preference for open and competitive tendering, except for E7 and E9 who claimed that it did not matter to their companies what manner of procurement method adopted as shown in Table 5.2. Again, in the words of Respondent E11 in respect of communication mode within the company:

It is top down that is from the Managing Director to project manager to the lower staff. We take instructions from the Managing Director who happens to be the owner of the company **(E11).**

5.2.2 Qualitative evaluation of causes of poor dam projects delivery in Nigeria

The respondents were asked questions relating to what they considered the most relevant factors causing poor dam projects delivery in Nigeria. This was broken into two sub-themes namely the contractor related causes and the client related causes of poor dam projects delivery in Nigeria. The responses ranged from contractors cutting corners to contractors engaging cheap and unqualified personnel. Further analysis of Tables 5.2 – 5.2c showed that contractors 'technical deficiencies and poor capacity rank highest accounting for about 60% of the causes while the other 40% was shared among cutting corners, engaging cheap and unqualified staff, handling too many jobs at the same time, and weak/unserviceable equipment/machines. On contractor-related causes of poor delivery of dam projects, some excerpts from responses to key informant interview are stated as follows.

> *The contractor related aspect has to do with the construction, especially when the procedure for the construction is not being handled according to the specification and according to the standards in the construction industry. It is very likely to have failure and that specifically has to do with a contractor because most times it is the responsibility of the contractor. In some cases, we may realise that the fund is not coming as at when due but that does not mean that the contractor should not follow the standard specification for construction. If those ones are not being followed, you are likely having a failed project* **(E7)**.

> *"Yes, in some cases, poor delivery of dam project can be attributed to the contractor and that is why it is good to go through due process to choose the contractor that will handle the project to make sure that dam project construction is given to contractors with adequate experience. If it is given to any contractor without adequate experience it leads to this kind of problem. Again, if contractors are not well supervised and make sure that they follow their program, there may be project failure. A contractor will have to submit work implementation program which must be seriously followed so that the timing of a section of the work is achieved. It is important to choose a very good supervisor and experienced consultant to supervise and follow up.*

Some contractors also try to make excessive gain. These are greedy contractors that may want to unnecessarily increase in project cost." **(E6)**

"Second cause of failure of dam projects is when a project is being handled by incompetent contractor and being supervised by incompetent professionals because in most cases you see that project are occasionally awarded to proxies, some people in government and in doing that they do not pass through proper scrutiny to make sure that projects are awarded to people of proven experience in such a project like dam just as I have said it is a specialized work which need specialty from different field of engineering. This is main reason for failure of dam projects. The other issue is when you use substandard materials in constructing these dams. There are standard materials to be used and they must be world tested. They must follow specifications so if you don't follow specifications the project is going to fail. The project must be constructed in accordance with specifications. If this is not properly done, the project can fail." **(E2)**

Other issues that may lead to poor dam projects delivery are said to be clients related. The problems attributable to clients range from poor funding of the projects to delays in payments for certified works and unto incomplete designs at tender. Further analysis showed that funding issues which envelopes delay in payment, poor budgeting and so on, accounted for over 70% of the problems while the other 30% was accounted for by issues such as incomplete designs at tender and multiple variations in the contracts. On client-related causes of poor delivery of dam projects, some excerpts from responses to key informant interview are stated as follows.

The one I will take first is timely payment of certificates. There are things the clients are supposed to provide particularly the finance. The clients are supposed to provide the finance as at when due. So, whenever the clients delay or default in payment, it affects the project planning and timing. Then, there are other aspects of the job that could be in the hands of the client to supply, like taking critical decisions, for example a project was aimed to be part of a power project, the decision to make it part of the power project took a long *time, so the original design was reversed to accommodate the power. These are the things which affect the project completion time and delivery* **(E3).**

"If you have a contract, I think the fundamental is to be sure that the cost is adequately planned for. For instance, a particular project is expected to be completed within a given time limit, it is also good to make sure that work schedule match up with availability of fund and this is where the cost planning comes in because in some cases where contracts are awarded, the contractor doesn't even have an assurance in terms of provision of money to ensure timely completion. That is one of the reasons why we have problem with uncompleted projects so far in this country." **(E6)**

"That has been a major problem of project delivery in Nigeria. particularly for local contractors. Some foreign constrictors are enjoying speedy payment but most of the contracts awarded to Nigerian contactors are not well funded. Projects that have been slated for two (2) years end up being delayed for like 5 or 6 years before execution or completion due to delay in payment and because no right values or right figures were budgeted for projects awarded. When projects are awarded and are not being funded, a project awarded for one to two years, will last 6 to 8 years, so it affects constructional method. It affects the contractor handling the project, it affects the projects even the delivery. Most dam projects in Nigeria are suffering this financial/funding failure." **(E1)**

"I think if we look at the way budgets are being made, in terms of Budgetary appropriation, we discovered that most of capital projects are not funded adequately. A project meant to be finished in 24 months, you later discover that it may take several years before the completion can see the light of the day. When project is not properly funded it can also bring about abandonment. With the little experience I have had so far and, on several occasions, when money is not been made available for the implementation of the project we have had experience where projects are abandoned for like 5-6 years. In most cases, this is attributed to scarcity of funds from Federal Government." **(E4)**

5.2.3 Qualitative evaluation of direct and indirect effects of poor dam projects delivery in Nigeria

The interview looked at the results of poor dam projects delivery in Nigeria. The effects were looked at as direct effects, the effects that is directly impacting the nation's economy, client or contractor because of poor dam projects delivery. The other aspects considered the effects that are said to be indirect, affecting the economy or the beneficiaries of the projects indirectly. From Tables 5.2 – 5.2c, the direct effects of poor dam projects delivery included loss of profit by the contractors, abandonment of the projects, waste of resources, litigations and government's inability to provide services to the people. The indirect effects range from poor water supply, loss of interest in government funded projects and poor supply of food and electricity. Further analysis of the responses showed that contractors' loss of profit account for about 31% of the responses for the direct effect of poor dam projects delivery in Nigeria. That is followed by project abandonment and waste of resources each with 23%, government's inability to provide services comes next with 15% while litigations made up the balance. On the direct effects of poor delivery of dam projects, some excerpts from responses to key informant interview are stated as follows.

> *"Yes, Dam failure has serious effect on the country's economy because dam construction is meant to achieve some purpose either for irrigation or for water supply. For irrigation purposes, it is for us to have food security. Thus, if there is failure or delay in construction of the dam it will have an adverse effect. It will also have adverse effect on the economy because it will not be able to add to the GDP. It will not be able to provide employment opportunities especially when dams are meant to be used for fisheries, irrigation purposes for crop production or supply portable water to the people. It could also have adverse effect on the community."* **(E3)**

> *"Poor delivery of dam project has serious effect on the contractor. If a contractor is given a project and he could not deliver on time, it is going to have impact on so many things. For instance, we had a project that was abandoned for 5 years because the government could not make money*

available. Within the period the company was seriously affected. The equipment engaged for the job was vandalized. Many of them were damaged for lack of use for a long duration and a lot of money spent to put them back to shape while some of them could not be used again. **(E1)**

A failed dam project could also lead to the company not being able to keep his manpower and some of the experienced staff who might leave on realizing that there is no fund coming. If a dam project was abandoned due scarcity of funds, by the time money is made available the market price of the construction materials might have increased." **(E4)**

On the indirect effects of poor dam projects delivery in Nigeria, poor supply of services by government accounts for about 62% of the responses, followed by abandonment of the project and loss of interest in government funded projects with 15% each while stunted development accounted for the balance. On the indirect effects of poor delivery of dam projects, some excerpts from responses to key informant interview are stated as follows.

"Dams are constructed for irrigation purposes, creating job opportunities for farmers and the likes and for hydro power generation. So, if we are unable to deliver on some of these dam projects, the impact is going to be felt so much in the economy because the purpose for which they were meant will not be achieved. The country will just be having setback in terms of improving the economy situation." **(E5)**

"Let me take off from the effect poor delivery of dam on the community. In a normal project, the land on which the dam is being built belongs to the community. They may have developed something on the land before it was acquired. The communities' hope is dashed of being compensated by the anticipated benefits of the dam is dashed once there is poor delivery. Secondly, there is also a direct damage by way of flooding that may affect the community either farmland or shelter. For client, a failed dam project damages the arufication and the intention of the Agency that is handling the work. Dam projects have huge financial implication, thus a failed dam project results in loss of funds. **(E6)**

5.2.4 Familiarity/frequency of use of techniques for cost control

A consideration of interview gauged level of familiarity of the respondents with existing methods of cost control. Awareness of the existence of some techniques to control costs was necessary. It stands to reason that ignorance of the existence would automatically imply zero frequency of its use. The interviewees responded to questions as to their familiarity with the existence of the techniques as well as the frequency or level of usage in the implementation of dam projects. The key informants' interview revealed that many of the respondents were quite conversant with existence of most of the techniques in literature. Responses ranged from very familiar to quite familiar and to not too familiar. Further analysis showed that 12 out of the 13 respondents amounting to 92% claimed familiarity with some of the techniques only one (8%) said otherwise. This finding is supported by the Akeem (2017) which stated that it was evident that cost control has a positive impact on organisational performance and also the style of management has a positive impact on organisational performance. On familiarity with and use of cost techniques, some excerpts from responses to key informant interviews are stated as follows.

> *"Variation analysis, cost forecasting, cost value relationship, the program of work, the cash flow as well. There are many techniques of course. We use as many as we can, to estimate everything from the beginning to the end, even before tendering."* **(E8)**

> *"First of all, the most common cost control technique is the cost value analysis. As contractors we also use the contingency provisions. These are the most commonly used ones."* **(E5)**

The interview also considered how frequently they use the cost techniques in dam construction delivery. The responses ranged from not using any at all to not very frequent depending on project complexity. Further analysis showed that 7 out of the 13 respondents amounting to 54% used cost control techniques frequently, not too frequent use accounted for about 31% while no use at all accounted for the balance of 15%. This finding agreed with the studies conducted by Skitmore and Marson (2005) and Adjei *et al.* (2016) which concluded that an understanding of the various types of cost control models are vital to enable managers to effectively prepare their cost control and the development of future forecasting techniques for effective project delivery.

> *"Yeah, no, no, I am not conversant with them. Basically, they are various techniques of doing that. Our company is not using any of the techniques in project planning and management, but we are doing the basic project management."* **(E11)**

5.2.5 Drivers and challenges in use of techniques for cost control

Another consideration of interview evaluated reasons why the construction companies adopt or use methods of cost control in dam projects delivery. These reasons were viewed as the drivers. In using cost techniques, there were issues or hinderances in delivery of dam projects. These issues are viewed as challenges. Tables 5.2 – 5.2c detailed the considerations of the interview respondents. The responses ranged from availability of skilled personnel or manpower to the required training to enable the personnel apply the techniques and to the complexity or cumbersomeness of the techniques. Further evaluation of the responses showed that 11 out of the 13 respondents indicated that major driver is the availability of trained or skilled manpower in the cost control techniques. This number amounted to 85% of the respondents, the balance of 15% is the simplicity of the cost control method and ability of staff to easily adapt to the use of the techniques. This finding aligns with the study by Adeagbo (2014) which revealed that the activities in the Building and Construction sector are often technical and specialised, they require adequate availability of skilled professionals and artisans but unfortunately, they are not available in the required quantity and quality and this affects the performance of the sector. On drivers of the use, some excerpts from responses to key informant interviews are stated as follows.

Yes, like I said the basic ones like the ordinary activity-based programmes are things we do. There is no basic software we use but we utilize all these but use old method of doing it. We know that there are new software's that are available in the market. I know there are new software in project management and they are all available. **(E13)**

*Presently we do not have (challenges) because we have several trainings on some of these techniques and of course we are trying to advance on those techniques***(E11)**

On the need for training some excerpts from the response to key informant interviews are stated as follows.

> *"What I think is that there is need to enlighten people. There is need for seminars on some of the techniques. People should have knowledge of what is cost control. Many people don't know, I encountered it when I went do my masters and that was when I got to know about it very well. If this kind of technique exists why are we not using it in the country as contractors in our projects? I think we need more enlightenment; more training is needed."*
> **(E10)**

The barriers or obstacles to the implementation of techniques for cost control in dam construction in Nigeria, according to respondents vary from the use of old methods, lack of qualified staff, the need to specially train people to cumbersomeness. A further study of the problems of use of these techniques showed that answers followed same pattern as the drivers for the cost control techniques. It showed that the use of old methods in the delivery of dam projects accounts for about 8 percent of the responses, the cumbersomeness of cost control techniques accounts for 8 percent while the balance of 84 percent was due to the lack of professional or well-trained staff. Some extracts from responses to key informant interviews:

"Of course, there are a lot of challenges but the change of basic rates in Nigeria, basic construction materials rate is really a challenging issue. Sometimes it is problematic to estimate the cost due to inflation rate in the market." **(E9)**

"The typical capacity of a contractor is very important in the sense that the dam project is a very technical project unlike other civil works. Company that does not have the experience and does not have the technical know-how may not be able to do deliver well." **(E4)**

In the application of cost control techniques, as earlier mentioned, if you don't manage the budget very well and if money is not released at the appropriate time as you have it in your budgeting, you face the challenge of timely completion of your project. Then if the variation also is beyond the capability of the budget or it is becoming too much, and it's not approved in good time, the project will suffer from serious delays. Some of these challenges arise if cost control technique is not well handled and managed **(E5)**

5.2.6 Ingredients of cost control model for effective delivery of dam projects

The respondents were asked to make inputs into ingredients that would engender a model for effective dam projects delivery in Nigeria. They were asked to consider penalty for failure to deliver projects on schedule. The responses were varied with majority being in support. The responses range from that the idea would discourage lazy contractors to that it should be applied to both the contractors and the client whosoever defaults. Twelve (12) out of the 13 amounting to 92% of the respondent were in support while only one was against the idea. On the inclusion of issues of penalty for poor performance in the proposed model, some of the excerpts from the responses to key informant interviews are stated as follows.

"Definitely, I can support it. Penalty is good in most of the cases but before applying penalties, there is need to be sure of the responsibilities of the client and if such responsibilities are discharged according to the agreement. Then there can be penalty for the contractor for poor delivery. However, if the client did not fulfil his contractual obligations it means there cannot be penalties." **(E6)**

> *"Yes, it will help develop control model because, when there is penalty and you face that penalty it means the contractor, client and all the stakeholders in the construction implementation and even then designers, the consultants they put everybody on their toe, because they know they have to pay penalty for failure, so it will definitely assist in developing a cost control model for these projects.***(E7)**

The respondents were also asked to consider a reward system for effective dam projects delivery in Nigeria. The responses were also majorly in support of the idea as it would encourage the contractors to do more. Some of the respondents believed that it will push the contractors to do better. All the respondents supported the idea 100%.

On the inclusion of reward for good performance in the proposed model, some of the excerpts from the responses to key informant interviews are stated as follows.

> *Yes, reward system for any work makes people to be adequately motivated to do their best, so I think it will go a very long way to help because it will motivate them. You know when they do this work without delay and failure they get rewarded for it. I think it will go a long way to avoid failure on all those projects.* **(E10)**

5.3 Results of Archival Data and Analysis

Archival data were collected from the records of the 18 dam projects earlier selected. Information were gathered from files, reports and contract documents. Table 5.3 shows summary of the data.

Table 5.3: Summary of Archival Data

Name of Dam	Project type	Procurement method	Design status at award	Cost at award (₦)	Revised Cost (₦)	Time elapsed since award (years)	Status
Ogwashi uku multi-purpose	Dam and hydropower	Tendering was free and competitive	Tentative drafting	440m	3.67b	12	completed
Jare multi-purpose	Multipurpose	Tendering was free and competitive	Tentative drafting	3.18b	11.07b	12	On-going
Ingawa dallaje	Multipurpose	Tendering was free and competitive	Tentative drafting	4.31b	10.91b	9	On- going
Ogbesse multi-purpose	Dam and hydropower	Tendering was free and competitive	Tentative drafting	5.49b	11.47b	10	On-going
Irawo multi-purpose	Multipurpose and hydropower	Tendering was free and competitive	Tentative drafting	5.64b	5.64b	5	On-going
Adada River	Dam, associated structures and water supply	Tendering was free and competitive	Tentative drafting	2.58b	5.60b	8	On-going
Mangu	Dam and water supply	Tendering was free and competitive	Tentative drafting	2.99b	13.26b	17	On-going
Otukpo multi-purpose	Multipurpose	Selective tendering	Tentative drafting	17.18b	47.83b	9	On-going
kagara	Multipurpose	Tendering was free and competitive	Tentative drafting	€15.39 + ₦199.2	14.45b	27	abandoned

Table 5.3a: Summary of Archival Data

Name of Dam	Project type	Procurement method	Design status at award	Cost at award (₦)	Revised Cost (₦)	Time elapsed since award (years)	Status
Qua falls	Dam, irrigation and hydropower	Tendering was free and competitive	Tentative drafting	3.31b	3.31b	9	abandoned
Ile ife	Multipurpose	Tendering was free and competitive	Tentative drafting	2.48b	10.87b	14	abandoned
Kontagora	Multipurpose	Tendering was free and competitive	Tentative drafting	11.38b	40.27b	12	abandoned
Jare	Dam, water supply, irrigation	Tendering was free and competitive	Tentative drafting	6.0b	6.0b	9	abandoned
Shagari	Dam and appurtenant structures	Tendering was free and competitive	Tentative drafting	699.31m	2.10b	4	completed
Gurara multi-purpose	Multipurpose	Tendering was free and competitive	Complete draft	-	52.92b	7	completed
Owiwi	Multipurpose	Tendering was free and competitive	Complete draft	2,35b	9.76b	8	completed
Ilesha	Multipurpose	Tendering was free and competitive	Complete draft	2.0b	3.5b	8	completed
Gimi	Multipurpose	Tendering was free and competitive	Complete draft	616.46m	982.63m	7	completed

Source: Researcher's Field Survey (2019)

Eighteen (18) dam projects under review, all of them where configured as multi-purpose dam projects, incorporating two or more of the following utilities: water supply, irrigation, flood control, recreation, fisheries and some even envisaged hydropower development as well. On procurement methods adopted at award, 17 projects amounting to 94% of the projects claimed to have gone through open and competitive bidding process though it was evident that the Public Procurement Act of 2007 had not come into effect at the time most of the contracts were awarded. Only one project accounting for 6% of the projects was procured through selective tendering.

On the status of the design of the projects at the time of award, only 4 of the contracts for the projects were awarded with complete and detailed design, this is equivalent to 22%of the projects, the other 14 accounting for 78% of the projects were awarded based on preliminary designs. At the time of award of the contracts, all the projects had construction duration ranging from 2 years to 4 years, but as at the end of 2019, many of them have had time elapsed on the project ranging from 5 years to 27 years, only Shagari dam was completed just 4 years after the initially allotted construction duration. None of the 18 dam projects was completed within the initial contract award sum. The cost differences range from Shagari dam which was completed at a cost variation of over 300% to Jare dam project with a variation of about 360% and the project was yet to be completed, Mangu dam has also attracted a variation of over 440% with time lapsed of 17 years and still on going. Some of the projects within the extended periods have received multiple revised construction costs, due to price escalations, inflation trends and other tendencies within the local economy such as labour cost and so on. It was also evident that none of those projects were completed within the initial cost schedule. Of all the projects considered, only Irawo dam has attracted time elapsed since award of 5 years with no variation in the award sum.

The above findings are supported by Ewa (2005) which revealed that the root causes of project abandonment in Nigeria include lack of articulated vision and objectives, lack of adequate planning for the project at inception, lack of adequate funds and budgetary allocation before projects are embarked upon and poor contract documentation. This position is further collaborated by Ewa (2013) who identified that many projects are conceived without a well-defined objective in mind, poor costing, lack of performance criteria, lack of planning, political influence in establishing projects. This is also in agreement with El-Rufai (2012) who was of the opinion that well defined vision and objectives precede execution phase if the project is not to be abandoned along the way and that the award of contracts should be guided by the Procurement Act which among others stated that funds must be available before contract is awarded.

5.4 Questionnaire Data Analysis

Data obtained from the questionnaire were analysed in this section with discussion of the results. The first part dwelt on the socio-economic profile of the respondents and their organisations while the subsequent sections were organised according to the study objectives.

5.4.1 Respondents Socio-economic profile and Organisational Profile

5.4.1.1 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 5.4 gives detailed pattern of the findings for each of the four categories of the respondents.

With regards to gender, Table 5.4 showed at least nine out of every ten of them, were males while the females accounted for less than 10 per cent. This suggests that the construction industry, especially the organizations dealing in dam construction, were male dominated. However, the few female respondents were among the NIWE and NICOLD categories. This suggests that Consultants and Contractors are likely to be more male dominated. This position is collaborated by the result of the key informants' interview which revealed that 100% of the respondents were males.

On age of the respondents, Table 5.4 illustrates that 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.

It appears the construction industry has highly educated and skilled workforce. For instance, Table 5.4 showed 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 (Table 5.4). This implies that these categories of respondents had good knowledge of various problems discussed. As collaborated in the table for results of the key informants' interviews.

Furthermore, there is the likelihood that the respondents had adequate experience of the issues around the study theme as Table 5.4 revealed that majority of them, at least six out of every ten of them, had spent 15 years or more in employment. The pattern is the same across the four categories of respondents as further revealed in the table.

Table 5.4: Socio-economic Profile of Respondents

	NIWE		Contractors		Consultants		NICOLD		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Gender										
Male	60	88.2	13	100.0	14	100.0	52	91.2	139	91.4
Female	8	11.8	0	0.0	0	0.0	5	8.8	13	8.5
Total	68	100.0	13	100.0	14	100.0	57	100.0	152	100.0
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	2	3.1	0	0.0	0	0.0	1	1.8	3	2.1
0-5	5	7.8	0	0.0	0	0.0	4	7.3	9	6.2
6-10	10	15.6	1	8.3	0	0.0	8	14.5	19	13.1
11-15	47	73.4	11	91.7	14	100.0	42	76.4	114	78.6
Above 15	64	100.0	2	100.0	14	100.0	55	100.0	145	100.0
Total										

Source: Researcher's Field Survey, 2019

5.4.1.2 Organisational profile

This section dwells on discussion of findings about the profile of the organizations with specific focus on location, ownership, management structure, staffing, operational characteristics and status of executed dam projects.

5.4.1.2.1 Location, ownership and years of existence

The overall pattern of findings about locations of organizations, ownership, and years of existence is illustrated in Table 5.5 while details of individual organizations are also presented. More than a third of the organizations have their headquarters in Abuja, the Federal Capital Territory (FCT). This is not unexpected because of the magnitude of construction activities in the FCT. Substantial proportions of the organizations also have their headquarters in the South West and the North Central zones of the country. However, as presented in Table 5.5, more than 70 per cent of the consultants, half of the contractors and less than a quarter of the NICOLD members have their headquarters in the FCT.

Table 5.5: Organisational Profile: Location, Ownership, Age and Staffing

	NIWE		Contractors		Consultants		NICOLD		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Location										
South East	5	8.6	1	10.0	0	0.0	5	10.2	11	8.5
South South	3	5.2	0	0.0	1	7.7	9	18.4	13	10.0
South West	9	15.5	1	10.0	0	0.0	12	24.5	22	16.9
North East	3	5.2	0	0.0	0	0.0	2	4.1	5	3.8
North West	8	13.8	0	0.0	2	15.4	3	6.1	13	10.0
North Central	9	15.5	3	30.0	0	0.0	6	12.2	18	13.8
FCT	21	36.2	5	50.0	10	76.9	12	24.5	48	36.9
Total	58	100.0	10	100.0	13	100.0	49	100.0	130	100.0
Ownership										
Nigerian										
Foreigner			7	53.8	13	92.8			20	74.1
Joint (Nigerian/Foreigner)			3	23.1	1	7.1			4	14.8
Total			3	23.1	0	0.0			3	11.1
			13	100.0	14	100.0			27	100.0
Year of existence										
0-5	0	0.0	0	0.0	0	0.0	1	1.8	1	0.7
6-10	1	1.5	0	0.0	1	7.1	4	7.3	6	4.1
11-15	11	16.9	0	0.0	2	14.3	5	9.1	18	12.2
Above 15	53	81.5	13	100.0	11	78.6	45	81.8	122	83.0
Total	65	100.0	13	100.0	14	100.0	55	100.0	147	100.0
Permanent Staff										
No of Cases		45		9		14		32		
Mean		238.56		291.67		38.21		230.34		
Std. Error of Mean		97.584		114.461		9.180		55.887		
Median		24.00		98.00		26.50		95.00		
Std. Deviation		654.611		343.382		34.347		316.144		
Minimum		3		40		10		3		
Maximum		4000		950		100		1500		

Source: Researcher's Field Survey (2019)

General pattern of organisations' ownership structure is illustrated in Figure 5.5. It **shows** that at least nine out of every ten of the organizations were owned by Nigerians. The pattern is the same across all the organizations as presented in Table 5.4 except for contractors' organizations with more than a fifth either jointly owned by Nigerians and Foreigners or wholly owned by foreigners.

As illustrated in Table 5.5, most of the organizations have existed for over 15 years and this is the pattern across the organizations. Table 5.5 further showed that the number of staff ranged from 3 for NICOLD and NIWE to 40 for contractors while the maximum number of staff ranged from 100 for consultants to 4000 for contractors. The mean number of staff ranged from 38 for consultants to 291 for contractors. This suggests that individual contractor employs more staff compared to other organizations. This is likely to be due to the magnitude of construction activities they engage in.

5.4.1.2.2 Operational attributes of organisations

The segment looks at study's results about the operational characteristics of the selected organisations. Specific focus was on frequency of meetings, communication model, procurement method and adopted planning techniques, among others. Many of the organizations, close to half of them, meet monthly as illustrated in Table 5.6. A little above one-fifth of them meet bi-monthly. Those who meet weekly accounted for less than one-tenth. This is the general pattern across the organizations, as presented in Table 5.6. This might be due to type of work which makes meeting at close intervals not possible.

Table 5.6: Organisation's Operational Characteristics

	NIWE		Contractors		Consultants		NICOLD		Total	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
Frequency of Meetings										
Weekly	5	7.8	2	15.4	1	7.7	5	9.6	13	9.2
Fortnightly	7	10.9	1	7.7	1	7.7	6	11.5	15	10.6
Monthly	27	42.2	8	61.5	4	30.8	29	55.8	88	47.9
Bi-monthly	17	26.6	2	15.4	5	38.5	8	15.4	32	22.5
Quarterly	0	0.0	0	0.0	2	15.4	2	3.8	4	2.8
Others	7	10.9	0	0.0	0	0.0	2	3.8	4	6.3
Total	64	100.0	13	100.0	13	100.0	52	100.0	142	100.0
Communication Model										
Top-Down	61	96.8	11	100.0	8	57.1	43	79.6	123	86.6
Bottom Up	2	3.2	0	0.0	6	42.9	11	20.4	19	13.4
Total	63	100.0	11	100.0	14	100.0	54	100.0	142	100.0
Plans Contract Operations										
Yes	58	85.3	11	84.6	14	100.0	48	84.2	131	86.2
No	7	10.3	1	7.7	0	0.0	6	10.5	14	9.2
No Response/Missing	3	4.4	1	7.7	0	0.0	3	5.3	7	4.6
Total	68	100.0	13	100.0	14	100.0	57	100.0	152	100.0
Adopted Planning Technique										
Strategic Planning	41	60.3	7	53.8	11	78.6	33	58.9	92	60.9
Action Planning	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Operational Planning	31	45.6	5	38.5	8	57.1	28	50.0	72	47.7
Assumption-based Planning	5	7.4	1	7.7	0	0.0	6	10.7	12	7.9
Contingency Planning	16	23.5	1	7.7	1	7.1	6	10.7	24	15.9
Preferred Procurement Method										
Open Tendering										
Restricted Tendering	39	60.9	10	76.9	6	42.9	46	83.6	101	69.5
Request for Proposal	4	6.2	0	0.0	3	21.4	3	5.5	10	6.8
Two-stage Tendering	14	21.9	1	7.7	4	28.6	4	7.3	23	15.8
Request for Quotations	3	4.7	0	0.0	1	7.1	1	1.8	5	3.4
Single source procurement	1	1.6	2	15.4	0	0.0	0	0.0	3	2.1
Negotiated Tendering	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	3	4.7	0	0.0	0	0.0	1	1.8	4	2.7
	64	100.0	13	100.0	14	100.0	55	100.0	147	100.0
Organisation uses Operational Software Package										

Yes										
No	12	18.8	4	36.4	3	25.0	8	15.7	27	19.6
Total	52	81.2	7	63.6	9	75.0	43	84.3	111	80.4
	64	100.0	11	100.0	12	100.0	51	100.0	138	100.0

Source: Researcher's Field Survey (2019)

Table 5.6 further shows that the most common communication model among the organisations is the ‘top-down’ approach. This is the approach adopted by majority of the organizations. However, substantial proportions of the consultants (at least two-fifth of them) and the NICOLD members (at least one-fifth of them) claimed they adopt the ‘bottom-up’ approach. This again may be due to the peculiarity of the activities undertaken by the respective organisations. The Table further shows that majority of the organisations do plan contract operations. This is the situation across all the organizations. The two most important planning techniques adopted by the organisations, in order of importance, are strategic and operational planning techniques, as illustrated in Table 5.6. The pattern is the same across all the organisations, as presented in Table 5.6. For the consultants, people responsible for operation planning activities are the CEO/Managing Director, Director Operations/Project Director and Board. For Contractors, people that are involved in operations planning activities are members of the Board, Planning Engineering Team and Technical/Management Team. For NICOLD, people involved in project operations planning are the CEO/Managing Director, Director Operations. In NIWE bodies, people responsible for project operations planning are the Head Project planning and members of the Procurement Planning Committee.

As illustrated in Table 5.6, the three most preferred tendering methods by the organizations, in order of preference, are open tendering, request for proposal and restricted tendering. Table 5.6 further shows that the pattern is the same across all the organizations. The use of operational software packages appears not to be in vogue among the organizations as Table 5.6 reveals that majority of them, at least eight out of every ten, claimed they do not use any. However, more contractors and consultants appear to appreciate the importance of operational software as more than a third of the contractors and a quarter of the consultants claimed they make use of it. Some of the types of operational software used by the organizations include advanced Microsoft project, Civil CAD, Primavera, Repsim, HEC-RAS, among others.

5.4.1.2.3 Organisations' annual turnover and status of executed projects

Findings with respect to organisations' annual turnover and the status of the executed projects are presented in Table 5.7. The figure ranged from 8 for contractors to 22 for NIWE. The minimum annual turnover ranged from 10Million for NICOLD members to 140Million naira for NIWE members while the maximum annual turnover ranged from 1 Billion naira for consultants to N120 Billion for contractors. Among the four organizations, the mean annual turnover ranged from 290 Million naira for consultants to 23.36 Billion naira for contractors. This implies that annual turnover is highest among the contractors while it is least among the consultants. This may be due to the types of services they render in dam construction value chain.

Table 5.7 Status of Executed Dam Projects

	No. of cases	Mean	Std. Error of Mean	Median	Std. Deviation	Minimum	Maximum
Turnover (₦'Billion)							
NIWE	22	3.63	2.31	0.15	10.84	0.014	50.0
Contractors	8	23.36	15.62	0.80	44.17	0.008	120.0
Consultants	12	0.29	0.08	0.19	0.29	0.003	1.00
NICOLD	18	0.44	0.16	0.14	0.66	0.001	2.4
Value of largest project handled (₦'Billion)							
NIWE	22	26.53	18.62	0.73	87.35	0.024	400.0
Contractors	8	39.19	17.24	13.00	48.75	0.35	120.0
Consultants	12	29.07	22.30	1.00	77.26	0.02	270.0
NICOLD	18	1.87	0.47	0.80	1.98	0.005	5.60
Number of projects handled							
NIWE	55	16.98	6.27	4.0	46.49	1	220
Contractors	12	4.75	1.10	3.00	3.82	1	12
Consultants	14	12.86	2.32	14.50	8.69	1	31
NICOLD	41	8.71	2.64	3.00	16.92	1	100
Number of projects completed							
NIWE	54	7.83	3.28	2.0	24.12	0	172
Contractors	12	3.17	0.84	2.00	2.92	0	8
Consultants	14	6.79	1.17	6.50	4.39	0	13
NICOLD	41	3.49	0.72	2.00	4.62	0	20

Source: Research Field Survey (2019)

The minimum value of largest project handled by the organizations ranged from 50 million Naira for NICOLD members to 350 million Naira for contractors. However, the maximum value of largest project handled ranged from 5.6 billion Naira for NICOLD members to 400 billion naira for members of NIWE. The corresponding mean value ranged from 1.87 billion Naira for NICOLD members to 39.19 billion Naira for contractors. This suggests that individual contractor handled projects of higher values compared to the other three organizations.

The mean number of projects handled ranged from approximately 5 for contractors to 17 for NIWE while the mean number of projects completed ranged from 3 for contractors and NICOLD members to 8 for NIWE members. This shows a discrepancy in the number of projects handled and the number completed. Some reasons were adduced for non-completion. These are presented in Table 5.8. The major reason was around funding issues like inadequate funding, poor budgeting, and irregular release of funds while the second reason was associated with cost variation.

This is in line with findings from previous works. For instance, Nzekwe *et al*. (2015) noted that project failure from a cost perspective is troubling while Abdul-Rahman *et al*. (2009) noted that the most important reason for delays in project execution was weak cash flow control, late payment and inadequate financial capital. Similarly, Al-Khalil and Al-Ghafy (2009) considered that the key reason for delay is finance. On funding issue, one of the respondents during the key informant interview stated the following:

> *"There is a work plan that we normally submit when we want to start a project, the work-plan. We normally stick to it. Based on the work-plan, you have done something, and you want to be paid but you are not paid at a time, the project lingers. Even if you decide to have a cost overrun, there is limit to which you can go as a contractor. So, if you cannot get the fund to now progress, you must surely delay the project to some extent that it will get to a time that you cannot even fund it anymore and you cannot progress in the project. Before you know it, the time laps will be extensive, and this is not too good for project. This*

is a main reason project fail. Before you know, you see a project of a year lasting almost ten (10) years before being completed. You will see a single work you have to do 2 times, 3 times which is not too good for a contractor." **(E10)**

Table 5.8 Reasons for Non-Completion of Dam Projects

	NIWE		Contractors		Consultants		NICOLD		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
First Reason										
Cost Variation	0	0.0	0	0.0	0	0.0	1	2.9	1	1.0
Funding Issue	39	100.0	9	100.0	14	100.0	30	85.7	92	94.8
Incompetence	0	0.0	0	0.0	0	0.0	1	2.9	1	1.0
On-going	0	0.0	0	0.0	0	0.0	3	8.6	3	3.1
Total	39	100.0	9	100.0	14	100.0	35	100.0	97	100.0
Second Reason										
Cost Variation	1	12.5	0	0.0	0	0.0	1	33.3	2	12.5
Funding Issue	0	0.0	0	0.0	0	0.0	1	33.3	1	6.3
Incompetence	3	37.5	0	0.0	1	33.3	0	0.0	4	25.0
Insecurity	1	12.5	0	0.0	0	0.0	0	0.0	1	6.3
On-going	0	0.0	2	100.0	2	66.7	1	33.3	5	31.3
Poor Design	1	12.5	0	0.0	0	0.0	0	0.0	1	6.3
Poor management	2	25.0	0	0.0	0	0.0	0	0.0	2	12.5
Total	8	100.0	2	100.0	3	100.0	3	100.0	16	100.0

Source: Research Field Survey (2019)

5.4.2 Quantitative evaluation of causes of Poor Dam Projects Delivery in Nigeria

An objective of this research was to determine reasons for the country's weak production of dam. This part of the report deals with outcomes in that regard. From results of a thorough literature review, various causative factors of poor dam production have been defined and clustered into five classes (contractor-related, procurement, cost, client and political causes). Each category likely included causes between 6 and 23. A Likert scale of 1-5 has been used to get information from the respondents based on their understanding of the degree of significance of each of the potential causative factors identified for poor performance of dam projects.

The scale was graduated as: Most relevant (5); Very relevant (4); Relevant (3); Slightly relevant (2); and Not relevant (1). Analysis was done at three levels. First the mean score for each individual causative factor was calculated and ranked group by group for each of the four categories of respondents. Second, the summary mean score was calculated and ranked group by group for all the four categories of respondents. Third, the summary mean score for each of the five groups of the causative factors was calculated and ranked to show the relative relevance of each of the groups of the causative factors in poor delivery of dam projects.

5.4.2.1 Contractor-related causes of poor dam projects delivery

The multiple factors possibly related to the contractors responsible for poor completion of dam projects are presented in Table 5.9. It shows three most significant factors, in order of severity are, unrealistic tender, technical incompetence, and variation and rework during construction. However, there are some variations across each of the four categories of respondents. For instance, to NIWE respondents, the three most critical factors, in order of relevance, are accuracy of estimates, over-estimating company’s capability, and variation and rework during construction.

Table 5.9: Contractor-Related Causes of Poor Dam Projects Delivery

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
Contractor-related Causes	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
C1.7 Unrealistic tender	3.71	6	3.92	2	4.21	1	3.91	1	3.85	1
C1.6 Technical incompetence	3.74	5	4.08	1	4.21	1	3.77	2	3.82	2
C1.17 Variations and rework during construction	3.75	2	3.54	9	3.64	13	3.75	3	3.72	3
C1.9 Low productivity and inefficiency of equipment	3.74	4	3.46	12	4.07	3	3.67	5	3.72	4
C1.12 Accuracy of estimates	3.82	1	3.85	3	3.64	12	3.49	11	3.68	5
C1.2 Lack of experienced staff and work force	3.62	8	3.85	3	3.79	7	3.70	4	3.68	6
C1.8 Over-estimating company’s capabilities	3.75	3	3.77	6	3.93	5	3.51	9	3.68	7
C1.1 Poor organization structure and communication	3.69	7	3.54	9	3.71	9	3.49	10	3.61	8
C1.13 Construction method adopted	3.49	12	3.69	8	3.71	8	3.58	8	3.56	9
C1.18 Price and design risk	3.54	10	3.46	11	3.50	14	3.58	7	3.55	10
C1.11 Poor quality of work	3.56	9	3.08	13	4.00	4	3.47	13	3.53	11
C1.14 Lack of in-depth knowledge of production process	3.53	11	3.77	7	3.71	9	3.35	16	3.50	12
C1.3 Poor working conditions	3.46	13	3.85	5	3.79	6	3.35	15	3.48	13
C1.10 Time overrun	3.38	14	2.92	18	3.71	9	3.60	6	3.45	14
C1.16 Updating cost information during construction	3.32	16	3.00	14	3.50	14	3.49	12	3.38	15
C1.15 Project complexity	3.34	15	2.92	16	3.29	19	3.35	14	3.30	16
C1.19 Quality of cost information	3.32	17	3.00	14	3.50	14	3.25	18	3.28	17
C1.20 Fraudulent practices	3.26	18	2.69	22	3.36	18	3.28	17	3.23	18
C1.23 Poor contractor – client communication	3.09	22	2.92	16	3.36	17	3.04	19	3.08	19

C1.5 Too many projects are handled simultaneously by contractors	3.16	19	2.77	21	2.93	21	2.91	21	3.01	20
C1.22 Irregular meetings	3.12	20	2.92	18	3.07	20	2.84	23	2.99	21
C1.4 Unavailability of software packages	3.12	20	2.85	20	2.64	22	2.84	22	2.95	22
C1.21 Disputes and litigation	2.99	23	2.08	23	2.64	22	3.04	20	2.89	23

Source: Researcher’s Field Survey (2019)

Among contractors, three most critical causes of poor delivery of dam projects, in order of relevance, are technical incompetence, unrealistic tender and lack of experienced staff and workforce/accuracy of estimate. Among the consultants, the three most critical factors are technical incompetence, unrealistic tender, and low productivity and inefficiency of equipment. Lastly, among NICOLD members, the three critical factors are unrealistic tender, technical incompetence, and variation and rework during construction. From the forgoing, it is revealed that unrealistic tender, technical incompetence and variation and rework during construction are critical contract-related factors responsible for poor delivery of dam projects.

5.4.2.2 Procurement-related causes of poor dam projects delivery in Nigeria

The outcome of study of the views of the respondents on the extent of relevance of procurement-related causes of poor dam projects delivery in Nigeria are presented in Table 5.10. Generally, out of the eight likely procurement-related factors, the three most critical ones, as presented in the table, which are financial status of the construction firm, the accuracy of estimates, and the adopted procurement method. There are slight variations among the four categories of respondents. Among the consultants, the second and most critical procurement-related causative factors of poor dam project delivery are error in the bill of quantities and fraudulent practices. Among the contractors, the second most relevant procurement-related factor is error in the bill of quantities.

Table 5.10 Procurement-related Causes of Poor Delivery of Dam Projects

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
Causes	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
C2.1 Financial status of the construction firm	3.82	2	4.08	1	4.07	1	4.00	1	3.93	1
C2.3 Accuracy of estimates	3.87	1	3.69	3	3.86	4	3.82	2	3.84	2
C2.2 Procurement method adopted	3.57	3	3.69	4	3.64	5	3.61	3	3.61	3
C2.7 Error in the bill of quantities	3.47	6	3.92	2	3.93	2	3.46	5	3.55	4
C2.5 Project complexity	3.54	4	3.23	6	3.57	6	3.49	4	3.50	5
C2.4 Lack of in-depth knowledge of production process	3.50	5	3.46	5	3.57	6	3.35	6	3.45	6
C2.8 Fraudulent practices	3.28	7	2.92	8	3.86	3	3.26	8	3.30	7
C2.6 Quality of cost information	3.24	8	3.23	7	3.43	8	3.28	7	3.27	8

Source: Researcher's Field Survey (2019)

On procurement-related causes of poor dam projects delivery, some excerpts from responses to key informant interview are stated as follows.

> *"Procurement as part of the process is really important. There are too many contractors in Nigeria and if the procurement process leads to the choice of the most experienced contractor, it will work the best for the client. But if you take the cheapest contractor, it might bring the situation to a certain level which will delay everything, and the client will receive poor quality."* **(E13)**
>
> *One of the important reasons for procurement process is select contractors and in doing that it is important to recognise that the capacity of the contractors is not the same. Therefore, the selection under all circumstances should be to classify the contractors into categories first before considering their competitiveness. The other reason that is related to procurement is corruption. When the procurement process is not free of corruption it is likely that you may end up picking the wrong people to do the job and when a wrong person is chosen."* **(E9)**

5.4.2.3 Finance/cost-related causes of poor delivery of dam projects

The analysis of the information on extent of the relevance of finance/cost-related factors to poor delivery of dam projects are shown in Table 5.11. Generally, out of the six likely finance/cost related causes, the three most critical ones, in order of relevance, are payment delays, variations and rework during construction, and accuracy of estimates. There is very slight variation among the categories of respondents. For instance, the second most relevant factor among the consultants is cost overrun while the third most relevant factor among the contractors is project reviews of cost information. As revealed in this analysis, 'delay in payment' is an important cause of poor dam delivery. This agrees with observations of Nguyen *et al*. (2013) and Abdul-Rahman *et al*. (2009).

Table 5.11Finance/Cost-related Causes of Poor Delivery of Dam Projects

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
Causes	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
C3.5 Payment delays	4.31	1	4.69	1	4.79	1	4.28	1	4.38	1
C3.4 Variations and rework during construction	3.90	2	4.23	2	3.93	3	3.91	2	3.93	2
C3.2 Accuracy of estimates	3.85	3	3.62	4	3.79	4	3.63	4	3.74	3
C3.1 Cost overrun	3.59	4	3.46	6	4.00	2	3.75	3	3.68	4
C3.6 Quality of cost information	3.50	5	3.62	4	3.57	5	3.40	6	3.48	5
C3.3 Project reviews of cost information	3.40	6	3.85	3	3.57	5	3.47	5	3.48	6

Source: Researcher's Field Survey (2019)

5.4.2.4 Client-related causes of poor delivery of dam Projects

There are various client-related reasons that could be responsible for poor delivery of dam projects. Findings on the extent of their relative relevance are presented in Table 5.12. Generally, the three most important ones, in order of relevance, are payment delays, technical omissions at design stage, and incomplete design at tender.

There are slight variations among the categories of respondents. For instance, among the contractors the second most relevant indices are poor project conception and poor planning for cost overrun. Among the NIWE members, the second and third most relevant factors are updating cost information and scope and design changes (variation at owner's request). The second most relevant factor among the consultants is design failure. One could see from this analysis again, the relevance of delay in payments.

Table 5.12: Client-related Causes of Poor Delivery of Dam Projects

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		**ALL**	
Causes	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	**Mean**	**Rank**
C4.12 Payment delays	4.31	1	4.54	1	4.57	1	4.39	1	4.38	1
C4.2 Technical omissions at design stage	3.87	5	4.15	4	4.36	3	3.89	2	3.95	2
C4.3 Incomplete design at tender	3.91	4	4.15	5	4.21	4	3.84	3	3.93	3
C4.1 Poor project conception	3.79	7	4.38	2	4.21	5	3.79	4	3.88	4
C4.13 Changes in design and scope (additional works at owners' request)	4.06	3	3.85	10	3.79	8	3.68	6	3.88	5
C4.5 Updating cost information during construction	4.12	2	4.00	6	3.71	9	3.47	12	3.83	6
C4.9 Variations and rework during construction	3.85	6	4.00	6	3.43	13	3.49	9	3.69	7
C4.7 Lack of plan for cost overrun	3.62	8	4.31	3	3.79	7	3.49	10	3.64	8
C4.4 Provision of mobilization funds for the project	3.54	9	3.85	11	3.86	6	3.63	7	3.63	9
C4.6 Design failures	3.50	10	4.00	6	4.43	2	3.47	11	3.62	10
C4.14 Client supervision	3.50	10	3.15	14	3.29	14	3.79	5	3.56	11
C4.8 Time overrun	3.49	12	3.92	9	3.64	12	3.51	8	3.55	12
C4.11 Clarity of exclusions in the contract	3.44	13	3.69	12	3.64	11	3.32	13	3.43	13
C4.10 Quality of cost information	3.40	15	3.46	13	3.71	9	3.26	14	3.38	14
C4.15 Disputes and litigation	3.26	16	2.69	17	2.93	16	3.21	15	3.16	15
C4.16 Irregular meetings	3.40	14	3.08	15	2.43	17	3.04	16	3.14	16
CD4.17 Unimproved contractor – client communication	3.19	17	3.08	16	3.21	15	2.98	17	3.11	17

Source: Field Survey of Researcher (2019)

5.4.2.5 Political-related causes of poor delivery of dam projects

There are political factors that could also cause poor delivery of dam projects as listed in Table 5.13. Political related causes refer to distortion or upheaval in the construction market environment occasioned by turbulence in the political sphere of the nation. For instance, whenever there is impasse or even during electioneering, the market experiences a lot of uncertainties which affect the cost of materials and labour. The inability of people to move about freely during electioneering also affect costs of materials and labour. Lack of cooperation among political parties refers to inability of politicians of different political ideologies or parties to work together to achieve a common goal, this for example manifest in a manner that a party in power intiates a project and when they lose election the new group often starts a different project rather than complete that which has been started by the previous office holder from another political party. Generally, the three most relevant of the seven factors listed in the table are price fluctuations, stability of market conditions and environmental regulations. There are also some variations among the group of respondents. For instance, the third most relevant factor, among the NICOLD members, consultants, and NIWE is political instability while the second most relevant political-related factors among the contractors is cost of labour.

Table 5.13 Political-related Cause of Poor Delivery of Dam Projects

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
Causes	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
C5.6 Price fluctuations	3.88	2	4.46	1	3.86	1	3.89	2	3.93	1
C5.2 Stability of market conditions	3.88	1	3.69	3	3.50	6	3.63	4	3.74	2
C5.1 Environmental regulations	3.43	6	3.31	5	3.43	7	4.26	1	3.73	3
C5.3 Political stability	3.78	3	2.92	7	3.64	3	3.75	3	3.68	4
C5.4 Government regulations	3.72	4	3.08	6	3.57	4	3.51	6	3.57	5
C5.5 Cost of labour	3.49	5	4.00	2	3.50	5	3.51	5	3.54	6
C5.7 Lack of cooperation among political parties	3.34	7	3.54	4	3.71	2	3.25	7	3.36	7

Source: Researcher’s Field Survey (2019)

On political-related causes of poor delivery of dam projects, some excerpts from responses to key informant interview are stated as follows.

> *"Of course, political instability could lead to poor project delivery because when some of the projects we are handling in Nigeria are awarded for like two (2) years, they end up dragging to like six (6) years because maybe along the line another government comes in, different from the one that awarded it. The new government might not have interest in such project and this will lead to delay or eventual failure of project delivery*." **(E10)**

5.4.2.6 Relative relevance of the groups of causes of poor delivery of dam projects

In this section, the relative relevance of all the five groups of causes of poor delivery of dam projects is examined. Table 5.14 details the relative relevance of the groups of causes of poor dam delivery in Nigeria.

Table 5.14 Relative Relevance of Groups of Causes of Poor Delivery of Dam Projects

Causes	NIWE		Contractor		Consultants		NICOLD		ALL	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
Financial/Cost-related causes of Poor Delivery of Dams	3.76	1	3.91	1	3.94	1	3.74	1	3.78	1
Client-related Causes of Poor Delivery of Dams	3.69	2	3.83	2	3.75	2	3.58	3	3.67	2
Political-Related Causes of Poor Delivery of dams	3.65	3	3.57	3	3.60	4	3.69	2	3.65	3
Procurement-related causes of Poor Delivery of dams	3.54	4	3.53	4	3.74	3	3.54	4	3.55	4
Contractor-related Causes of Poor Delivery of Dams	3.46	5	3.30	5	3.56	5	3.40	5	3.43	5

Source: Researcher's Field Survey (2019)

As presented in Table 5.14, the three most critical causes of poor delivery of dam projects, in order of relevance, are financial/cost, client-related and political causes. This pattern cuts across all categories of respondents with a very slight exception. Among the contractors, the third most relevant group of causes of poor delivery of dam projects is procurement related. The summary is presented in Table 5.15. Four of the groups of causes were rated to be very relevant while only contractor-related causes group was rated relevant.

Table 5.15 Summary of Causes of Poor Dam Projects Delivery in Nigeria

Causes	Mean Score	Relevance
Financial/Cost-related causes of Poor Delivery of Dams	3.78	Very Relevant
Client-related Causes of Poor Delivery of Dams	3.67	Very Relevant
Political-Related Causes of Poor Delivery of dams	3.65	Very Relevant
Procurement-related causes of Poor Delivery of dams	3.55	Very Relevant
Contractor-related Causes of Poor Delivery of Dams	3.43	Relevant

Source: Researcher's Field Survey (2019)

Anyanwu (2013) opined that it is pertinent that efficient costing should be a very strong element in project design and implementation and that the key to the success of construction investment is professional management, this position concurs with the finding of this study that one of the major causes of poor dam projects delivery is cost related. Anyanwu (2013) further stated that when management techniques are appropriately utilized during construction from the planning stage to the completion period exhausting all other principles of cost management, the cost of such scheme must be within the target cost, a further confirmation cost related issues are very vital if projects were to succeed. Ewa (2013) in confirming the importance of planning in projects success stated that project promoters should undertake adequate planning for any given project at inception based on detailed design, costing and timelines and ensuring adequacy of funds and budgetary allocation in compliance with the Public Procurement Act. According to Fugar and Agyakwah-Baah (2010), the financial group of delays ranked highest, this result agrees with Frimpong *et al*. (2003) who discovered that financial problems were the main factors that caused delay in the construction of groundwater projects in Ghana. Financial problems were revealed as the prime major factors causing delay in construction projects in Malaysia (Alaghbari *et al*., 2007; Assaf *et al*., 1995).

5.4.3 Quantitative evaluation of effects of poor dam projects delivery in Nigeria

The study's second objective was to describe the impacts of weak dam delivery in Nigeria. The emphasis was on different aspects of the results. Which are: direct effects; indirect effects; effects of the failure to apply techniques for cost control in implementing dam construction; effects of failure to apply techniques for cost control on construction costs; effects of failure to apply techniques for cost control on construction time of dams; effects of failure to apply techniques for cost control on quality of dam work. Likert scale of 1-5 was used to evaluate respondents on perception of the extent of severity on each of the listed possible effects of poor delivery of dam projects. The scale was as graduated as: Most severe (5); Very severe (4); Severe (3); Slightly Severe (2); and Not Severe (1). Analysis was done at three levels. First the mean score for each individual effect was calculated and ranked group by group for each of the four categories of respondents.

Second, the summary mean score was calculated and ranked group by group for all the four categories of respondents. Third, the summary mean scores for each of the categories of effects of poor delivery of dams were calculated and ranked to determine their relative severity. Findings on all these aspects are presented in this section.

5.4.3.1 Direct and indirect effects of poor dam projects delivery in Nigeria

5.4.3.1.1 Direct effects

The identified six possible direct effects of poor delivery of dams are listed in Table 5.16 with their mean scores and ranks. Overall pattern reveals the three critical effects of poor dam delivery, in order of severity, to be inability of government to provide services to the people; loss of revenue by the client; and inability of client to recover investment. The pattern is the same across the four categories of respondents with the exception of the consultants who perceived the third most critical effects to be contractor's loss (profit margin/income). The general rating of the direct effects is presented in Table 5.17. All the six possible direct effects were rated 'very relevant'.

Table 5.16 Direct Effects of Poor Dam Projects Delivery

	NIWE		**CONTRACTORS**		**CONSULTANTS**		**NICOLD**		**ALL**	
	Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
D1.6 Inability of government to provide services to the people	3.90	1	4.23	1	4.14	1	3.89	1	3.95	1
D1.3 Loss of revenue by the client	3.79	2	3.69	3	4.00	2	3.72	2	3.78	2
D1.5 Inability of client to recover investment	3.69	3	4.00	2	3.64	4	3.65	3	3.70	3
D1.1 Contractor's loss profit margin/income	3.65	4	3.38	5	3.93	3	3.51	4	3.60	4
D1.2 Discord between the contractor and host community	3.59	5	3.46	4	3.64	4	3.51	5	3.55	5
D1.4 unemployment	3.47	6	3.31	6	3.29	6	3.32	6	3.38	6

Source: Field Survey (2019) of the Researcher

Table 5.17General rating of Direct effects of Poor Dam Projects Delivery

	Mean Score	Rating
D1.6 Inability of government to provide services to the people	3.95	Very Severe
D1.3 Loss of revenue by the client	3.78	Very Severe
D1.5 Inability of client to recover investment	3.70	Very Severe
D1.1 Contractor's loss profit margin/income	3.60	Very Severe
D1.2 Discord between the contractor and host community	3.55	Very Severe
D1.4 unemployment	3.38	Severe

Source: Field Survey (2019) of the Researcher

5.4.3.1.2 Indirect effects

The identified six possible indirect effects of poor delivery of dams are listed in Table 5.18 with their mean scores and ranks. Overall pattern, as presented in Table 5.19, reveals the first three most critical indirect effects of poor delivery of dam projects to be waste of resources, poor access to water supply, and poor power supply. However, there is slight variation among the four categories of respondents. To NICOLD members, the third most critical indirect effect is 'stunts in economic growth of the nation while among the contractors, it is 'citizen's loss of belief in government funded projects. The general rating of the direct effects is presented in Table 5.20. Of all the six possible indirect effects, only food scarcity was rated 'relevant' while all others were rated 'very relevant'.

Table 5.18 Indirect Effects of Poor Delivery of Dams

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
D2.1 Waste of resources	4.13	1	4.08	1	4.43	1	4.05	1	4.13	1
D2.2 Poor access to water supply	4.03	2	3.69	4	4.00	4	3.79	4	3.91	2
D2.6 Poor power supply	3.94	3	3.85	2	3.71	6	3.86	2	3.88	3
D2.5 Stunts economic growth of the nation	3.94	4	3.46	5	4.29	2	3.81	3	3.88	4
D2.4 Citizens' loss of belief in government funded projects	3.93	5	3.77	3	4.14	3	3.72	5	3.86	5
D2.3 Food scarcity	3.46	6	3.15	6	3.86	5	3.35	6	3.43	6

Source: Researcher's Field Survey (2019)

Table 5.19 Ratings of Indirect effects of Poor delivery of Dam Projects

	Mean Score	Rating
D2.1 Waste of resources	4.13	Very Severe
D2.2 Poor access to water supply	3.91	Very Severe
D2.5 Stunts economic growth of the nation	3.88	Very Severe
D2.6 Poor power supply	3.88	Very Severe
D2.4 Citizens' loss of belief in government funded projects	3.86	Very Severe
D2.3 Food scarcity	3.43	Severe

Source: Researcher's Field Survey (2019)

5.4.3.1.3 Rating of direct and indirect effects

Table 5.20 lists the direct and indirect effects. It reveals, though indirect effects have higher mean score than direct effects, the two categories of effects are very relevant.

Table 5.20: Rating of main and indirect impacts of poor dam delivery

	Mean Score	Rating
Direct effects	3.66	Very Severe
Indirect Effects	3.85	Very Severe

Source: Field Survey of the Researcher (2019)

5.4.3.2 Effects of Non-application of techniques for cost control on delivery of dam projects

Failure to apply cost management strategies to major dam projects would likely have negative effects on various aspects of dam production. This segment looks at views of interviewees on impact of non-application of cost techniques on delivery of dam projects, using the same Likert scale of Most severe (5); Very severe (4); Severe (3); Slightly Severe (2); and Not Severe (1). Findings are presented in Table 5.21. It is revealed that generally, the three most important areas affected, in order of severity, by the non-application of cost management strategies are project expense, project completion time and project quality. This pattern cuts across most of the organizations. The exception was recorded for contractors who perceived completion time of the project and stakeholders' satisfaction with the project as the first and the third most critical aspects affected by the non-application of cost management techniques in dam projects. General rating is presented in Table 5.22. It shows that non-application of control cost was generally perceived to have very severe effect on all the listed aspects of delivery of dam projects.

Table 5.21: Effects of Non-application of techniques for cost control on delivery of dam projects

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
	Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
D3.1 Project cost	4.32	1	3.62	4	4.71	1	4.19	1	4.25	1
D3.2 Completion time	4.19	2	3.92	1	4.14	2	4.02	2	4.10	2
D3.3 Project quality	3.79	3	3.77	3	3.86	3	3.75	3	3.78	3
D3.4 Project scope	3.57	4	3.62	5	3.50	5	3.46	4	3.53	4
D3.5 Stakeholders' satisfaction with the project	3.51	5	3.85	2	3.57	4	3.39	5	3.50	5

Source: Field Survey of the Researcher (2019)

Table 5.22: Rating of direct and indirect effects of poor delivery of dam projects

	Mean Score	**Rating**
D3.1 Project cost	4.25	Very Severe
D3.2 Project duration	4.10	Very Severe
D3.3 Quality of the project	3.78	Very Severe
D3.4 Scope of the project	3.53	Very Severe
D3.5 Stakeholders' satisfaction with the project	3.50	Very Severe

Source: Researcher's Field Survey (2019)

5.4.3.3 Effects of non-application of cost control techniques on specific aspects of dam projects delivery

From literature it was reported that failure to implement cost management strategies may have negative effects on certain aspects of dam project delivery. For example, Ayodele and Alabi (2014) observed that many developers do not use techniques for cost control while Ogunsemi (2000) concluded that non-use of techniques for cost control resulted to incessant buildings collapse in Lagos State. Likewise, Rahman *et al*. (2013) listed construction completion delay and loss in financial return as likely consequences. Mukuka *et al*. (2014) also reported that time delay, cost overrun, arbitration, lawsuits, conflicts, and complete project abandonment may be some of the results of cost management strategies not being implemented. In this regard, the analysis appraised effects of non-application of cost control technique on delivering dam projects, and the results are summarized in this section.

5.4.3.4 Effects of non-application of techniques for cost control on construction cost of dam projects

It is expected that non-application of methods to manage costs could have influence on aspects of construction cost of dam delivery. The perceptions of the four categories of respondents were evaluated and the findings are presented in Table 5.23. As revealed by the Table, generally, if cost control technique was not applied, the first three most critical effects were perceived to be cost escalation, project delays and total project abandonment. All of them were perceived to be very severe. While the pattern cuts across the four categories of respondents, there is slight variation among the respondents. For instance, the contractors rated cost escalation and waste of resources as the most important critical effects and total project abandonment and project delays as the third most critical consequences of the inability to implement cost management strategies on the construction costs of the dam delivery. Summary rating of effects on construction cost of dam projects delivery is presented in Table 5.24. It shows that all of them were perceived to be very severe.

Table 5.23: Effects of non-application control technique on construction cost of dam projects.

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
D5.1 Cost escalation	4.24	2	4.54	1	4.57	1	4.39	1	4.35	1
D5.8 Project delays	4.25	1	4.38	3	3.93	3	3.96	2	4.13	2
D5.7 Total project abandonment	4.01	3	4.38	3	3.93	3	3.93	3	4.01	3
D5.6 Waste of resources	4.00	4	4.54	1	4.14	2	3.82	4	3.99	4
D5.9 Negative public perception	3.87	5	3.69	9	3.64	7	3.75	5	3.79	5
D5.5 Less returns on investment	3.75	6	3.92	6	3.79	5	3.53	9	3.68	6
D5.2 Contractual disputes and litigation	3.60	7	3.77	8	3.79	6	3.68	8	3.66	7
D5.3 Quality of the project	3.56	8	3.92	5	3.64	7	3.72	6	3.66	8
D5.4 Loss of profit by contractor	3.43	9	3.77	7	3.64	7	3.70	7	3.58	9

Source: Researcher's Field Survey (2019)

Table 5.24: Rating of effect of Non-application of techniques for cost control on cost of dam

	Mean Score	Rating
D5.1 Cost escalation	4.35	Very severe
D5.8 Project delays	4.13	Very severe
D5.7 Total project abandonment	4.01	Very severe
D5.6 Waste of resources	3.99	Very severe
D5.9 Negative public perception	3.79	Very severe
D5.5 Less returns on investment	3.68	Very severe
D5.2 Contractual disputes and litigation	3.66	Very severe
D5.3 Quality of the project	3.66	Very severe
D5.4 Loss of profit by contractor	3.58	Very severe

Source: Researcher's Field Survey (2019)

5.4.3.5 Effect of non-application of techniques for cost control on construction period of dam projects

It is also expected that non-application of cost control technique could have effect construction period of delivery of dam projects. Findings on the perception of the four categories of the respondents are examined in this section, as presented in Table 5.25. Generally, out of the listed thirteen possible areas of effects of non-application of cost control technique on construction period, the three most critical areas were perceived to be cost escalation, project cost, and inability to secure finance. This is the general pattern across the four categories of respondents with slight variation. To NIWE members and the contractors, the third most critical areas where non-application cost control technique could have effect on period of delivery of dam projects are 'total project abandonment' and 'reduction in the rate of national development and growth respectively'.

In Table 5.26, is summary rating of effects of the non-utilisation of techniques for cost management on construction cycle for delivery of dam projects. It shows that all of them were perceived to be very severe.

Table 5.25: Effects of non-application control technique on construction period of dam.

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
	Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
D6.2 Cost escalation	4.22	1	4.38	1	4.36	1	4.23	2	4.25	1
D6.1 Cost of the project	4.18	2	4.08	4	4.21	2	4.26	1	4.20	2
D6.6 Inability to secure project finance	3.88	4	4.31	2	3.93	3	3.79	3	3.89	3
D6.11 Reduction in the rate of national development and growth	3.87	5	4.15	3	3.86	4	3.79	3	3.86	4
D6.8 Total project abandonment	3.94	3	3.92	7	3.79	5	3.75	5	3.86	5
D6.9 Loss of returns on investment	3.79	6	3.69	12	3.71	9	3.60	7	3.70	6
D6.5 Loss of confidence	3.59	7	3.85	11	3.43	11	3.65	6	3.62	7
D6.13 Frustration of the project host communities	3.57	8	3.92	9	3.79	5	3.46	12	3.58	8
D6.4 Negative public perception	3.57	9	4.08	4	3.50	10	3.47	11	3.57	9
D6.12 Dissatisfaction of stakeholders	3.56	10	4.08	4	3.71	7	3.42	13	3.57	10
D6.10 Added risks	3.47	12	3.92	7	3.71	7	3.53	9	3.55	11
D6.7 Contractual disputes and litigation	3.51	11	3.85	10	3.21	13	3.51	10	3.51	12
D6.3 Quality of the project	3.44	13	3.62	13	3.43	11	3.56	8	3.50	13

Source: Researcher's Field Survey (2019)

Table 5.26: Rating of effect of Non-application of techniques for cost control on Construction period

	Mean Score	Rating
D6.2 Cost escalation	4.25	Very severe
D6.1 Cost of the project	4.20	Very severe
D6.6 Inability to secure project finance	3.89	Very severe
D6.3 Quality of the project	3.50	Very severe
D6.4 Negative public perception	3.57	Very severe
D6.5 Loss of confidence	3.62	Very severe
D6.8 Total project abandonment	3.86	Very severe
D6.11 Reduction in the rate of national development and growth	3.86	Very severe
D6.9 Loss of returns on investment	3.70	Very severe
D6.13 Frustration of the project host communities	3.58	Very severe
D6.12 Dissatisfaction of stakeholders	3.57	Very severe
D6.10 Added risks	3.55	Very severe
D6.7 Contractual disputes and litigation	3.51	Very severe

Source: Field Survey of Researcher (2019)

5.4.3.6 Impact of non-application of techniques for cost control on quality of work of dam projects

It also analyzed the impact of the non-application of cost methods in handling of dam projects on the efficiency of work performed. Ten probable effects were identified, and the respondents' perception was sought on Likert scale of 5. The analytical findings are set out in Table 5.27. It indicates that the perceived three most important areas where the quality component may be undermined in the event of a failure to implement cost management strategies are, in order of magnitude, waste of money, project delivery time and project expense. However, there were some variations among the categories of respondents. For instance, the consultants perceived two of the likely effects as the third most critical areas where the effect on quality could be seen. These are loss of confidence and frustration of the stakeholders. The summary ratings of all the likely effects are presented in Table 5.28. It shows that seven of the ten likely effects were perceived to be very severe while the remaining three were adjudged to be severe.

Table 5.27: Effects of non-application control technique on quality of work of dam projects.

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
D7.3 Waste of resources	4.21	1	4.46	1	3.93	2	3.98	2	4.12	1
D7.2 Project duration	4.03	2	4.15	3	3.64	7	4.02	1	4.00	2
D7.1 Project cost	3.96	3	4.23	2	4.07	1	3.91	3	3.97	3
D7.5 Stakeholders' satisfaction with the project	3.66	4	3.85	4	3.71	5	3.65	4	3.68	4
D7.8 Less return on investment	3.66	4	3.62	8	3.71	6	3.61	6	3.64	5
D7.10 Frustration of the stakeholders	3.60	6	3.54	9	3.86	3	3.58	7	3.61	6
D7.9 Loss of confidence	3.38	8	3.54	10	3.86	3	3.63	5	3.53	7
D7.4 Scope of the project	3.54	7	3.85	4	3.07	10	3.49	9	3.51	8
D7.7 Loss of job	3.35	10	3.69	7	3.36	9	3.51	8	3.44	9
D7.6 Contractual disputes and litigation	3.37	9	3.77	6	3.50	8	3.37	10	3.41	10

Source: Field Survey of Researcher (2019)

Table 5.28: Rating effect of Non-application of cost control technique on Quality of work of project delivery

	Mean	Rating
D7.3 Waste of resources	4.12	Very severe
D7.2 Project duration	4.00	Very severe
D7.1 Project cost	3.97	Very severe
D7.5 Stakeholders' satisfaction with the project	3.68	Very severe
D7.8 Less return on investment	3.64	Very severe
D7.10 Frustration of the stakeholders	3.61	Very severe
D7.9 Loss of confidence	3.53	Very Severe
D7.4 Scope of the project	3.51	Very severe
D7.7 Loss of job	3.44	Severe
D7.6 Contractual disputes and litigation	3.41	Severe

Source: Researcher's Field Survey (2019)

5.4.3.7 Impact of non-application of techniques for cost control on Scope of work of dam projects

Scope of work in the implementation of dam projects is very important. As Alinaitwe *et al*. (2013) have noted, five main reasons for delays include adjustments in the scope of works. Therefore, the research investigated the impact of non-application of techniques for cost control on quality of work performed. Ten probable effects were identified, and the respondents' perception was sought on Likert scale of 5. The analytical findings are set out in Table 5.29. The three most important effects associated with the scope, as viewed by the respondents' generality, are project expense, project completion time, and expense escalation in that order. There are slight variations among individual categories of respondents. For instance, among the consultants, the first most critical effect is cost escalation which was perceived as the third most critical factor among the NIWE members. The summary ratings of all the likely effects are presented in Table 5.30. Seven of the likely effects were rated as very severe while the remaining three were rated as severe.

Table 5.29: Effects of non-application control technique on Scope of work of dam projects.

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
D8.1 Project cost	4.12	1	4.23	2	4.14	2	4.18	1	4.15	1
D8.2 Project duration	4.10	2	4.31	1	3.79	5	4.09	2	4.09	2
D8.6 Cost escalation	3.96	3	4.15	4	4.29	1	3.77	4	3.93	3
D8.8 Total abandonment of the project	3.88	5	3.85	6	3.57	6	3.88	3	3.85	4
D8.4 Waste of resources	3.90	4	4.00	5	3.86	3	3.53	8	3.76	5
D8.9 Inability to secure project finance	3.69	6	3.69	10	3.86	4	3.75	5	3.73	6
D8.3 Quality of the project	3.62	7	4.15	3	3.36	7	3.65	6	3.65	7
D8.5 Stakeholders' satisfaction with the project	3.47	8	3.77	8	3.29	9	3.47	9	3.48	8
D8.10 Stakeholders satisfaction	3.38	9	3.69	9	3.36	8	3.40	10	3.41	9
D8.7 Contractual disputes and litigation	3.25	10	3.85	7	3.14	10	3.56	7	3.41	10

Source: Field Survey of Researcher (2019)

Table 5.30: Summary rating of the effect of Non-application of cost control technique on Scope of work of Dam project delivery

	Mean	Rank
D8.1 Project cost	4.15	Very Severe
D8.2 Project duration	4.09	Very Severe
D8.6 Cost escalation	3.93	Very Severe
D8.8 Total abandonment of the project	3.85	Very Severe
D8.4 Waste of resources	3.76	Very Severe
D8.9 Inability to secure project finance	3.73	Very Severe
D8.3 Quality of the project	3.65	Very Severe
D8.5 Stakeholders' satisfaction with the project	3.48	Severe
D8.7 Contractual disputes and litigation	3.41	Severe
D8.10 Stakeholders satisfaction	3.41	Severe

Source: Researcher's Field Survey (2019)

5.4.3.8 Effect of non-application of techniques for cost control on Clients' satisfaction with dam projects

It is very crucial to place premium on client's satisfaction in project implementation. In this regard, the effect of non-application of cost control technique on client's satisfaction with delivery of dam projects was analysed and the findings are set out in Table 5.31. Generally, three most critical areas where non-application of cost control can have effect on client's satisfaction, in order of severity, are completion duration, cost and cost escalation. This is the general pattern with slight variation. Among the contractors, cost escalation was rated first while among the contractors, waste of resources was rated second. The summary ratings of all the likely effects are presented in Table 5.32. Of all the thirteen possible effects of non-application of cost control techniques on client's satisfaction with delivery of dam projects, seven were rated very severe while the remaining six were rated as severe.

Table 5.31: Effects of non-application control technique on Client's satisfaction with delivery of dam projects.

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
	Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
D9.2 Project duration	4.58	1	4.23	3	4.07	2	3.96	2	4.27	1
D9.1 Project cost	4.04	2	4.08	5	4.29	1	4.02	1	4.06	2
D9.7 Cost escalation	3.88	3	4.38	1	4.07	2	3.81	3	3.91	3
D9.6 Waste of resources	3.75	5	4.38	2	3.71	4	3.75	5	3.80	4
D9.3 Quality of the project	3.84	4	4.00	6	3.36	12	3.72	6	3.76	5
D9.12 Total project abandonment	3.69	6	4.15	4	3.43	11	3.75	4	3.73	6
D9.5 Stakeholders' satisfaction with the project	3.62	7	3.85	9	3.71	4	3.58	7	3.63	7
D9.15 Inability to secure project finance	3.60	8	3.54	13	3.50	8	3.37	13	3.50	8
D9.4 Scope of the project	3.50	9	3.85	11	3.29	13	3.46	8	3.49	9
D9.9 Negative public perception	3.34	11	4.00	6	3.29	14	3.42	10	3.42	10
D9.11 Loss of income	3.32	12	3.31	16	3.64	6	3.46	9	3.40	11
D9.14 Loss of confidence	3.28	14	3.85	9	3.50	7	3.40	11	3.39	12
D9.13 Returns on investment	3.41	10	3.54	12	3.50	8	3.28	15	3.38	13
D9.8 Contractual disputes and litigation	3.29	13	3.92	8	3.29	14	3.37	12	3.38	14
D9.10 Loss of job	3.13	15	3.46	14	3.07	16	3.28	14	3.21	15
D9.16 Added risks	3.01	16	3.38	15	3.43	10	2.98	16	3.07	16

Source: Researcher's Field Survey (2019)

Table 5.32: Rating of the effect of Non-application of cost control technique on Client's satisfaction

	Mean	Rank
D9.2 Project duration	4.27	Very severe
D9.1 Project cos	4.06	Very Severe
D9.7 Cost escalation	3.91	Very Severe
D9.6 Waste of resources	3.80	Very Severe
D9.3 Quality of the project	3.76	Very Severe
D9.12 Total project abandonment	3.73	Very Severe
D9.5 Stakeholders' satisfaction with the project	3.63	Very Severe
D9.15 Inability to secure project finance	3.50	Very Severe
D9.4 Scope of the project	3.49	Severe
D9.9 Negative public perception	3.42	Severe
D9.11 Loss of income	3.40	Severe
D9.14 Loss of confidence	3.39	Severe
D9.8 Contractual disputes and litigation	3.38	Severe
D9.13 Returns on investment	3.38	Severe
D9.10 Loss of job	3.21	Severe
D9.16 Added risks	3.07	Severe

Source: Field Survey of Researcher (2019)

5.4.3.9 Impact of non-application of techniques for cost control on host community's satisfaction with delivery of dam projects

The issue of project acceptability, especially by the host community or the beneficiaries is very crucial to project sustainability. This is the reason why it is essential to ensure that the host community is satisfied with the delivery of implemented projects, including dams. In this regard, the effect of non-application of cost control technique on host community's satisfaction with delivery of dam projects was examined in the analysis and the results are set out in Table 5.33. On aggregate, the three most critical effects of non-application of cost control techniques on host community's satisfaction were perceived to be, in order of severity, total project abandonment, completion time of the project (likely to be extended), and negative public perception. Again, there are variations among the categories of respondents. For instance, among the contractors, the most critical effect has to do with the project framework while for NIWE members the third most critical effect is waste of resources. The summary ratings of all the effects of non-application of cost control technique on host community's satisfaction are presented in Table 5.34. It shows that of all the ten possible effects, only three were very severe while the remaining seven were severe. The three effects perceived to be very severe are completion time of the project, waste of resources, negative public perception.

Table 5.33: Effects of non-application control technique on Host Community's satisfaction.

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
	Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
D10.9 Total project abandonment	3.65	1	4.23	2	2.86	9	3.81	1	3.68	1
D10.2 Completion time of the project	3.60	2	4.08	3	3.86	1	3.61	2	3.67	2
D10.8 Negative public perception	3.50	4	3.62	9	3.43	3	3.56	3	3.53	3
D10.5 Waste of resources	3.51	3	4.00	4	3.14	6	3.47	5	3.51	4
D10.6 Cost escalation	3.40	5	4.00	4	3.43	2	3.53	4	3.50	5
D10.3 Quality of the project	3.35	6	4.00	7	3.36	5	3.39	7	3.42	6
D10.7 Contractual disputes and litigation	3.34	7	3.92	8	3.00	8	3.40	6	3.38	7
D10.1 Cost of the project	3.24	8	4.00	4	3.36	4	3.35	8	3.35	8
D10.4 Scope of the project	3.19	9	4.31	1	3.07	7	3.25	9	3.30	9
D10.10 Added risks	2.93	10	3.54	10	2.71	10	2.86	10	2.93	10

Source: Researcher's Field Survey (2019)

Table 5.34: Rating of the effect of Non-application of cost control technique on host community's satisfaction with dam project delivery

	ALL	
	Mean	**Rating**
D10.9 Total project abandonment	3.68	Very Severe
D10.2 Completion time of the project	3.67	Very Severe
D10.8 Negative public perception	3.53	Very Severe
D10.5 Waste of resources	3.51	Very Severe
D10.6 Cost escalation	3.50	Severe
D10.3 Quality of the project	3.42	Severe
D10.7 Contractual disputes and litigation	3.38	Severe
D10.1 Cost of the project	3.35	Severe
D10.4 Scope of the project	3.30	Severe
D10.10 Added risks	2.93	Severe

Source: Researcher's Field Survey (2019)

The finding of this study poor project delivery leads to contractor loss of profit is supported by Akeem (2017) who concluded that for an organisation to ensure more profit growth by producing quality goods and services with available resources, there is a need to control cost and reduce cost to acceptable limit and reduction on wastage and loss. Further underlining the importance of contractor's profit and project delivery, Adjei *et al*. (2016) noted that with maximum profit in mind, because the goals of any business cannot be achieved without profit, the contractor will have to turn to cost control for assistance. Ayodele and Alabi (2014) pointed out that the principle objective of project cost control is to maximise profit while completing the project on time at a satisfactory level of quality. Ayodele and Alabi (2014) further noted that it has been observed that many building projects development in Nigeria do not bother about the use of cost control techniques, this was corroborated by Ogunsemi (2002) who found that non-use of cost control has contributed to incessant building collapse in Lagos state of Nigeria and that private developers do not utilize Bill of Quantities or any cost control measures which has resulted in low quality job done, generally elongated time of project delivery and ultimately high cost. Ayinde (2018) indicated that project success depends on how cost control can be used to achieve project objectives of completing project within the estimated budget to required specification within the predetermined duration. Sanni and Hashim (2013) concluded that if contractors could not manage the construction cost and they go bankrupt, then the project would be abandoned, and this will be a loss to the client.

5.4.4 Familiarity and frequency of use of techniques for cost control in dam projects in Nigeria

Application of cost management techniques is very essential in dam projects delivery, it is also essential that those who should apply the techniques be familiar with the appropriate techniques. The extent to which organizations are familiar with cost control techniques and frequency of use were examined in the study. The findings in this regard are examined in this section.

5.4.4.1Familiarity with cost control techniques in dam projects delivery

Findings on the extent to which the respondents across the four categories rated their familiarity with the various cost control techniques are presented in Table 5.35. Generally, the three most popular cost control techniques among the respondents, in order of popularity, are project budget, project meetings and contingency budget provision. There are some variations among the four categories of respondents. Among the contractors, the first and third most popular cost control techniques are schedule control and cost forecasting respectively while among the NIWE members, cost-value relation is the second most frequent technique of cost-control.

Table 5.35: Familiarity with Cost Control Techniques

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
	Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
E1.4 Project budget	4.41	1	4.15	2	4.00	1	4.28	1	4.30	1
E1.9 Project meetings	4.10	3	4.00	5	4.00	1	4.04	4	4.06	2
E1.8 Contingency budget provision	4.10	4	3.77	11	3.71	10	4.09	3	4.03	3
E1.1 Traditional method	3.93	5	4.00	7	3.79	9	3.91	5	3.91	4
E1.6 Schedule control	3.56	11	4.23	1	3.71	10	4.21	2	3.88	5
E1.3 Cost value relationship	4.13	2	3.69	12	4.00	4	3.51	12	3.85	6
E1.7 Variation analysis	3.74	8	4.00	5	3.86	7	3.91	6	3.84	7
E1.2 Activity based costing	3.75	7	4.08	3	4.00	1	3.70	10	3.78	8
E1.12 Cash flow analysis and work programmes	3.62	9	3.85	8	4.00	4	3.81	7	3.74	9
E1.5 Cost forecasting	3.76	6	4.08	3	3.57	14	3.56	11	3.70	10
E1.10 Resources management related strategy	3.57	10	3.77	9	3.86	8	3.72	9	3.67	11
E1.11 Cost reports	3.38	12	3.77	9	3.71	12	3.75	8	3.59	12
E1.14 Value analysis/engineering	3.19	14	3.38	14	3.93	6	3.37	14	3.34	13
E1.13 Life cycle costing	3.21	13	3.46	13	3.64	13	3.37	13	3.33	14
E1.15 Earned value analysis	2.78	15	3.31	15	3.43	15	3.07	15	2.99	15

Source: Field Survey of Researcher (2019)

Summary ratings of extent of familiarity with various cost control techniques are presented in Table 5.36. Out of the fifteen listed cost control techniques, the respondents claimed being very familiar with twelve.

Table 5.36: Summary rating of Familiarity with Cost Control Techniques

	ALL	
	Mean	**Rating**
E1.4 Project budget	4.30	Very Familiar
E1.9 Project meetings	4.06	Very Familiar
E1.8 Contingency budget provision	4.03	Very Familiar
E1.1 Traditional method	3.91	Very Familiar
E1.6 Schedule control	3.88	Very Familiar
E1.3 Cost value relationship	3.85	Very Familiar
E1.7 Variation analysis	3.84	Very Familiar
E1.2 Activity based costing	3.78	Very Familiar
E1.12 Cash flow analysis and work programmes	3.74	Very Familiar
E1.5 Cost forecasting	3.70	Very Familiar
E1.10 Resources management related strategy	3.67	Very Familiar
E1.11 Cost reports	3.59	Very Familiar
E1.14 Value analysis/engineering	3.34	Familiar
E1.13 Life cycle costing	3.33	Familiar
E1.15 Earned value analysis	2.99	Familiar

Source: Field Survey of Researcher (2019)

5.4.4.2Frequency of use of techniques for cost control in dams

Previous section established that interviewees were familiar with many of the cost control techniques listed next is to ascertain how frequently techniques for cost control are applied in the delivery of dam projects. Findings are in Table 5.37. In general, the three cost control techniques most frequently used are, contingency budget provision, project budget, and project meetings. There are some variations among individual categories of respondents. For instance, among the contractors, the most often used technique is cost forecasting while the third most often used one is the traditional method. Among the consultants, the third most often used technique is activity-based costing. The summary rating of the frequency of use of cost control techniques are presented in Table 5.38. Out of the fifteen listed cost control techniques, nine were rated ‘often’ while the remaining six were rated ‘sometimes’. This implies that nine of listed cost control techniques are often used while the remaining six are sometimes used.

Table 5.37: Frequency of use of Cost Control Techniques

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
	Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
E2.8 Contingency budget provision	4.63	1	3.77	8	3.43	8	4.00	2	4.21	1
E2.4 Project budget	4.24	2	4.23	2	4.00	1	4.14	1	4.18	2
E2.9 Project meetings	4.03	3	3.38	13	3.86	2	3.93	3	3.92	3
E2.1 Traditional method	3.90	4	4.15	3	3.71	4	3.84	4	3.88	4
E2.2 Activity based costing	3.68	6	3.92	5	3.71	3	3.70	5	3.71	5
E2.7 Variation analysis	3.75	5	3.77	8	3.43	10	3.60	6	3.66	6
E2.6 Schedule control	3.54	8	4.00	4	3.36	12	3.56	7	3.57	7
E2.12 Cash flow analysis and work programmes	3.57	7	3.85	7	3.71	4	3.33	12	3.52	8
E2.5 Cost forecasting	3.41	10	4.31	1	3.43	10	3.44	9	3.50	9
E2.10 Resources management related strategy	3.51	9	3.77	8	3.36	12	3.39	10	3.47	10
E2.3 Cost value relationship	3.31	11	3.92	6	3.43	8	3.49	8	3.44	11
E2.11 Cost reports	3.16	12	3.69	11	3.57	6	3.37	11	3.32	12
E2.14 Value analysis/ engineering	3.00	13	3.46	12	3.57	7	2.91	14	3.06	13
E2.13 Life cycle costing	2.97	14	3.31	14	3.21	14	2.95	13	3.01	14
E2.15 Earned value analysis	2.71	15	3.23	15	3.07	15	2.84	15	2.84	15

Source: Researcher’s Field Survey (2019)

5.38: Summary rating of Frequency of use of Cost Control Techniques

	Mean	Rating
E1.8 Contingency budget provision	4.21	Often
E1.4 Project budget	4.18	Often
E1.9 Project meetings	3.92	Often
E1.1 Traditional method	3.88	Often
E1.2 Activity based costing	3.71	Often
E1.7 Variation analysis	3.66	Often
E1.6 Schedule control	3.57	Often
E1.12 Cash flow analysis and work programmes	3.52	Often
E1.5 Cost forecasting	3.50	Often
E1.10 Resources management related strategy	3.47	Sometimes
E1.3 Cost value relationship	3.44	Sometimes
E1.11 Cost reports	3.32	Sometimes
E1.14 Value analysis/engineering	3.06	Sometimes
E1.13 Life cycle costing	3.01	Sometimes
E1.15 Earned value analysis	2.84	Sometimes

Source: Researcher's Field Survey (2019)

Ayinde (2018) noted that despite the availability of various cost control techniques software, many construction projects still do not achieve their cost objectives, therefore, to solve this problem, good practice of cost control techniques is important. The study further revealed that though, practitioners are more comfortable with the conventional method of cost control with limited involvement in information technology, there are five commonly used cost control techniques, valuation, material management, record keeping, site meetings and work programme. Ayinde (2018) concluded that the most frequently used cost control techniques were valuation of work in progress, site meetings, record keeping and material management on site, this is quite contrary to the findings on Table 5.38 above. In another study Chigara *et al*. (2013) observed that majority of contractors' efforts to manage project costs are centred on management of project resources in addition to monthly cost reports, variance management, project budgets and cash flow forecasting.

5.4.5 Drivers and challenges of techniques for cost control in achieving effective dam delivery in Nigeria

Fourth goal, to find out drivers and challenges of applying techniques for cost control to achieving dam project delivery. This section looks at the results in this regard.

5.4.5.1 Drivers of cost control techniques in achieving effective dam projects delivery in Nigeria

Twelve possible drivers of cost control techniques were identified as listed in Table 5.39. Respondents were requested to rate each on Likert scale of 1-5 (5-Very high influence; 4-High influence; 3-Slight influence; 2-Small influence; 1-No influence). Table 5.39 shows the three most important factors to be the availability of expertise or technological know-how, the need to train people to adopt cost management strategies and the contracting company's experience in order to exercise their influence. This underlines the value of competence, technological know-how and experience in the use of cost management methods in dam projects.

Table 5.39: Drivers of Cost Control Techniques

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
	Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
F1.1 Availability of Skill or Technical Know-how	4.43	1	4.23	1	4.07	1	5.18	1	4.66	1
F1.2 The need to train people to implement cost control techniques	4.28	2	3.62	11	4.00	2	4.21	3	4.17	2
F1.7 Experience of the contracting company	4.07	4	4.23	1	3.93	6	4.23	2	4.13	3
F1.10 Desire to complete project within cost envelope	4.12	3	3.92	6	4.00	2	4.02	4	4.05	4
F1.9 Desire to complete project on schedule	4.00	5	3.69	9	4.00	2	3.95	6	3.95	5
F1.6 Complexity of the project	3.90	7	4.00	4	4.00	2	3.98	5	3.95	6
F1.11 Desire to maximise profit	3.88	8	4.15	3	3.86	7	3.86	8	3.89	7
F1.5 Size/ technical requirement of the project	3.82	10	3.92	7	3.79	8	3.86	9	3.84	8
F1.12 Need to achieve best quality of project	3.91	6	3.77	8	3.57	9	3.77	10	3.82	9
F1.8 Client requirement or influence	3.68	11	4.00	4	3.57	9	3.93	7	3.79	10
F1.3 The cost of applying the techniques	3.84	9	3.77	8	3.50	11	3.65	11	3.73	11
F1.4 Cumbersomeness of applying the techniques	3.59	12	3.62	10	3.29	12	3.42	12	3.50	12

Source: Researcher's Field Survey (2019)

However, there are variations among the categories of respondents. For instance, the contractors rated 'experience of the contracting company' and 'desire to maximize profits' as first and third most influential drivers respectively. This corroborates the opinion of Charoenngam and Sriprasert (2001) that construction companies saw cost control as a requirement for earnings optimisation and effective project delivery.

The NIWE members rated 'desire to complete project within cost envelope' as the third most influential driver of use of control technique. All these point to the fact that while skill, technical know-how is critical in effective use of techniques for cost control, profit motive and effectiveness were also of prime motive. Summary ratings of drivers of use of techniques for cost control are presented in Table 5.40. Control methods, of the twelve potential drivers of cost implementation, the only one rated as of 'very high influence' is 'availability of skill or technical know-how'. This again underscores the critical importance of skill and technical expertise in usage of the cost management methods. The remaining eleven possible drivers were rated as having 'high influence'.

Table 5.40: Summary Ratings of Drivers of Cost Control Techniques

	Mean	Rating
F1.1 Availability of Skill or Technical Know-how	4.66	Very High Influence
F1.2 The need to train people to implement cost control techniques	4.17	High Influence
F1.7 Experience of the contracting company	4.13	High Influence
F1.10 Desire to complete project within cost envelope	4.05	High Influence
F1.6 Complexity of the project	3.95	High Influence
F1.9 Desire to complete project on schedule	3.95	High Influence
F1.11 Desire to maximise profit	3.89	High Influence
F1.5 Size/ technical requirement of the project	3.84	High Influence
F1.12 Need to achieve best quality of project	3.82	High Influence
F1.8 Client requirement or influence	3.79	High Influence
F1.3 The cost of applying the techniques	3.73	High Influence
F1.4 Cumbersomeness of applying the techniques	3.50	High Influence

Source: Field Survey of Researcher (2019)

5.4.5.2 Institutional aspects of techniques for application of cost control

After analysing views of respondents from the four organizations on drivers of applying techniques for cost control in dam projects, institutional aspects of the actual application of the techniques are discussed. The section focused on the existence of an active strategy for implementing techniques cost control, updating strategy and existence of a blueprint for managing / controlling construction costs and the degree to which organizations are responsive to innovations.

With regards to availability of active policy on application of cost control techniques, Table 5.40, 67.3 per cent of respondents answered in affirmative. However, the fact that close to a third of them do not have an active policy in place raises the concern about good use of the methods for cost management.

The situation cuts across the four organizations, as presented in Table 5.41, reveals that more of the contractors, at least nine out of every ten of them, claimed having in place an active cost control technique application policy. Next to the contractors are the consultants. This implies the contractors and consultants are likely to have in place strong institutional framework for application of cost control techniques.

Table 5.41: Availability of Active Policy for application of cost control techniques by Organization

	Yes		No		Total	
	Num	%	Num	%	Num	%
NIWE	41	63.1	24	36.9	65	100.0
Contractor	12	92.3	1	7.7	13	100.0
Consultant	12	85.7	2	14.3	14	100.0
NICOLD	34	61.8	21	38.2	55	100.0
Total	99	67.3	48	32.7	147	100.0

Source: Researcher's Field Survey (2019)

It also gathered details on the frequency of review of active policy on application of cost control techniques. As illustrated in Table 5.42 annual review is the most common among the organizations followed by review when the need arises and quarterly review, in that order. As further presented in Table 5.42, review of policies as the need arises is more popular among the contractors while quarterly and monthly reviews are more common among the consultants.

Table 5.42: Frequency of Review of Policy by Organization

	NIWE		Contractor		Consultant		NICOLD		Total	
	Num	%	Num	%	Num	%	Num	%	Num	%
Annually	16	59.3	5	41.7	2	16.7	11	47.8	34	46.6
Bi-annually	2	7.4	0	0.0	0	0.0	3	13.0	5	6.8
Monthly	0	0.0	1	8.3	4	33.3	1	4.3	6	8.2
Quarterly	2	7.4	1	8.3	4	33.3	6	26.1	13	17.8
As the need arises	7	25.9	5	41.7	2	16.7	2	8.7	15	20.5
Total	27	100.0	12	100.0	12	100.0	23	100.0	73	100.0

Source: Researcher's Field Survey (2019)

On whether organizations undertake regular review of cost control techniques applied in previous projects, Table 5. 43 shows that a little above three-fifths of the respondents claimed their organizations do undertake regular review.

The proportion of the respondents that claimed they do undertake review of cost control techniques applied in previous projects ranged from 56.1 per cent among NIWE members to 78.6 per cent among the consultants. This implies that regular review of cost control techniques applied in previous projects is most common among Consultants compared to others as shown in Table 5.43.

Table 5.43: Proportion of Respondents that undertake regular review of Cost Control Techniques applied in previous projects (by Organization)

	Yes		**No**		**Total**	
	Num	**%**	**Num**	**%**	**Num**	**%**
NIWE	37	56.1	29	43.9	66	100.0
Contractor	8	61.5	5	38.5	13	100.0
Consultant	11	78.6	3	21.4	14	100.0
NICOLD	32	60.4	21	39.6	53	100.0
Total	88	60.3	58	39.7	146	100.0

Source: Researcher's Field Survey (2019)

The perception of the respondents was sought on whether continuous reviews can improve cost control process. It was the consensus of almost all the respondents, as illustrated in Table 5.44, that undertaking continuous review can improve cost control process. The pattern is the same across all the organizations. The proportion of the respondents that shared this view ranged from 89.4 per cent among NIWE members to 96.2 per cent among NICOLD members. This implies that more NICOLD members hold the perception that continuous reviews can improve cost control process when compared to members of other organizations.

Table 5.44: Proportion of Respondents that undertake regular review of Cost Control Techniques applied in previous projects (by Organization)

	Yes		No		Total	
	Num	%	Num	%	Num	%
NIWE	59	89.4	7	10.6	66	100.0
Contractor	10	90.9	1	9.1	11	100.0
Consultant	13	92.9	1	7.1	14	100.0
NICOLD	51	96.2	2	3.8	53	100.0
Total	133	92.4	11	7.6	144	100.0

Source: Researcher's Field Survey (2019)

Effective construction cost management can be enhanced by having in place special template for the purpose. The extent to which organizations have this in place was also examined in the study. As illustrated in Table 5. 45, just about half of the respondents claimed their organizations have in place special template for managing/controlling construction cost. This raised doubts as to how well organizations can ensure effective management of cost controls.

Table 5.45: Existence of special template for managing/controlling construction cost (by Organisation)

	Yes		**No**		**Total**	
	Num	**%**	**Num**	**%**	**Num**	**%**
NIWE	26	40.6	38	59.4	64	100.0
Contractor	8	61.5	5	38.5	13	100.0
Consultant	8	57.1	6	42.9	14	100.0
NICOLD	29	55.8	23	44.2	52	100.0
Total	71	49.7	72	50.3	143	100.0

Source: Researcher's Field Survey (2019)

Across the organisations, the proportion of respondents that claimed having special template for construction cost management ranged from 40.6 per cent among NIWE members to 61.5 per cent among contractors. This implies the likelihood that more consultants, compared to other respondents, appreciate the use of templates for controlling construction cost. Next to the consultants in this regard are contractors and NICOLD members in that order.

Information was also collected on the extent to which respondents' organisations are receptive to innovations and new ideas in construction cost control. Table 5.46 reveals that generally, very few of the respondents claimed their organisations are not receptive. This provides opportunity for spread of new ideas on construction cost control, especially when more than half of the respondents claimed their organisations are very receptive.

As presented in Table 5.46, it appears contractors and consultants are more open to new ideas and developments on construction cost control compared to other categories of respondents. At least seven out of every ten of the contractors claimed their organisations are very open to new ideas.

Table 5.46: Extent of being open to new ideas and developments on construction cost control (by Organisation)

	NIWE		Contractor		Consultant		NICOLD		Total	
	Num	%	Num	%	Num	%	Num	%	Num	%
Not Receptive	2	3.6	0	0.0	0	0.0	3	5.3	5	3.9
Slightly Receptive	12	21.4	0	0.0	1	7.1	7	12.3	20	15.7
Receptive	6	10.7	2	20.0	3	21.4	6	10.5	17	13.4
Very Receptive	27	48.2	7	70.0	7	50.0	24	42.1	65	51.2
Most Receptive	9	16.1	1	10.0	3	21.4	7	12.3	20	15.7
Total	56	100.0	10	100	14	100.0	47	82.5	127	100.0

Source: Field Survey of Researcher (2019)

It is instructive to note that, on aggregate, at least nine out of every ten of the respondents signified that their organisations will encourage new way to reduce / control costs. As presented in Table 5.47, more consultants and NICOLD members, compared to others expressed the willingness of their organizations to encourage new way to reduce / control costs.

Table 5.47: Willingness to encourage new way to reduce / control costs (by Organisation)

	NIWE		Contractor		Consultant		NICOLD		Total	
	Num	%	Num	%	Num	%	Num	%	Num	%
Yes	61	93.8	10	83.3	11	100.0	45	97.8	127	94.8
No	4	6.2	2	16.7	0	0.0	1	2.2	7	5.2
Total	65	100.0	12	100.0	11	100.0	46	100	134	100.0

Source: Researcher’s Field Survey (2019)

5.4.5.3 Barriers to use of techniques for cost control to achieve effective dam delivery

As was done for drivers of application of cost control techniques, challenges were stated as flip side of the drivers and the respondents were asked to rate them, perceiving them as challenges on the same Likert scale of 1-5. Findings in this regard are presented in Table 5.48. The Table reveals the three most influential challenges, in order of their influence, to be availability of skill or technical know-how, the need to train people to bring cost management strategies and contracting business expertise into practice. Those are crucial problems that must be tackled if cost reduction strategies are to be implemented successfully in delivering dam projects. The only notable difference is about the contractors who, besides the availability of expertise or professional know-how, also ranked 'project difficulty' as the first most important challenge when applying cost-control. This indicates that the design of the dam project often matters among the contractors in applying cost-control.

Importance of contractor capacity, technological know-how and contracting firms experience, corroborate other scholars' views. For example, Adjei *et al*. (2018) described challenges of cost control practices in projects to include; absence of know-how on the use of existing resources, technologies, outdated principles, overemphasizing outcomes while ignoring the cost control mechanism, weakness in decision making and negative attitude towards information technology. Similarly, Malkanthi *et al*. (2017) noted that lack of knowledge and lack of experience were the key obstacles stopping contractors from using the techniques for cost control.

Summary ratings challenges of utilizing techniques for cost control are presented in Table 5.49. Of all the twelve possible challenges, only two were rated as having slight influence while the remaining ten were of very high influence. The two with slight influence are ‘Desire to maximize profit’ and ‘Need to achieve best quality of project’.

Table 5.48: Challenges in the Use of Cost Control Techniques

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
	Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
F9.1 Availability of Skill or Technical Know-how	4.09	1	4.00	1	4.21	1	4.40	1	4.21	1
F9.2 The need to train people to implement cost control techniques	4.06	2	3.85	3	3.79	3	4.18	2	4.06	2
F9.7 Experience of the contracting company	3.88	3	3.69	4	4.00	2	3.79	3	3.84	3
F9.6 Complexity of the project	3.72	6	4.00	1	3.36	8	3.77	4	3.73	4
F9.5 Size/ technical requirement of the project	3.72	6	3.54	5	3.36	8	3.77	5	3.69	5
F9.3 The cost of applying the techniques	3.75	4	3.31	7	3.64	4	3.68	7	3.68	6
F9.8 Client requirement or influence	3.65	8	3.31	7	3.57	5	3.67	8	3.62	7
F9.4 Cumbersomeness of applying the techniques	3.75	5	3.54	5	3.21	11	3.53	10	3.60	8
F9.10 Desire to complete project within cost envelope	3.56	10	2.92	10	3.36	8	3.68	6	3.53	9
F9.9 Desire to complete project on schedule	3.62	9	2.85	11	3.21	11	3.63	9	3.52	10
F9.11 Desire to maximise profit	3.54	11	2.92	9	3.43	6	3.46	11	3.45	11
F9.12 Need to achieve best quality of project	3.49	12	2.85	11	3.43	6	3.44	12	3.41	12

Source: Field Survey of Researcher (2019)

Table 5.49: Summary Ratings of Challenges in the use of Cost Control Techniques

	Mean Score	Rating
F9.1 Availability of Skill or Technical Know-how	4.21	High Influence
F9.2 The need to train people to implement cost control techniques	4.06	High Influence
F9.7 Experience of the contracting company	3.84	High Influence
F9.6 Complexity of the project	3.73	High Influence
F9.5 Size/ technical requirement of the project	3.69	High Influence
F9.3 The cost of applying the techniques	3.68	High Influence
F9.8 Client requirement or influence	3.62	High Influence
F9.4 Cumbersomeness of applying the techniques	3.60	High Influence
F9.10 Desire to complete project within cost envelope	3.53	High Influence
F9.9 Desire to complete project on schedule	3.52	High Influence
F9.11 Desire to maximise profit	3.45	Slight Influence
F9.12 Need to achieve best quality of project	3.41	Slight Influence

Source: Researcher’s Field Survey (2019)

5.4.5.4 Strategies to improve use of cost control techniques

Six possible strategies were listed as presented in Table 5.50 and respondents across the four organisations were to rate them on Likert scale of 1-5 (5-Very Important; 4-Highly Important; 3-Slightly Important; 2- Important; and 1-Not Important). The Table shows that generally, the respondents considered the three most important strategies that could improve use cost of control technique to be, in order of importance, enhanced project management capability, benchmarking of new projects by a comparison class with related projects completed (Reference class forecasting), and computer-aided cost analysis and process forecasting. The major variation noted is that, to the consultants, pre-qualification of contractors is the first most important strategy.

The overview scores are in Table 5.51. The Table reveals that only 'enhanced project management capability' has been classified as very critical out of the six potential strategies. The remaining five have been identified as highly significant. The emphasis on project management capability is consistent with Yismalet and Patel (2018)'s view that construction companies, need to improve ability to effectively achieve company and project goals.

Table 5.50: Respondents' rating of Strategies that could improve use of cost control technique

Source: Researcher's Field Survey (2019)

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
	Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
F10.1 Enhanced project management capability	4.54	1	4.62	1	4.29	1	4.61	1	4.55	1
F10.2 Bench marking (Reference class forecasting)	4.24	3	4.46	3	4.07	3	4.33	2	4.28	2
F10.3 Computer assisted models for cost forecasting.	4.28	2	4.46	2	4.00	4	4.30	3	4.28	3
F10.5 Pre - qualification of contractors	4.12	4	4.15	4	4.29	1	4.18	5	4.16	4
F10.4 Risk and contingency planning.	4.12	4	4.00	5	3.79	5	4.26	4	4.13	5
F10.6 Use of public - private - participation models.	3.99	6	3.77	6	3.79	5	3.86	6	3.90	6

Table 5.51: Summary Ratings of Strategies that could improve use of cost control technique

	Mean Score	Rating
F10.1 Enhanced project management capability	4.55	Very Important
F10.2 Bench marking. (Reference class forecasting)	4.28	Highly Important
F10.3 Computer assisted models for cost forecasting.	4.28	Highly Important
F10.5 Pre - qualification of contractors	4.16	Highly Important
F10.4 Risk and contingency planning.	4.13	Highly Important
F10.6 Use of public - private - participation models.	3.90	Highly Important

Source: Researcher's Field Survey (2019)

5.4.6 Cost control model for effective dam projects delivery

The fifth aim of this study is to develop a model for cost control of dam projects for effective delivery in Nigeria. In addition to all the information gathered and analysed for the other four objectives, information was also collected on the status of cost control capacity in the respondents' organizations as well as factors that could engender a model for effective dam projects delivery. Findings in this regard were examined in this section.

5.4.6.1 Status of organizations' cost control capacity

In this section, focus is on whether the organizations have dedicated department responsible for cost control; perception of the respondents on whether instituting cost control unit could lead to additional running costs; whether there would be a need for cost management preparation; and respondents' suggestions on how to use cost management strategies to improve project execution for dams.

Generally, less than two-fifths of the respondents claimed their organizations have a dedicated department responsible for cost control activities. This is likely to have adverse effect on capacity for effective application of cost control techniques.

There are some variations across the organisations as presented in Table 5.52. Compared to the general pattern, more contractors have dedicated departments for cost management while NIWE members recorded the least proportion. This suggests the likelihood that capacity for cost control application could be stronger among the contractors compared to other organisations.

Table 5.52: Availability of Dedicated department responsible for Cost Control

	NIWE		Contractor		Consultant		NICOLD		Total	
	Num	%	Num	%	Num	%	Num	%	Num	%
Yes	17	25.8	9	69.2	7	50	26	47.3	59	39.9
No	49	74.2	4	30.8	7	50	29	52.7	89	60.1
Total	66	100	13	100	14	100	55	100	148	100

Source: Researcher's Field Survey (2019)

One of the factors that could discourage creation of a dedicated unit could be the fear of incurring additional running cost. Majority of the respondents believed creating a dedicated unit for cost control has financial implication. This could be the reason why many of the organizations do not have a dedicated department for the purpose. Of all the organizations, it was most of the consultants that had a contrary view as presented in

Table 5.53. To majority of the consultants, creating additional unit may not necessarily lead to additional running cost.

Table 5.53: Respondents' Perception on whether Instituting cost control unit will lead to additional running cost

	NIWE		Contractor		Consultant		NICOLD		Total	
	Num	%	Num	%	Num	%	Num	%	Num	%
Yes	42	62.7	7	53.8	6	42.9	31	58.5	86	58.5
No	25	37.3	6	46.2	8	57.1	22	41.5	61	41.5
Total	67	100.0	13	100.0	14	100.0	54	100.0	147	100.0

Source: Researcher's Field Survey (2019)

The need for capacity building on application of cost control techniques appears to be very critical among the organizations. Majority of the respondents, at least eight out of every ten of them, expressed the need for training in this area. Across the organizations, as presented in Table 5.54, the pattern is the same. The proportion of the respondents that expressed the need for training ranged from 53.8 per cent for Contractors to 92.8 per cent for NICOLD members (Table 5.54). This underscores the need to address the challenge of capacity building for effective application of cost control techniques.

Table 5.54: Perception on need for training in cost control (Aggregate)

	NIWE		Contractor		Consultant		NICOLD		Total	
	Num	%	Num	%	Num	%	Num	%	Num	%
Yes	55	84.6	7	53.8	12	85.7	49	92.5	123	84.8
No	10	15.4	6	46.2	2	14.3	4	7.5	22	15.2
Total	65	100.0	13	100.0	14	100.0	53	100.0	145	100.0

Source: Researcher's Field Survey (2019)

The perception of the respondents was sought on whether cost control technique could improve dam delivery. Most respondents expressed the conviction that application of cost management techniques could improve dam projects delivery. The pattern is the same across all the organizations as presented in Table 5.55.

Table 5.55 Perception on whether cost control technique could improve dam project delivery (by Organisation)

	NIWE		Contractor		Consultant		NICOLD		Total	
	Num	%	Num	%	Num	%	Num	%	Num	%
Yes	60	90.9	12	92.3	12	92.3	50	94.3	134	92.4
No	6	9.1	1	7.7	1	7.7	3	5.7	11	7.6
Total	66	100.0	13	100.0	13	100.0	53	100.0	145	100.0

Source: Researcher's Field Survey (2019)

Suggestions were offered by respondents about how cost management strategies can be properly implemented towards enhancing effective dam projects delivery. The various suggestions offered by the respondents are highlighted Table 5.56.

Table 5.56: Ingredients of effective dam projects delivery

Serial number	**Factors to enhance cost control techniques and engender effective dam projects delivery**	**Number of Respondents**	**% Response**
i	Putting in place appropriate policy framework	40	16.7
ii	Additional and continuous training in application of cost control techniques	37	15.4
iii	Completion of designs including site surveys and site investigation	37	15.4
iv	Creation of a dedicated department for cost control in projects delivery	37	15.4
v	Cost control techniques should be project-based	36	15
vi	Diligent application of cost control techniques	32	13.3
vii	Effective planning	32	13.3
viii	Efficient fund management	29	12.1
ix	Efficient utilization of equipment and workmen to maximize output and save time and cost	29	12.1
x	Engaging cost control engineers	29	12.1
xi	Engaging professional accountants	25	10.4
xii	Ensuring project cost monitoring during delivery process	25	10.4
xiii	Including relevant clauses for cost control in the contract document	25	10.4
xiv	Allow for innovations and updates on cost control techniques/information	25	10.4
xv	Proper project budgeting and management	21	8.8
xvi	Proper monitoring of fluctuation in basic prices of construction materials	20	8,3

xvii	Ensuring Transparency in cost control	20	8.3
xviii	Using appropriate software for activity-based costing	18	7.5

Source: Field Survey of Researcher (2019)

It is very important for construction companies to put in place appropriate policy frameworks for deployment of cost management methods for the construction of dams. The importance of additional and continuous training in techniques for cost control was underlined. Companies that need to apply cost control must not only develop a policy for it, the companies must ensure that the requisite staff are properly trained, and the training must be continuous as the staff would be required to update their skills and knowledge periodically. It is also important to properly prepare effectively for the projects. The clients are required to ensure the completion of designs including site surveys and site investigation before construction as to enhance proper planning and cost management by the contracting firms.

5.4.6.2 Factors that could support a model for effective dam projects delivery

In evaluating factors that could support a model for effective dam projects delivery as part of actualizing the fifth objective of the study, 20 possible factors were listed, and respondents were to rate on Likert scale of 1-5 (5-most important; 4-Very important; 3-Important; 2-Slightly important; 1-Not important). Outputs of analysis, Table 5.57. Generally, three most essential impacts that could support a model are, proper project conception and design, technical capacity of the contractor, and contractor's knowledge and experience. The pattern is the same across all the organizations. The slight variation is that the contractors also rated the issue of realistic tenders first in addition to proper project conception and design. The fact that technical capacity, knowledge and experience were highly rated underscored the importance of the critical issue of capacity building and experience in ensuring successful use of the methods for cost management.

Summary ratings of the variables involved are presented in Table 5.57. Only proper project conception and design was rated 'most important' while other factors were rated as very important. This implies that all the factors are critical in engendering effective delivery of dams.

On the critical importance of proper project conception and design, some of the excerpts from the responses to key informant interviews are stated as follows.

> *"Unfortunately, many projects are given to Contractors without the comprehensive design. Hence the Contractor or the client will start to redesign or review the design and at times it will delay everything."* **(E1)**

> *"When design is not completed before construction of commences, it can lead to delayed delivery. Experience has shown that most times when contractor mobilizes to site, the design work will have to also be in progress, some of the time it is attributed to the additional site evaluation required. The design aspect is an area that has to be properly looked into because if the contractor is on site and the design is not finalized or maybe additional work is being incorporated into the contract based on fresh information from site investigation necessitating design amendment, it may cause delay in terms of project delivery."* **(E4)**

> *"At the point of conception, if the project design that should factor in certain engineering parameter of the environment and availability of materials is not comprehensive, there could be project failure. For example, if you are designing a dam and you have not been able to capture properly the catchment area of the flood that you are expecting and you happen to put a smaller spillway eventually the dam will fail because it is just a smaller spillway to accommodate a large catchment.*"**(E9)**

> *"The quality of the of design affects project delivery in that, If you don't design the dam appropriately, you are using the available materials on site because when a dam is been properly designed you have to consider the availability of materials if you have not designed it in accordance with the available materials on site, you will discover that, one, it will take a very long time and it will be very expensive to come by in such a way that the client and the*

contractor can be cutting corners. It will affect the quality of the delivery. If you make a mistake or errors in designing, you will discover that being a special project, you may be causing an obstruction to the flow of river which will mount a lot of pressure on that particular structure which you are putting there, either an earth dam or concrete dam or whichever type of dam. It is a structure like a building which is expected to withstand some pressure and if you have not designed it to be able to withstand such pressure there may be failed delivery." **(E13)**

Table 5.57: Respondents' of rating of factors that could engender a model for effective delivery of dams

	NIWE		CONTRACTORS		CONSULTANTS		NICOLD		ALL	
	Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
G6.1 Proper project design	4.51	1	4.54	1	4.79	1	4.75	1	4.63	1
G6.16 Technical capacity of the contractor	4.35	2	4.54	1	4.43	2	4.37	3	4.38	2
G6.3 Contractor knowledge and experience	4.34	3	4.31	4	4.43	2	4.42	2	4.38	3
G6.10 Availability of skilled manpower	4.24	7	3.85	10	4.07	8	4.23	4	4.18	4
G6.19 Penalty for poor performance	4.12	9	4.08	7	4.36	4	4.21	5	4.17	5
G6.20 Reward for effective delivery of projects	4.18	8	3.85	10	4.29	5	4.19	6	4.16	6
G6.7 Delay in payment for certified works	4.29	5	3.85	10	4.14	7	3.93	8	4.11	7
G6.5 Design failures	4.32	4	4.23	5	4.00	10	3.82	12	4.10	8
G6.4 Influence of procurement methods	4.26	6	4.00	9	4.00	10	3.93	9	4.09	9
G6.6 Quality of available cost information	3.94	11	4.23	5	3.86	14	4.18	7	4.05	10
G6.2 Unrealistic tenders	4.00	10	4.54	1	4.21	6	3.61	17	3.92	11
G6.14 Stability of the market/price fluctuation	3.91	12	3.85	13	4.07	8	3.84	11	3.89	12
G6.18 Professional bodies regulating the conduct of contractors	3.91	13	4.08	7	3.71	16	3.86	10	3.89	13
G6.9 Project sustainability	3.81	14	3.77	16	4.00	12	3.68	16	3.78	14
G6.15 Project host community related issues	3.72	15	3.69	17	3.64	18	3.77	14	3.73	15
G6.11 Instability in the polity	3.60	17	3.85	13	3.79	15	3.81	13	3.72	16
G6.13 Stakeholders satisfaction	3.54	19	3.85	13	3.64	17	3.74	15	3.65	17
G6.12 Government regulations	3.66	16	3.62	18	3.86	13	3.56	19	3.64	18
G6.8 Disputes and instigation	3.56	18	3.54	19	3.29	19	3.54	20	3.53	19
G6.17 Fraudulent practices	3.53	20	3.38	20	3.29	19	3.60	18	3.52	20

Source: Researcher's Field Survey (2019)

Table 5.58: Summary ratings of Factors that could engender a model for effective delivery of dams

	Mean Score	Rating
G6.1 Proper project conception and design	4.63	Most Important
G6.3 Contractor knowledge and experience	4.38	Very Important
G6.16 Technical capacity of the contractor	4.38	Very Important
G6.10 Availability of skilled manpower	4.18	Very Important
G6.19 Penalty for poor performance	4.17	Very Important
G6.20 Reward for effective delivery of projects	4.16	Very Important
G6.7 Delay in payment for certified works	4.11	Very Important
G6.5 Design failures	4.10	Very Important
G6.4 Influence of procurement methods	4.09	Very Important
G6.6 Quality of available cost information	4.05	Very Important
G6.2 Unrealistic tenders	3.92	Very Important
G6.14 Stability of the market/price fluctuation	3.89	Very Important
G6.18 Professional bodies regulating the conduct of contractors	3.89	Very Important
G6.9 Project sustainability	3.78	Very Important
G6.15 Project host community related issues	3.73	Very Important
G6.11 Instability in the polity	3.72	Very Important
G6.13 Stakeholders satisfaction	3.65	Very Important
G6.12 Government regulations	3.64	Very Important
G6.8 Disputes and instigation	3.53	Very Important
G6.17 Fraudulent practices	3.52	Very Important

Source: Researcher's Field Survey (2019)

On the inclusion of professional bodies in the proposed model, some of the excerpts from the responses to key informant interviews are stated as follows.

> *"That is a serious question because, I don't know about the ability of COREN or their relationship with contractors. In my opinion, if you have a reliable contractor, who is serious with the project, the manpower is experienced one, that has good equipment, with material on site and everything okay, it means that the contractor does not need any assistance from a third party to deliver the project. But if COREN or other organisations within Nigeria will be part of projects, of course it will give some additional issues to the contractor, maybe it can assist the contractor by choosing the appropriate manpower like qualified Engineers, but I really don't know to what extent that can be of any assistance."* **(E9)**

> *"Yes, it will have a positive effect because the professional bodies are more or less like a regulatory institution and once we have a project and every professional knows that they are to operate within the code of professional conduct it will add value to*

> *project delivery. The issue of having people not adhering strictly to the fundamentals that govern some of these engineering works will be addressed. It may also ensure having the right peg in the right hole. COREN has a lot of work to do and I think the regulatory body is really trying. I am aware that if somebody is not registered as an engineer, he is not even allowed to be a project manager in any construction firm and I think it is as very good development in terms of making sure we have people that can be held accountable for whatever is the outcome at the end of the project.***(E10)**

Nzekwe *et al.* (2015) revealed that in the success of a construction project, many factors are ranked as being highly important border on having the right skills and expertise, many cases of abandonment or collapse may not be unconnected with lack of required expertise. Sanni and Hashim (2013) affirmed that improper contract document, engagement of inexperienced staff, lack of research and innovation are the leading challenges affecting the cost control practices. Charoenngam and Sriprasert (2001) found that contractors perceive cost control as a prerequisite towards profit maximization. According to Sanni and Hashim (2013), the competency of the essential personnel in the contracting organisation should be high in the construction cost control practices and activities, the more efficient they are, the better for the progress and growth of the company. The study further concluded that if the contractor's personnel are very efficient in discharging their work, this may result in the efficient production in the organisation. Adjei *et al*. (2017) identified challenges of project cost control practice in the construction industry to include using obsolete methods and concepts, lack of knowledge on the use of available tools and technology, serious decision failure and poor attitude towards information communication technology usage. Song (2014) revealed that most owners of construction firms have little level of education or no knowledge of cost management which hinders practices in the knowledge of cost control, due to this reason they rely on previous work experiences acquired from past projects, the challenge therefore is that these outdated cost management practices cannot be used to solve current real-world situation of cost variances. Adjei *et al.* (2017) also noted that most contractors are not willing to invest in cost management methods or not ready to pay a professional to handle cost issues for the organisation.

5.4.7. Data purification and assessment for PLS-SEM

Some of the measures were adapted from established scales, while some were exploratory. As a result, there was need to refine and test the measurement items for the various reliability factors before the data review (Churchill, 1979; Anderson and Gerbing, 1988). Exploratory factor analysis (EFA) initially carried out on scales. Adhering to procedures suggested by Gerbing and Hamilton (1996), as a guide to further analytical techniques, EFA was used as an exploratory technique to create multiple indicator measuring models. The EFA results provided an indication of a clean factor analysis because all items loaded well on their respective factor except for a few items with loads below 0.5 which had been removed.

Researchers also test the reliability and validity of the constructs through their measurement objects when assessing measures in quantitative research. Reliability tests, according to Reis and Judd (2000), provide proof of the repeatability, unidimensionality, and reliability over time the frequencies or ratings extracted from assessment of the content. Parveen (2014) described numerous available methods and tests for evaluating study reliability, including inter-rater reliability, test-retest reliability, the alpha coefficient of Cronbach and split-half test. However, amongst the methods, the most frequently employed method of testing reliability is the Cronbach's alpha, that assists in checking measures for internal consistency. Internal consistency according to Roberts *et* *al*. (2006), describes how all the findings obtained from a single study or survey are related. In other words, Creswell and Plano Clark (2011) stated that reliability in quantitative research refers to scores obtained consistent over time. For Cronbach alpha (α), the appropriate value is 0.70 or above (Hair *et al*., 2010). A Cronbach alpha coefficient of 0.55 is suitable for measuring large structures (Van de Ven & Ferry, 1979). Table 5.59 presented 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 5.59.: 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

Source: Researcher's Field Survey (2019)

Creswell & 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.

5.4.8 Partial least squares

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.

5.4.8.1 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 5.60 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 5.1 which have below 0.7 were excluded as indicators.

Table 5.60: 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		
Effects	EF_CS	0.8506	0.724	0.912	0.874
	EF_HC	0.8547	0.731		
	EF_Quality	0.8165	0.667		
	EF_Time	0.7874	0.620		
	EF_WS	0.7934	0.629		
Failure	FL_CL	0.8638	0.746	0.895	
	FL_CT	0.8491	0.721		
	FL_PR	0.8664	0.751		0.739
Performance	PRJ_1	0.9304	0.866	0.928	0.912
	PRJ_2	0.8141	0.663		
	PRJ_3	0.9519	0.906		
Strategies	ST_3	0.8334	0.695	0.826	0.614
	ST_4	0.7609	0.579		
	ST_5	0.7537	0.568		
Technique	FM_1	0.9016	0.813	0.836	0.720
	FM_2	0.7916	0.627		

Source: Field Survey of Researcher (2019)

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 5.61, 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 5.2 which are below 0.7 were omitted as indicators.

Table 5.61: 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**

Source: Researcher's Field Survey (2019)

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.

5.4.8.2 Structural model

Bootstrapping performed to evaluate hypothetical route analysis after evaluating the discriminant validity, reliability and analysing specific process bias of the measures used. Results are shown in Figures 5.1 and 5.2. The structural model 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 .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 Tables 5.62.

Table 5.62: 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

Source: Researcher Field Survey (2019)

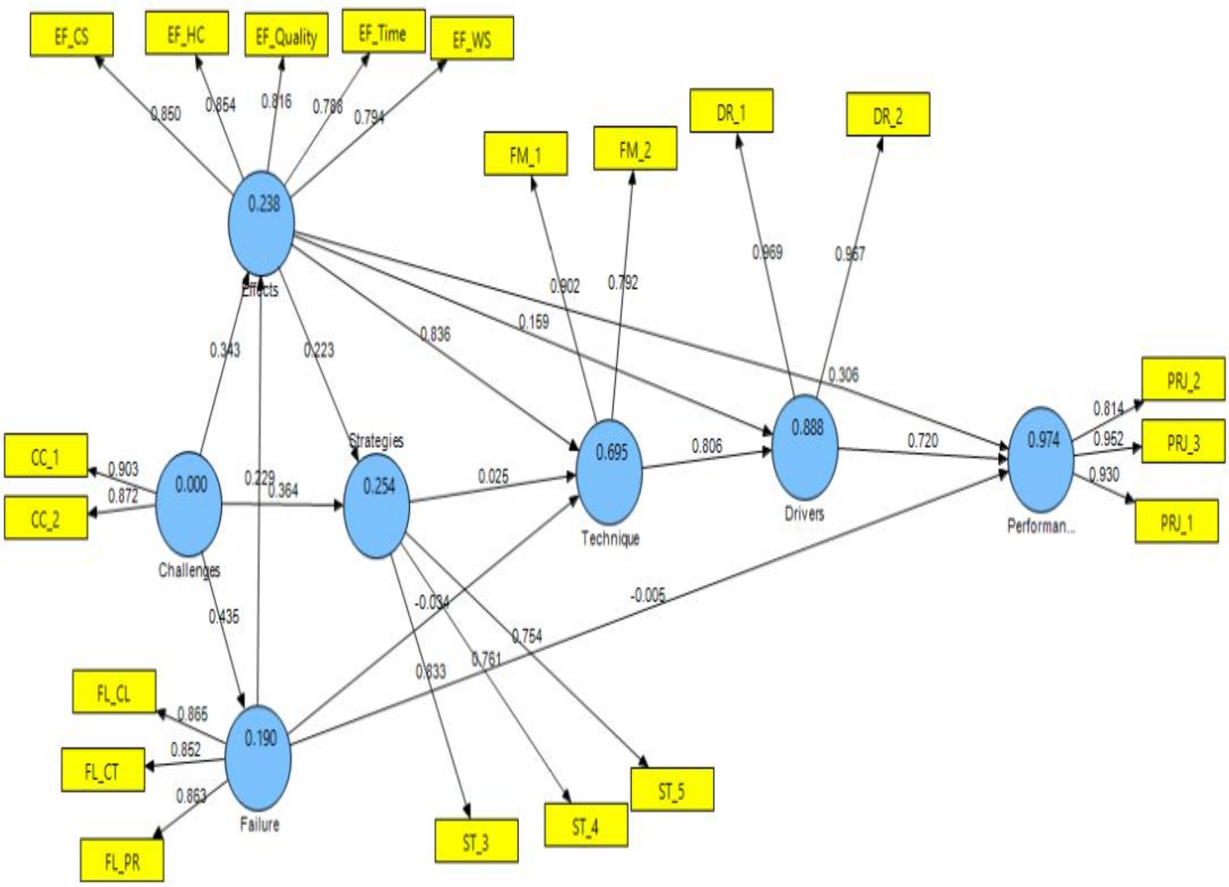

Figure 5.1: Path coefficient structural model and R^2 values

Source: Field Survey (2019) of the Researcher

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 5.60. 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 5.63: 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*

Source: Researcher's Field Survey (2019)

Therefore, the fitted models for *the effective project delivery* can be stated as:

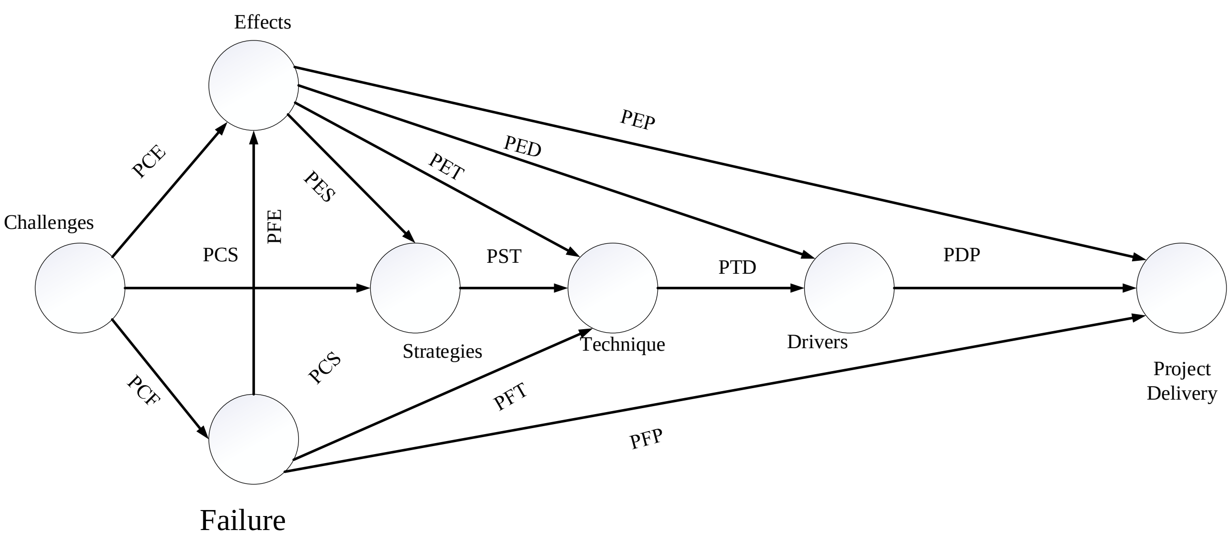

Figure 5.2: Structural model equation path

Source: Field Survey of Researchers (2019)

Where: PCE = Performance Challenges – Effect

PCF = Performance Challenges – Failure

PCS = Performance Challenges – Strategies

PFE = Performance Failure – Effects

PFT = Performance Failure – Techniques

PFP = Performance Failure – Performance

PES = Performance Effect – Strategies

PET = Performance Effect – Techniques

PED = Performance Effect – Drivers

PEP = Performance Effect – Performance

PST = Performance Strategies – Techniques

PTD = Performance Techniques – Drivers

PDP = Performance Drivers - Performance

Therefore, the equations for the direct and indirect paths are thus stated as follows:

$y = \beta X + \varepsilon 1$

$$Effects\ (\boldsymbol{y}_{EF}) = \beta_0^{(EF)} + \beta_{PCE}^{(EF)}(PCE) + \beta_{PFE}^{(EF)}(PFE) + \varepsilon 1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.1)$$

$$Failure\ (\boldsymbol{y}_{FA}) = \beta_0^{(FA)} + \beta_{PCF}^{(FA)}(PCF) + \varepsilon 1 \ldots\ldots\ldots\ldots\ldots\ldots..\ldots\ldots\ldots\ldots\ldots\ldots.\ldots\ldots\ldots (5.2)$$

$$Strategies\ (\boldsymbol{y}_{ST}) = \beta_0^{(ST)} + \beta_{PCS}^{(ST)}(PCS) + \beta_{PES}^{(ST)}(PES) + \varepsilon 1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.3)$$

$$Techniques\ (\boldsymbol{y}_{TE}) = \beta_0^{(TE)} + \beta_{PFT}^{(TE)}(PFT) + \beta_{PST}^{(TE)}(PST) + \beta_{PET}^{(TE)}(PET) + \varepsilon 1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..\ldots\ldots\ldots (5.4)$$

$$Drivers\ (\boldsymbol{y}_{ST}) = \beta_0^{(DR)} + \beta_{PTD}^{(DR)}(PTD) + \beta_{PED}^{(DR)}(PED) + \varepsilon 1 \ldots\ldots\ldots\ldots..\ldots\ldots. (5.5)$$

Overall effects

$$\boldsymbol{y}_{PD} = \beta_0^{(PD)} + \beta_{PCF}^{(PD)}(PCF) + \beta_{PCE}^{(PD)}(PCE) + \beta_{PFE}^{(PD)}(PFE) + \beta_{PCS}^{(PD)}(PCS) + \beta_{PES}^{(PD)}(PES) + \beta_{PFT}^{(PD)}(PFT) + \beta_{PST}^{(PD)}(PST) + \beta_{PET}^{PD}(PET) + \beta_{PED}^{(PD)}(PED) + \beta_{PEP}^{(PD)}(PEP) + \beta_{PTD}^{(PD)}(PTD) + \beta_{PFP}^{(PD)}(PFP) + \beta_{PDP}^{(PD)}(PDP) + \varepsilon 1 \quad (5.6)$$

$$Y_{PD} = 0.436PCF + 0.343PCE + 0.229\,PFE + 0.346PCS + 0.223PES - 0.033PFT + 0.025PST + 0.837PET + 0.16PED + 0.306PEP + 0.805PTD - 0.005PFP + 0.719PDP \quad (5.7)$$

Where, $\boldsymbol{y}_{PD}$ = the dependent variable

X = all measured variables

β = Path coefficient of variables in the model

y = Effective projects delivery

5.5 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 Chapter 3 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 3.3, 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 5.63 and summarised in Table 5.64

H1: The complexities of using cost control techniques and the results of using cost control techniques are positively related.

Based on the analysis, the coefficient for the path from challenges of controlling cost of dam project to their effects on project performance was positive and significant at 1 % significance level (β=0.443, t=6.327) supporting proposition in H1.

H2: A strong positive correlation exist between the complexities of using cost management strategies and inability to use them in the execution of projects.

As suggested in the route model, the study proposed a positive relationship between difficulties and failure of dam construction projects. At 99 per cent confidence point, the relationship was positive and important (β=0.436, t=5.860). The findings lend support to the H2 proposition.

H3: A strong positive association exist between the results of cost management strategies and the failure to use them in the execution of projects.

Hypothesis was empirically tested to determine whether the results of using techniques for cost control and failure to use techniques for cost control in project execution have a substantial positive relationship. The relation was found to be positive and important at a meaning level of 5 percent (β=0.229, t=2.348).

H4: A strong positive association exist between the results of dam project cost control and the degree of cost control techniques used.

Hypothesis 4 states that poor effects of cost control have positive significant relationship with cost control techniques. This proposition was upheld by the result of the structural model (β=0.936, t=26.00) at 99% level of confidence.

H5: A strong positive relationship exist between project failure causes and cost management technique.

H5 posited that the causes of project failure will negatively influence cost control technique to be adopted. The value of the Path coefficient has been found negligible (β= -0.033, t=0.717) at 1 per cent. So, it did not support H5.

H6: A significant positive relationship exists between the degree of use of cost control strategies and the drivers of their use.

H6 postulated that cost control technique would positively affect cost control drivers, and this statement was also confirmed by path analysis findings with substantial path coefficient and t-values (β=0.805, t=23.168) at 1 percent significance point.

H7: A significant positive correlation exist between the utilization results of cost control strategies and the drivers.

H7 proposed that effects of poor cost control of dam project have positive significant impact on drivers of project cost control. Coefficient for the path from effects to drivers was positive and significant at 1% significance level (β=0.16, t=3.917) supporting H7. This finding is in line with Liu and Shih (2009), who asserted that when appropriate project information is available and on time, there will be improvement in project delivery and in turn project will experience less cost and time overruns.

H8: An important positive relationship exists between the level of use of cost control methods and user improvement strategies.

H8 indicates that cost management approaches affect cost reduction techniques positively. The coefficient value (β=0.025, t=0.609) was found to be not significant. So, it did not support H8.

H9: A strong positive relationship exist between cost-control issues and approaches to enhance its use.

It was suggested that challenges of controlling cost of dam project may be reduced when it is confronted with the relevant strategy. The results revealed significant positive relationship between the two latent variables at 1% level of significance ($\beta=0.364$, $t=3.065$). The hypothesis is supported.

H10: A significant positive relationship exist between the cost-control techniques and strategies used to enhance their application.

The research proposed and argued that effects of poor cost control could influence strategies to be used to enhance project performance. Findings of the study backed this hypothesis at ($\beta=0.223$, $t=2.297$) at 5% level of significance.

H11: A strong positive relationship exist between the drivers of cost control and project delivery techniques

H11 suggests that cost control drivers positively affect project efficiency, the path analysis results showed that the path coefficient value was significant for this relationship ($\beta=0.719$, $t=46.492$) showing that H11 is strongly sustained. The result affirms that cost management strategy is essential to effective project execution in the construction process (Harmelink & Yamin, 2001).

H12: A major positive relationship exist between the cost-control strategies and project execution results.

With respect to H12, it was posited that poor effects of cost control will positively influence performance of project. This is evident in the result which the path coefficient value ($\beta=0.307$, $t=18.299$) was shown to be important, hence H12 is supported.

H13: A major negative connection exist between failure to use cost management strategies and completion of projects.

H13 proposes that causes of project failure negatively influence performance of project, but the coefficient value was not important (β= -0.005, t=0.389), so H13 is not supported.

Table 5.64: 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*

Source: Researcher's Field Survey (2019)

5.6 Model Application

The research used the rating of the respondents (clients, contractors and consultants) for their agreement on how much each of the constructs provided for in the Model (Eq. 5.6) satisfies or meets project requirements, by means of a five-point scale, in which one is strongly disagree; three = 'moderately agree;' and five = 'strongly agree.' to effectively monitor the construction costs for a specific dam project. The iteration of SEM was carried out to explore further, the possibility of the developed model accurately predicting the relation between the concepts presented in the study:

$$\boldsymbol{y}_{PD} = \beta_0^{(PD)} + \beta_{PCF}^{(PD)}(PCF) + \beta_{PCE}^{(PD)}(PCE) + \beta_{PFE}^{(PD)}(PFE) + \beta_{PCS}^{(PD)}(PCS) + \beta_{PES}^{(PD)}(PES) + \beta_{PFT}^{(PD)}(PFT) + \beta_{PST}^{(PD)}(PST) + \beta_{PET}^{PD}(PET) + \beta_{PED}^{(PD)}(PED) + \beta_{PEP}^{(PD)}(PEP) + \beta_{PTD}^{(PD)}(PTD) + \beta_{PFP}^{(PD)}(PFP) + \beta_{PDP}^{(PD)}(PDP) + \varepsilon 1 \text{..........................} (5.6)$$

Y_{PD} = *0.436PCF + 0.343PCE + 0.229 PFE + 0.346PCS + 0.223PES - 0.033PFT + 0.025PST +0.837PET +0.16PED + 0.306PEP+ 0.805PTD – 0.005PFP + 0.719PDP*……………………………………………………………………………(5.6a)

In practice, assumming that the dam project is perfectly compliant with all the criteria for latent variables, and thus makes this cost control process the most appropriate mechanism for the time, cost and quality delivery of the project. In the model (Eq. 5.6), the independent variables would then be classified as 5 (the maximum on the Likert scale).

Y_{PD} = *0.436(5) + 0.343(5) + 0.229 (5) + 0.346(5) + 0.223(5) - 0.033(5) + 0.025(5) +0.837(5) +0.16(5) + 0.306(5) + 0.805(5) – 0.005(5) + 0.719(5)*…………………(5.6b)

Y_{PD} = *2.18 + 1.715 + 1.145 + 1.73 + 1.115 – 0.165 + 0.125 + 4.185 + 0.8 + 1.53 + 4.025 – 0. 025 + 3.595 = 21.955*…………………………………………………………(5.6c)

This result from equation 5.6c represents the best score for the cost control achievable by the dam project.

The worst cost control score for the model would be represented by the value in equation 5.6c:

Y_{PD} = *0.436(1) + 0.343(1) + 0.229 (1) + 0.346(1) + 0.223(1) - 0.033(1) + 0.025(1) +0.837(1) +0.16(1) + 0.306(1) + 0.805(1) – 0.005(1) + 0.719(1)*……………… (5.6d)

Y_{PD} = *0.436 + 0.343 + 0.229 + 0.346 + 0.223 – 0.033 + 0.025 + 0.837 + 0.16 + 0.306 +0.805 – 0.005 + 0.719 = 4.391*……………………………………………………… (5.6e)

And finally, for a dam project, the moderate cost control score for the model would be represented by the value in equation 5.6g:

Y_{PD} = *0.436(3) + 0.343(3) + 0.229 (3) + 0.346(3) + 0.223(3) - 0.033(3) + 0.025(3) +0.837(3) +0.16(3) + 0.306(3) + 0.805(3) – 0.005(3) + 0.719(3)………………* (5.6f)

= *1.308* + *1.029* + 0.687 +1.038 +0.669 -0.099 + 0.075 + 2.511+ 0.48 + 0.918 +2.415 – 0.015 + 2.157 = 13.173……………………………………………………… (5.6g)

In practice, a real project cannot fully fulfill the latent variables criteria that show the mechanism of cost control is the best way to achieve efficient project delivery. The extreme scores of 4.391 to 21.855 are therefore the continuum of possible results that constitute expected cost control scores of dam projects which, based upon selected latent variables criteria, have experienced or have cost control mechanisms in place between pre-construction and post-construction phases. Thus, any lower than moderate score (13.173) is a poor mechanism for project delivery. The stakeholders can identify problems with cost control mechanisms through cost-control models, and preventive measures can be implemented to ensure that the project is delivered efficiently if they are detected early.

5.7 Research Summary

Key aim of this research is to establish a cost-management model for successful construction of dam in Nigeria. The study established the following five key research questions: -

Question (1): What makes dam development projects in Nigeria fail?

Question (2): Evaluate the consequences of those deficiencies on Nigeria's implementation of dam construction projects?

Question (3): What is the level of use of strategies for cost management and their impact in enhancing project performance of dam construction?

Question (4): What are the drivers and challenges of cost management strategies for achieving successful dam construction in Nigeria?

Question (5): Determine mediating role of strategies for cost management (drivers) in optimizing execution of projects?

Question (6): Can cost management model be built to deliver dam construction projects effectively in Nigeria?

Study tried to resolve research problems defined by the following research objectives: -
Objective (1): Examine causes of dam construction failures and impact on delivery in Nigeria.

Objective (2): To determine the impacts of Nigeria's inadequate project execution of dam projects.

Objective (3): To assess the extent of use of cost management strategies and their role in enhancing execution of projects.

Objective (4): Evaluate drivers and challenges of strategies for cost management in achieving successful dam production in Nigeria.

Objective (5): To build a cost management model for efficient dam construction projects in Nigeria.

A systematic overview of literature content was performed as an initial phase of the study. Content research was performed to determine reasons for inadequate performance, obstacles, challenges, and cost management strategies being used. As a result of the findings of content appraisal of over 100 related publications, it was found that majority of the studies were performed in the context of overseas countries on either the impact of cost control on projects or cost control strategies. Most of the studies employed quantitative methods without examining the underpinning theories. Consequently, this was one of the impetuses to conduct the current study on how to develop an all-inclusive model for effective cost control in Nigeria using mixed methods, and with due considerations for the underpinning theories.

The gap, research questions, and objectives were identified based on the content analysis and literature review findings. Then, to precede analysis, defining the dam construction projects that have suffered delay and perhaps abandoned due to poor control of costs or others related issues. Using archival data, the study considered 8 ongoing, 5 abandoned and 5 completed dam projects that have experienced the challenges earlier stated were identified; the various cost control techniques being used or considered to have been used were examined.

Senior managers and officers from the organizations involved in these projects were interviewed after the identification of the projects regarding the various causes of failures, strategies, challenges and drivers of the use of control techniques and other issues on the subject. The categories from the interview transcripts were defined using constant methods of comparison. Based on results of interview, reasons for failure of dam construction, theory and structure were identified.

To develop model for the study, economic analysis theory, project cost control process theory along with index to-complete theory, cost-projection theory, analysis of variance theory and earned value management theory were incorporated. Those elements were adapted from previous studies for the survey questionnaire. The products have been pre-tested following the validity protocol for the materials. Twenty carefully chosen practitioners reviewed the proposed questionnaire items to ensure compatible with the frameworks and all items were retained for further study.

Subsequently, the questionnaire's reliability assessment was conducted. This was accomplished through a pilot study which was conducted on the identified projects with response from 15 practitioners involved. 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.

The questionnaires were sent to 254 individuals, 152 of whom showed a response rate of 59.8% and were 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.

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.

5.8 Findings Summary

Summarized in this section is the major findings of the study. The key results are summarized in Table 5.62, which focused on each of the five objectives.

Table 5.65 Key Findings

Num	Target	Findings
1	Identify causes of poor project delivery of dam projects in Nigeria	Three highest ranked *contractor-related causes* of poor project delivery of dam projects are: 1. Unrealistic tender 2. Technical incompetence 3. Variations and rework during construction Top three *Procurement-related causes* of poor project delivery of dam projects are: 1. Financial status of the construction firm 2. Accuracy of estimates 3. Procurement method adopted Top three *finance/cost-related* causes of poor project delivery of dam projects are: 1. Payment delays 2. Variations and rework during construction 3. Accuracy of estimates Top three *client-related causes* of poor project delivery of dam projects are: 1.Payment delays

		2. Technical omissions during concept process 3. Incomplete design at tender Top three *political-related causes* of poor project delivery of dam projects are: 1.Price fluctuations 2.Stability of market conditions 3.Environmental regulations Rating of the *categories of causes* in order of importance 1.Financial/Cost-related causes 2.Client-related Causes of Poor Delivery of Dams 3.Political-Related Causes of Poor Delivery of dams 4.Procurement-related causes of Poor Delivery of dams 5.Contractor-related Causes of Poor Delivery of Dams
2	To assess the effects of poor dam projects delivery in Nigeria	Top three *direct effects* of poor dam projects delivery in Nigeria are: 1.Inability of government to provide services to the people 2.Loss of revenue by the client 3.Inability of client to recover investment Top three indirect consequences of Nigeria's weak dam delivery programs are: 1.Waste of resources 2.Poor access to water supply 3.Poor power supply Top three *effects* of non-application of techniques for cost control on dam construction are: 1.Project cost 2.Project duration 3.Project quality

		Top three consequences of the failure to apply cost management strategies on the construction costs of the dam delivery projects are: 1.Cost escalation 2.Project cost 3.Inability to secure project finance Top three *effects* of non-application of cost control techniques on quality of work of dam projects are: 1. Waste of resources 2.Completion time 3.Project cost Top three *effects* of non-application of cost control techniques on scope of work of dam projects are: 1.Project cost 2.Completion time 3.Cost escalation Top three *effects* of non-application of techniques for cost control on clients' satisfaction with dam projects are: 1.Completion time 2.Project cost 3.Cost escalation Top three *effects* of non-application of techniques for cost control on host community's satisfaction with delivery of dam projects are: 1.Total project abandonment 2.Completion time of the project 3.Negative public perception
3	Evaluate level of familiarity with techniques for cost control and frequency of use of techniques for cost control in Nigeria	Top three *most familiar* cost control techniques are: 1.Project budget 2.Project meetings 3. Contingency budget provision Top three *most frequently used* cost control techniques are: 1. Contingency budget provision 2. Project budget 3. Project meetings

4	To evaluate the drivers and challenges of techniques for cost control in achieving effective project delivery of dams in Nigeria	Top three *drivers* of techniques for cost control application are: 1.Availability of Skill or Technical Know-how 2.The need to train people to implement cost control techniques 3.Experience of the contracting company Top three *challenges* of cost control techniques application are: 1.Availability of skill or technical know-how 2.The need to train people to implement cost control techniques 3.Experience of the contracting company
5	To develop a cost control model for effective project delivery of dams in Nigeria	Top three *strategies* for cost control techniques application are: 1. Enhanced project management capability 2. Benchmarking of new projects into a comparison class with related projects completed (Projected Reference Class) 3. Program helped with cost analysis and process forecasting. Top three *factors for cost control model* for dam projects are: 1.Proper project conception and design 2.Technical capacity of the contractor 3.Contractor knowledge and experience

Source: Researcher's Field Survey (2019)

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 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 ineffective procurement process, 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 also found that majority of the practitioners were familiar with existing cost control techniques, but they seldomed use them owing to high cost of their applications and lack of technical manpower or knowledge, contingency budget provisions, project budgets and project meetings were found to be the most frequently used techniques. It further revealed that non-availability of technical skills, need to train staff and inexperienced contractors were some challenges of application of techniques for cost control while availability of skilled manpower was a major driver in its use. 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.

6.2 Recommendations

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:

i. 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.

ii. Clients or project promoters should ensure that funds are made available as required to avoid delays in payment for certified works.

iii. Contractors should update technical knowledge from time to time and use competent professionals during tendering to avoid unrealistic tenders.

iv. Project promoters should adopt effective procurement process, engage skilled and competent contractors and ensure adequate cash flow during the construction process.

v. Adopting cost-control methods in project delivery is dependent on familiarity with, simplicity and ease of application of the cost control technique.

vi. 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.

vii. The challenge for the application of cost control techniques could be overcome by training and re-training staff.

viii. The need to have a mechanism in place that will detect costs and budget overruns in enough time, correct them while the negatively impacted projects are still under way.

ix. To the policy makers the need for training and retraining of practitioners has been well established, it is therefore needful that this aspect is well factored into policy to ensure effective dam projects delivery. Secondly, the need to concede certain levels of authority to project control centres at site has also been underlined and should be considered seriously as a matter of policy. Training and capacity building is a major forth of the acadamia, the study underlines major trust areas where curricula should be developed to support project delivery. The imperative of this is that current curricula in the built environment or construction industry needs to be tinkered with to accommodate the findings of this study as requirement to improve the industry.

x. The construction industry particularly the heavy construction projects should not be all comer's affair.

6.3 Contribution to Knowledge

i. The developed model for effective project delivery and testing of the hypothetical paths (SEM) have contributed greatly to the contextual understanding of the current discourse on cost control techniques.

ii. The employment of mixed methods methodology, the results of this study permits a better understanding on how cost control techniques could be modelled to ensure effective project delivery.

iii. While challenges of cost control technique form the bedrock of the model, it is not enough to engender effective project delivery without the strategies and drivers.

As prior works proposed that quantitative approaches be applied to construction projects. A critical contribution from this study is the creation of a cost-control systemic model to ensure successful construction delivery. This model was partially validated by testing theories, and, using PLS-SEM, where the nexus was evaluated with other constructs used in the model. The use of PLS-SEM has assisted in estimating multiple interrelated dependence relationship through series of structural equation than separate equations. It has also helped in representing unobserved concept in the relationship and give details of measurement errors in the estimation process.

6.4 Research Limitations

The research was not without its limitations. The analysis provided empirical knowledge regarding the effect of techniques for cost control on efficient dam construction. Adopting a mixed methods methodology has assisted in answering research questions discussed earlier. Nonetheless, following the response rate, the findings of this analysis should be generalised with caution. In addition, for the interview performed, purposive sampling method was used to pick the interviewees; this may also restrict the generalizability of the qualitative study’s findings.

Generalisation of the theoretical model is another limitation of this thesis. However, supporting proof for the current model was found in the explanation of the cost control and project delivery relationship, and this may be country specific or perhaps not applicable in all contexts. Accordingly, the research findings, both qualitative and quantitative, have been used in fitting the model. This is less readily available in practice, because data are not being kept for the purpose for which it is being used for. This may limit the applicability of the theoretical model and the research methodology.

Considering a couple of cautions, the findings of this analysis should be considered carefully. Second, the study was cross-sectional and therefore, causality was difficult to conclude. Third, given the methodological and administrative procedures for resolving the prevalent process factor, such bias cannot be over looked in fully influencing results. These limitations notwithstanding, Findings of this research have incorporated various aspects to the literature's protection standards so that it affects compliance with safety. Nonetheless, the degree these results holds true in other infrastructure projects and in another context must be ascertained

6.5 Further Research Areas

Following the results and limitations identified in the preceding sections, the following areas for future research is proposed.

i. Further studies may consider the approach of sequential mixed methods where qualitative approach comes before quantitative and other factors influencing the adoption of such methods. For example, the questions raised by respondents as the causes of failure, challenges or drivers for adoption of control techniques could be used to refine questionnaire and methods used in data collection.
ii. The research suggests that future studies should include important mediators and moderators in the model in order to further explain the relationship between hypothetical paths. Future research may also want to address the challenges in using cost control methods rather than the extent of use as the former provides a

more realistic representation of why project fails due to lack of cost control method.

iii. More research work is needed to analyse how more effective management and accountability mechanisms are being implemented, and more reliable communication methods and networks for use on construction sites can help reduce project failure. This should be achieved with regards to the construction companies' structures vis-à-vis the organisational structures on construction sites.

iv. Research indicates a lack of accountability in execution of construction projects, such as dam project. Therefore, research that will focus on developing standard criteria for selecting high-potential contractors that will provide monitoring and evaluation procedures will offer great potential to mitigate the threat of poor delivery of dam projects.

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APPENDIX A

SAMPLE LETTER AND CONSENT FORM

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, NIGERIA

SCHOOL OF ENVIRONMENTAL TECHNOLOGY DEPARTMENT OF BUILDING

DOCTOR OF PHILOSOPHY (PhD)

COST CONTROL MODEL FOR EFFECTIVE PROJECT DELIVERY OF DAMS IN NIGERIA

QUESTIONNAIRE FOR CONTRACTORS

Dear Respondent,

This research project is being undertaken for academic purpose. It is expected that the outcome of the study will enrich our knowledge in the field of application of cost control techniques in project implementation, particularly delivery of dam projects. It is in this regard that your maximum cooperation is sought by responding to the following questions. Information provided will be treated with absolute confidentiality. Thank you very much.

Nicholas Dumebi Madu
Email: maduengr@yahoo.co.uk

PhD/SET/2015/787

CONSENT FORM

Please respond to the following:

i. I have read the introduction letter and I understand what kind of information that I am required to provide ☐

ii. I agree to answer the questions posed in the questionnaire and provide accurate information to the best of my knowledge ☐

iii. I understand that my participation is voluntary and that I am free to withdraw at any time without offering reasons ☐

iv. I agree to take part in this study ☐

v. Name of respondent and organisation………………………

Signature …………………. and Date…………………..

APPENDIX B

SAMPLE QUESTIONNAIRE

Q.No	Question	Response	Code
SECTION A: SOCIO-ECONOMIC CHARACTERISTICS			
A1	What is your gender?	Male	1
		Female	2
A2	Please indicate your age group (in years)	18 - 30 years	1
		31 -45 years	2
		46 -60 years	3
		> 60 years	4
A3	What is your highest educational qualification?	OND	1
		HND	2
		B.SC	3
		M.SC	4
		PH.D	5
		Others (Specify)	6
A4	What is your current position in the organisation (job title)		
A5	How long have you been in the employment of the organisation (in years)	0 -5 years	1
		6-10 years	2
		11 -15 years	3
		> 15 years	4
A6	What is your total number of years of experience in the construction industry	0 -5 years	1
		6-10 years	2
		11 -15 years	3
		> 15 years	4
SECTION B: ORGANIZATIONAL PROFILE AND ACTIVITIES			
B1	Name of your organisation		
B2	Please state the mission statement of your organisation		
B3	Kindly indicate the geographical location of your organisation's operational Headquarters	South East	1
		South South	2
		South West	3
		North East	4
		North West	5
		North Central	6
		FCT	7
B4	Please indicate the ownership of the organisation:	Nigerian	1
		Foreigner	2
		Joint (Nigerian and Foreigner)	3

B5	What is the average annual turnover of your organisation in Naira?	₦	
B6	What is the highest value of the project in Naira your organization executed in the last five years?	₦	
B7	How many years has your organisation been in existence	0 -5 years	1
		6-10 years	2
		11 -15 years	3
		> 15 years	4
B8	What is the estimated number of permanent staff in your organization	Project site	
		Headquarters	
		Total	
B9	How often do you have staff meeting in your organisation?	Weekly	1
		Fortnightly	2
		Monthly	3
		Bi-monthly	4
		Others (Specify)	5
B10	What kind of communication model do you have in your organisation	Top-Down	1
		Bottom-Up	2
B11	Information on Dam Projects involved in	Total No of Dams	
		Total Completed	
		Total NOT Completed	
B12	What are the reasons for non-completion of the projects?		
B13	Does your organisation plan its contract operations?	Yes	1
		No	2
B14	If yes to B13, who is responsible for the operational planning?		
B15	What method of procurement does your organisation prefer most when it comes to dam construction? (Tick only one)	Open tendering	1
		Restricted tendering	2
		Request for proposal	3
		Two stage Tendering	4
		Request for quotations	5
		Single source procurement	6
		Negotiated tendering	7
B16		Strategic planning	1

	What types of organisation planning techniques or methods do you use? (Please Tick as many as may be applicable)	Action planning					2
		Operational planning					3
		Assumption-based planning					4
		Contingency planning					5
B17	Does your organization use operational planning software package?	Yes					1
		No					2
B18	If yes to B17, kindly state the name(s) of the software						
SECTION C: CAUSES OF POOR DELIVERY OF DAM PROJECTS IN NIGERIA *Kindly rate as appropriate according to a scale of 1 - 5: 5 = Most relevant, 4 = Very relevant, 3 = Relevant, 2 = Slightly relevant, 1 = Not relevant to dam projects failure in your organization*							
C1	**Contractor-related Issues**	5	4	3	2	1	
C1.1	Poor organization structure and communication						
C1.2	Lack of experienced staff and work force						
C1.3	Poor working conditions						
C1.4	Unavailability of software packages						
C1.5	Contractor handling too many projects at the same time						
C1.6	Technical incompetence						
C1.7	Unrealistic tender						
C1.8	Over-estimating company’s capabilities						
C1.9	Low productivity and inefficiency of equipment						
C1.10	Time overrun						
C1.11	Poor quality of work						
C1.12	Accuracy of estimates						
C1.13	Construction method adopted						
C1.14	Lack of in-depth knowledge of production process						
C1.15	Project complexity						
C1.16	Updating cost information during construction						
C1.17	Variations and rework during construction						
C1.18	Price and design risk						
C1.19	Quality of cost information						
C1.20	Fraudulent practices						
C1.21	Disputes and litigation						
C1.22	Irregular meetings						
C1.23	Poor contractor – client communication						
C2	**Procurement related issues**	5	4	3	2	1	
C2.1	Financial status of the construction firm						
C2.2	Procurement method adopted						
C2.3	Accuracy of estimates						
C2.4	Lack of in-depth knowledge of production process						
C2.5	Project complexity						
C2.6	Quality of cost information						
C2.7	Error in the bill of quantities						

C2.8	Fraudulent practices					
C3	**Finance / cost related issues**	5	4	3	2	1
C3.1	Cost overrun					
C3.2	Accuracy of estimates					
C3.3	Project reviews of cost information					
C3.4	Variations and rework during construction					
C3.5	Payment delays					
C3.6	Quality of cost information					
C4	**Client related issues**	5	4	3	2	1
C4.1	Poor project conception					
C4.2	Technical omissions at design stage					
C4.3	Incomplete design at tender					
C4.4	Provision of mobilization funds for the project					
C4.5	Updating cost information during construction					
C4.6	Design failures					
C4.7	Lack of plan for cost overrun					
C4.8	Time overrun					
C4.9	Variations and rework during construction					
C4.10	Quality of cost information					
C4.11	Clarity of exclusions in the contract					
C4.12	Payment delays					
C4.13	Changes in design and scope (additional works at owner's request)					
C4.14	Client supervision					
C4.15	Disputes and litigation					
C4.16	Irregular meetings					
C4.17	Unimproved contractor – client communication					
C5	**Political related issues**	5	4	3	2	1
C5.1	Environmental regulations					
C5.2	Stability of market conditions					
C5.3	Political stability					
C5.4	Government regulations					
C5.5	Cost of labour					
C5.6	Price fluctuations					
C5.7	Lack of cooperation among political parties					
SECTION D: EFFECTS OF POOR DELIVERY OF DAM PROJECTS IN NIGERIA *This is a checklist of the effects of poor delivery of dam projects mentioned in the literature. Kindly* ***tick as many as are relevant*** *in your opinion. Rate on a scale of 5 - 1: 5 = Most severe, 4 = Very severe, 3 = Severe, 2 = Slightly severe, 1 = Not severe.*						
D1	**Direct effects**	**5**	**4**	**3**	**2**	**1**
D1.1	Contractor's loss profit margin/income					
D1.2	Discord between the contractor and host community					
D1.3	Loss of revenue by the client					
D1.4	Unemployment					
D1.5	Inability of client to recover investment					
D1.6	Inability of government to provide services to the people					

D2	Indirect effects	5	4	3	2	1
D2.1	Waste of resources					
D2.2	Poor access to water supply					
D2.3	Food scarcity					
D2.4	Citizens' loss of belief in government funded projects					
D2.5	Stunts economic growth of the nation					
D2.6	Poor power supply					
D3	**Effect of non-application of cost control techniques on delivery of dam project:** *Rate as 5 = Most severe, 4 = Very severe, 3 = Severe, 2 = Slightly severe, 1 = Not severe*					
		5	**4**	**3**	**2**	**1**
D3.1	Cost of the project					
D3.2	Completion time of the project					
D3.3	Quality of the project					
D3.4	Scope of the project					
D3.5	Stakeholders' satisfaction with the project					
D4 **Effect of non-application of cost control techniques on poor project delivery of dams in Nigeria:** *Rate as 5 = Most severe, 4 = Very severe, 3 = Severe, 2 = Slightly severe, 1 = Not severe*						
		5	**4**	**3**	**2**	**1**
D4.1	Cost of the project					
D4.2	Completion time of the project					
D4.3	Quality of the project					
D4.4	Scope of the project					
D4.5	Stakeholders' satisfaction with the project					
D5	**Effect of non-application of cost control techniques construction cost of project delivery of dams:** *Rate as 5 = Most severe, 4 = Very severe, 3 = Severe, 2 = Slightly severe, 1 = Not severe*					
		5	**4**	**3**	**2**	**1**
D5.1	Cost escalation					
D5.2	Contractual disputes and litigation					
D5.3	Quality of the project					
D5.4	Loss of profit by contractor					
D5.5	Less returns on investment					
D5.6	Waste of resources					
D5.7	Total project abandonment					
D5.8	Project delays					
D5.9	Negative public perception					
D6	**Effect of non-application of cost control techniques on construction period of dam projects**: *Rate as 5 = Most severe, 4 = Very severe, 3 = Severe, 2 = Slightly severe, 1 = Not severe*					
		5	**4**	**3**	**2**	**1**
D6.1	Cost of the project					
D6.2	Cost escalation					
D6.3	Quality of the project					
D6.4	Negative public perception					
D6.5	Loss of confidence					
D6.6	Inability to secure project finance					

D6.7	Contractual disputes and litigation					
D6.8	Total project abandonment					
D6.9	Loss of returns on investment					
D6.10	Added risks					
D6.11	Reduction in rate of national development and growth					
D6.12	Dissatisfaction of stakeholders					
D6.13	Frustration of the project host communities					
D7	**Effect of non-application of cost control techniques on quality of work of dam projects:** *Rate as 5 = Most severe, 4 = Very severe, 3 = Severe, 2 = Slightly severe, 1 = Not severe*					
		5	**4**	**3**	**2**	**1**
D7.1	Cost of the project					
D7.2	Completion time of the project					
D7.3	Waste of resources					
D7.4	Scope of the project					
D7.5	Stakeholders' satisfaction with the project					
D7.6	Contractual disputes and litigation					
D7.7	Loss of job					
D7.8	Less return on investment					
D7.9	Loss of confidence					
D7.10	Frustration of the stakeholders					
D8	**Effect of non-application of cost control techniques on scope of work of dam projects:** *Rate as 5 = Most severe, 4 = Very severe, 3 = Severe, 2 = Slightly severe, 1 = Not severe*					
		5	**4**	**3**	**2**	**1**
D8.1	Cost of the project					
D8.2	Completion time of the project					
D8.3	Quality of the project					
D8.4	Waste of resources					
D8.5	Stakeholders' satisfaction with the project					
D8.6	Cost escalation					
D8.7	Contractual disputes and litigation					
D8.8	Total abandonment of the project					
D8.9	Inability to secure project finance					
D8.10	Stakeholders satisfaction					
D9	**Effect of non-application of cost control techniques on clients' satisfaction with delivery of dam projects:** *Rate as 5 = Most severe, 4 = Very severe, 3 = Severe, 2 = Slightly severe, 1 = Not severe*					
		5	**4**	**3**	**2**	**1**
D9.1	Cost of the project					
D9.2	Completion time of the project					
D9.3	Quality of the project					
D9.4	Scope of the project					
D9.5	Stakeholders' satisfaction with the project					
D9.6	Waste of resources					
D9.7	Cost escalation					
D9.8	Contractual disputes and litigation					
D9.9	Negative public perception					

D9.10	Loss of job					
D9.11	Loss of income					
D9.12	Total project abandonment					
D9.13	Returns on investment					
D9.14	Loss of confidence					
D9.15	Inability to secure project finance					
D9.16	Added risks					
D10	**Effect of non-application of cost control techniques on project host community satisfaction:** *Rate as 5 = Most severe, 4 = Very severe, 3 = Severe, 2 = Slightly severe, 1 = Not severe*					
		5	**4**	**3**	**2**	**1**
D10.1	Cost of the project					
D10.2	Completion time of the project					
D10.3	Quality of the project					
D10.4	Scope of the project					
D10.5	Waste of resources					
D10.6	Cost escalation					
D10.7	Contractual disputes and litigation					
D10.8	Negative public perception					
D10.9	Total project abandonment					
D10.10	Added risks					
D10.11	Reduction in the rate of national growth					
SECTION E: FAMILIARITY WITH AND FREQUENCY OF USE OF COST CONTROL TECHNIQUES IN DAM PROJECT DELIVERY						
E1	**Familiarity with cost control techniques in dam project delivery:** *Rate your familiarity with the listed cost control techniques as 5 = Most familiar, 4 = Very familiar, 3 = Familiar, 2 = Slightly familiar, 1 = Not familiar*					
		5	**4**	**3**	**2**	**1**
E1.1	Traditional method					
E1.2	Activity based costing					
E1.3	Cost value relationship					
E1.4	Project budget					
E1.5	Cost forecasting					
E1.6	Schedule control					
E1.7	Variation analysis					
E1.8	Contingency budget provision					
E1.9	Project meetings					
E1.10	Resources management related strategy					
E1.11	Cost reports					
E1.12	Cash flow analysis and work programmes					
E1.13	Life cycle costing					
E1.14	Value analysis/engineering					
E1.15	Earned value analysis					
E1.16	Please state any other method of cost control that you are familiar with					

E2	**Frequency of use of cost control techniques in dam project delivery:** *Rate your frequency of use of each of the cost control techniques as 5 = Always, 4 = Often, 3 = Sometimes, 2 = Rarely, 1 = Never*					
		5	**4**	**3**	**2**	**1**
E2.1	Traditional method					
E2.2	Activity based costing					
E2.3	Cost value relationship					
E2.4	Project budget					
E2.5	Cost forecasting					
E2.6	Schedule control					
E2.7	Variation analysis					
E2.8	Contingency budget provision					
E2.9	Project meetings					
E2.10	Resources management related strategy					
E2.11	Cost reports					
E2.12	Cash flow analysis and work programmes					
E2.13	Life cycle costing					
E2.14	Value analysis/engineering					
E2.15	Earned value analysis					
SECTION F: EVALUATE THE DRIVERS AND CHALLENGES OF APPLICATION OF COST CONTROL TECHNIQUES IN ACHIEVING EFFECTIVE PROJECT DELIVERY OF DAMS IN NIGERIA: *Kindly rate the factors that drive or motivate the use of cost control techniques in project delivery as 5 = very high influence, 4 = high influence, 3 = slight influence, 2 = little influence, 1 = no influence*						
F1	**Drivers of the use of cost control techniques**	**5**	**4**	**3**	**2**	**1**
F1.1	Availability of skill or technical know-how					
F1.2	The need to train people to implement cost control techniques					
F1.3	The cost of applying the techniques					
F1.4	Cumbersomeness of applying the techniques					
F1.5	Size/ technical requirement of the project					
F1.6	Complexity of the project					
F1.7	Experience of the contracting company					
F1.8	Client requirement or influence					
F1.9	Desire to complete project on schedule					
F1.10	Desire to complete project within cost envelope					
F1.11	Desire to maximise profit					
F1.12	Need to achieve best quality of project					
F2	Does your organisation have an active policy for application of cost control techniques in projects implementation?	Yes			1	
		No			2	
F3	If there is active policy, how often is the policy reviewed?	Monthly			1	
		Quarterly			2	
		Bi Quarterly			3	
		Annually			4	
		Others			5	
F4		Yes			1	

	Is there a regular review of cost control techniques applied in previous projects handled by your organisation?	No	2
F5	Do you think that continuous reviews can improve cost control process in your organisation?	Yes	1
		No	2
F6	Is there a special template for managing/controlling construction cost?	Yes	1
		No	2
F7	How receptive is your Management to innovations and new ideas in construction cost control? Briefly explain	Not receptive	1
		Slightly receptive	2
		receptive	3
		Very receptive	4
		Most receptive	5
F8	Would you encourage a new form of construction cost reduction / management in your organization?	Yes	1
		No	2

F9	**Challenges in the use of cost control techniques** *Kindly rate the factors that hinder the use of cost control techniques in projects delivery in Nigeria as 5 = very high influence, 4 = high influence, 3 = slight influence, 2 = little influence, 1 = no influence*					
		5	**4**	**3**	**2**	**1**
F9.1	Availability of skill or technical know-how					
F9.2	The need to train people to implement cost control techniques					
F9.3	The cost of applying the techniques					
F9.4	Cumbersomeness of applying the techniques					
F9.5	Size/ technical requirement of the project					
F9.6	Complexity of the project					
F9.7	Experience of the contracting company					
F9.8	Client requirement or influence					
F9.9	Desire to complete project on schedule					
F9.10	Desire to complete project within cost envelope					
F9.11	Desire to maximise profit					
F9.12	Need to achieve best quality of project					
F10	**Strategies that could improve the use of cost control techniques in projects delivery:** *Kindly rate as 5 = very important, 4 = highly important, 3 = slightly important, 2 = important, 1 = not important*					
		5	**4**	**3**	**2**	**1**
F10.1	Enhanced project management capability					
F10.2	Bench marking new projects to a reference class of similar completed projects. (Reference class forecasting)					
F10.3	Computer aided cost estimating and forecasting models.					
F10.4	Risk and contingency planning.					
F10.5	Pre - qualification of contractors					
F10.6	Use of public - private - participation models.					

SECTION G: COST ONTROL MODEL FOR EFFECTIVE PROJECT DELIVERY OF DAMS IN NIGERIA						
G1	Does your organisation have a dedicated department responsible for cost control?	Yes				1
		No				2
G2	Would instituting cost control unit in your organisation lead to additional running cost?	Yes				1
		No				2
G3	Would there be a need to train someone or people particularly in the area of cost control in your organisation?	Yes				1
		No				2
G4	Would you say the cost control technique mentioned can improve dam project delivery?	Yes				1
		No				2
G5	Please give suggestions on how cost control techniques can be used to improve dam projects delivery in Nigeria					
G6	**Factors that could engender a framework for effective project delivery of dams in Nigeria:** *Kindly rate them as 5 = most important, 4 = very important, 3 = important, 2 = slightly important, 1 = not important*					
		5	**4**	**3**	**2**	**1**
G6.1	Proper project conception and design					
G6.2	Unrealistic tenders					
G6.3	Contractor knowledge and experience					
G6.4	Influence of procurement methods					
G6.5	Design failures					
G6.6	Quality of available cost information					
G6.7	Delay in payment for certified works					
G6.8	Disputes and instigation					
G6.9	Project sustainability					
G6.10	Availability of skilled manpower					
G6.11	Instability in the polity					
G6.12	Government regulations					
G6.13	Stakeholders satisfaction					
G6.14	Stability of the market/price fluctuation					
G6.15	Project host community related issues					
G6.16	Technical capacity of the contractor					
G6.17	Fraudulent practices					
G6.18	Professional bodies regulating the conduct of contractors					
G6.19	Penalty for poor performance					
G6.20	Reward for effective delivery of projects					

APPENDIX C

SAMPLE OF THE INTERVIEW TRANSCRIPT

INTERVIEW WITH “X” AND “Y” DAM PROJECTS CONTRACTOR.

Interview was carried out on the 14th of September 2019

Interviewer: Good morning sir

Respondent: Good morning

Interviewer: My name is Nicholas Madu, I am a student conducting a research that is trying to evaluate Cost Control Techniques in delivering of Dam projects in Nigeria. I would need to ask you some questions if you agree to take part in this study.

Respondent: Yeah, sure

Interviewer: would you please introduce yourself to me?

Respondent: My name is Mr. “Z”, I am a Civil Engineer. I am working in “ABZ” Construction Company, as at today I am the Operations Manager of the company in charge of all the project outside Abuja. Unless you want to ask me another.

Interviewer: Okay, I am informed that you are the coordinator in charge of “X” dam and “Y” Dams, is that correct?

Answer: Yes, that is correct.

Interviewer: Okay. Emmmm. Kindly let me also inform you that this interview is being recorded please.

Answer: No problem

Interviewer: I am required to let you know that it is for academic purposes only

Answer: No problem as far as you are not taking me to court.

Interviewer: Please, I am supposed to evaluate the causes of Dam projects delivery failure in Nigeria. From your experience, having been in this industry for a long time as I am told, what do you think is the major cause of our inability to deliver our Dam projects on time?

Answer: what is the main cause?

Interviewer: The reason why these projects are not delivered on time

Answer: Why they are not delivering on time. There are many reasons for not delivering on time. The first is lack of funds. That is one. The second is the design. Unfortunately, many projects are really given to Contractors but not with the comprehensive design. Hence the Contractor or the client will start to redesign or review the design and at times it takes a lot of time and at the end of the day it will delay everything. These are the two things that are very important. Also, I think if you have a poor organization structure, it will add to the problem. But for our company, this issue is not relevant.

Interviewer: Thank you very much**.** From my study in literature, some of the reasons why projects are not delivered on time can be attributed to the contractor. Do you agree?

Answer: No, not at all.

Interviewer: Okay, but ….

Answer: Let me put it on the right direction. Am talking from my experience, my company "ABZ" construction company will never ever be the cause of delay of delivery dam project to our clients. Not the fault of the contractor. If we look back, lack of funds and delay of payment were most relevant issue that caused delay.

Interviewer: Okay, now …. Procurement is the system is selecting contractors for each of the dam projects. Do you think that the system of procurement has a part to play in the ability to deliver a project on time?

Answer: Definitely yes, because the procurement part on this process is really important. You know there are too many contractors in Nigeria and if the procurement will take correct contractor with the most experience one, it means it will work the best for the client. But if you take the cheapest contractor, it might bring the situation to a certain level which will delay everything, and the client will receive poor quality.

Interviewer: Okay thank you very much. Now, so also, issues like poor conception of the project, technical omissions at the design stage, these are client related issues, do you think this can affect the inability of contractors to deliver project on time?

Answer: Are you talking about design?

Interviewer: Yes, design, conception etc. … these are issues that are domiciled with the client.

Answer: I think l mentioned that the design part is a major part. of course, the design must be taken into consideration before the contractor should take possession on site. If the design will be completed then a contractor might review the design if there any problems with the design then all the clients or the contractor should be mandated to correct it, but the design is a relevant or a very important part from the beginning.

Interviewer: Is there a relationship between design deficiency or incomplete and occurrence of variations in the project or the contract Sum?

Answer: Off course, variation always go with a poor design, if there is poor design at the beginning and you need to review the design of course there will be a significant variation in the course of the project. Off course.

Interviewer: Now in your own opinion, this is just a confirmation question, what could you say is the simple most important cause of dam project failure?

Answer: After handing over?

Interviewer: No, before completion of the construction process

Answer: Can your repeat the question please.

Interviewer: A project implementation is considered failed if the contractor fails to deliver it on time, what would you say is the single most important reason why projects fail?

Answer: If the contractor is reliable contractor and one that can deliver on a normal circumstance, it means that the one and only thing that can delay the handing over or the process of construction of the dam will be lack of funds. Unfortunately, from my experience in the past with those two projects that you mentioned at the beginning, the lack of delivery was definitely because of lack of funds by the clients. That is delay in payment.

Interviewer: Now as a contractor you plan the execution of your projects very well. Do you think there is a relationship between poor planning and poor delivery of project?

Answer: Definitely yes!

Interviewer: So, you agree that it is important for contractors to plan the operations very well?

Answer: Definitely! Program of work is the major part before starting any construction project.

Interviewer: As part of my study, I am expected to evaluate effects of project delivery in Nigeria. Now in your opinion what are the direct effects of inability to deliver project on time. I will like you to relate this question to; How does it affect the contractor; how does it affect the community and how does it affect the country as a whole? I mean the inability to deliver project on time, how does it affect these different categories of people.

Answer: Of course, it will affect everything significant and why? Because let's assume that the contractor should deliver their projects within two (2) years, if the deliver it after four (4) years we know what is the consequences of late delivery, everyone is losing.

Interviewer: So, everybody is affected by the inability to deliver the project.

Answer: Definitely, definitely

Interviewer: Now there are also indirect effect in our inability to deliver the project on time such as waste of resources and poor access to water supply for example. Do you agree with that?

Answer: Sorry can you repeat that?

Interviewer: We have categorised from literature the different effects, there are direct effects and indirect effects. Do you agree that waste of resources is an indirect effect?

Answer: I believe that.

Interviewer: Now further down, I am also to determine the challenges in the use of cost control techniques. From literature we have found that there are quite a number of cost control techniques that are available in the construction industry. Some of them are activity based costing, some are cost value relationship, even the project budget is a cost control technique, site meetings, variation analysis, contingency of budget etc. what cost control techniques therefore does your company leverage itself on majorly?

Answer: Yes! Variation analysis of course, cost forecasting, cost value relationship, of course, the program of work, the cash flow as well. Direct and Indirect cause, there are many things that related to it, therefore they must be taken into consideration. There are many techniques of course. We use as many as we can, to estimate everything from the beginning to the end, even before tendering.

Interviewer: Does your company have challenges in the use of these cost control techniques?

Answer: Of course, there are a lot of challenges but the change of basic rates in Nigeria, basic construction materials rate is really challenging issue which sometimes you can estimate but sometimes is a problem to estimate the cost according to the rate in the market.

Interviewer: Do you think it is necessary to train people in the use of cost control techniques? in your organization for example, do you have a division or a section responsible for cost control?

Answer: Yes, we have a division for cost control.

Interviewer: Do you need to train people to use this cost control effectively?

Answer: As at today, we have the full manpower to do the cost control. We don't need to add. We have the entire tools, everything that is needed, computers, software etc. I don't think that we need to add.

Interviewer: At the end of this my study, it is hoped that we would be able to generate a model that would help to deliver dam projects better in Nigeria. My question is, do you think that proper project conception and design would help us deliver projects better?

Answer: Definitely, those are two factors that are really important.

Interviewer: The technical capacity of a contractor to handle a particular project is it important? In your opinion in delivering the project?

Answer: It is the most important thing. Without technical capacity of the contractor, how can he start construction from the beginning. Yes, it is one of the most factors.

Interviewer: In literature, we found that there is a need for professional bodies regulating professionals in the construction industry, like COREN, NIQS etc. if they play more roles in regulating their professionals within the industry will it help in effective delivery of projects?

Answer: That is a really serious question because actually, I don't know what ability of COREN etc. or relationship with contractors. It means that as far as, in my opinion, if you have a reliable contractor, who is serious with the project, the manpower is experienced one, that has good equipment, with material on site and everything is okay, it means that the contractor does not need any assistance from a third party to deliver the project. But if COREN or other organisations within Nigeria will be part of projects, of course it will give some additional issues to the contractor, may it can assist the contractor by choosing the correct manpower, the real Engineers, by choosing the experienced ones, of course it can assist but to how much I really don’t know.

Interviewer: Fair enough, let’s say at the end of this study we recommend a penalty for poor performance, how would that go with you?

Answer: Definitely, I can support it. Penalty is something that everyone around the world, even criminals know that it is something that can affect their lives. So penalty is good in most of the cases but before you apply penalties, you need to check where is your responsibility as a client, you would have to check if you as the client did everything according to the agreement then you can come with the penalty item to the contractor for poor delivery or whatever but if the client did not fulfil its contractual obligations it means you cannot give penalties

Interviewer: Your answer is comprehensive enough. Finally, suppose we also advice a need to institute a reward for effective delivery, how would you look at that.

Answer: Same as my answered for the penalty. If the contractor would receive full support in fulfilling the contract obligation from the client, he would definitely have the ability to handover the project even before time and then you can reward him.

Interviewer: Okay Mr. “Z” thank you. We have come to the end of the interview. I thank you for your time, I appreciate your participation in the study. Let me also assure you once again that this interview is for academic purposes only. Thank you

APPENDIX D

SAMPLE EXTRACTS FROM ARCHIVAL RECORDS

Ogwashi-Uku multipurpose Dam Status: On-going	
Name of project	Ogwashi-Uku Multipurpose Dam
geographical location	Aniocha South LGA, Delta State
Project configuration at award	Construction of Dam and Hydropower
Year of award	Phase 1: 23rd December, 2006
Procurement method	Open and Competitive Tendering
Cost at award	₦440,703,912.60
Design status of the project at award	Preliminary Design
Duration of contract at award	18 months
Time elapsed since award	12yrs
Variation / review	Reviewed
Revised Estimated Total Cost (RETC) as at Dec. 2018	₦3,174,619,881.14
Status as at December 2018	85%
Cost of the project as at December 2018	₦3,674,619,881.14
Status of the implementation of the project	On-going
Status of completion of the project at Dec. 2018	85%
If completed, what year was it completed	On-going
Amount expended on the project as at June, 2019	₦3,674,619,881.14
Cost at completion (₦)	N/A

Jare Multipurpose Dam Status: On-going	
Name of project	Jare Multipurpose Dam
Geographical location	Bakolori LGA, Katsina State.
Project configuration at award	Construction of Dam, Water Supply, Irrigation & Access Road
Year of award	30th November, 2006
Method of procurement	Open and Competitive Tendering
Cost at award	₦3,182,035,148.03
Design status of the project at award	Preliminary Design
Duration of contract	3 years
Time elapse since award	12 years
Variation / review	Reviewed
Revised estimated total cost (RETC) as at Dec. 2018	₦11,071,986,728.37
Status as at December 2018	40%
Current cost of the project	₦11,071,986,728.37
Status of the implementation of the project	On-going
If complete, what year was it completed	On-going
Amount expended as at June, 2019	₦2,687,619,305.50
Cost at completion (₦)	N/A