A MODEL FOR PREDICTING COST CONTROL PRACTICE IN THE GHANAIAN CONSTRUCTION INDUSTRY

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A MODEL FOR PREDICTING COST CONTROL PRACTICE IN THE GHANAIAN CONSTRUCTION INDUSTRY

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DEDICATION

This thesis is dedicated to Bishop Paul Enu of Fair Heavens Chapel, Kumasi, and also to Prophet Francis Atton of Apostle Continuation Church, Apayo-Sokoban, Kumasi.

DECLARATION

DECLARATION BY STUDENT

I, Kofi Owusu Adjei, hereby proclaim that to the best of my knowledge, this thesis, ‘A model for predicting Cost Control Practice in the Ghanaian Construction Industry’’ is my own unaided work and that every other source that I have utilised or alluded to has been properly recognised in the reference section. This thesis is being submitted to the University of Johannesburg, Faculty of Engineering and the Built Environment, for the fulfillment of the requirements for the Doctor of Philosophy in Engineering Management. It has not been presented by me or any other individual to any other institution for any degree or examination.

……………………………………….. ………………………………

Kofi Owusu Adjei Date

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EXECUTIVE SUMMARY

One of the key roles of construction project managers is to execute construction projects within the targeted project cost. In Africa, most construction projects suffer huge cost overruns. Project cost control practice is required by every construction firm to keep the project cost in line with the budgeted cost. A comprehension of the different parts of cost control philosophies is fundamental to empower project cost managers to adequately set up robust cost controls and to improve future strategies for active construction project cost delivery. Although there are efforts by project cost managers to control cost, there is a lack of understanding of the factors that determine cost control practice in Ghana, as a developing nation. The factors enhancing cost control practice and a formal model are needed for consideration by project cost managers to guide their operations. This study develops a model for predicting cost control practice in the Ghanaian construction industry.

Mixed-method methodology was utilised for this study. The qualitative survey used the Delphi survey approach to investigate the primary factors and measurement-related factors. The study identifies project cost control as eight-factor constructs: project cost estimation, project cost budgeting, project cost reporting, project cost monitoring, project cost analysis, decision-making, change management and project cost communication. These had strong inter-quartile deviations.

The preliminary discovery from the literature shows lack of change management and project cost communication concepts in cost control practice. These concepts are significant in predicting cost control practice of contractors. Both the Delphi survey and the factor analysis confirmed the eight-factors for cost control practice. The relationships of the related factors are presented in this study. The regression analysis indicates two latent constructs, project cost monitoring and decision-making to be good predictors of cost control practice of contractors.

The findings contributing to the body of knowledge were categorised under four sections, project cost control model, theoretical, methodological and practical. The results of both the Delphi survey and factor analysis confirm that cost control theory has eight-factor constructs. The data collected were validated. The relationships of the variables and the outcomes of cost control practice are presented. The key issues on cost control practice and the results of this investigation lead to direct recommendations for further research under the project cost control model, the theoretical, methodological and practical aspects. The recommendations

include expanding the developed model to include more variables in future studies to improve cost control practice. Moreover, research should be carried out on all the variables to determine their relationships and the fitness of the model, using a two-stage approach, including structural equation modelling. Contractors should, wherever possible, provide training to site management team members to adopt and appreciate the need for cost control practice.

Keywords: construction industry, cost control, cost management, cost overruns, factors, Ghana.

LIST OF ABBREVIATIONS

ABC	-	Activity Based Costing
AC	-	Actual Costs
ACWP	-	Actual Cost of Work Performed
BCWS	-	Budgeted Cost of Work Scheduled
BOQ	-	Bills of Quantities
CCC	-	Cost Control Challenges
CEAC	-	Cost Estimate at Completion
CM	-	Change Management
CPD	-	Continuous Professional Development
CPM	-	Critical Path Method
CPI	-	Cost Performance Index
C/SCSC	-	Cost/Schedule Control Systems Criteria
CV	-	Cost Variance
DM	-	Decision Making
DSO	-	Delphi Survey Objectives
EFA	-	Exploratory Factor Analysis
ETC	-	Estimate to Complete
EV	-	Earned Value
EVA	-	Earned Value Analysis
EVM	-	Earned Value Management
EVMS	-	Earned Value Management System
GIE	-	Ghana Institution of Engineers

GIOC	-	Ghana Institute of Construction
GhIS	-	Ghana Institute of Surveyors
ICT	-	Information and Communications Technology
IQD	-	Interquartile Deviation
KMO	-	Kaiser-Meyer-Olkin
LPT	-	Leading Parameter Technique
MIS	-	Mean Item Score
MM	-	Mixed Method
MMR	-	Mixed Method Research
NASA	-	National Aeronautics and Space Administration
OCC	-	Outcomes of Cost Control
PCA	-	Principal Component Analysis
PCAN	-	Project Cost Analysis
PCB	-	Project Cost Budgeting
PCE	-	Project Cost Estimation
PCC	-	Project Cost Control
PCCM	-	Project Cost Communication
PCM	-	Project Cost Monitoring
PCR	-	Project Cost Reporting
PERT	-	Program Evaluation and Review Technique
PMBOK	-	Project Management Body of Knowledge
POC	-	Contractor’s Organisational Culture
POS	-	Contractor’s Organisational Structure

PV	-	Planned Value
RO	-	Research Objectives
RQ	-	Research Questions
SEM	-	Structural Equation Modelling
SD	-	Standard Deviation
SPSS	-	Statistical Package for Social Sciences
USD	-	United States Dollars
WBS	-	Work Breakdown Structure

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Construction cost is dynamic in nature and it is affected by several other uncertainties (Yang & Cheng, 2015). It is therefore required that the construction project cost is controlled from the commencement of the project to its completion (Bahaudin *et al.*, 2012). Project cost management applies cost control techniques to solve cost overruns in construction costs. The practice assists organisations to eradicate or decrease unnecessary wastage of construction resources in the execution of construction projects (Adjei *et al*., 2017a; Bahaudin *et al*., 2012). An understanding of the different parts of cost control philosophies is fundamental to empower project cost managers to adequately set up robust cost controls to improve future strategies for active construction project delivery (Skitmore & Marston, 2005).

Both private and public sectors of the construction industry have lost extensive amounts of income as a result of projects unsuccessful in terms of cost and time. This also occurs in construction projects, both large and small, modern-day construction (Olawale & Sun, 2015; Olawale & Sun, 2010). In developing and sub-Saharan countries, project cost overruns are severe in spite of the availability of cost control techniques and information communication and technology tools (Olawale & Sun, 2010). This indicates that cost control practice is a challenge for contractors or project team members handling construction projects. Project cost control systems are more essential and mandatory for the construction industry than for any other industry. It is surprising that the construction industry's focus is on customer-based projects in the production and delivery of the construction projects and not on cost management strategies to curb problems arising in the construction of the project (Pries *et al.*, 2004). Almost all construction companies carry out construction projects on an insignificant profit margin to enable them to attract more projects to keep them in the construction business. For this reason, project cost control (PCC) cannot be overemphasised (Ashworth *et al.*, 2002; Sanni & Hashim, 2013). Project teams and other stakeholders expect contractors to have the capacity to execute the construction projects within the planned project scope, including the project budgeted cost (Nazilli & Postavaru, 2012, Halpin & Woodhead, 1998). When this expectation is not met, it usually results in high cost overruns (Nazilli & Postavaru, 2012; Olawale & Sun, 2010; Halpin & Woodhead, 1998). Project cost managers are faced with the challenge of ensuring that project cost success is achieved at the end of the project. The project managers or cost experts are also required to make decisions at different stages and to transform the decisions into actions that will achieve good cost control mechanisms (Harris & McCaffer, 2002). The project quantity surveyor or the cost engineer may need to apply the PCC practice to develop a series of options for other project members to help them consider and select the best option within the approved budget limit (Dikko, 2002).

Otim *et al*. (2011) and Raina (1999) have identified major problems contractors face in controlling construction project cost at their construction sites. Some of the difficulties identified include poor project preparation, lapses in the management of construction projects, over budgeting, poor materials, labour shortages, increases in the cost of materials, delay in delivery of materials, wastage of materials, unexpected weather changes, loss of materials, insecurity and poor communication on construction sites. The challenges facing building contractors in managing construction project cost is not only limited to Ghana. It exists as a global phenomenon. Adjei *et al*. (2017b) further add that the challenges of cost control practices can be attributed to the cost manager's personal characteristics, knowledge of cost control processes and the technology used in the practice of cost control.

Several definitions of construction cost control condense to confirm that of Cleland & Ireland (2002). Cleland & Ireland, (2002) define cost control as the process of monitoring, evaluating and comparing the real results with the planned results to determine the position of the project cost. Otim *et al*. (2011) further explain that cost control is a process whereby the construction project cost goes through all its likely suitable approaches or techniques so that the contractor does not suffer any losses at the time of executing the various activities of the construction project. There appears to be a lack of key management functions in the existing theories of controlling construction cost. Researchers have supported the fact that some more enhanced models, such as a more informed simulation, work breakdown structure and knowledge-based models for carrying out construction cost control, are required for development to meet modern trends (Al-jibouri, 2002; Bahaudin *et al*., 2012). The systems that exist for the practice of cost control require more current research and expansion to ensure that they also become generally satisfactory to construction companies and that they are suitable in their area of operation (Al-jibouri, 2002; Bahaudin *et al*., 2012).

Likewise, Olawale & Sun (2015) show that the existing cost control framework of Charoenngam & Sriprasert, (2001) is relevant for cost control practice, having the main attributes necessary, although it has not seen advancement over the years. The work by Olawale & Sun (2015) adds to the constructs of the core attributes of cost control. The existing core attributes of cost control system are: construction cost estimation leading to project budgeting, cost monitoring, analysing the cost status, project cost reporting, cost forecasting, project cost decision-making and corrective actions (Adjei *et al.*, 2017a; Charoenngam & Sriprasert, 2001). Researchers like Adjei *et al*., (2017a) Khamidi *et al*., (2011) Al-Jibouri, (2003) and Dikko, (2002) concur that there is the likelihood of cost variances, thus changes, occurring within the original budgeted cost. The definition of cost control points out the comparison of the actual against the budgeted. Therefore, the changes in the construction project cost could be also managed with change management concepts. Hafez *et al*. (2015) buttressed the fact that project cost control systems should include estimation, monitoring, project reporting, forecasting and change management processes which encompass assessing the impact of change, reporting on the change decisions and implementing the change in the scope of the work. Zou & Lee (2008) also support the concept that construction projects with change management principles accomplish better in cost performance than those lacking change management principles. In addition, Zou & Lee (2008) show that change management is one of the best and most important practices in project management but that this is seen less often in construction cost control.

The existing cost control framework is deficient in using change management to bring life into construction project cost control practice. For this reason, the concept of change management and project cost communication principles are being introduced into existing theories of construction cost control. The required framework needs to answer 'what is' and also to look at how to fit these concepts into construction cost control practice.

This study seeks to develop a model for predicting cost control practice in the Ghanaian construction industry.

1.2 PROBLEM STATEMENT

Construction project cost management is concerned with the process of planning and controlling the budget of a project. Akintoye & Fitzgerald, (2000) suggest; that it includes activities such as planning, cost estimating, cost budgeting, financing, funding, managing and controlling costs, leading to project being completed within the approved budget. These project cost management activities are frequently ignored in construction projects and this leads to cost overruns.

Globally, most construction projects executed do not meet their project cost objectives, resulting in project cost overruns (Niazi & Painting, 2017; Azhar and Farouqi, 2008; Ahmad *et al*., 2002). The issue of project cost overruns is a concern in developed and developing countries and in the public and private sectors (Memon *et al.*, 2013). Aljohani *et al.* (2017) point to the following projects which experienced cost overruns: Great Belt Link project in Denmark, 54%, the Humber Bridge project in UK, 175%, seven megaprojects in Korea, 122.4% and railway projects in the USA which had a 61% cost overrun. The above clearly show the gravity of cost overrun in developed economies. However, there seems to be lack of available data on the degree of cost overrun in developing countries.

Although, in the case of Ghana, Frimpong *et al*. (2003) indicate that 75% of construction projects executed exceed their initial cost, they fail to explain the extent to which this affects project delivery. Similarly, Ahadzie (2003) and Fugar & Adinyira (2009) claim that, PCC practices have not made the necessary impact on Ghanaian contractors in the execution of construction projects. Surprisingly, none of these studies clearly indicates the factors of cost control practice in Ghana. Moreover, extant literature on construction project cost overruns in emerging economies is very scanty. In this regard, there is a lack of empirical models that predict the factors that assist contractors in the practice of construction project cost control in developing countries.

Construction projects cost overruns are often due to a lack of resource planning, cost estimating, cost budgeting and cost control (Ramabodu and Verster, 2010; Gunasekaran & Ngai, 2004; Akintoye & Fitzgerald, 2000; Kaming *et al*., 1997). Admittedly, most small and medium scale contractors in developing countries, including Ghana, lack project cost management skills. This often leads to a lack of appreciation of the budgeted cost against the expenditure of the project, in order to determine the status of the cost variations and develop corrective measures during construction execution.

Contractors in developing countries often fail to identify, in the initial phase of a project, the resources required to complete the project activities. If the resource types and quantities in terms of time, material, labour and equipment are not known in the initial stages, the associated costs cannot be determined.

There are several cost estimating methods that can be applied to predict how much a construction will cost. However, contractors in developing countries seem to lack knowledge of these estimating methods and this often leads to poor project control techniques in the long run (Iyer & Jha, 2005). The cost estimates of a construction project serve as the basis for the project schedule as well as input for cost budgeting. This means that the lack of knowledge in cost estimation by contractors leads to poor construction project cost budgeting. Poor construction project cost budgeting further leads to poor construction cost control.

Construction cost control is concerned with measuring variances from the cost budget or baseline and taking effective corrective action to achieve minimum costs. When actual cost information becomes available, an important part of cost control is to explain the cause of the variance from the cost baseline. However, a lack of appreciation of construction resource planning techniques, cost estimating methods, cost budgeting and cost control by contractors contributes largely to construction cost overruns in developing countries. Furthermore, the lack of empirical models to predict the factors that assist contractors in the practice of construction project cost control in developing countries have exacerbated the problem of construction cost overruns.

This study is an attempt to develop a model that predicts the factors that assist contractors in the practice of construction project cost control in developing countries, using Ghana as a case study.

1.3 AIM OF THE STUDY

The aim of the research is firstly to reveal the factors that determine cost control practice and secondly, to develop a model to predict the factors enhancing PCC practices for contractors in the Ghanaian construction industry. The study aims to show the relationships between the variables of project cost estimation, project cost budgeting, project cost reporting, project cost monitoring, project cost analysis and decision-making. These are the primary variables that measure project cost control practice, as indicated by previous scholars' works. Further, the study considers change management and project cost communication concepts which add to the existing exogenous variables. In addition, it aims to show the role the exogenous variables play in predicting the endogenous variable. The model, if appropriately applied, will assist the determination and measurement of the project cost control practice for contractors.

The new developed model will help contractors in the Ghanaian construction industry to achieve effective project cost delivery.

1.4 RESEARCH MOTIVATION

At present, no study has investigated cost control factors in the Ghanaian construction industry and developing nations with identical characteristics. This investigation addresses the research gaps in addition to providing cost control information for Ghana as a developing nation. The investigation assesses the existing six-factor constructs of cost control: project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis and decision-making. It examines the relationships of the main and related factors and their influence on the outcome of cost control practice. Additionally, the identified gaps of change management and project cost communication have not been addressed by previous studies.

Infrastructure projects are still required by the developing nations, including Ghana. Construction project costs should be carried out to meet their project cost objectives. The researcher is motivated by the need to predict cost control factors for effective project cost delivery in construction projects.

1.5 SIGNIFICANCE OF THE STUDY

There is a gap in literature about the factors enhancing the practice of construction project cost control in developing countries. This study, therefore, contributes to the prevailing body of knowledge by identifying the factors that determine cost control practice for contractors and establishing the impact of the factors classified as exogenous variables in the thesis. This study does not use existing methodology on cost control but uses a different approach to establish the factors for the practice of cost control. This study further uses the mixed methodology of qualitative and quantitative methods. Delphi survey and questionnaire survey techniques to explore the factors enhancing cost control practice for contractors.

Hence, the study adds new knowledge of the factors that determine cost control practice for contractors. This innovative method and the outcome variable measures used in the study further contribute to the existing body of knowledge of cost control in the construction industry. Like the empirical study, is a critical literature review on cost control practice theory, expanding existing knowledge by providing synthesised literature that will be useful for improving cost control practice in both developing and developed countries.

The construction industry is such that infrastructural development is always needed and governments and individuals will always contribute to infrastructure development. Cost control becomes a key issue to be considered to achieve cost objectives of the construction project. This study provides a guide for the factors to be considered in cost management.

Contractors who find it very difficult to control costs on their construction sites due to a number of reasons can easily adopt this new model in their practices. It serves to offer better understanding of the factors which enhance the practice of PCC. It also spells out all the main and related factors and the organisational elements needed to be in place by the contractors for effective cost control practice.

Furthermore, the current study shows the current challenges of PCC practices in the Ghanaian construction industry. This will serve as a source of information and will offer better understanding to young graduates and professionals practising project cost control so that they will be able to fully formulate better strategic solutions to overcome the challenges of the practices of PCC.

1.6 THE STUDY

The following aspects of the study are covered: research questions, research objectives, research methodology, data needed and means of obtaining it (empirical measures), the study area, data analysis, the results and delimitations of the study.

1.6.1 RESEARCH QUESTIONS

The following research questions are dependent on the exploration goal and the problem statement:

RQ1 What are the determinants that influence the practice of cost control of contractors in the Ghanaian construction industry?

RQ2 To what extent do the elements of organisational philosophies assist contractors in cost control practice?

RQ3 To what extent do cost control factors predict the outcomes of cost control practice?

RQ4 To what extent does the hypothesised project cost control framework fit the

identified exogenous factors?

1.6.2 RESEARCH OBJECTIVES

In order to achieve the aim of the study, the following research objectives have been set:

RO1: To identify current theories and literature on cost control practice in construction with a view to identifying gaps for further studies**.**

RO2: To determine the main and sub attributes that influence cost control practice and **to** examine whether the attributes that determine cost control practice in other cultural contexts are the same in Ghana.

RO3: To develop a holistic cost control conceptual framework for contractors in Ghana.

RO4: To determine the organisational elements that influence cost control practice in Ghana.

RO5: To determine the cost control challenges for contractors in Ghana

RO6: To predict the factors that determine cost control practice for contractors in Ghana.

The details of how each RO has been achieved are presented in chapters six and eleven. Notwithstanding, a short awareness is created on how each RO has been reached in this section of the study.

The research objective RO1 was accomplished through an extensive literature review related to the field of study. RO2 and RO4 were also accomplished by extensive literature reviews and then affirmed by utilising a Delphi survey technique with experts who had understanding of the cost control practice. Additionally, RO3 was accomplished through a literature review, a Delphi study and the confirmed research gaps by the Delphi experts. RO5 was accomplished using a desktop questionnaire. Finally, RO6 was accomplished through the fieldwork questionnaire survey together with data analysis technique of multiple linear regression modelling of the findings, using SPSS version 24 software.

1.6.3 RESEARCH METHODOLOGY

The investigation embraced strategies and philosophies that empowered the researcher to accomplish the exploration objectives. Despite the fact that strategies are characterised as the systems and instruments utilised for data accumulation, sampling and testing the data or information, the approach is the investigation of the research methods (Bryman, 2008). The philosophy and techniques were considered as an arrangement of philosophical underpinnings and standards fundamental for the specific procedures used to accomplish the present research targets (Denzin & Lincoln, 2000; Saunders *et al*., 2007). Along these lines, the exploration approach (structure) explicates the plans and strategies of the techniques for information gathering, investigation, elucidation, strategy and the philosophical presumptions employed by the researcher to accomplish the objectives (Creswell, 2014). This examination surveys the methodological conventions used for comparative investigations and the information collection procedures and draws from several examinations. In view of the benefits of both the qualitative and the quantitative methodologies, a blend of the mixed method strategy was applied for the research.

1.6.3.1 Quantitative research

Quantitative research depends on the standards of the normal sciences and, along these lines, depends on the suspicions of a target perspective on the social world. Target techniques for estimations are subsequently used in the estimation of amounts in this examination classification. Trochim (2004) further claims that quantitative methodology is deductive and validating in principle as against subjective, which is inductive and exploratory. There are numerous research issues which can be inspected employing either a subjective or quantitative strategy. Or maybe, both strategies have components of inductive, deductive, supportive and exploratory methodologies. Bryman (2003) contends that quantitative research underscores evaluation in information gathering and investigation, while subjective research stresses words and is diverse with respect to tendency and hypothesis.

As per Creswell (2009), in utilising a quantitative methodology, researchers fundamentally use post-positivist cases for advancing information. Scientists therefore embrace analyses and overviews for information accumulation, utilising the foreordained instrument for measurable information. Then again, scientists generally make information claims dependent on productive viewpoints. The revelation is reinforced by analysts recommending that the quantitative strategy is deductive and positivistically situated, while the subjective is viewed as inductive and constructionist (Bryman, 2003).

Quantitative data were used to test for the reliability and validity of the data. The independent and dependent variable measurements on the cost control factors were determined. The quantitative data also provided the relationships between the main constructs and the outcomes of the cost control practice. The development of the model to predict the cost control factors was conducted via the quantitative research approach. This is supported by Bryman & Bell (2007). According to Bryman & Bell (2007), searching for predictors and theory building is developed by hypothesised models, using quantitative research.

1.6.3.2 Qualitative research

Creswell, (2009) discloses that, the qualitative methodology embraces systems of request including accounts, phenomenology and case studies, whereas quantitative methodology employs techniques to explore and gain an overview of factual information, utilising pre-set instruments. In investigating methodological choices, scientists are affected by the aims of the examination and the kind of information required; exploration studies may embrace one of the two wide philosophies or join the two as impacted by the research paradigm (Aigbavboa, 2013; Creswell, 2009).

Mwanaumo (2014) cites Seymour & Rooke (1995) in their declaration that there have been numerous problems in the construction sector since learning has been overwhelmed by unbending methodological ideal models, endorsing an evaluation and factual methodology. The utilisation of qualitative data offers a point-by-point understanding of an exploration issue, while quantitative information carries an increasingly broad comprehension (Creswell & Plano Clark, 2011; Ngulube & Ngulube, 2015). Specialists are deciding on numerous examination systems, as methodological pluralism gives preferable quality information over a solitary methodology (Creswell & Garrett, 2008; Ngulube & Ngulube, 2015). Methodological pluralism uses methodologies of request that include gathering information, either all simultaneously or consecutively to fathom enquiries about issues (Creswell, 2009).

The Delphi survey method which has been classified under qualitative research methodology was employed for this study. The Delphi information was applicable in light of the fact that the aim was to comprehend, clarify, investigate and clear up the discernments and encounters of industry members on cost control practice. This is consonant with work by Kumar (2005).

1.6.3.4 Mixed-method approach

This study has adopted the mixed-method approach. The mixed method (MM) approach includes the gathering or investigation of both quantitative and qualitative information in a solitary report (Creswell *et al*., 2003; Bryman & Bell, 2007). Additionally, Tashakkori and Teddlie (2003) characterise a MM inquiry as one that consolidates qualitative and quantitative ways of dealing with the exploration techniques of a solitary report or multi-staged examination. Information is gathered simultaneously, consecutively or by transformation. This includes the coordination of the information, at least one phase during the time spent researching (Tashakkori & Teddlie, 2003: 687; Creswell & Plano Clark, 2007: 85). Flick (2011) states that there are two fundamental methodologies: joining techniques in subjective and quantitative research, and qualitative and quantitative investigation in a similar report.

According to Edwards *et al*. (1998) in Bryman and Bell (2007), a qualitative technique is used to advise quantitative methodology. It takes into account access to examine members' viewpoints and their implications on issues, while factors and topics are investigated. Utilising a subjective methodology, connections between factors are investigated with respect to cause and impact. This means that the specialist can recognise autonomous, reliant and interceding factors. This is valuable for the present investigation as it seeks to discover the variable referred to above and which is in charge of cost control practice. The cost control procedure likewise impacts on the construction project cost delivery. Having decided the constructs and related factors, the quantitative technique is employed to assess the all-inclusive statement of the qualitative discoveries. The utilisation of MMR is supported by numerous researchers (Bryman & Bell, 2007).

The use of the mixed method curbs the weaknesses in theory, hypothesis and model development of both approaches (Bryman & Bell, 2007: Flick, 2011). It also helps to achieve the reliability of the data in a single research study (Tashakkori & Teddlie, 2003).

The prediction of the factors enhancing cost control practice in Ghana requires knowing the influential variables. The experts in Ghana determine the variables using a qualitative technique, as supported by Bryman (2003). The existing cost control theories of Abubakar (1992) and Charoenngam & Sriprasert (2001) have been explored and confirmed by experts. Researchers have supported the use of a small sample size, setting research objectives, data collection, open-ended questions, grouping the data to develop hypotheses in studies where a similar approach was implemented (Flick, 2011; Bryman & Bell, 2007; Bryman, 2003). The idea was to develop theories using qualitative means. In accordance with Creswell (2013) a pragmatic paradigm was applied for the study. The Delphi qualitative survey technique was used for the concept of cost control practice.

1.6.4 Data needed and means of obtaining it (empirical measures)

Literature on cost control practice is reviewed from books, accredited journals, published and unpublished works such as dissertation and web-based publications on the specified field of study. Two methods were used for collecting the data. The Delphi survey and the fieldwork in the form of a questionnaire survey. The details of the two methods are presented in the chapter seven of this study.

1.6.5 The study area

Ghana was deliberately chosen as the examination region because the researcher is increasingly comfortable with the development of several infrastructure projects in this territory. For this reason, decided to use this territory for getting significant and solid information. Additionally, Ghana was picked as the examination territory in light of the fact that there is little focus in the existing literature on cost control practice there, so there is a need to investigate cost control issues in Ghana.

1.6.6 Data analysis

Data obtained from the Delphi survey was analysed using descriptive statistics. The output is presented in means, standard deviations and their deviations, such as the inter-quarter deviations. The questionnaire survey was analysed using factor analysis and regression analysis. The multi-linear regression analysis was used to predict the factors enhancing cost control practice for contractors. Reliability and the validity tests were conducted. The statistics are presented in the form of charts, graphs and tables.

1.6.7 The results

The main goal of the study has been to develop a model to predict cost control practice in the Ghanaian construction industry. The results related to the interconnections among the exogenous variables (project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis, decision-making, change management and project cost communication) and the endogenous variables (outcomes of cost control) are presented in graphs, charts and tables. Lastly, the reliability and validity test results from the questionnaire and Delphi survey data are presented to aid in conceptualising the model predicted.

Objectives of the Delphi Survey

DSO 1: To establish the attributes (main and sub) that determine the practice of cost control and to examine whether the factors influencing cost control practice applicable in other cultural locations are the same in Ghana.

DOS 2: To confirm or otherwise whether the factors revealed as gaps in the literature influence the practice of cost control.

DOS 3: To determine the elements of organisational structure that affect cost control practice.

DOS 4: To determine the elements of organisational culture that affect cost control practice.

DOS 5: To determine the elements of ICT tools and knowledge that affect cost control practice.

DOS 6: To evaluate the project cost control output as a result of the practice of cost control.

Objectives of the fieldwork questionnaire survey

The objectives directing the fieldwork survey and addressing the overall research objectives (numbers RO5 & R06) where the model is validated, are incorporated in the accompanying:

QS1 To establish how the revealed factors influence cost control practice in the construction industry.

QS2 To predict the factors with the greater influence on cost control practice in the construction industry.

QS3 To determine the cost control challenges.

QS4 To validate the model developed.

Two different hypotheses have been used for the study. The first one is based on the fact that the views of the respondents are normally distributed. The second hypothesis is based on the fact that the overall cost control model directly influences the exogenous variables (project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis, decision-making, change management and project cost communication) and predicts cost control outcomes for contractors in the Ghanaian construction industry.

1.6.8 Delimitations of the study

The scope of the study covers cost control practice in the Ghanaian construction industry. The work looks at the variables, both the main and the related factors, that influence cost control practice. This is established through the literature review, the Delphi survey and the questionnaire. The IQD and factor analysis establish the factors, while the regression analysis model is used to predict the factors for the construction industry. The statistics are presented in charts, graphs and tables.

This study is limited to top-class contractors with D1K1 and D2K2 registrations with the Ministry of Water Resources, Works and Housing. The selection of the contractors was because these firms have well-managed structures and demonstrate a high frequency of the practice of cost control. Contractors executing live construction projects in Accra (Greater

Accra region) and Kumasi (Ashanti region) were used. The study examines the cost control practice of these firms in order to predict the relevant factors.

Lastly, the findings are discussed and suggestions are outlined to improve cost control practices in Ghana for effective cost control practice in Ghana, and for other developing nations as well.

1.7 ETHICAL CONSIDERATIONS

It is appropriate to consider the best possible ethical considerations of this investigation. This is to secure the interests of the study respondents. With respect to the overview respondents, nobody was compelled to provide answers to the questions used in this study. The respondents took part of their personal free will. They were assured of their right to withdraw at any time they wished. Likewise, they were advised of the motivation behind the examination and how or why they were selected. All things considered, they were free from misleading or stress that might have emerged from their cooperation in this exploration. Countless efforts were made to safeguard the privacy of the respondents by ensuring confidentiality in not making identifying information accessible to anyone who was not directly involved in the study. The study did not reveal the respondents' personalities and personal information was held in strict confidence.

1.8 ORGANISATION OF THE STUDY IN CHAPTERS

The systematic presentation and organisation of the study are covered under twelve chapters. The details of the various chapters are presented as follows:

Chapter 1 –Introduction

The introductory chapter enables readers to become acquainted with the whole of the study. This chapter firstly presents the background or rationale of the study. In addition, the research aim, research objectives and a summary of the methodology are described in this chapter. Further, the scope of the study and an explanation of its contribution to the body of knowledge is presented. There is also an overview of the structure of the chapters used in this thesis.

Chapter 2 – Theoretical overview of project cost control

This chapter presents definitions of cost control and describes the PCC system. PCC processes are discussed and PCC techniques, organisational factors for cost control, pre and post cost control processes are outlined. In addition, it presents the challenges of PCC practices.

Chapter 3 – Cost control theories

Existing frameworks or models that assist the practice of PCC are presented in this chapter. Cost control theories are unveiled and clarified together with the theory behind the cost control practice and how the interacting elements within the various concepts in the theory work. Further, various cost control factors appropriate to the proposed model for study are discussed.

Chapter 4 – Gaps in cost control practice

This chapter presents gaps emerging from literature on cost control practice. These require further examination as primary factors in the prevailing cost control frameworks, models and procedures for the Ghanaian construction industry. The primary and related factors of the gaps and how they relate to cost control practice are presented. Three gaps are presented that have not been completely addressed or analysed by past researchers in the cost control practice. These are: project cost monitoring procedure, change management and project cost communication.

Chapter 5 – African literature review on PCC

This chapter presents construction project cost control practices on the African continent in five countries, namely Egypt, South Africa, Uganda, Nigeria and Ghana. Both contractors' and consultants' views on cost control practices are presented in this chapter. Further, cost control methods used by the various countries, the challenges faced in controlling construction cost and the core attributes of cost control practice, such as estimation, budgeting, reporting, monitoring, cost analysis and decision-making are presented.

Chapter 6 – Research methodology

This chapter presents all the research processes needed to carry out the research and explains how this information has been converted into an interview format for the fieldwork study.

This chapter explains the qualitative, quantitative and mixed methods approaches used to meet the research objectives. Furthermore, the justification for using the mixed methods approach is provided. The research design, data collection methods, structure of the fieldwork questionnaire, sampling technique and the data analysis, ethical considerations and limitations for the study are outlined.

Chapter 7 – Delphi survey results and discussion

The results of the qualitative data emerging from the use of Delphi survey technique are presented in this chapter. The Delphi survey technique uses views from experts on cost control factors applicable to the Ghanaian construction industry. The levels of influence (probability) each factor has on cost control practice are based on their knowledge and working experience. The results of the three rounds views were analysed using median, mean, SD and IQD. Moreover, the consensus reached from the relevant factors is also presented. The discussion of the results is in the conclusion of the chapter and is based on the objectives set for the Delphi survey technique.

Chapter 8 – Conceptual framework on PCC

Chapter eight outlines the primary and related factors of cost control practice of existing frameworks or models and the gaps in these factors that need to be filled in PCC practices. A new cost control model is proposed for cost control practice. The theories are further unveiled to clarify the theory behind cost control practice and how the interacting elements within the various concepts in the theory work. Both the dependent and the independent variables of the conceptual framework are discussed.

Chapter 9 – Fieldwork data presentation and analysis

The quantitative data is analysed and presented in this chapter. The results are presented in three forms, descriptive statistics, factor analysis and finally, the regression analysis. In addition, reliability and validity tests are conducted on the survey data. The test for the hypothesis of the cost control practice and its direct relationships with the primary constructs are determined for the outcomes of cost control practice in the Ghanaian construction industry. The data are presented using tables and graphs.

Chapter 10: **Discussion of results from the fieldwork survey**

The chapter discusses the results of the descriptive and inferential statistics for the fieldwork data. The extent of hypothesised relationship fitting and identified factors are discussed. The fieldwork data and their relationship with the Delphi survey results is discussed. Furthermore, the factors that predict the multi-linear regression model are Presented in this chapter.

Chapter 11 - Conclusions and recommendations

Conclusions are drawn from an analysis of the literature review and fieldwork findings by revisiting the research aim and objectives and answering the research objectives. Recommendations are made for contractors and policy makers for the adoption of the model in the Ghanaian construction industry.

1.9 CONCLUSION

Chapter one presents the subject matter of the research study. How the thesis is structured and the significance of the study are presented in this chapter. The new need cost control theory to solve the rate of project cost overruns is presented. This chapter also outlines the problems of cost control in relation to developing countries, of which the Ghana construction industry is no exception.

CHAPTER TWO

THEORETICAL OVERVIEW OF PROJECT COST CONTROL

2.0 INTRODUCTION

This chapter presents the definitions of cost control and the project cost control aims. Project cost control steps are discussed. It also outlines project cost control techniques, organisational factors for cost control, pre- and post-cost control processes. In addition, it presents the challenges of project cost control practices.

2.1 PROJECT COST CONTROL PRACTICE

Charoenngam & Sriprasert (2001) define cost control as a sort of information system intended to be given to top management team members with advantageous and exact cost execution information for corrective actions to be made to solve deviations. According to Cleland & Ireland (2002), PCC is a procedure of observing, assessing and contrasting arranged outcome with real outcomes to decide the status of the construction cost, duration and specialised execution targets. The fundamental meaning of cost control is offered by Korke *et al.* (2017) who state that cost control is as ceaseless procedure throughout the developmental duration of the construction project to keep the infrastructure expenses close to the initial approved cost. According to the project management body of knowledge (PMBOK) (2008), cost control is the approach of checking the project cost performance while updating the budgeted spending plan, and in addition managing the changes for the cost deviations. Kumar *et al*. (2015) and Harris and McCaffer (2006) add PCC also aims to keep the final project cost in line with the client's financial plan, in light of the initial rough estimate of price prepared by the cost expert during the early stages of the project initiation. PCC practice serves as a source of data on cost to use in future evaluating of similar projects (Oxley &Poskitt, 1996)

Cost control is where the development cost of the task is accomplished by strategies and systems for the builder to avoid misfortunes in project cost while completing the activities of the project (Harris & McCaffer, 2002). Cost control includes the consultations, activities and responses to the cost deviations while executing the infrastructure to keep the infrastructure expenses close to the initial planned cost (Olaoluwa, 2013). It is a means to accomplish parity and intelligent dispersion of the accessible funds among the different areas of the project. For example, the moneys set aside for activities like concrete works, windows, doors and tiling among others, will be legitimately identified with the class of structure and to one another (Harris & McCaffer, 2006). Cost control provides the client value for money, using the funds to complete the project achieving economic savings, avoiding high costs in maintaining the structure and avoiding time and cost overrun, all of which affect cost (Harris & McCaffer, 2006).

The definition of PCC can be summarised, for the purpose of this study, as management information systems to keep the construction project cost consistent with the budgeted cost, to avoid deviations from the planned or approved cost using key management philosophies.

2.2 STAGES OF PROJECT COST CONTROL IN CONSTRUCTION PROJECTS

Every construction project undergoes three main stages: pre-construction, construction and post-construction (Wood, 2010). The cost control practice in construction projects begins from the initial stage, the conception stage (pre-construction), the development stage (construction) and after the construction stage, the post construction (Bahaudin *et al.*, 2012). This is further illustrated in the diagram in figure 2.1 below:

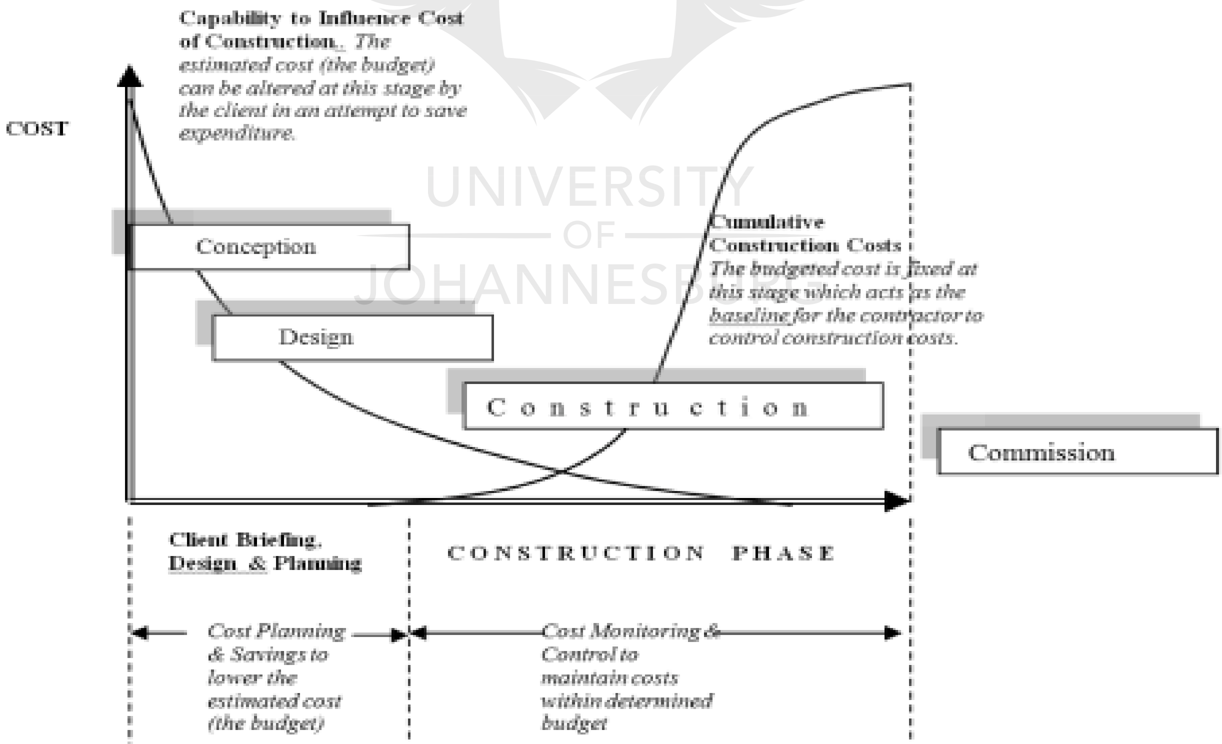

Figure 2. 1: Cost aspects in project life cycle

Source: Bahaudin *et al*., (2012).

The pre-construction cost control stage is where most savings can be made while the project remains at its initial stage and no major cost prices have been put into the project. During the actual development stage, any modifications made will cause inevitable price increases (Benjaoran *et al*., 2009). As construction work progresses, deviations that arise affect the construction cost and measures are required to keep the cost in line with the initial agreed project cost (Al-Jibouri, 2003).

The three stages of cost control practice are illustrated in figure 2.2 below:

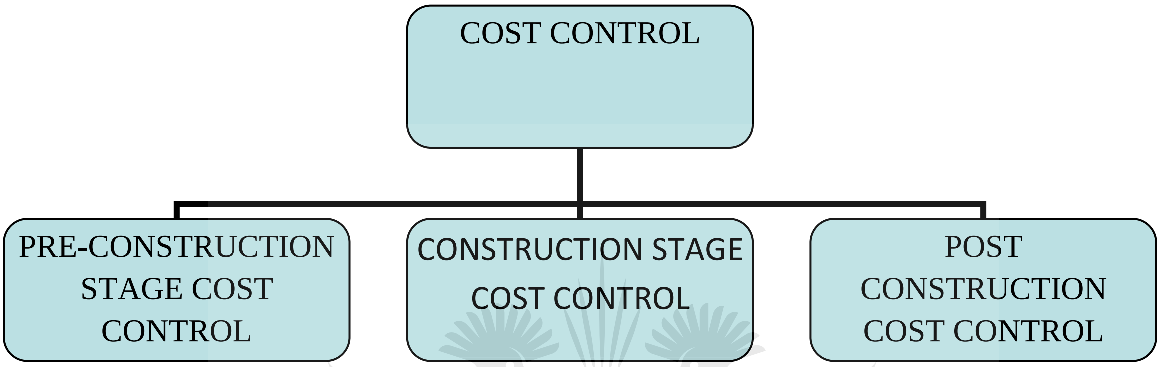

Figure 2. 2: Cost control stages

Source: Author's construct

2.2.1 PRE-CONSTRUCTION COST CONTROL

The main goal of the pre-construction cost control practice is to guarantee that the contractors' bid will in no way be more than the approved cost to be committed to the project (Cunningham, 2015). The project quantity surveyor or cost engineer has to take actions that are critical to cost management issues from the produced drawings like giving reasonable initial cost guidance, arranging how spending plans ought to be dispensed to the different structural components, effectively observing the developing building plans, informing the group of designers and the project owner with respect to the imaginable cost consequences of the choices of building plan and recommending alternatives to keep the project cost in line with the agreed initial cost (Cunningham, 2015; Pott, 2008).

The pre-construction cost control activities are project cost estimation, project cost budgeting, project cost checking, or project cost analysis, and project cost forecasting.

2.2.1.1 PROJECT COST ESTIMATION

Researchers and experts have derived various definitions for project cost estimation. The Chartered Institute of Building (CIOB, 2009) defines project cost estimation as a technical process of predicting costs of construction. Furthermore, the Association for Advancement of Cost Engineering (AACE, 2013) is of the view that cost estimation serves as the basis for project management, business planning, budget preparation, and cost and schedule control. The Project Management Institute (PMBOK, 2013) describes cost estimating as the development of an approximation (estimate) of costs of the needed resources that will help complete project activities. Larson and Gray (2011) state that "project cost estimation is the process by which time, cost, and other resources needed for project execution are predicted and forecast, to accomplish the project objective". According to Akintoye (2000), project cost estimation is a technical process in which the cost of implementing activities is put in place in order to accomplish the set objectives of the construction project over a particular period of time. He suggests that, in order for the estimate to be correct, it should be based on the detailed information of the project. Project cost estimation is defined as the predictive process of subjecting financial resources that are dependent on the scope of investment, to quantification to establish the project budget (Dysert, 2003). Project cost estimation is conducted at the start of construction projects to provide the basis for decision-making about whether to continue with the project at hand. Project cost estimates allow monitoring the progress of the project and making decisions with regard to project completion or termination (Barzandeh, 2011). In conclusion, cost estimation involves the presaging of the future costs of a project before it comes into existence. However, the the project's final cost cannot be known until the construction of the project has been completed and other facilities are in operation.

2.2.1.1.1 Reliability of Project Cost Estimates

It is generally known that the correctness of cost estimation has a vital effect on the construction industry. For instance, it may seriously impact the contractor's ability to compete successfully with other contractors. Another effect is the impact on the contractor's profit. Therefore, this research seeks to recommend, through the literature, which influences cost control with its corresponding factors, which factors should be taken into consideration when preparing cost estimations for future projects.

Cost estimation is the process of predicting the cost of a construction project. The beauty of the completed project does not only involve the cost of construction alone but also includes other costs such as land acquisition and documentation fees, site investigation, insurance cover for the construction, payment of the consultants, which is usually expressed as a percentage of the budget, tax payment (value added tax) and a contingency sum to cover the risk of unforeseen works (Pott, 2008). The endorsed estimates turn into the approved undertaking spending budget. This is frequently portrayed as a cost restraint. The budgeted cost is what is expected of the all members of the design to work within. A detailed drawing serves as the basis for cost checking the final drawing, produced to guarantee that the budgeted cost is not more before the tender documents are offered for the tendering process to commence. The bills of quantity have to be priced by the quantity surveyor for final cost checking, before sending the tender out for contractors to tender blank bills of quantities. Measures have to be taken when the priced costs exceed what was planned (Cunningham, 2015).

The cost estimates are made available to the project owner and the design team members, at different phases as the designs go through. Figure 2.3 illustrates how the cost precision turns out to be continuously and more dependable by the provision of detailed project information of the client's brief (Cunningham, 2015; Brook, 2008). The cost estimates start from unit cost of accommodation, floor area cost and continue through to a detailed production of the priced bills of quantities for the tendering process.

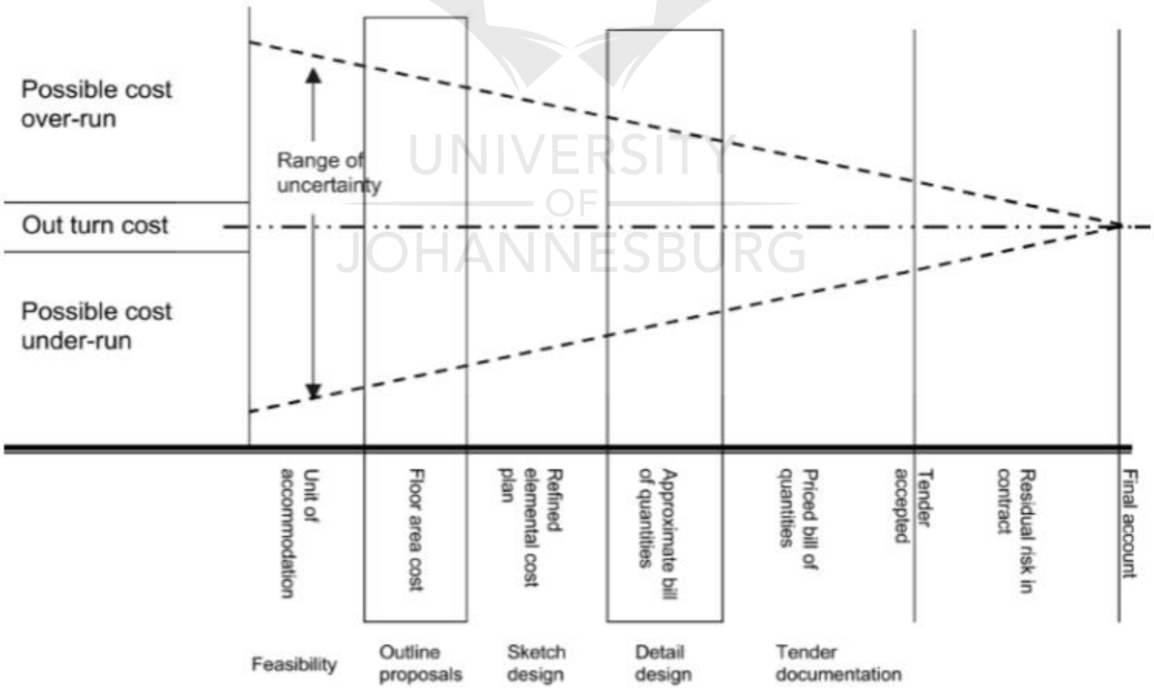

Figure 2. 3: Reliability of project cost estimates at pre-construction stage

Source: Brook, (2008).

Establishing the project cost estimates cannot be 100% accurate, therefore the quantity surveyor can forecast an allowable range of cost percentages for the project cost estimates. This is part of the professional practice. Plus or minus 15% is allowed for any project, while 25% to 30% and 25% to 50% are allowed for higher class of construction and engineering projects respectively (Cunningham, 2015; Pott, 2008; Ashworth, 2004). Skitmore and Marston (2005) add that the percentage forecast depends on accurate historic and design data prevailing when the estimates are prepared. Pott, (2008), Skitmore and Marston (2005) and Ashworth (2004) further state that the accuracy level of the cost estimates differs from the feasibility stage to the final design stage. The percentage at the feasibility stage is minus 25% to plus 50%, while it reduces to minus five to plus ten percent where the detailed priced bills of quantities have been prepared from the detailed designs. Figure 2.4 below shows the accuracy of the estimates at different stages of the pre-construction process:

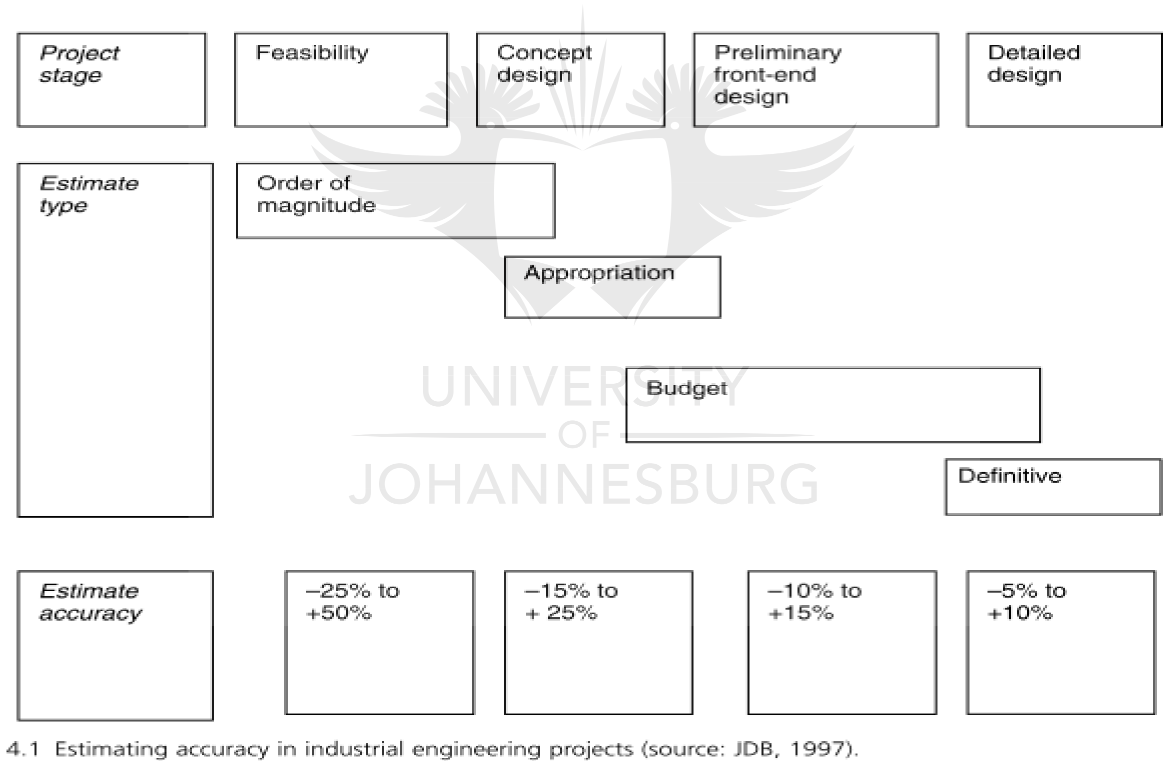

Figure 2. 4: Accuracy level of project cost estimates at pre-construction stage

Source: Pott, (2008)

The following section presents some project cost estimating definitions. It also gives some details of cost estimating types and finally, it mentions previous work, in order to get a predetermined list of factors that may affect building construction project cost estimating.

2.2.1.1.2 The Importance of Project Cost Estimation

Most public construction owners are obliged to select the lowest bidder. In addition, the contractor is required to successfully pass a qualification screening. In situations like this, the contractor must be prepared to lower the bid cost, reduce the completion date of the project or accept additional owner requirements which do not involve the loss of money. This can be achieved through a good cost estimation undertaken by a qualified estimator. Cost estimates allow space for owners and planners to evaluate project feasibility and control costs effectively in detailed project design work before work execution (Feng *et al.,* 2010). The purpose of estimating is to provide information for decisions of construction. Some examples of such decisions include procurement and pricing of construction, contractual amounts established for payment and controlling actual quantities by project management (Carr, 1989). Dysert (2006) claims that the cost estimate is usually used to establish a project budget, but it may also be used for other purposes, such as:

• Determination of the economic feasibility of a project;

• Evaluating project alternatives;

•Providing a basis for project cost and schedule control.

While GAO (2009) believes that cost estimates have two general purposes:

(1) To assist managers to evaluate affordability and performance against plans, as well as the selection of alternative systems and solutions.

(2) To help the budget process by providing estimates of the funding required to efficiently execute a work.

2.2.1.1.3 Types of Project Cost Estimation

Project cost estimation is performed throughout the lifecycle of a construction project. This is undertaken at different levels, depending on the various stages of development (Peurifoy & Oberlender, 1989). As shown in Figure 2.5, which began with the first estimate and extended to the various phases of design and into construction, it is important to note that there are different types of cost estimating as the construction project advances. Detailed estimates cannot be made based on computed quantities at the concept, preliminary design stage, since the project is not yet defined. On the other hand, the estimate process becomes more expensive as more detailed and accurate techniques are implemented.

2.2.1.1.3.1 Feasibility Estimates

With feasibility estimates, the owner/client looks at the definition of the project. Regardless of size or type of project, the owner/client performs an initial project cost estimation. This is called the feasibility cost estimation. There are two objectives of this cost estimation:

1- to determine whether to execute the project or not

2- to project cost information for the owner/client for obtaining funding for the project.

2.2.1.1.3.2 Conceptual Estimates

When the project is found to be feasible and funding is obtained, the owner proceeds in the engagement of firms to assist in the design, for the purpose of defining the project's special requirements and the type and quality of construction. At this stage, the design team prepares approximate estimates of project cost. This type of estimate is known as the parametric range or conceptual estimate. The purpose of the conceptual estimate varies, depending on owner's demand and the type and size of the project.

Generally, the conceptual estimate is used to:

1- Support of the owner's feasibility estimate;
2- Evaluate possible design modifications in order to meet the owner's budget;
3- Evaluate contractor bids;
4- Be an aid in budgeting cash flow needs throughout the project (Akeel, 1989).

Different kinds of conceptual estimates exist, depending on the type and size of the construction project and owner's needs. In general, several things should be considered when selecting the type of conceptual estimate; some of them are the following:

1- The needs of the owner, hence the purpose of the conceptual estimate;
2- The resources available (time and money) from the owner to make an estimate;
3- The amount of design information and experiential information available;
4- The resources (information, data, skill) of the estimator;
5- The prevailing construction market (Barrie & Paulson, 1992).

2.2.1.1.3.3 Contractors' Detailed Estimates "Bid Estimates"

If the conceptual estimate is judged to be within budget, the design firm prepares the project contract documents, which are the basis for preparing the cost estimates by contractors, in order to bid for the project. The major contract documents include the project drawings, specifications, general conditions, special conditions, agreements and addenda. Usually the project drawings and specifications play the most significant role in the preparation of the bid estimate by the contractor. The drawings indicate the quantity of work to be performed and the specifications indicate the quality of work to be performed (Barrie & Paulson, 1992). The next step is that the owner invites contractors to bid, then the contractors prepare their detailed bid estimates. The purpose of these estimates is to determine the real cost of executing the project. The contractor should submit the lowest possible cost estimate, because the objective of the contractor is to win the bid. which means being the lowest responsible bidder, and to minimise the amount of money left on the table so he can win his profit (Akeel, 1989). Detailed project cost estimation is a time-consuming process. It is prepared when all the documents of the construction project have been completed. Creativity and knowledge are essential for preparing a construction cost estimate. Different contractors use different processes, methods and technologies during construction. Therefore, cost estimators need knowledge, creativity and experience to execute the estimating task successfully. Detailed project cost estimation consists of the following steps:

1- Dividing the project into individual work items and estimates. This is also known as quantity taking off.

2- Determining labor, equipment and material needed for executing the various work items based on the specification and construction method.

3- Selection of the work items necessary for the elements.

4- Productivity is defined as the amount of work a crew can perform in a unit of time.

5- Costs of labour, equipment and material must be decided after the work items have been determined for each element.

6- Calculating the total cost for each work item by summing all work item costs.

7- s Addition of taxes, overhead cost and profit complete the estimate

8- Review and analysis by the cost estimator is also required to determine whether the price of the project seems reasonable for work that has to be carried out (Samphaongoen, 2010)

2.2.1.1.3.4 Progress Estimates

The contractor's detailed bid estimate does not reflect the last cost estimate prepared for construction project. Several types of project cost estimates are determined during the construction phase. The progress cost estimate is one of these types of estimates. Several progress cost estimates are done during construction. The main purpose of these estimates is the final estimates. With the completion of the project, it is necessary to make a final cost estimate for the whole work done. This cost estimate is made to verify the quantities executed which will determine the final payment for the contractor.

2.2.1.1.3.5 Other Types of Estimates

Between the conceptual estimate and the detailed estimate, there are other cost estimates that are performed as the project becomes more defined and more information becomes available. Those estimates are required to assess most accurately the expected cost of the project at the time the estimate is carried out. These may be referred to as budget, appropriation, control, semi-detailed, design or engineering estimates, and are carried out for the purpose of assigning project budgets and to monitor and control project costs. In addition to the above listed pre-construction cost estimates, other cost estimates are also performed during the project's construction phase, or after the construction completion, to assess the final actual cost of the project. The project cost estimates in this stage are known as "definitive estimates". These cost estimates are updates of the detailed cost estimates with emphasis on actual, rather than projected, construction costs (Bley, 1990, Asal, 2014).

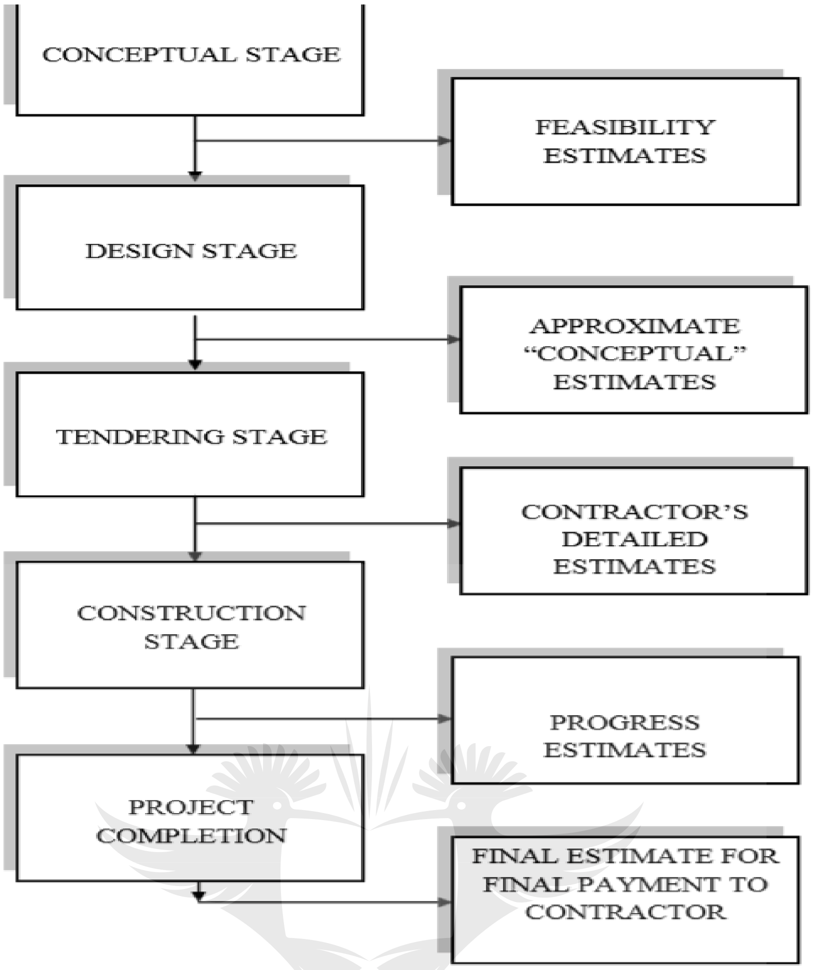

Figure 2. 5: Types of project cost estimating

Source: Akeel (1989)

Traditional estimates

There are two classification of estimate approaches. These are approximate and analytical or operational. The approximate approach does not provide estimates that are substandard to others. The approximate estimate is normally used for projects where historic data is unavailable. The traditional estimate approach is a way of estimation when the quantity surveyor is familiar with a particular approach, with the prevailing duration to establish the estimates (Skitmore & Marston, 2005).

Functional or performance-related estimation

Functional or performance-related estimation is where a single item is given a price by the quantity surveyor to represent the whole project. A typical example is when clients want to know the cost per bed for a hostel to know the total project cost for all the bedrooms to make a decision on the return on their capital and the extent of the project. Other examples include cost per car for car parks, cost per kilometer for road construction and cost per student for school projects. This approach is very fast and simple but can only be used at the inception stage of the project because it provides quite accurate and reliable estimates. (Kumar *et al*., 2015; Pott, 2008).

Size-related estimation

This method of estimation is also known as gross floor area cost estimation. This method relates to the size of the construction project and the size of the land will determine the cost of the project. The total floor area is multiplied by the determined unit square meter cost of the floor. This method of project cost estimation is used where there are no detailed designs and does not take into consideration the shape of the project (Kumar *et al*., 2015; Pott, 2008).

Elemental cost-analysis

This method of project cost estimation lists all the elements of the structure and various costs are assigned to each element to establish the project cost estimates. The floor area cost is first determined and cost limits are set for the various elements within the structure. When there are detailed designs, the actual elements are priced or revised, based on the final specifications of the elements (Pott, 2008).

Cunningham (2015) adds that where the quantity surveyor sees that the cost is exceeded, different items are recommended and a new cost that will fit the budget is established. A typical example is the use of sandcrete block cost instead of bricks.

Conference estimation

This technique of estimation is the first-hand estimates that are given to the client at the initial stage so he can have a rough idea of how much the project will cost. It is a collective decision of the estimates from the project team members or stakeholders, who brainstorm to reach consensus. It is based on historic cost data of similar projects (Ashworth, 2004).

2.2.1.1.4 Techniques of Project Cost Estimating

Daschbach and Apgar (1988) and Shash and Al-Khaldi (1992) have documented the use of parametric project cost estimation techniques such as simple arithmetic formulae and statistical formulae. Groen and Tan (1977) have produced a detailed application of cost factor estimation, while Klumpar (1990) has shown how project cost estimates can be produced based on capital cost estimation. Capital cost estimation, based on correlation techniques, uses a combination of material, labour and plant cost factors to produce an installation cost for manufacturing equipment. Considering that the project cost estimation of a construction project is time consuming and often tedious, and to improve the quality of the estimate, Bryan (1991) advocates the use of an assembly pricing technique (also called work module pricing, system pricing, rapid pricing or aggregate pricing). This method addresses costs in composite pieces that can be related easily to the drawings. Although most contractors use the standard cost estimation procedure, Beeston (1983) recommends a simple procedure to improve project cost estimation performance, involving the use of several methods for each cost estimate and maintaining records which allow contractors to select the best method or combination of methods. Vergara and Boyer (1974) argue that the precision of cost estimates depends, not only on the method used, but also on the type of work and on the intended use of the cost estimate. They add that, to increase the reliability of estimates, the level of details involved should be increased up to a limit (optimum level of detail) at which the cost of increased reliability equals the value of the increased reliability. Because of the time and cost constraints associated with this practice, Akintoye & Fitzgerald (2000) encourage a probabilistic approach to project cost estimation. Shash & Al-Khaldi (1992) identify factors affecting the accuracy of cost estimating. These are classified as financial issues, bidding situations, project characteristics and the estimating process itself. The main factor identified in the study by Shash & Al- Khaldi (1992) as responsible for the accuracy of cost estimates, irrespective of the size of contractors, is the previous experience of the contractor regarding the type of project. This factor is followed by anticipated or frequent delays in periodic payments, type and size of contract and project location. The study by Al-Harbi *et al.* (1994) shows that the major problems facing cost estimators in preparing cost estimates, in order of importance, are: tough competition, contract period, incomplete drawings and specifications, incomplete project scope definition, unforeseeable changes in material prices, changes in owners' requirements, current workload, errors in judgment, inadequate production time data, lack of historical data for similar jobs and lack of experience in similar projects.

2.2.1.1.5 Factors Affecting Project Cost Estimation

It is an indisputable fact that a key factor for a successful project is the preparation of an accurate estimate. This accurate estimate is also influenced by number of factors. Enshassi *et al.* (2013) state that the success of any construction project depends on the accuracy of several estimations. There are several factors that influence the success of a construction project such as project complexity, contractual obligations and effective communication.

Farrukh Arif *et al.* (2015) show that the involvement of the contractor in the estimation procedure and labour rates is a significant factor influencing the success of a construction project. In addition, the early involvement of the contractor in the phases of the project can result in realistic estimates through timely input from subcontractors, materials suppliers and manufacturers. Further, Elhag *et al.* (2005) strongly argue that only quantitative factors can be considered when estimating tender prices of projects. Since the qualitative factors are subjected to measurement with difficulty, most qualitative factors, such as client priorities, project characteristics and procurement methods are often ignored in the actual cost estimation process. A firm understanding of these qualitative tender cost-influencing factors could improve the competence of quantity surveyors in preparing more reliable and accurate tender estimates. This knowledge is also critical for quantity surveyors to achieve cost control at the construction stage.

A study by Tebin (2009) identifies two critical determinants of tendering price: client responsibility and contractor responsibility. The study emphasises the importance of both the project client and contractor having comprehensive knowledge about the construction process to accurately calculate the tender price. Chan and Park (2005) measured and evaluated factors that influence construction costs in Singapore, based on national construction project data. The projects were divided into three main groups based on project characteristics, contract type and type of owner/consultant. The findings indicate that special requirements influence construction costs: the level of technology, the special skills of the contractor and publicly administered contracts. Technical expertise of contractors, financial factors and level of construction familiarity are also high-level influence factors. Bubshait and Al-Juwairah (2002) evaluated 42 factors that could affect construction costs in Saudi Arabia. These factors were divided into five main groups. The results indicate that material cost, incorrect planning, contractor experience, contract management and poor financial control have significant influence on costs. Another study, conducted by Akintoye and Fitzgerald (2000) in the UK identifies 24 cost influencing factors, of which project complexity, scale and scope of construction, market conditions and method of construction are deemed the most significant factors. Dissanayaka and Kumaraswamy (1999) investigated factors influencing construction cost, based on projects in Hong Kong. This study uses multiple linear regressions and identifies four main construction cost influential factors: level of client confidence in the construction team, payment method, risk of client's quantity variation and complexity of construction. Different researchers have used different approaches to classify factors affecting construction prices of tenders and cost overruns. Table 2.1 below shows the factors extracted from the literature under seven main categories: project characteristics, client characteristics, contractor characteristics, tendering related issues, consultant related issues, external factors and estimation procedure.

Table 2. 1: Factors affecting project cost estimation

Related factors	Arif *et al.*, 2015	Cong *et al.*, 2014	Asal, 2014
Client characteristics			
Financial provision of the client	√	√	x
Clear project briefing	√	√	x
Type of client	√	√	x
Setting timelines for project	√	√	x
Setting quality requirement for project	√	√	x
Project characteristics			
Location of the project	√	√	√
Method of construction	√	√	√
Duration of the project	√	√	√
Size of the project	√	√	√
Type of the structure	√	√	√
Access to the site	√	√	x
Storage facilities for project	√	√	x
Magnitude and scope of the construction	√	√	√
Buildability	√	√	√
Environmental issues	x	x	√
Weather conditions	x	x	√
Nationality of labour	x	x	√
Social and cultural impact	x	x	√
Site conditions	x	x	√
Firm planning and management strategy	x	x	√
Contractors characteristics			
Experience of similar related project	x	√	x
Contractors' management team members	x	√	x
Previous relationship with owners	x	√	x
Current work execution	x	√	x
Urgency for the project	x	√	x
Planning abilities for projects	x	√	x
Tender related issues			
Standard tender documentation	x	√	√

Setting tendering period	x	√	√
Good analysis of tenders	x	√	x
External factors			
Level of competition	√	√	√
Market prices	√	√	x
Number of tenderers	√	√	√
Interest/inflation rate	√	√	x
Consultants related factors			
Completeness of project information	√	√	x
Procurement method used	√	√	x
Type of contract	√	√	x
Tendering method used	√	√	x
Attitude of consultants	√	x	x
Estimating procedure			
Availability of project cost information	√	x	√
Standard procedure for updating the cost	√	x	√
Setting time for the estimates	√	x	√
Method of determining the contingency	√	x	√
Profit or overhead calculation method	√	x	x
Experience of the estimator	x	x	√
Estimation method used	x	x	√
Available cost indexes	x	x	√

2.2.1.2 COST CHECKING

Cost checking is done to ensure that the final budgeted cost is same as the initial cost plan. The practice ensures that cost is controlled from the design stage to enable contractors to bid on the same specification without exceeding the budget (Pott, 2008). The detailed bills of quantities are produced and priced which presents accurate cost as compared with the cost plan. In areas where the price exceeds the budgeted cost, corrective measures are taken to bring back the cost on track (Cunningham, 2015; Kumar *et al*., 2015).

2.2.1.3 COST REPORTING

Pott (2008) documents various costs to be considered at the pre-construction stage for cost control. These cost reports are presented to the project team and/or the client at different milestones. They are:

- The initial budget
- Cost planning report

- Pre-tender cost estimates
- Contract sum
- Financial statement
- Final account.

2.2.1.4 COST PLANNING

Cost planning occurs when the quantity surveyor identifies and appraises the cost estimates by finally selecting the estimate that is best economically in terms of value for money. The quantity surveyor itemises the various elements or components of the building project and assigns appropriate cost items to each element. Cost designs are ordinarily organised in basic arrangements and they are dependent on estimated amounts of work valued at current composite rates. This procedure empowers particular target expenses to be connected to every component of the building (Cunningham, 2015).

2.2.2 CONSTRUCTION STAGE PROJECT COST CONTROL

During the construction stage cost control practice the project cost estimates are converted to project cost budgeting, then the processes of project cost monitoring, project cost reporting, project cost analysis and decision-making can proceed.

2.2.2.1 PROJECT COST BUDGETING

Yang and Chen (2015) define cost budgeting in two different areas. Project cost budgeting is the maximum funds the client is prepared to commit to the designing and execution of the structure. Their other definition refers to budgeting as the maximum funds agreed and permitted by the management or construction team members for the execution of the project. According to Slebioda (2008), "a budget expresses strategic plans of business units or organisations for a defined period of time in quantifiable terms." Frederick (2001) defines it as "a plan that is quantifiable and applied within a specific time period." Lucey (2000) defines budget as "a quantitative expression of a plan of action prepared in advance of the period to which it relates." He states that this plan must be approved prior to the budget period. It must reveal the incremental effects on previous figures or be set at zero. Budgets can be done for the whole company or a particular department or unit within the organisation, taking into account the strategic plan of the organisation.

2.2.2.1.1 TYPES OF PROJECT COST BUDGET

2.2.2.1.1.1 Master Budget

The construction project master budget provides a detailed range of budgets or a financial statement set for the entire duration of the project (Lucey, 2002). The master budget which is very comprehensive brings all the various budgets under a single cost which reflects the organisation's purpose of constructing a project in the financial year (Emmanuel *et al.,* 1990) and embraces the impacts of both operating decisions and financing decisions (Horngren, 2012). The master budget comprised various cost of achieving the project cost objective in a unit of budget such as cost of production, profit, consultancy charges, land purchase and documentation costs (Horngren, 2012).

2.2.2.1.1.2 Functional Budget

This is a budget which applies to a limited area of the organisation such as a function, department, division, project or other specific aspect of the organisation. The most commonly used ones are: the budget for sales, the budget for purchase, the budget for production, the labour cost budget, the cash budget and the capital expenditure cost. The functional budgets are one of the key areas of budgeting that every construction firm like to prepared just as the master budget which shows combination of various budget for achieving the targeted operations for the financial year (Lal, 2000). Functional budgets and operating and capital budgets are notable for the allocation of capitals for work done and work activities to be constructed (Blumetritt, 2006).

2.2.2.1.1.3 Operational Budget

The operating budget is mostly prepared yearly by the construction firm. The budget includes costs such as production, administration, and marketing of the project. The sales cost also include the income capital the organisation is expecting to receive. These budgets are prepared base on the experience gained in the previous, present or upcoming patterns in project cost. The financial statement will provide the deficit or surplus achieved for the financial year by the calculation of the total revenue and actual expenditures (Emmanuel *et al*., 1990). The high demand for construction projects will determine the quantity to be produced. However, the management team of the construction firm has to develop strategies and system of control for the operational sales budget (Frimpong-Manso, 2014; Anthony & Govindarajan, 2003; Wood & Sander, 1998). Budgeting promotes planning and controlling of the activities of organisations. The activities construction firms undertake are affected by the budget plans and control. Therefore, every class of construction firm is required to produce operational budget to guide its operation (Hope and Fraser, 2000). The budget plan is a standout amongst the most significant element of the top management team in construction projects. It is along these lines an important prerequisite for the administration of task cost and cost control. A spending limit is a significant reason for assessing the performance of construction project cost. In this way, it advances productivity and fills in as a hindrance to waste and wastefulness in project cost (Frimpong-Manso, 2014; Weygandt *et al*, 2008).

2.2.2.1.1.4 Incremental Budget

Incremental budgeting is a budgeting technique which uses the past period's budget as the base for the new budget period with incremental additions of new amounts throughout the period. This method allows for gradual changes in the project cost and easier management of multiple project cost budgets. Resource allocation is based on previous experience. This method of budgeting is simple to use, easily understandable and operation-friendly in its nature. It aids project managers or contractors to operate consistently in their individual departments of the construction firms (Drury, 1996).

2.2.2.1.1.5 Capital Budget

The preparation of a capital budget requires reserving huge sum of money for future use. The funds are budgeted for items such as acquisition of buildings or offices, heavy-duty tools and equipment, land, among others depending on the construction firm future plans. The budget plan is a long-term savings for the growth and sustainability of the firm (Finkler et al., 2007; Emmanuel et al., 1990). The benefits of the capital budget include raising capital, asset acquisition and setting investment for the company. This type of budget implies an organisation's decision for investing available monetary resources in long-term projects/activities such as the acquisition of new plants or equipment for projects, investment in new product lines, which are worth pursuing with the hope that future economic benefits will flow to the organisation within a period of time (Pandy, 1999).

2.2.2.1.1.6 Fixed Budget

This budget technique is mostly adopted by companies who rely on their forecasts. It is the budget method which once made and accepted cannot be changed, since fixed costs are considered to remain constant and to continue despite the production cost (Hofstede, 1968). The fixed budget does not allow for any change in cost factors such as changes in the market prices of materials, labour or plant, building in different environment or location. The cost is static which does not allow for alternative use of construction procedures or resources. It is used for short-term period of projects and stable economy for construction cost where fluctuation or other expenses are not permitted (Lal, 2000).

2.2.2.1.1.7 Participative Budgeting

The participative budgeting is the way toward permitting representatives all through the company who have influence of monetary decisions to be effectively engaged with the budgetary preparation (Hilton, 1997). When is final budget is established, it will yield to more prominent responsibility to achieve the financial limits and the objectives of the budget by every member of the organisation. In the event that representatives are permitted to partake in the budget readiness, they feel increasingly dedicated to it than opposing it (Karikari, 2015; Hilton, 1997). In the construction industry, the top management team members meet to discuss and develop the budget without the association of the site personnels who are at the lower level of management in the organisation (Charoenngam and Sriprasert, (2001). This method can be exceptionally successful, it can likewise prompt postponements of budget meetings because of long talks involved in the development of the budget (Karikari, 2015; Arlita and Dalston, 2005).

2.2.2.1.2 BUDGET CONTROLS PROCESS

Budgeting is a multiple process and as well as can be expected possibly be accomplished when a mix of variables are well-thought-out. Spending limit experiences a few procedures before it winds up both a rule and monetary device. Budgetary procedure includes all administrative and managerial elements for the improvement of an occasional budget plan (Osei, 2015). The final budget document achieved is as a result of totality of the procedure it goes through. The monetary allowance delineates the harmony among income and expenses. The budgeting procedure includes settling on exchange off choices in a situation of jumbled needs and assets (Osei, 2015). Dobell and Ulrich, (2002) outline what the budgeting procedure involves: it incorporates the policies and the management approaches expected to take choices and activities identified with usage and it includes changing commands, destinations, assets and practices set up to guarantee the acknowledgment of plans and following of cost performance. Management approval of the budget is required for its execution and accountability (Osei, 2015).

Charoenngam & Sriprasert (2001) also summarises that a construction budget process has; conversion of the cost estimates, negotiation of the budget, approval of the budget, establishing the working budget, and providing funding for the project. Olawale & Sun's (2015) studies also supported and added periodic revision of the budget and ensuring that project team members understand the budget.

2.2.2.2 PROJECT COST MONITORING AND CONTROLLING SYSTEMS

Project monitoring and control is a recurring process involving comparison of actual to scheduled performance, estimates to completion, and corrective actions based on such forecasts. To keep project cost overruns on track requires either performance adjustments or revision of contract targets regarding schedule, price and level of quality (Marco *et al.*, 2009). Project cost monitoring is the process of recording, collecting and reporting cost information regarding the performance of the projects (Tom *et al*., 2013). Further, PMBOK (2001) explains that monitoring and control of projects can be termed as "the process of tracking, reviewing and regulating the progress to meet the objectives of the performance defined in the management plan of the project." Therefore, the performance of the project can be seen as controlled by data from monitoring activity to bring actual performance to planned performance, as would be captured in the management plan. In order to keep a critical watch on the progress of a construction project, a monitoring system must be established. This, according to Patel (2000), helps in detecting deviations from the initial plan in the implementation plan. In addition, Andawei (2014) posed that it helps in analysing emerging problems and the likely corrective action(s) that would be required. The comparison is either made at designated milestone(s) in the project or at specific/regular time interval(s). It is likely that some work packages will be half completed at the reporting date and this makes it necessary to estimate their percentage of completion to serve as a background for comparing actual time with scheduled time of completion.

The construction project budget is consummated during the construction process. Therefore, it is the prime responsibility of the project manager to control the costs associated with the work packages. Project costs can be usually classified as direct, indirect and overhead costs. During the budgeting process, all these costs are summed up to develop a cost baseline. A cost baseline is defined as a cumulative time-phased budget that will be used to measure and monitor the current and future project cost performance (PMI, 2004; Khamidi *et al*., 2011)

De Marco (2009) state that an effective monitoring system is a basic requirement for tracking cost, time and quality of construction projects. According to Al-Jibouri (2003), some of the earlier monitoring systems are more responsive to changes than others. The study also shows that the Activity-Based Ratio Technique gives a clearer and simpler indication of the overall progress of the project than the other two techniques.

2.2.2.2.1 Activity-Based Ratios

Al-Jibouri (2003) describes activity-based ratio as a financial control technique that employs the ratios between the earnings and expenditures of the activities as measures of performance. The system can also be used to measure the performance of the whole project and that of its activities. The study shows that the Activity-based Ratio Technique displays a simpler indication of the overall progress of the project than the Leading Parameter Technique (LPT) and Variances Method (VM). According to the study, LPT shows deviations of the project performance from the existing plan but does not show the reasons for these deviations. The VM highlights the differences between two expenditures, the planned and the actual. Incomes or any other values could be used but because it is possible to produce these figures for the whole project, it does not show whether the project is behind schedule or whether overspending has occurred, unlike the Activity-Based Ratio Technique which is relatively known but needs more data and effort to perform calculations than the other systems described so far. It also produces a large number of parameters to give clearer descriptions to the state of the project. This makes it more difficult to use and to communicate to all levels of staff. According to the study of Al-Jibouri (2003), regarding the effectiveness involved in the use of some commonly found monitoring systems in detecting deviations from the planned cost and performance, the Activity-Based Ratio Technique can be engaged in the measurement of the performance of the whole project and its activities.

The three ratios the system relies on for the calculation of performance are:

1) Planned Performance = Planned Earning / Planned Expenditure

2) Actual performance= Actual Earning/Actual Expenditure

3) Efficiency=Actual performance/planned performance.

These above ratios can be calculated at any time and over any duration for which a plan is available. Both planned and actual work must be evaluated using the same rates for earning and expenditure. If the earning rates come from the original estimates, the performance measures calculated evaluate the performance against the estimate, and the efficiency gives a measure of the project performance against the plan. All values should, in theory, be in line with each other, although it is sensible to plan slightly optimistically. It is perhaps advisable to aim for the planned performance and efficiency of the activity base ratios (Ansah & Boamfo-Adjei, 2012; Al-Jibouri, 2003).

The measures used in this technique are both simple to calculate and simple to interpret. They require relatively little data and can be applied to a range of levels on a project. They can, for example, be prepared for a whole project or for a section of it and can, therefore, be used in measuring contributions of individual subcontractors to a project. Based on the above, it can be concluded that the measures used in this method are excellent communication tools and are particularly useful for short-term applications. However, the forecasts made are based solely on the plan and are not statistically reliable (Ansah & Boamfo-Adjei, 2012; Al-Jibouri, 2003).

The Activity Based Ratio refers to is a financial control technique that employs the ratios between the earnings and expenditures of the project activities as measures of performance. According to Al-Jibouri (2003) and Ansah and Boamfo-Adjei, (2012) some of the earlier monitoring systems are more responsive to changes than others.

2.2.2.2.2 Variance

One of the first and most popular used project management tools/ techniques accessible for project cost monitoring and controlling is the use of variance to measure project performance including cost (Ansah &Boamfo-Adjei, 2012; Al-Jibouri, 2003). In this context, variance is the difference between two values (Lockyer & Gordon, 1996). In project measurement and control there are usually differences between the two expenditures of the planned and actual. Variance is a method used to consider the current and final states of the actual cost plan; it is also possible to build a detailed picture of the project, using this method. Indeed, because it is possible to produce these figures for the whole project or for any section of the project, variance is commonly used to assess the whole or sections of a project, or, for example, the performance of single subcontractors. Fundamentally, by plotting several expenditure arcs, such as the first project budget, the last estimated total cost, the latest estimated expenditure and the budget value of works done, two main types of variance can then be determined: budget revision variance and total cost review variance. They are the main project variances which may show an increase in the cost of the project compared with its budgeted expenditure. They do not, however, identify the causes of this increase (Al-Jibouri, 2003; Ansah & Boamfo-Adjei, 2012). It is possible to break these two main variances down into more detailed sub-divisions in order to assist in recognising the reasons for the changes in cost. For example, the ‘Total Cost Review Variance’ can be broken down into the ‘Current Budget” and ‘Future Budget’ variances. Some current budget variances, for example, mean that the incurred cost of work done to date is greater that the planned expenditure. However, it does not show, whether the project is behind schedule of if overspending has occurred. Further sub-dividing of this variance into two more components as follows can indicate this:

Performance Variance = Budget value of work done - budget expenditure to date.

Efficiency Variance = Incurred cost - budget value of work done.

The ‘performance variance’ indicates that progress of the project is ahead of schedule if it positive or behind schedule if it is negative. The ‘efficiency variance’, on the other hand, indicates over-spending if it is negative. An extension of the idea of the method of variances is the earned value analysis technique. This technique is relatively popular. However, it requires rather more data and effort to calculate than the other systems described so far (Al-Jibouri, 2003; Ansah & Boamfo-Adjei, 2012).

2.2.2.2.3 Leading Parameter Technique

According to Pilcher (as cited in Al-Jibouri, 2003), the leading parameter is a technique that is based on the idea of selecting one or more of the major types of work as measures of the performance of the whole project. An example is a project where concreting forms a large portion of the work. The amount of concrete poured at any one time of the project can be used as a measure of the performance of the work. Using the project cost management technique, the actual cost per leading parameter as well as the total cost of the project, is usually compared with the planned cost during the same period of time. This technique can also be used to monitor a project which is made up of many sections with different kinds of work in each. In such a situation, it is possible to use a different parameter as a measure of performance for each section, depending on the nature of the scope of the project. According to Al-Jibouri (2003), investigations of the effectiveness of some commonly used monitoring systems, in detecting deviations from the planned cost and performance, indicate that the ‘activity based ratios’ and the ‘variances’ techniques have both shown the effect of cost factors on the system better than the ‘leading parameter’ technique. However, industry professionals could include this project management tool/ technique for monitoring their cost and controlling procedures in post contract stages to discover and consider setbacks.

2.2.2.2.4 Earned Value Analysis

Earned value (EV) is a well-known project management tool that uses cost information, schedule and work performance to establish the current status of a project (Czarnigowska, 2008; Kenley, 2003). It proves the earned value of completed work and compares it with actual cost and planned cost to determine the project performance and forecast its future trends. EVA is also described as an integrated, indirect or remote monitoring technique for the complex interaction of time and cost parameters to provide the performance measurement of a whole project (Kenley, 2003). Furthermore, it is seen as a project control technique which integrates cost, schedule and technical performance as stated by Lipke *et al*. (2009). Kenley (2003) confirms that EVA is an integrated, indirect or remote monitoring technique for complex interactions of parameters, such as time and cost to provide the performance measurement of the whole project. It proves the earned value of a completed work and compares it with actual cost and planned cost to determine the forecasts, project performance and its future trends. It helps clients and contractors to assess the project performance following its effective nature. The concept of Earned Value was evolved in 1967 by the US Department of Defense and subsequently developed a 35 criterion-based approach, the then called Cost/Schedule Control Systems Criteria (C/SCSC). Initially, C/SCSC was considered a financial control tool which confined its use to project and programme management. However, in 1989, the Undersecretary of US Department for Acquisition adopted the C/SCSC for programme management and procurement. In 1996, it was revised by the US industry and renamed Earned Value Analysis (EVA). Since then, it has been widely used by many US government agencies like the United States Department of Energy, NASA and the US Defense Acquisition Department. Besides in the United Sates, EVA has also attracted the attention of many other governments and public and industrial departments. In the construction industry, EVA is seen and used as a time and cost control tool. It brings together planning and management functions. During the last decade, many developed countries have utilised the EVA technique in their public- and private-funded construction projects and achieved remarkable improvements in their industrial practices. The South Korean Congress, in July 2000, passed a bill named ‘The Effective Plan of the Public Construction Industry Bill’ which mandated construction firms to adopt the Earned Value Management System (EVMS) in their projects worth more than USD 50 million (Kwon *et al*., 2013; Ansah & Boamfo-Adjei, 2012). EVA is a three-dimensional approach and is based on the following data sources:

• Planned Value (PV) describes the portion of the project budget planned to be spent at any given point in time.

• Earned Value (EV) is a description of work progress at a given point in time and reflects the amount of work that has actually been accomplished.

• Actual Costs (AC) is the amount of spending that is utilised for the completion of the work package activity. EVA takes these three data sources and compares the budgeted value of work schedule (PV) with the Earned Value (EV) of physical work completed and the Actual Value (AV) of work completed. Thus, performance data achieved by using EVA is an objective measure of actual work performed.

As noted, there are many ways to calculate the EV, PV and AC of work packages in progress. Comparison of those figures can serve to identify specific work packages in which performance and progress is inadequate or advanced. This will hopefully lead to remedial action by the project manager and team. Cost and schedule performance should be measured and analysed as feasible with regularity and intensity consistent with project management need, including the magnitude of performance risk. Analysis should be progressive and should follow the principle of management by exception. Variance thresholds should be established in the planning phase and should be used to guide the examination of performance (Subramani *et al.*, 2014). The standard earned value analysis graph is shown in figure 2.6 below.

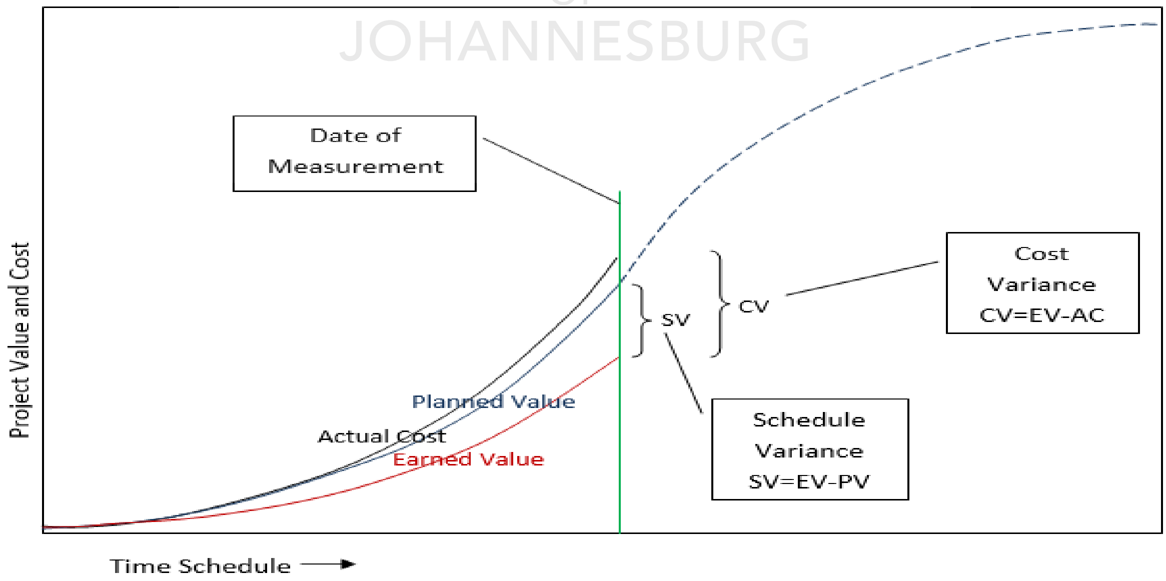

Figure 2. 6: Standard earned value analysis graph

Source: Subramani *et al.*, (2014)

Earned value project management is a well-known management system that integrates cost, schedule and technical performance. It allows the calculation of cost and schedule variances and performance indices, and forecasts of project cost and schedule duration. The earned value method provides early indications of project performance to highlight the need for eventual corrective action (Subramani *et al.*, 2014).

EVM establishes work package earned value baselines by integrating project scope, time schedule and cost objectives (Chithkara, 2006; Lakade & Gupta, 2010; Verma *et al.*, 2014).

This baseline is called PCC and is used for performance evaluations of projects on a given date. Analysis of variance from the baseline provides cost-related information for problem identification, trend analysis and corrective actions, such as re-planning and revising the budget. Earned value analysis serves two main purposes (PMI, 2008; Chithkara, 2006). It analyses cost changes which result in time and cost over-runs or under-runs so that timely corrective actions are taken, such as modification of cash flow, updating of financial forecast and project profitability expectations. Analysis of variance from the baseline, using earned value management systems provides a variety of variances which are analysed to provide the current status of projects, to initiate corrective actions and to forecast future trends (Chithkara, 2006; Verma *et al.*, 2014)

According to PMI PMBOK (2014), there is a list of earned value cost performance variance and indicators. Some of the key parameters are discussed below:

Cost Variance (CV): Cost variance is the difference between the value of the work and the amount of money that was spent on it. Mathematically it is represented as:

$$\mathbf{CV = EV - AC \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .. (1)}$$

A positive value of CV shows that the project is spending less than the planned budget, whereas a negative value shows that actual cost exceeds the budgeted amount.

Cost Performance Index (CPI): This indicates the efficiency of the use of resources and measures the worth of the work that achieved against every single unit dollar spent. Mathematically it is expressed as:

$$\mathbf{CPI = EV \div AC \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .. (2)}$$

A ratio less than 1.0 is unfavorable and suggests the value of the work that has been accomplished is less than the amount of money spent. A CPI ratio greater than 1.0 conversely suggests the value of the work accomplished is greater than the amount of money spent.

Cost Estimate at Completion (CEAC): This is a forecasting indicator and calculates the finishing cost of the project by assuming the current cost performance efficiency. It is calculated as:

CEAC = BAC ÷ CPI……………………………………….. (3)

Estimate to Complete (ETC indicates the estimated remaining worth of the project work. It is calculated as:

ETC = (BAC – EV) ÷ CPI………………………….. (4)

Anbari (2003) mentions that there might be important lessons to learn from each step or formula in terms of estimating, budgeting, performance management and cost control in EVA. Ambari's (2003) formulas of cost variance and schedule variance are illustrated in the above list of earned value cost performance variance and indicators.

Steps to successful earned value analysis implementation

The recommended steps for the successful implementation of EVA are as follows:

1. Obtain top level organisation commitment to EVA;

2. Education and training of the people in the project in EVA;

3. Scope well-defined, detailed and identified, with proper WBS and packages;

4. Schedule and budget organised according to the WBS;

5. Clear Project Responsibility Tables, with clear responsibility descriptions;

6. Clear flowchart of activities and relationships with the main participants;

7. Cost/Schedule Control System with database and data collection procedures;

8. Suitable reports related to EVA, well-planned, analysed and distributed;

9. Procedures for consistency analysis and validation of information;

10. Lessons Learned - continuous improvement process.

Material Control

It is commonly more difficult to control material variances than anything else, largely because of the effort necessary to determine accurately what has been already built into the structure. Factors that add to the difficulty of keeping precise control of material costs can be divided into price and quantity variances (Harris & McCaffer, 2013).

- Price Variance Inflation refers to changes in the buying situation from the time when the estimate was prepared. For example, bulk buying, discounts, shortages and changes in quality demanded by the client or available at the time.

- Quantity Variances Wastage and Breakages These include theft and loss, short deliveries, remedial work, delays in the recording system and inaccurate site measurement of work done.

Undertaking the keeping of comprehensive records would enable all these variances to be calculated for various material cost codes, but the expense of undertaking this work would probably far exceed the potential savings (see end of chapter for ‘points to consider when choosing a PCC system’). In practice, it is probably sufficient to generate an overall materials variance that is expressed in monetary terms (£). Thus:

Materials represented in measured work to end of last period	a
Materials in measured work in this period	b
Materials value to date	$c= a + b$
Cost of materials used to end of last period	D
Cost of materials delivered in this period	E
Total cost of materials purchased to date	$f = d + e$
Materials currently on site	g
Materials used to date	$h = f - g$
Materials variance	$j = c - h$

The value of materials (a, b and c) should be measured at the construction site to determine its material cost control. Costs should be based on a careful combination of the information from invoices and delivery notes. (Relatively sophisticated computer systems have been devised to improve the reliability of this summation.) When adverse material variances reach unacceptable levels, the manager will institute ad-hoc investigations and will act to prevent recurrences (Harris & McCaffer, 2013).

2.2.2.2.5 Effectiveness of Monitoring Projects

The essential components of an effective monitoring system are the establishment at the planning phase of an appropriate scope breakdown, a useful performance metrics, a management scheme organised for the identification and reporting of performance and accuracy in performance forecasting. Activating any adjustment late into the project is often ineffective and expensive (Sterman, 1992; Nepal *et al.*, 2006); the later the corrective action, the less its ability to influence the outcome of the project. Thus, the most effective managerial control is the one carried out during the early stages of the construction effort, for example, during the planning and designing stage. Yet, any initial project control must face the inherent uncertainty of the construction startup process and the availability of a reliable set of progress information, which will be on hand as activities unfold. To this end, project managers have to keep a watch on early cost and time estimates at completion, based on anticipated progress reporting, and to consider earned value (EV) analysis as a crucial tool in undertaking any control strategy.

2.2.2.2.6 Monitoring Measurement of Monitoring

EV of an activity is a measure of completed work, and this represents the budgeted cost of work performed (PMI, 2005). This shows that if there is a failure in predicting schedule and cost to completion this may result in time and cost overruns and jeopardise the target of the construction work in question. Generally speaking, EV indicates how the project team can efficiently utilise the project resources and measure what has been obtained and what was expected to be obtained. Two wide indices are used in evaluating project progress, the Schedule Performance Index (SPI) and the Cost Performance Index (CPI). Apart from these indices, several estimations are of interest. For example, completion cost and completion time of a project according to PMI (2005). For more on EV, indices and estimates should be considered. SPI is a conformance measure of actual progress to schedule. SPI is measured as the ratio of EV to Planned Value (PV), that is:

$$\mathbf{SPI = EV/PV,}$$

where PV, known also as the Budgeted Cost of Work Scheduled (BCWS), is planned to be used during the project. CPI is a measure of budgetary conformance of the actual cost of work performed and is the most useful index indicating the cumulative cost efficiency of a project. CPI is the ratio of EV to Actual Cost (AC), that is:

$$\mathbf{CPI=EV/AC,}$$

where AC, known also as Actual Cost of Work Performed (ACWP), is an indication of the resources that have been used to achieve the actual performed work. These two schemes are widely utilised by authors in construction project management (Aliverdi *et al*., 2013). Thus, project managers are required to keep watch and undertake rigorous monitoring and evaluation of projects and to develop guidelines and frameworks for measuring the various impacts (Kahilu, 2010).

2.2.2.2.7 Monitoring Project Budget Cost

The budget of every project is essential to its success. Projects require budgets which set the pace and guarantee the client's financial commitment and provide the basis for cost control and measurement of the cost performance of the project (Baccarini, 2004). It is therefore essential to keep an eye on the budget because the traditional project management tool/ technique used for cost monitoring and controlling is 'Budget Monitoring'. According to Hendrickson (2000), for cost control on a project, the construction plan and its associated cash flow estimates can provide the baseline reference for subsequent project monitoring and control. That simply implies that the final or detailed cost estimate provides a baseline for the assessment of financial performance during the execution of the project. Projects are thought to be under financial control, to the extent that costs are within the detailed estimate. If overruns occur in particular cost categories, it is a signal that there is the possibility that problems will be encountered along the line.

When this project management tool/ technique is used for control and monitoring purposes, the original detailed cost estimate is typically converted to a project budget and the project budget is then subsequently used as a guide for management. Specific items in the detailed cost estimate become job cost elements. Expenses incurred during the course of a project are recorded under specific job cost accounts to be compared with the original cost estimates in each category. Thus, individual job cost accounts generally represent the basic unit for cost control (Hendrickson, 2000). With this understanding, it was clear that the pricing of tenders is very important in effective cost controlling by contractors, hence the basis of project cost estimate which is later the project baseline is the tender pricing. As depicted through literature, practitioners have further developed tools/techniques based on this project management tool/ technique together with the use of web applications, further incorporating or integrating it with other related tools/ techniques or systems. For example, Benjaoran (2009) created a collaborative approach for effective cost control to help monitor the progress of project costs and to allow a real-time comparison with the Bills of Quantities (BOQ). The developed system uses the quantities of captured materials in the BOQ as the budgeted costs or allowable quantities. Project cost monitoring assists contractors track the progress of work done on their different projects.

2.2.2.3 PROJECT COST REPORTING

The purpose of cost control documentation is to inform management team members of the project cost status. Reports used for cost control should be brief, concise, timely, factual and limited to pertinent information. The shorter and more concise the report, the better and faster the feedback for appropriate corrective action to be taken (Liang, 20015; Dekker, 2005). The information provided should be self-explanatory and easily referred to during the preparation of later financial reports (Ashworth, 2004). Cost control reporting systems have progressed from manually recorded information systems to today's computerised systems. Computerised systems not only make extrapolations from the status data, but information can also be selected for inclusion in other cost reports (Dekker, 2005).

Computer-generated reports also allow users to browse and view information in a video display format. Simply having the information on a computer is not enough; appropriate cost information must be readily obtainable and presented in a clear, intelligible manner (Dekker, 2005; Ademola, 2012).

2.2.2.3.1 Frequency of cost reports

Cost control reports should be coordinated with project scheduling as well as with accounting cutoff dates. Optimally, these reports are issued each month (Patrascu, 1988). Cutoff dates for reports must be strictly adhered to in order to be of practical use; any major changes occurring after the cutoff date may be presented in an accompanying narrative report (Dekker, 2005). A weekly cost report is the basic timely report prepared by every organisation at the construction site (Liang, 2015).

2.2.2.3.2 Variance analysis report

Variance reporting is a system that emphasises cost and schedule control during all stages of design, construction, manufacturing and operations. The purpose is to report to the client and the organisation all the cost deviations using the budgeted cost. Every cost report should include an explanation of overruns and underruns as at the last cost report. Furthermore, the cost engineer should be able to account for all changes made to the initial forecast at the inception of the project (Dekker, 2005).

2.2.2.3.3 Report Distribution

According to Dekker (2005), provision for the best guide for the distribution of cost reports is to decide whether the reports are needed for general information only or whether they are to be used for decision-making, and at what level those decisions are to be made. Depending on the intended distribution of the report, cost control reports can be grouped into the following categories:

2.2.2.3.4 Multilevel Cost Reporting

Not everyone in a company needs access to all the cost information contained in the project cost control system. Multilevel reporting systems allow for different levels of objective cost determination and reporting (Dekker, 2005).

Examples of these include:

- Cost summary;
- Labour rate;
- Quantity and workhour rate;
- Variance reporting.

2.2.2.3.5 Combined cost/schedule reporting

Combined cost/schedule reports are generated by extrapolating information from both the cost and schedule systems (Dekker, 2005).

Examples of these reports include:

- Cash flow report;
- Cost/schedule performance curves;
- Productivity profile;
- Productivity trend chart;
- Bulk quantity curves.

2.2.2.3.5 Types of cost control reports

According to Dekker (2005), several other reports may be the products of a cost control system. Examples of these may include:

- Material requisition status;
- Subcontractor status;
- Vendor drawing status;
- Fabrication status;
- Critical items report;
- Quality trends.

Every construction project is unique and each has its own specific reporting requirements (Dekker, 2005).

Ademola (2012) developed several cost control reports or templates using the case study of a project. The details of the cost reports are discussed and presented in Chapter Five of this report. The reports include:

- Labour cost report;
- Material cost report;
- Plant cost report;
- Daily, weekly, monthly work done cost report;
- Profit and loss cost report.

2.2.2.3.6 Periodic labour cost reports

The contractor's PCC system will include a mechanism for the preparation, analysis and use of periodic cost reports. Most contractors prepare cost reports on a weekly basis throughout the duration of each construction project (Liang, 2015; Rounds & Segner, 2011). It should be noted that the information that appears in the labour cost reports is derived directly from the coded labour information that the supervisor has noted on each craft worker's timecard. A typical periodic labour cost report describes the activity undertaken, labour cost update, variances and projected labour cost to the completion of the construction project (Rounds & Segner, 2011).

2.2.2.4 PROJECT COST ANALYSIS

The actual site cost measured is compared with the budgeted cost to identify areas of cost deviations (Venkataraman & Pinto, 2008). The essence of cost analysis is to provide meaning to the cost data collected. The basic methods used are variances and trend analysis. The earned value principle provides the variance and trend analysis to be performed as and when an activity is completed, to know the cost status for corrective measures to be taken. Some causes of the variances include errors arising from the estimation, variations, price fluctuations and extreme wastage of materials. These should be identified to enable the decision-making process (Charoenngam & Sriprasert, 2001). Cost analysis uses the relevant and detailed cost data to calculate actual project cost, compare budgeted cost with actual cost, compare actual cost with forecast cost, analyse cost variance, identify causes of cost overrun and to update the cost status of the project (Venkataraman & Pinto, 2008; Charoenngam & Sriprasert, 2001, Al-Jibouri, 2003; Abubakar, 1992).

2.2.2.5 DECISION MAKING IN PROJECT COST CONTROL

Every organisation in the process of attaining its objectives incurs costs and for profit-oriented organisations, the level of cost incurred has a direct relationship with the amount to be realised as profit. For this reason, it is necessary for management of organisations to able to plan and control costs. Determination of future costs which are necessary for effective planning and control, is one of the key challenges that confront management accountants in corporate organisations. The knowledge of the pattern of cost behaviour and ways that future costs and other factors can be predicted are fundamental elements in short term planning and decision-making processes in an organisation. The understanding of cost behaviour is very important for management's efforts to plan and control construction project costs (Okunbor, 2013). According to Okunbor (2013), decision-making depends on the output shown in the patterns that arise from the graph, whether it is linear or a curve. Where costs do not vary in direct proportion to activity changes, the function is non-linear or curve-linear.

A decision is the agreement to adopt an alternative(s) to resolve a particular issue. The processes of making decisions face two difficult situations: Dynamic situations where decisions may be affected later if additional alternatives are generated, or if criteria and preferences are changed (Ulman, n.e) and complicated situations where decisions are made under the influence of multi-objectives (Ruotsalainen, 2010). In complicated situations, objectives are generally conflicting and prevent simultaneous optimisation of each objective (Yulan *et al.*, 2008).

A good manager must know how to act promptly under conditions of uncertainty, and for this, the manager needs a decision model. Basically, such a model is made up of a decision formula support, often based on quantitative techniques (Lepadatu, 2011). The decision model includes the following elements:

- A selection criterion (objective function), which is an objective that can be quantified. Usually, this objective is represented by the cost reduction;
- A set of alternative decisions from which the purpose can be achieved;
- A set of relevant decisions that may affect the results. These events, taken together, must be exhaustive (to cover all possible situations), taken individually, they must be disjointed;
- A set of probabilities, of presenting relevant events;
- A set of possible results, which measures, in terms of the objective function, the expected consequences of different possible action combinations and events. Each such result depends on a specific event and on a specific action (Lepadatu, 2011).

2.2.2.5.1 Definition of corrective measures

Corrective measures are defined by several researchers as an action an organisation should consider to eliminate or reduce the effect of project cost variances on construction cost by acting as a remedy (Patel & Patel, 2013; Tomić & Spasojević Brkić, 2011; Olawale & Sun, 2010). Tomić and Spasojević Brkić (2011) add that corrective measures are a sequence of arrangements that should be added to change or amend a system's performance in an organisation. Corrective measures take place in identified areas in the cost control process where remedy is needed. Corrective measures act as reactive measures only when an event has occurred (Olawale & Sun, 2010).

2.2.2.5.2 Role of Corrective Measures in Construction Cost Control Practices

Corrective measures need to be undertaken in all aspects of construction project management such as cost, time quality, risk and health and safety management. Corrective measures in project cost control are part of a decision-making process where measures are taken to solve or overcome any problem in the cost variances. Project managers must be able to identify early warning signs in cost control practice and make the right corrective decisions to mitigate the issue in the future activities of the construction project. In construction cost control, corrective measures are taken on cost variances on all resources such as material, labour, plant and equipment and profit and overheads. In a simplified approach, all the work activities of the various work sections are controlled with corrective measures (Adjei *et al.*, 2017; Haji-Kazemi *et al.*, 2012; Veronika *et al.*, 2006).

The success of construction project cost control practices and thoughts largely depends on effective corrective measures taken in the execution of the construction projects (Bahaudin *et al.,* 2012). Research conducted by Charoenngam and Sriprasert, (2001) on cost control practice incorporated corrective measures in its cost control system. The major areas of cost control systems are budgeting, monitoring, analysing cost status, reporting, forecasting, decision-making and corrective actions.

Many studies have been conducted in the construction industry on corrective measures for project cost control. Bahaudin *et al.*, (2012) developed a model for corrective cost control where preventative cost control is performed through systematic reporting of the problem, identifying the causes and then providing possible solutions to solve the cost problems identified. Olawale & Sun, (2010) classify corrective measures under corrective and preventive measures. These measures are added to the process to prevent future problems from occurring and serve as a remedy in the current situation. Veronika *et al.* (2006) identify the causes of project cost variances in material management and present comprehensive corrective measures to solve the causes. There is therefore, a need to bring all the concepts of performing corrective measures in project cost control together to make the practice effective (Adjei *et al.*, 2017).

2.2.2.5.3 Corrective Measures Procedures

Both simple and complex steps have been developed by researchers to deal with approaches to tackle corrective actions to assist managers in the construction industry. The simple step has a two-way approach for the practice of corrective measures. According to Andersen and Fagerhaug (2009), Tomić and Spasojević Brkić (2011) and Veronika *et al.* (2006) the two simple steps of undertaking corrective measures are firstly, identifying the real cause of the problem and then taking corrective measures to eliminate or reduce the negative cost effect.

The Performance Review Institute (2006) has developed a flow chart for undertaking corrective measures, as illustrated in figure 2.7. The process starts with the identification of the problem, gathering and using data to determine the root cause and direct and contributing factors of the problem, then setting out specific and preventive measures and follow-ups to ensure the variances are solved and also to prevent future reoccurrences. There exists a loop in the process that should be followed. This means that if the corrective measure undertaken is not effective, then an alternative measure will be implemented until finally there is a solution to the problem. Beecroft *et al.* (2003) add that there should be various alternate plans or solutions in place until an effective one is selected. Patel and Patel (2013) further add that monitoring and evaluation of the corrective measures aimed at eliminating the problem is very necessary.

In summary, the process for effective corrective measures for project cost control are: identifying the root or main cause of the problem, analysing the problem and grouping the causes of the problem under root, direct and contributing causes, developing alternative possible corrective measures for the cost variances in project cost control, selecting the relevant possible solution, implementing the solution and evaluating the corrective measure. This is illustrated in figure 2.8 (Adjei *et al.*, 2017). Haidar, (2016) supports the corrective measures process illustrated in figure 2.7 by providing the basic elements of decision-making or corrective measures. These include seeking for information, ascription of meaning (interpretation), applying decision criteria and subsequent implementation action.

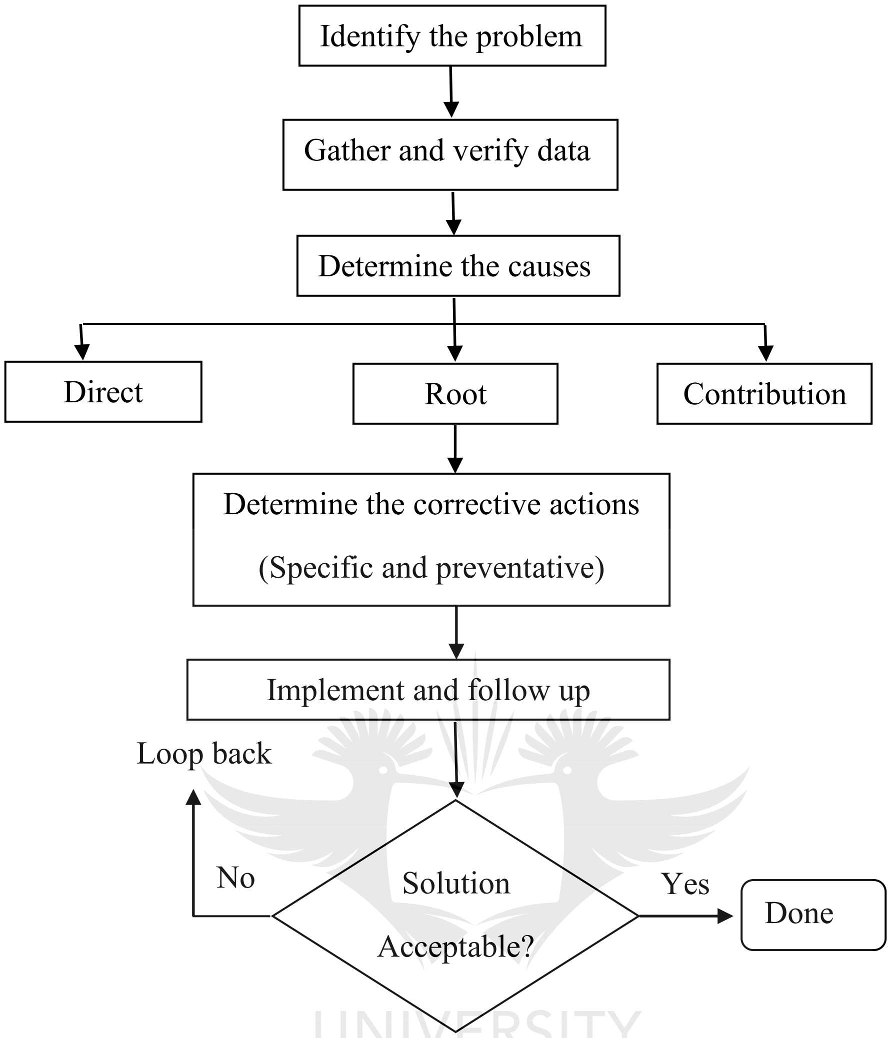

Figure 2. 7: Corrective action process
Source: Performance Review Institute (2006)

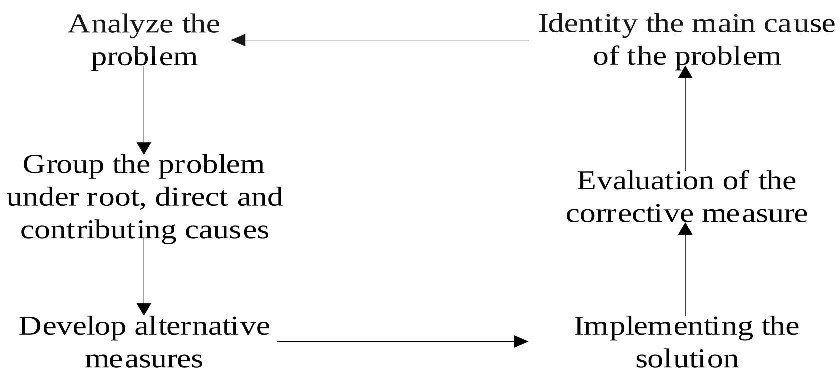

Figure 2. 8: Corrective measures cycle for project cost control

Source: Adjei *et al.*, (2017)

2.2.2.5.4 Skills required for undertaking Corrective Measures in Project Cost Control

Cost or project managers need skills and competencies for undertaking effective corrective measures. The following skills and competencies are necessary (Haidar, 2016; Patel & Patel, 2013; Bahaudin *et al.*, 2012; Tomić & Spasojević Brkić, 2011; Olawale & Sun, 2010):

- Systematic documentation of problem;
- Creative thinking in seeking alternative types of knowledge and information;
- Brainstorming;
- Problem-solving skills;
- Effective collaboration in the work environment.

The above competences and skills key for the core tasks of the top management team of every construction organisation practising corrective measures. The top management team of the organisation should always meet and solve the problem as and when it occurs. The corrective measures taken at every stage of the construction project or period should next be communicated to the middle management team and then to those on the ground, working on the construction project. Periodic project reporting is also important in change management. Weekly and monthly reports should be made regarding the corrective measures taken and their effect (Adjei *et al.*, 2017).

2.3 COST CONTROL STEPS

Most cost control processes or cycles emanate from project control theories (Venkataraman & Pinto, 2008; Al-Jibouri, 2003).

Venkataraman and Pinto, (2008) suggest four steps or process for cost control: 1. Cost plan design: the baseline plan commences with the development of the detailed work breakdown structure. These structures are mainly a representation of all the work activities of the project in Gantt chart format with its resource allocation to the activities – money, men, etc. The cost items become the cost plan which is used for future comparison and control of cost.

1. 2. Checking the cost update: the project manager or quantity surveyor is expected to focus on the status of the actual cost of the project at a predetermined period. The earned value management is used to source the cost performance of the project.

2. 3. Cost analysis: the actual site cost measured is compared with the budgeted cost to identify areas of cost deviations. The purpose of this stage is to allow room for corrective measures to be taken to solve the cost deviations. It is simpler for managers to solve the cost deviations if there are not too many. 4. Decision-making: remedial actions are measures taken by the top management team members to transform the cost deviation to its original position. How much the cost is affected will determine the development of a robust approach to solve the cost deviation.

Al-Jibouri (2003) presents the cost control process in five different areas: (1) establish the cost plan, (2) put the cost plan into action by executing the project. (3) track the site cost by reporting it, (4) report on the site cost against the budgeted cost and the cost variations and (5) make decisions to correct the variations. Al-Jibouri (2003) further explains that cost monitoring and decision-making are the major factors of cost control. Ansah and Boamfo-Adjei (2012) emphasise the fact that the estimates become the budgeted project cost which the top management team members use to guide decision-making about the cost deviations.

The cost control process by Abubakar (1992) has four main elements:

1. *Setting standards for cost control:* these are the plans against which the controls can be checked. The budget inputs should be set in a standard format and should be clearly outlined by every organisation practising construction cost control. The details of the cost control standards include:

1. Labour costs and outputs;
2. Material quantities and costs;
3. Plant costs and outputs;
4. Quality and quantity of outputs;
5. Subcontractors' resumption and finish dates;
6. Suppliers' delivery schedules;
7. Levels of general and project overheads;
8. Profit levels;
9. Establishment costs;
10. Periodic expenditure forecasts;
11. Schedule of expected revenue;
12. Contract programme.

2. *Recording performance for cost:* The recording of the project cost status should be done in a consistent manner. The relevant information must be recorded, stored in an appropriate

place and an appropriate format of capturing cost data should be used. In the capturing of the cost data, ICT plays a key role with several advantages. Managers are expected to consider the use of modern technologies in the recording of cost data. Both manual and electronic forms of recording are needed. Some typical formats for the recording and monitoring of cost performance at construction projects site are:

1. Work sections (as in standard methods of measurement);
2. Functional elements;
3. Trades;
4. Operations;
5. Individual resources;
6. Company-designed cost codes;
7. Subcontract packages;
8. Activity gangs.

3. *Monitoring and evaluating the cost performance*: The monitoring and evaluation of cost performance is a stage where the cost performance recorded is compared with the budgeted cost in order to show the cost deviations of the various cost activities. The monitoring and evaluation of the cost performance process is performed by capturing the raw data and presenting it in the form of a written report and diagrams, processing the data to clearly show the deviations, and performance evaluation using computation methods to show the deviations or using a judgemental approach to show the deviation and finally, reporting on the current cost status on the project.

4. Taking corrective action: The last aspect of the cost control process is undertaking corrective actions. These are decisions to be carried out to restore the cost deviation to the original plan. Identification of the causes of the cost deviation is needed as the basis for tackling the cost deviation. The following steps help to achieve corrective actions:

1. Analysing the reported performance from the cost data to determine the cause(s) of any identified loss of the cost performance.
2. Making rational decisions about what measures need to be taken to correct the deficiency and to try to return the cost performance to the desired stage.
3. Communicating the corrective decisions to the right level of management or the right division, at the right time, (generally it should be as soon as possible) for its implementation.
4. Implementing the corrective decisions by instructing the staff and management of the new tactics to be taken to solve the cost deviation.

Table 2.2 below provides a summary of the cost control steps from the three authors, Venkataraman and Pinto, (2008), Al-Jibouri (2003) and Abubakar (1992). The cost control steps concentrated in five main steps: cost planning, putting the cost plan into action, measuring, reporting the cost status and areas of cost variations, cost analysis and decision-making.

Table 2. 2: Summary of cost control process

Cost control process	Venkataraman & Pinto, (2008)	Al-Jibouri, (2003)	Abubakar (1992)
Cost planning	√	√	√
Putting cost plan into action by executing the project	√	X	X
Measuring, reporting cost status and areas of variation	√	√	√
Cost analysis	√	√	√
Decision-making	√	√	√

2.4.0 PROJECT COST CONTROL SYSTEMS

According to Harris and McCaffer (2006) the following systems are used in construction industry for controlling cost at the construction site:

2.4.1 Overall Profit or Loss

The contractor waits until the contract is complete and then compares the sums of money that have been paid with the monies incurred in purchasing materials, payments for labour, plant and overheads. The figures are normally extracted from the financial accounts compulsorily kept by all companies. Such a system is useful only on minor contracts of short duration involving a small workforce and little construction equipment, typically labour-only subcontracting. It scarcely qualifies as a control system, as the information it produces can only be used to avoid the recurrence of gross errors in later contracts (Harris & McCaffer, 2006).

2.4.2 Profit or Loss on Each Contract at Valuation Date

In this system, the total costs are compared with valuations gross of retentions. Care has to be taken to include the cost of materials delivered but not yet invoiced and to exclude materials on site not yet built into the permanent work. If the certificate is not a time reflection of the value of work done, a further adjustment is necessary. This system suffers from the disadvantage that there is no breakdown of the profit figures between types of work; it therefore provides guidance only on which contract requires management attention. It is not suitable for contracts that involve significant set-up costs that are distributed over the unit rates. Hence, it would be more appropriate for a general subcontractor (Harris & McCaffer, 2006).

2.4.3 Unit Costing

Unit cost is a noteworthy way of using cost information. The unit cost for any item or operation is the direct cost for one unit of measurement (Harris & McCaffer, 2006). In this way, it is important to make sure that the actual work is carried out directly and the quantity is measured accurately. Consideration of a ''give and take" method of interim measurement must be taken in order to avoid a clash with the calculation of unit rates and results in temporarily high or low unit costs for a particular item. In calculating, the unit rates must be solely to the work under consideration. It is important that the supervisory staff do not allocate the hours when their operatives are not properly and efficiently employed on productive work. It may result in unavoidably poor unit cost for that work if it is allocated. Another problem is to identify whether unit costs should be stored in terms of money or man-hours. If it is in terms of money, it is always a risky and approximate business. In terms of man-hours, it will remain constant with the same conditions over years. For managers who are involved in controlling the costs, money has more impact than man-hours in measuring the efficiency of an operation in progress when the data is collected. Cost identified in terms of money is usually for immediate use, whereas the man-hours which are not for immediate use are the historical data and feedback for use in future estimations of work. Nevertheless, it is rarely necessary for details of every single operation involved in a contract to be fed back to the estimating department. The "80/20 rule" is often accepted regarding bills of quantities. It means that 80% of the value of the work is often in 20% of the items in the bill. Clearly this 20% holds an important consideration in tendering procedure and in subsequent PCC (Harris & McCaffer, 2006).

According to Harris and McCaffer (2006), the costs of various types of work, such as mixing and placing concrete, are recorded separately. The costs, cumulatively on a periodic basis, are divided by the quantity of work of each type that has been done. This provides unit costs that can be compared with those in the tender. Considerable care must be taken to ensure that all costs are accounted for. Any miscellaneous costs must be recorded and allowed for in some way. For example, by proportional distribution over the defined work types. It is usually best to record site costs only and to compare these with bill rates net of contribution for profit and head-office overheads.

2.4.4 Standard Costing

The concept of standard costing is the assignation of pre-determined standard costs of direct labour, direct cost and manufacturing overheads to products rather than actual costs. Sulaiman *et al*. (2005) define standard costing as specifying in advance what should be achieved and then measuring the extent to which it is being achieved. The differences between these actual costs and standard costs are referred to as variances and can be used for evaluating performance and in turn enable timely action by management (Edwards-Nutton, 2008). Drury (2006) supports the view that standard costing can be used in stock valuation, but also adds that standard costing can: i) assist with decision-making, ii) assist in setting budgets, iii) act as a control device and iv) provide a challenge for staff to aim at.

Standard costing relies on predetermined costs achieved mainly through work study techniques and very detailed cost records. Variances are calculated by comparing the value of the output with the cost of producing it. A variance is the amount by which the achieved profit differs from budgeted profit. The value of work done can be assessed in relation to the contract budget, which in turn must reflect the amount that the contractor can expect to be paid. The predetermined costs are then compared with actual expenditure. The system seems to work better in the manufacturing sector than in the construction industry because there is too much variety and uncertainty associated with the construction production process. This frequently renders the pre-determined cost unreliable. However, this system is basically sound and provides comprehensive control within the company from boardroom down to workforce (Harris & McCaffer, 2006).

Variances are calculated, by comparing the value of the output with the cost of production. A variance is the amount by which the achieved profit differs from the budgeted profit. With appropriate records, it is possible to analyse the total variance into sub-variances, for example:

- Material price;
- Material usage;
- Labour efficiency;
- Fixed and variable overhead expenditure;
- Volume of production;

- Sales.

Standard costing is seldom directly applicable in construction because of the variety of the product. This makes the use of standard minute values difficult, if not impossible. However, as an alternative, the value of work done can be assessed in relation to the contract budget, which in turn must reflect the amount that the contractor can expect to be paid. One of the important features of standard costing is the calculation of a sales variance. This encourages the company to define sales (marketing, public relations, negotiations, estimating and bid strategy) as the responsibility of one department. An adverse variance immediately indicates that the level of acquiring new contracts is inadequate. Altogether, quite substantial departures from the manufacturing system are necessary and this accounts for the fact that standard costing is not in common use in construction. However, as has previously been stated, the system is basically sound and provides comprehensive control within the company from boardroom down to workforce (Harris & McCaffer 2013).

2.5.0 CONTRACTOR TEAM ROLES IN PCC

The contractor's in-house management team solely responsible for PCC is as follows:

2.5.1 Project Manager

Most construction firms in Ghana are beginning to focus attention on engaging the services of a project manager or project leader, in the case of the traditional procurement system, as a key manager who supervises all the activities in the construction field to achieve the desired growth and direction of the organisation (Adjei *et al*., 2015).

The project manager is the main person controlling the costs associated with the work packages of the construction project.

Project managers should get sufficient help to maintain a deep intuitive understanding into potential risk areas. With the help of a clear picture of the project cost performances, managers can create risk mitigation plans, based on actual cost, schedules and technical progress of the work. It is like an alarm for managers to identify and control problems by taking timely corrective action before the problems become too great to overcome (PMI, 2005; Bhosekar & Vyas, 2012).

2.5.2 Storekeeper/Manager

The store manager performs material management functions. Material management can be defined as a process that coordinates planning, assessing requirements, sourcing, purchasing, transporting, storing and controlling materials, minimising wastage and optimising the profitability by reducing costs of materials (Patel & Vyas, 2011). There is a need for efficient material management in order to control productivity and cost in construction projects. Hence, the overall objectives of any on-site management activity should be directed to provide full guard on construction materials and to ensure efficient usage of such materials (Mohamed & Anumba 2006; Ayegba, 2013).

Components of material management are:

- Material estimation, budgeting, planning and programming;
- Scheduling, purchasing and procurement;
- Receiving and inspection;
- Inventory control, storage and warehousing;
- Material handling and transport;
- Waste management.

2.5.3 Quantity Surveyor

The quantity surveyor can also be described as the economist and cost accountant of the construction industry, whose services enable construction clients to achieve optimum value for money (Seeley, 1983, 1984). Willis *et al*., (I994) summarise the body of knowledge of the quantity surveyor as including: preliminary cost advice, cost planning, including investment appraisal, life-cycle costing and value analysis, procurement and tendering procedures, contract documentation, evaluation of tenders, cash flow forecasting, financial reporting and interim payments, final accounting and the settlement of contractual disputes, cost advice during use by the client, project management and specialist services such as expert witness, arbitration and loss assessment (Nkado & Meyer, 2001). Male (1990) emphasises that the skills of the quantity surveyor are associated with measurement and valuation which provide the basis for the proper cost management of construction projects in the context of forecasting, analysing, planning, controlling and accounting.

On most projects, a quantity surveyor is engaged by the client to prepare a cost plan at the conceptual stage and a bill of quantities at the design stage of the project lifecycle. The quantity surveyor's role at the construction stage is to check the validity of progress and variation claims made by the main contractor (Uher & Davenport, 2002). The quantity surveyor is also responsible for checking invoices of material and plant cost during the construction stage.

2.5.4 Site Manager

The mission of a site manager is to successfully accomplish construction project objectives and to deliver the project product(s) as stipulated in the project mission statement. These can be achieved through the effective integration of several management techniques (Fapohunda & Stephenson, 2010; Adjei *et al*., 2015).

2.6.0 CHALLENGES OF PROJECT COST CONTROL

The following are challenges building contractors face in executing PCC:

2.6.1 Using obsolete methods and concepts

Small and medium construction firms are currently using primitive PCC processes which rely mainly on manual, paper-based information, instinct and former work experiences (Benjaoran, 2009). Ademola (2012cites that using manual and paper-based means for cost control involves site managers, quantity surveyors or cost engineers preferring to use calculators and notebooks or writing pads to arrive at cost control analyses instead of using the appropriate tools and technology available. Song (2014) adds that many owners of construction firms have little education or no knowledge on cost management which hinders practice requiring knowledge of cost control. This makes them rely on previous work experience acquired from previous projects. The limitation of current cost management competences and self-learning narrowed knowledge, continuous development of organisations and the changing work environment have rendered their previous work experience and methods out-of-date. The challenge is that these outdated cost management practices can no longer be used to solve current real-world situations of cost variances.

In situations where construction firms do not develop to be further acquainted with the constantly changing work environment, their problems increase and cost control issues become tough for them. So, using obsolete methods and concepts without constantly upgrading knowledge and practices do not help in the practice of cost control (Song, 2014; Adjei *et al*., 2018a).

2.6.2 Over-emphasising results while ignoring the project cost control process

Managers of construction companies are very mindful of cost control issues and have repeatedly stressed their importance. Managers are concerned about the cost variances in a particular or predetermined period. They often fail to examine the sources of cost change(s) and how to handle the change management process. This means that some managers of organisations disregard cost control methods in the execution of construction projects (Song, 2014).

The PCC process should never be inactive. It should always be active, alive and operational, particularly during the execution of construction projects. The basis of real time PCC is monitoring and reporting cost variances at regular periods, hence, the PCC process demands not just a series of records of costs changes but also the probability of subsequent cost commitments in the project (Bahaudin *et al.*, 2012; Ferry *et al.*, 1999). Most contractors are not willing to invest in cost management methods or are not ready to pay a professional to handle cost issues for the organisation. It is often considered a waste of money to the company or a way to cut down unnecessary expenses during the execution of construction projects, although it could save the organisation huge money loss through the practice of cost control. Cost managers necessarily need to undertake PCC processes from the beginning of the construction project and keep the PCC practice active throughout the project (Song, 2014).

2.6.3 Lacking project cost control processes and systems suitable to the enterprise

As previously explained, managers of construction companies are very mindful of cost control issues and have repeatedly stressed them as a necessity. Many managers prefer an easy way of performing cost control processes without following due process which eventually becomes bad practice. Most cost managers are mindful of the need to focus on and keep construction costs on track but are not prepared to spend much time in developing a cost control template for every construction project to use in the PCC process. This is because formulating a cost control process for a project takes much time. This frequently results in specific attention only being given to aspects of the construction project activities where variances of cost have occurred or are likely to occur.

Procedural and systematic structures can be executed over a long period by corporate managers at all levels. The PCC flow should be a long-term strategy, instead of just once-off when the construction project commences. It is also very important for simplifying the management of cost; specifically cost control in construction project delivery (Song, 2014; Adjei *et al*., 2015; Adjei *et al.*, 2018a).

2.6.4 Lack of consistency in cost management by managers

Many construction companies take the initiative to perform or undertake PCC processes only when there exist cost problems, predicaments or challenging cost issues. This is a common phenomenon with most construction managers. Conversely, the organisation only executes or deliver the construction project as planned. Although cost managers recognises the essence of performing PCC processes, they fail to pass the concept to the other members of the organisation in order to accomplish the cost objectives of the project (Song, 2014; Adjei *et al.,* 2015). Instead of being consistent in the practice of cost control during construction project execution, managers mostly do so irregularly or occasionally when the need arises. Not only is there a lack of PCC processes and systems, but also many cost managers lack continuous engagement with PCC processes in the delivery of construction projects (Song, 2014; Adjei *et al.*, 2015).

2.6.5 Serious decision failures, exorbitant marketing expenses

This is another important aspect of PCC practice. The project quantity surveyor or the cost engineer needs to apply the cost control practice to develop a series of options for the other project members to consider and also to select the option that best fits within the approved budget (Khamidi *et al.*, 2011; Dikko, 2002). Corrective measures are therefore considered as a decision-making concept to be used to solve the variances that occur in the construction costs. Alternative solutions must be undertaken to solve identified cost problems (Adjei *et al.*, 2018a). Failure in effective decision-making and corrective action affects the organisation and leads to high project costs. This depends on whether cost managers of the organisations are knowledgeable and experienced in the practice of PCC in decision-making and cost management. Decision failures, including mal-apportioning of funds or loss of opportunities caused by decision delays, indirectly affect the organisational cost expenses. Initial slight decision failures made by managers will eventually be absorbed by the organisation (Song, 2014; Adjei *et al*., 2015).

2.6.6 Poor attitude towards the use of information communication technology

Availability of information communication technology (ICT) tools and knowledge is widespread for use in the construction industry. Regardless of the existence of numerous advantages ICT offers to construction firms, many organisations are still very slow in exploring its potential benefits (Egbu & Botterill, 2002). The barriers to ICT adoption in the construction industry include cultural, psychological, technical and financial factors (examples of technical and financial factors are the continuous call for advancement and high investment budgets) (Ba¨ckblom *et al*., 2003; Bjo¨rk, 2003). Construction professionals are also accustomed to using traditional methods and tools in managing cost. This becomes a barrier to cost control (Samuelson, 2002; Achar *et al.*, 2005). One of the critical factors for the successful use of ICT is the individual and organisation attitude to communication. In many construction firms, individual attitudes and behaviour towards technology usage and attitudinal change have become a problem in the delivery of construction projects (Brewer & Gajendran, 2009; Brewer & Gajendran, 2006; Davis & Songer, 2008).

2.6.7 Difficulty in monitoring different sources of day-to-day cost data

Charoenngam and Sriprasert (2001) advocate that "accurate and realistic estimate" helps organisations to win construction contract. In addition, it offers a path to attain maximum returns and finally, it aids effective PCC. The method used in the monitoring of construction costs might be seen as the most problematic function to be accomplished. It is the responsibility of the staff dealing with the main cost data at the construction site to monitor the routine dynamic construction operations. As the construction work advances, the earned value of each work element must be monitored to permit the identification of cost status at any given stage. The monitoring process may be involved with a vast amount of data collection from many different sources or parties. Well-established standard procedures can smooth the advancement and guarantee completeness of data for the PCC practice (Sanni & Hashim 2013; Charoenngam & Sriprasert, 2001).

2.6.8 Variations in contract

Ashworth and Hogg (2002) state "that the initial estimate of variations to the contract is likely to be of a budgetary nature and it is important that such estimates be progressively updated as more detailed information becomes available in the form of measurement quotations or day work records". Charoenngam and Sriprasert (2001) recommend that decision support systems should be provided at all levels of management with updated information about the various aspects of the project cost performance. Furthermore, exception reports enhance the management's productivity by concentrating on the most critical subset of performance information. Moselhi *et al.* (2004), add that "the earned-value method is widely used for reporting project status with consideration of two performance indicators (time and cost) in an integrated manner." The competencies of the personnel in the contracting organisation should be high in construction PCC practices. The more efficient the cost managers are, the better for the progress and growth of every construction organisation. Pries *et al*. (2004) state that the construction businesses today are about fulfilling client satisfaction through efficient production and delivery of construction projects. Thus, if the contractor's cost managers are very efficient in discharging their work, it will result in highly cost-effective construction project delivery by the organisation (Sanni & Hashim, 2013).

2.6.8 Lack of financial commitment in projects

The most important factor to be considered by every contractor is the opportunity to remain in business by taking on construction projects. Most contractors are concerned with profit or turnover before taking up a new construction project. Contractors are well aware of the need to maintain a flow of cash for the day-to-day activities in project delivery and also to maintain a cash flow for the survival of the company. Additionally, some contractors have suffered liquidation or bankruptcy, not because their construction work was unprofitable, but because of cash flow problems in the short-term during construction project delivery (Adjei *et al.*, 2018a; Sanni & Hashim, 2013).

2.6.9 Lack of knowledge about the use of available tools and technology

Knowledge is considered the key element for every construction organisation to do well and to be competitive in the sector (Martin, 2010; Ademola, 2012). The 'knowledge' of cost control can be considered as technical and managerial knowledge and the lack of it affects the practice of PCC (Ademola, 2012). It is surprising to see current graduates who are site managers, quantity surveyors or cost engineers often using calculators and notebooks to arrive at the cost control analysis of the project rather than using current technology and less complicated methods available for use for cost control practice. The battle to study and understand complex procedures and steps of cost control using appropriate tools is a challenge for many professionals (Ademola, 2012).

2.6.10 Abandonment of complicated strategies

More often than not, site managers, quantity surveyors or cost engineers find it difficult to combine residual knowledge with experiences from previous endeavours (Ademola, 2012). Systematic strategies using mathematics with computerised bases are a problem for some professionals in the day-to-day activities in managing construction project costs (Ademola, 2012; Adjei *et al.*, 2018a).

2.6.11 SUMMARY OF COST CONTROL CHALLENGES

Table 2.3 summarises the challenges of cost control of different countries.

Table 2. 3: Summary of findings from literature

S/No.	Source	Country	Challenges of cost control
1	(Kirun &	India	Improper planning and scheduling, ineffective planning, reworks due to errors, due to defective

	Varghese, 2015)		work, wastage of materials, design changes, additional works, currency value, fluctuation in material cost and increase in interest rate.
2	(Sanni & Hashim, 2013)	Nigeria	Improper contract document, engagement of inexperienced staff, unstable market conditions, complexity of projects, unstable government regulations, choice of procurement method, lack of research and innovation, price and design risk, quality factors of cost information, non-provision of training of young professionals, inadequate access to software packages, non-clarity of exclusions, and ineffectiveness of professional bodies.
3	(Ademola, 2012)	South Africa	Lack of knowledge of the use of available tools and technology, Abandonment of complicated strategies.
4	(Song, 2014)	China	Using obsolete methods and concepts, Over emphasising results and ignoring the process of PCC, Lacking PCC processes and systems suitable to the enterprise, Lack of consistency in cost management by managers, Serious decision failure, exorbitant marketing expenses.
5	(Charoenngan & Sriprasert, 2001)	Thailand	Difficulty in monitoring different sources of day-to-day cost data.
6	Adjei *et al.*, 2017b	Ghana	Poor attitude towards ICT usage, Lack of financial commitment in projects.

Source: Literature review

2.7 ORGANISATIONAL ELEMENTS ENHANCING PROJECT COST CONTROL PRACTICE

The following are organisational elements that enhance the practice of project cost control in the construction industry. The organisational elements are organisational structure, organisational culture and ICT tools and knowledge.

2.7.1 ORGANISATIONAL STRUCTURE

2.7.1.1 Definition of organisational structure

There are many definitions of organisational structure offered by researchers (Ubani, 2012; Zaki *et al.*, 2015; Tran & Tian, 2013; Underdown, 2012). Ubani (2012) explains organisational structure as the management framework adopted to oversee the various activities of a construction project or other activities of an organisation. A suitable organisational structure assists the project management team or construction firms to achieve high performance in projects through gains in efficiency and effectiveness (Zaki *et al.*, 2015). Tran and Tian (2013) claim that the purpose of the formation of the organisation can be described as successful or unsuccessful. This means that for a successful organisation to be achieved there are required goals, creation of internal orders and relationships among members (Zaki *et al.*, 2015). The goals, creation of internal orders and relationships are described as organizational structure. Underdown (2012), adds that organisational structure "is the formal system of task and reporting relationships that controls, coordinates and motivates employees so that they cooperate to achieve an organisation's goals". According to Naoum (2011), organisational structure is ‘‘a mechanism for linking and coordinating people and groups together within the framework of their roles, authority and power. Structure can be regarded as the skeleton of the organisation and its effectiveness depends on how strong or weak the backbone is’’.

Analysing all the definitions of organisational structure, the researcher summarises organisational structure as a network of personnel that guides a construction organisation to achieve organisational performance through their various roles, authority and power (Adjei *et al.*, 2019)

2.7.1.2 Elements of organisational structure

Greenberg (2011) and Zaki *et al.* (2015) summarise the main structural elements in organisational structure as follows:

a. The formal relationships with well-defined duties and responsibilities;

b. The hierarchical relationships between superior and subordinates within the organisation;

c. The tasks or activities assigned to different persons and departments;

d. Coordination of various tasks and activities;

e. A set of policies, procedures, standards and methods of evaluation of performance which is formulated to guide the people and their activities.

Latifi and Shooshtarian (2014) in their studies, point out that organisational structure has the following elements: nature of formalisation, specialisation, standardisation, centralisation, professionalism, complexity, hierarchy of authority and personnel ratios. Meduenyi *et al.* (2015) and Damanpour (1991) also support the notion of formalisation, layers of hierarchy, levels of horizontal integration, centralisation of authority and patterns of communication as part of organisational structure. Kim (2005) found and explains organisational structures in four main areas: nature of formation, number of layers, level of horizontal integration and locus of decision-making. Kim (2005) continues to explain the nature of formation consisting of the number of layers with very few levels of management structure.

Organisational structure includes the nature of the layers of hierarchy, the centralisation of authority and horizontal integration. It is a multi-dimensional construct which concerns: work division, especially roles or responsibility. It includes specialisation, differentiation or departmentalisation, centralisation or decentralisation, complexity,
and communication or coordination (Kariuki, 2015; Adjei *et al.*, 2019). Kariuki (2015) further adds that organisational structures are characterised by different attributes such as control, communication, organisational knowledge, task, prestige, governance and values.
The organisational structural elements are summarised as roles and position, formal relationships, nature of formation/number of layers, specialisation/professionalism, centralisation of authority or decentralisation (locus of decision-making), level of horizontal integration, patterns of communication, coordination, personnel ratios, mechanisms for problem solving, accountability, organisational knowledge, set of policies/procedures and standards, prestige, governance and values.

2.7.1.3 Effectiveness of the organisational structure

Ubani (2012) and Akpan and Chizea (2002) further posit that, for the organisational structure to be effective and efficient, it has to possess the following:

Flexibility. It needs to be amenable to change as situations change. It should allow for optimum delegation and room for individual creativity.

Simplicity. Organisational structure should be simple to the extent that no one is in doubt of what is expected of them.

Lean staff. The top-level management should be as lean staffed as is needed for prompt decision-making.

Optimal span of control. The middle management, including the supervisors should not be encumbered with many people under their direct control. At the same time, the span of control should not be so small as to miniaturise its role and importance within the structure.

Human-oriented. The structure should be seen to enhance humanism, job fulfilment and enhancement. It should be people-oriented and responsive to its environment

Result and quality-oriented. The structure should indicate without any doubt that it is result and accountability oriented.

2.7.1.4 Types of organisational structure

There are different form or types of organisational structures presented by researchers (Zaki *et al.*, 2015; Kariuki, 2015; Bobera, 2008). Naoum (2011) classifies organisational structure into three types: (1) the traditional simple structure (also known as craft structure), (2) the functional structure (also known as line manager structure) and (3) the matrix structure (also known as task structure). Similarly, Bobera (2008) presents three types in different ways. They are: (1) functional type of organisation where the project is part of the functional organisation of the enterprise; (2) pure project organisation and (3) combined or matrix systems. Zaki *et al.* (2015) in their studies on organisational structure also classify the types into four: (1) traditional structure, (2) functional structure, (3) divisional structure and (4) matrix structure. Furthermore, Kariuki (2015) presents six types of organisational structure: divisional structure, functional structure, geographical structure, horizontal structure, hybrid structure and matrix structure. The types of organisational structures are further summarised and presented in Table 2.4 below:

Table 2. 4: Types of organisational structure

Types of	Kariuki, 2015	Zaki *et al.*, 2015	Naoum, 2011	Shtub & Karni, 2010	Bobera, 2008

	-	Traditional	Traditional		-
	Functional	Functional	Functional	Functional	Functional
	Matrix	Matrix	Matrix	Matrix	Matrix
	Divisional	Divisional	-		-
	-	-	-	Project organisation	Pure project organisation
	Geographical	-	-		-
	Horizontal	-	-		-
	Hybrid	-	-		-

2.7.1.4.1 Traditional organisational structure

Traditional organisational structure is also known as simple or craft organisational structure (Naoum, 2011). It is very simple in that it commences when an owner starts a business where the owner or manager controls his subordinates and the various heads also control their subordinates. It has an informal line of relationships among the members of the organisation (Naoum, 2011). It is used where there are few items or products to control (Zaki *et al.*, 2015). Ganesh (2013) describes the levels of authority in the traditional organisational structure in terms of the horizontal layers comprised of the top manager, directors, divisions, departments and section levels. A typical example is illustrated in the figure 2.9 below:

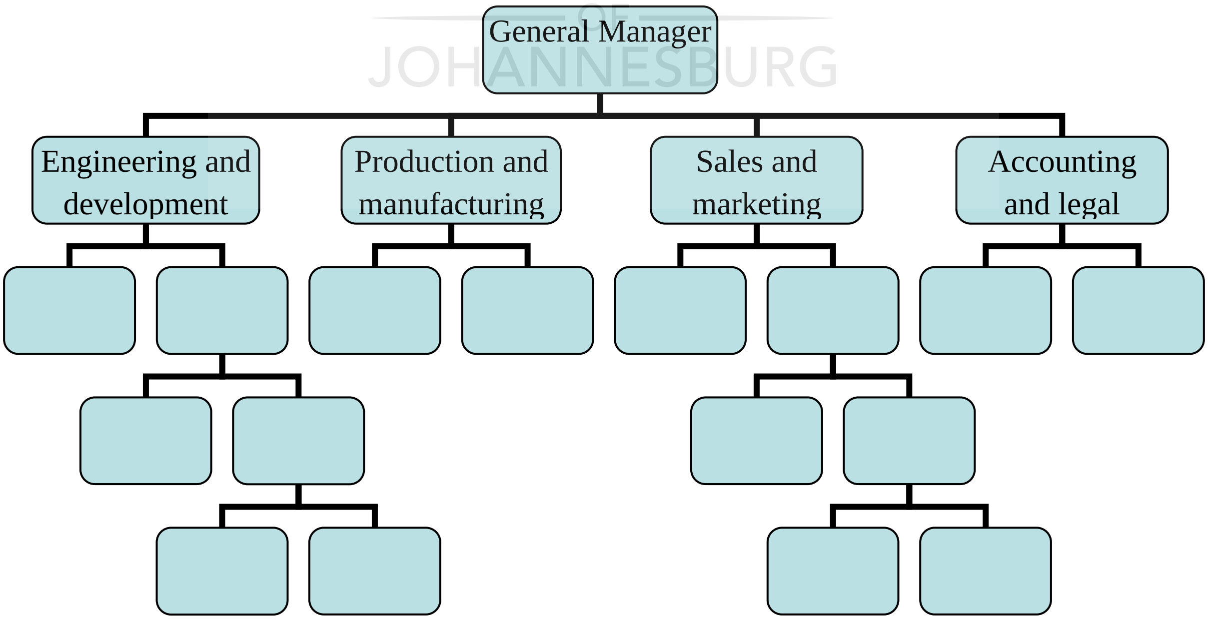

Figure 2. 9: Example of traditional organisational structure

Source: Ganesh, 2013, *adapted and revised*

2.7.1.4.1.1 Advantages and disadvantages of the traditional organisational structure

The advantages and disadvantages of the traditional organisational structure are presented in works by Ganesh (2013) and Zaki *et al.*, (2015). The advantages include; building of team work is easier, easy budgetary allocation and cost control are possible, quick response and/or feedback exists but may be dependent upon the priorities of the functional managers in the organisation, continuity in the functional disciplines, well-defined policies, procedures, and lines of responsibility and good control of personnel because of a direct reporting system.

The disadvantages of using the traditional organisation structure include the following: no one is directly responsible for the total project, it does not provide the clear project-oriented focus that is necessary to accomplish the project objectives, coordination becomes complex and much time is required in the decision-making processes and ideas of people in the organisation tend to be functionally oriented with little regard for on-going projects.

2.7.1.4.2 Functional organisational structure

This is an organisational structure where groups of individuals are put into units within the organisation to perform specific functions (Shtub & Karni, 2010). Each unit or specialist department provides a common service throughout the organisation (Naoum, 2011). In a very large organisation, each unit is usually a sub-divided group to help facilitate better coordination and management within the organisation (Shtub & Karni, 2010). A typical example is the structure in figure 2.10 where the engineering section has three different sub-divisions, the electrical, mechanical and material engineering units

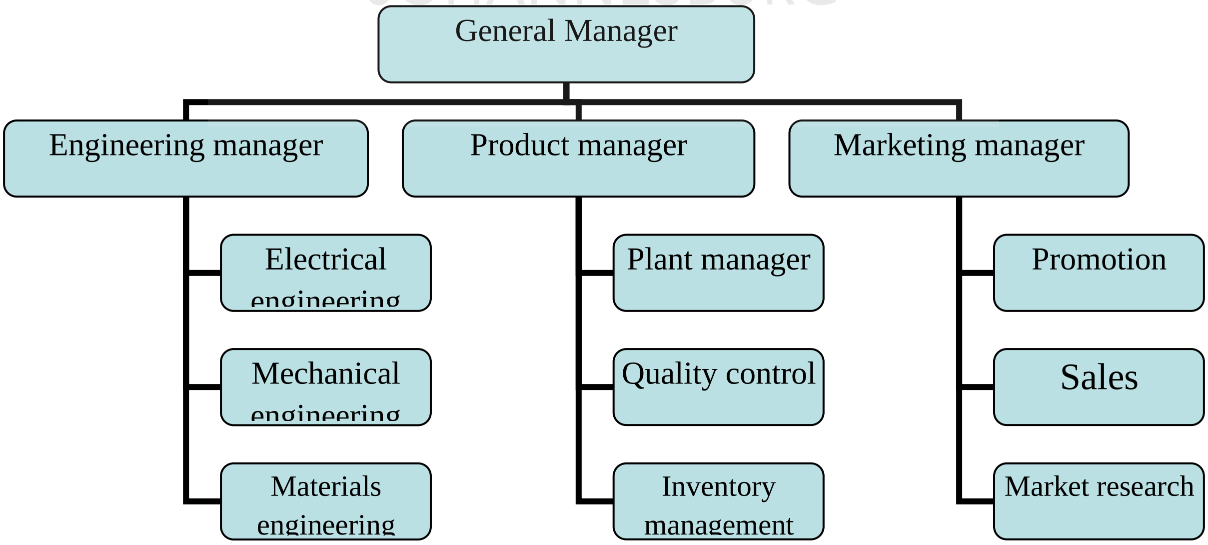

Figure 2. 10: Example of functional organisational structure

Source: Bobera, (2008) *adapted and revised*).

2.7.1.4.2.1 Advantages and disadvantages of the functional organisational structure

The advantages and disadvantages of the functional organisational structure are presented in works by Ganesh (2013), Zaki *et al.* (2015), Naoum (2011), Bobera (2008), and Shtub and Karni (2010). The advantages of the functional organisational structure include: team members are comfortable to work in groups according to their functional specialties and expertise, career advancement for functional team members within the functional area is possible when they show improved morale and productivity, better communication due to vertical and well-established channels, flexibility to use any of the resources as and when needed for projects, functional managers maintain absolute control over cost budget and have authority and therefore projects may be completed within allocated budgets and schedules, high production control at a senior level, a clear definition of roles and authority is provided in the functional organisational structure, better utilisation of resources is achieved, experts in the department can be grouped to exchange the knowledge and experience they possess and experts can be engaged in many different projects.

The disadvantages of the functional organisational structure include: the differences in goals and processes may be a barrier between the functions and prevent functional units from working together on projects, the competition between functions may arise for shared resources resulting in conflict, some of the decisions from upper management may favour the strongest and loudest groups only, in multi-group project situations, there might be difficulty in establishing authority and responsibility, functional form becomes inflexible and costly to operate when the number of products offered becomes too great or if scheduling becomes a problem, mutual inter departmental communication exchange is insufficient, communication between different organisational units may be difficult due to the different goals, different interests and different backgrounds of the members of these organisational units and high utilisation of resources may lead to poor overall performance of the organisation.

2.7.1.4.3 Divisional organisational structure

Divisional organisational structure is where the employees are grouped according to the kind of projects they contribute to the organisation. The same approach may be used or extended to the geographical location of the projects as illustrated in the figure below (Ganesh, 2013; Zaki *et al.*, 2015). This organisational structure is grouped according to the various divisions which need a manager and it requires further division of the unit into subunits to be managed by a manager who only reports to his/her immediate leader.

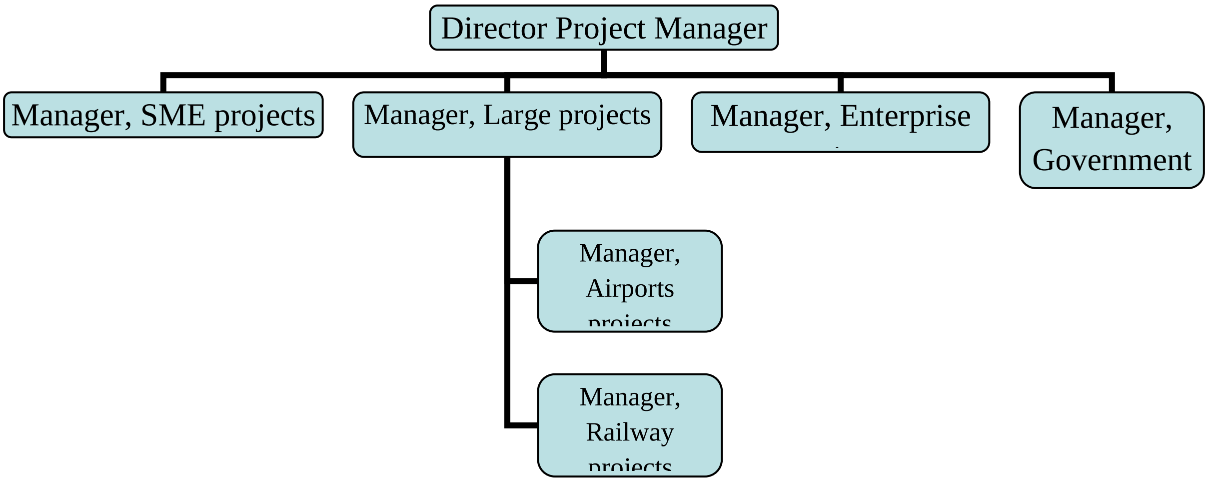

Figure 2. 11: Divisional organisational structure

Source: (Ganesh 2013; Zaki *et al*. 2015, *adapted and revised)*

2.7.1.4.3.1 Advantages and disadvantages of the divisional organisational structure

The advantages and disadvantages of the divisional organisational structure are presented by works by Ganesh (2013) and Zaki *et al.* (2015). The advantages of a divisional organisational structure include the following: organisations differentiate and focus on products, customers, locations or projects thereby enabling them to address various issues and impacts caused by their individual needs due to their focus and close proximity to issues, project teams have a better understanding of specific needs, team members respond quickly to changes that affect the product, customer or location and unprofitable projects can be easily recognised and eliminated.

The disadvantages of a divisional organisational structure are that too much focus on an existing product may cause individuals not to keep up with technological advances in their own field, and a lack of opportunity to share new advances and technology between groups. In addition, there may be duplication of effort and therefore increase in costs, and there is the danger of instability of employees if projects are terminated

2.7.1.4.4 Matrix organisational structure

The matrix organisational structure is a structure which combines the functional structure and the project structure (Shtub & Karni, 2010; Bobera, 2008). Naoum (2011) adds that the matrix organisation is necessary for organisations to add a horizontal dimension to their traditional functional structure in order to improve coordination and functional integration of individuals and groups. A typical example of the matrix organisational structure is illustrated in Figure 2.12 (Naoum, 2011):

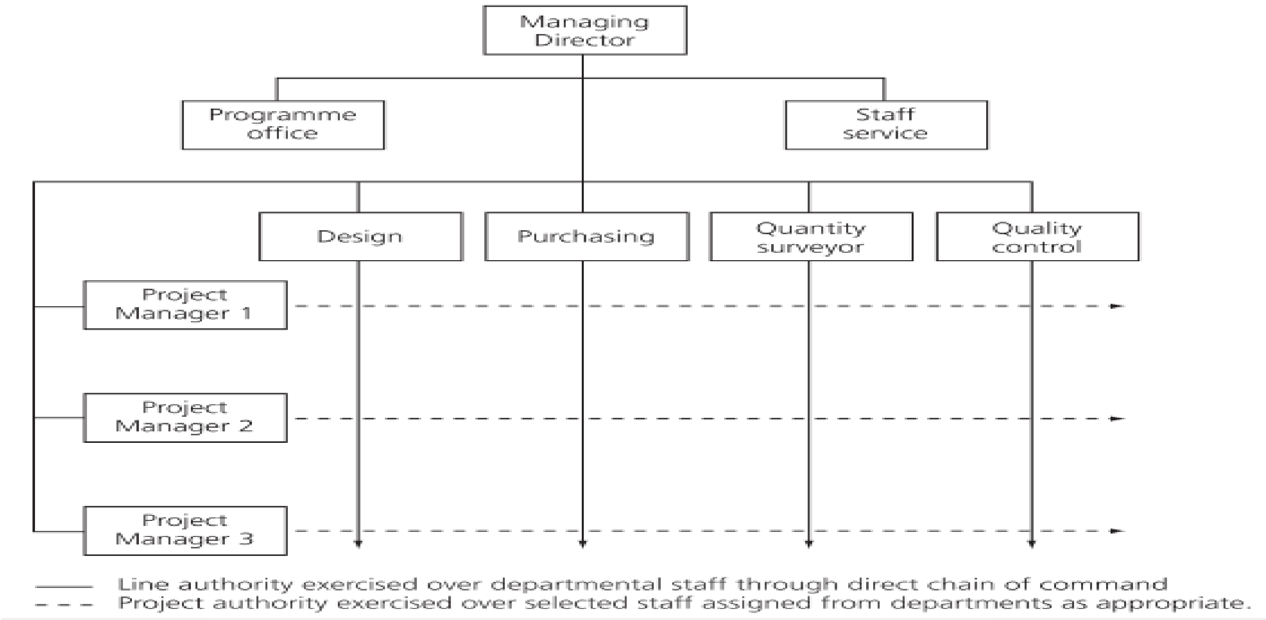

Figure 2. 12: Matrix organisational structure

Source: Naoum, (2011)

The matrix structure can be applied at two levels:

(a) At the organisational level where line managers and the supporting staff form a relational grid. This means that people with specialist knowledge are integrated with the management structure in an informal matrix structure. In this structure, the individual authority relationship, defined previously as 'functional', now becomes part of the actual structure under the heading of 'staff relationships' (Naoum, 2011; Mullins, 2010).

(b) At the project or operational level where project managers and organisational staff form a team relational grid. This grid facilitates the liaison, considered necessary for the elements of a particular project, between departments. This is known as a formal project management matrix structure. In this structure, a two-way flow of authority and responsibility can be established between members of the project team and other organisation staff. Within the functional department, authority and responsibility flow vertically down the line, but the authority and responsibility of the project manager flows horizontally across the organisational structure (Naoum, 2011).

2.7.1.4.4.1 Advantages and disadvantages of matrix organisational structure

The advantages and disadvantages of matrix organisational structure are presented in works by Zaki *et al.* (2015), Ganesh (2013), Naoum (2011), and Bobera (2008). The advantages of matrix organisational structure include: the project manager takes over full responsibility for project management, its realisation as planned, within the framework of an advanced defined budget, specifications and quality, management can to use the existing administrative staff. The result of this is consistency in terms of policies, procedures and practice of the existing enterprise, which will be saved. It takes advantage of both the function and the project or the department structures, leading to flexibility in responding to changes and the decision-making process becomes simplified due to this authority. This results in budgeting and staffing for projects becoming easy to create and manage, team members of a project are accountable for project deliverables and performance. There is a high level of performance and greater worker job satisfaction, processes can be tailored for individual projects, provided there are no conflicts with general organisational policies. Procedures and new project or functional teams develop from necessity.

Disadvantages of the matrix organisational structure are that employees reporting to dual supervisors may run into potential conflict during their allocation to projects, there may be duplication of efforts if communication fails between projects, the best available human resources may end up with higher-priority projects and shifting team members between projects may hinder their growth and development in specialised areas. Lessons learned on projects may not be communicated to other new or existing projects. Further, if there is any doubt about the responsibility, the project suffers. If there is uncertainty about the positive result of the project, the struggle for prestige following the question, "Who is responsible for praise and glory?" may increase and the need to satisfy different term plans of every project may increase conflict between project managers

2.7.2 CONTRACTORS' ORGANISATIONAL CULTURE

2.7.2.1 Definition of organisational culture

According to Oyewobi *et al.* (2016) and Jones (2013), organisational culture 'is the set of shared values and norms that controls organisational members' to achieve organisational goals. Cheung *et al.* (2011) further add that, organisational culture is the social or normative glue that binds an organisation together with regard to the social ideals, values and beliefs that members of an organisation come to share. Ankrah *et al.* (2009) describe organisational culture as "the way we do things around here to succeed."

Organisational culture influences the success or otherwise of strategy, mergers, acquisitions and diversifications, integration of new technologies, meetings and communications in face-to-face relationships and socialisation (Ankrah & Langford, 2005).

2.7.2.2 Classification of organisational culture

Cameron and Quinn, (2011) cited by Arditi *et al*. (2017) and Choi *et al*. (2010) define four major culture types of organisational culture, namely: “clan” culture, “adhocracy” culture, “hierarchy” culture, and “market” culture.

• An organisation that is dominated by “clan” culture attaches great importance to teamwork, participation, consensus, morale and loyalty. Success is defined in terms of sensitivity to customers in “clan” culture-oriented organisations (Cameron & Quinn, 2011; Arditi *et al*., 2017). The most significant features are participation and teamwork in organisations with clan culture. It is believed that success cannot be achieved individually; teamwork is required for success. Furthermore, the personal development of employees is important (Albayrak & Albayrak, 2014).

• “Adhocracy” culture encourages creativity, experimentation, innovation and individual initiative. Gaining unique products and being a product leader are the criteria of being successful in organisations that are dominated by “adhocracy” culture (Cameron & Quinn, 2011; Arditi *et al*., 2017). Leaders are entrepreneurial and innovative; also, they tend to take risks. They attach great importance to the vision. Entrepreneurship, flexibility and risk-taking are significant elements for the company. "Innovation feeds new resources" is the main management principle. Creativity, growth, research and development activities, new products and services are foremost in this culture. Especially in unstable market conditions, taking decisions and applying them quickly are vital for these companies (Albayrak & Albayrak, 2014).

• “Hierarchy” culture leads to an organisation that has a formalised structure, formal rules and policies. Success is defined in terms of dependable delivery and smooth scheduling in “hierarchy” culture-oriented organisations

• “Market” culture focuses on getting the job done which brings about goal-oriented competition. Reputation and market leadership are the main concerns of success in “market” culture oriented organisations (Cameron & Quinn, 2011; Arditi *et al*., 2017). Leaders are expected to be competitive, productive and determined. Defining goal, production and competition are the focus of these companies. The basic strategy of the company is high profitability. Increasing the market share of the company is seen as a measure of success (Albayrak & Albayrak, 2014).

The classification of the organisational cultures has further been developed by Elgar, (2006) as illustrated in Figure 2.13 below:

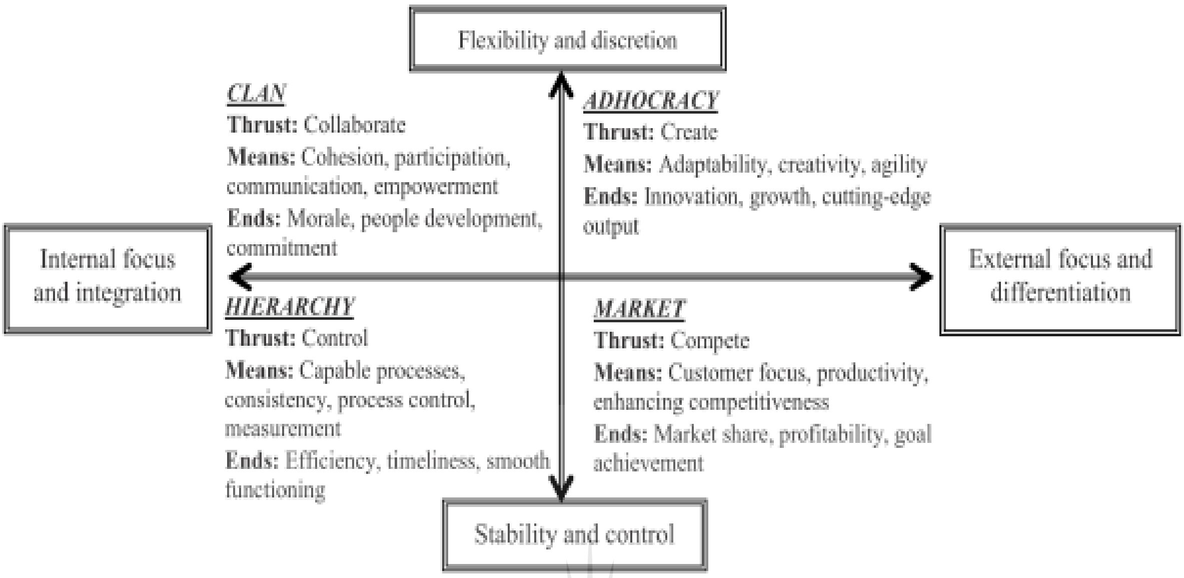

Figure 2. 13: Types of organisations according to "Computing Values"

Source: Elgar, (2006)

The organisational culture computing values was further developed in 2011 by Cameron & Quinn (2011) as shown in Figure 2.14 below:

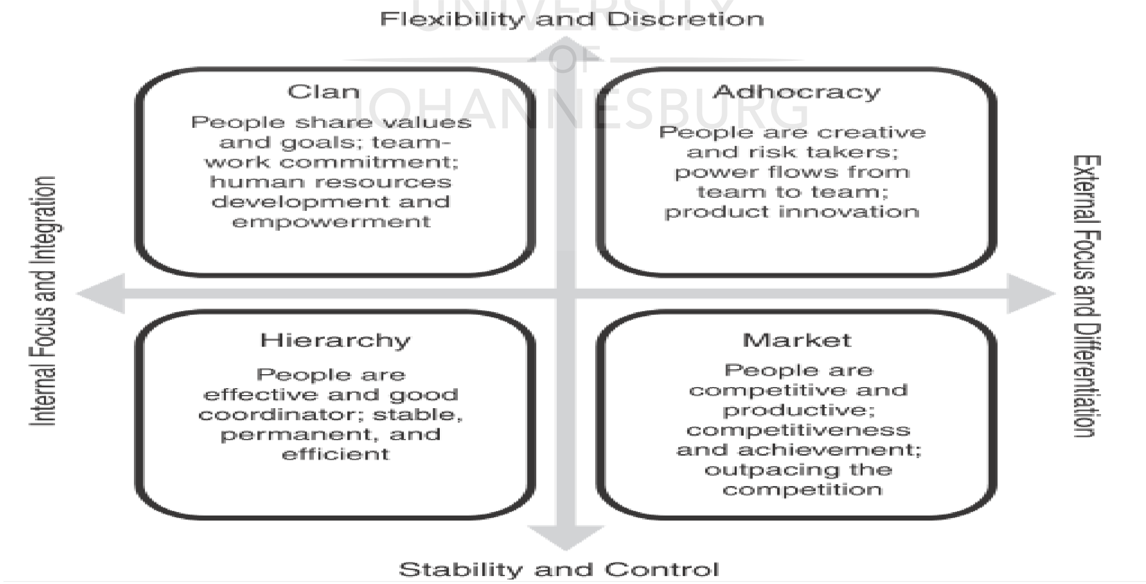

Figure 2. 14: The competing values framework

Source: Cameron & Quinn (2011)

Choi *et al*. (2010) explain that an organisation can possess either a predominantly internal or external focus and may either be wishing to achieve flexibility and discretion or stability and control. This combination of factors creates the four potential cultural categories, each representing a distinct set of cultural values (Willar *et al.*, 2016).

There are a number of well-recognised organisational culture models developed by American researchers, used for identifying and measuring organisational culture. One of these models is the Competing Values Framework (CVF), (Willar *et al*., 2016). The CVF consists of four major culture types (Clan, Adhocracy, Market, Hierarchy) that are theorised to compose cultural profiles within various kinds of organisational contexts (Choi *et al*., 2010; Willar *et al*., 2016). The values are illustrated in Table 2.5 below using six cultural dimensions: dominant characteristics, organisational leadership, management of employees, organisational "glue", strategic emphasis and criteria of success.

Table 2. 5: The nature and typology of organisational culture assessment instrument

Cultural dimensions	Culture types			
	Clan culture	Adhocracy culture	Market culture	Hierarchy culture
Dominant characteristics	A very personal place like a family	Entrepreneurial and risk taking	Competitive and achievement-oriented	Controlled and structured
Organisational leadership	Mentoring, facilitating and nurturing	Entrepreneurial, innovative or risk taking	No-nonsense, aggressive, results oriented	Coordinating, organising, efficiency oriented
Management of employees	Teamwork, consensus and participation	Individual risk taking, innovation, freedom and uniqueness	Competitiveness and achievement	Security, conformity, predictability
Organisation glue	Loyalty and mutual trust	Commitment to innovation and development	Emphasis on achievement and goal accomplishment	Formal rules and policies
Strategic	Human development,	Acquisition of resources and	Competitive	Permanence

emphases	high trust, openness	creating new challenges	actions and winning	and stability
Criteria of Success	Development of human resources, teamwork and concern for people	Having the most unique and newest products and services	Winning in the marketplace and outpacing the competition	Dependable, efficient, and low cost

Source: Choi *et al*., (2010); Willar *et al*., (2016)

2.7.2.3 Organisational culture frameworks/models in the construction industry

Schein (2004) proposed a three-level framework of organisational culture shown in figure 2.15 below. The three levels are artifacts. Artifacts are at the base level and include all the phenomena that one sees, hears and feels when one encounters a new group with an unfamiliar culture. Artifacts can be observed but it is not easy to apprehend the deeper assumptions. Nonetheless, these artifacts reflect the beliefs and values shared by members of an organisation. The innermost level of culture is the basic assumptions that members of an organisation subscribe to. It represents a level of concordance in the basic assumptions that are believed to be non-confrontable and non-debatable (Cheung *et al*., 2011). In this regard, Schein (2004) advocates that leadership and organisational culture are two sides of the same coin because very often these basic assumptions are those of the leader.

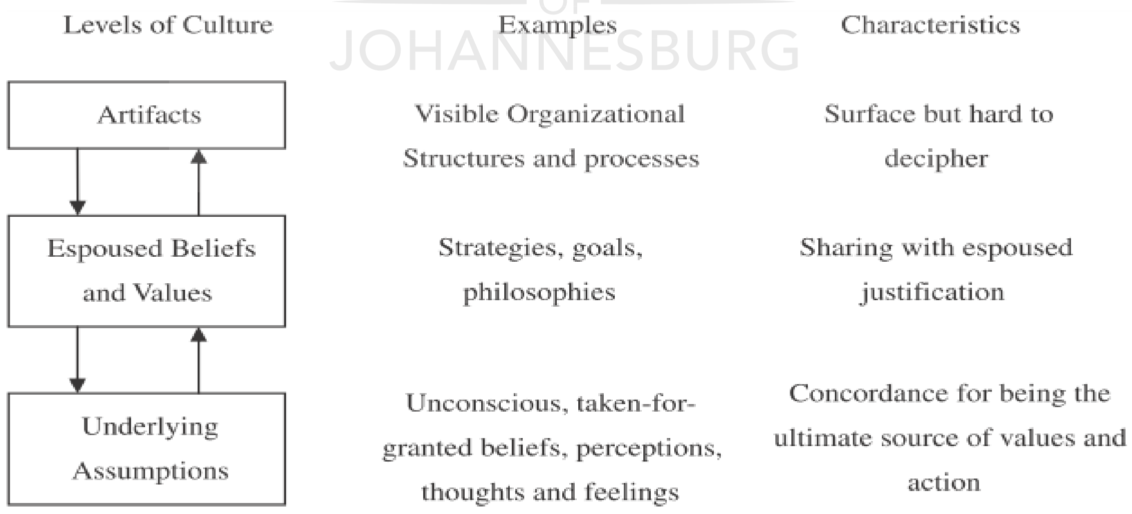

Figure 2. 15: Organisational culture framework

Source: Schein (2004)

Denison (2000) developed the Denison Organisational Culture Model to evaluate the culture of organisations. The model is based on four traits that have been shown to have a strong influence on organisational performance: (i) involvement, (ii) consistency, (iii) adaptability, and (iv) mission. Each trait is further measured by three indices. For the trait of involvement, empowerment, team orientation and capability development are the indices used (Cheung *et al.*, 2011). 'Empowerment' measures the authority, initiative, and ability that an individual uses in managing his own work. 'Team orientation' measures the degree of cooperation among employees in working toward common goals. 'Capability development' measures the degree to which the organisation continually invests in the development of employees' skills in order to be competitive and able to meet on-going business needs. For the trait of consistency, the three indices are core values, agreement, coordination and integration. 'Core values' measures a set of values that create a sense of identity that members share. 'Agreement' measures the extent to which members of the organisation are able to reach agreement on critical issues (Cheung *et al*., 2011). 'Coordination and integration' measure the extent to which different functions and units of the organisation are able to work together to achieve common goals. For the trait of adaptability, the three indices used are creating change, customer focus and organisational learning. 'Creating change' measures the degree to which the organisation creates adaptive ways to meet changing needs. 'Customer focus' reflects the degree to which the organisation is driven by the concern to satisfy their customers. 'Organisational learning' measures the degree to which the organisation encourages innovation, gaining knowledge and developing capabilities. For the trait of mission, the three indices are strategic direction and intent, goals and objectives and vision. 'Strategic direction and intent' measure the degree to which clear strategic intentions are conveyed to make it clear how everyone can contribute. 'Goals and objectives' measure the degree to which clear direction is provided for employees in their work (Cheung *et al*., 2011).

According to Hatch & Cunliffe (2006), organisational culture has four elements or domains: (1) organisational culture and identity, (2) organisational strategy, (3) organisational design, structure and processes and (4) organisational behaviour and performance. These are illustrated in Figure 2.16 below. Dauber *et al.* (2012) explain the model as one in which all the domains are connected to each other and no specific processes are identified.

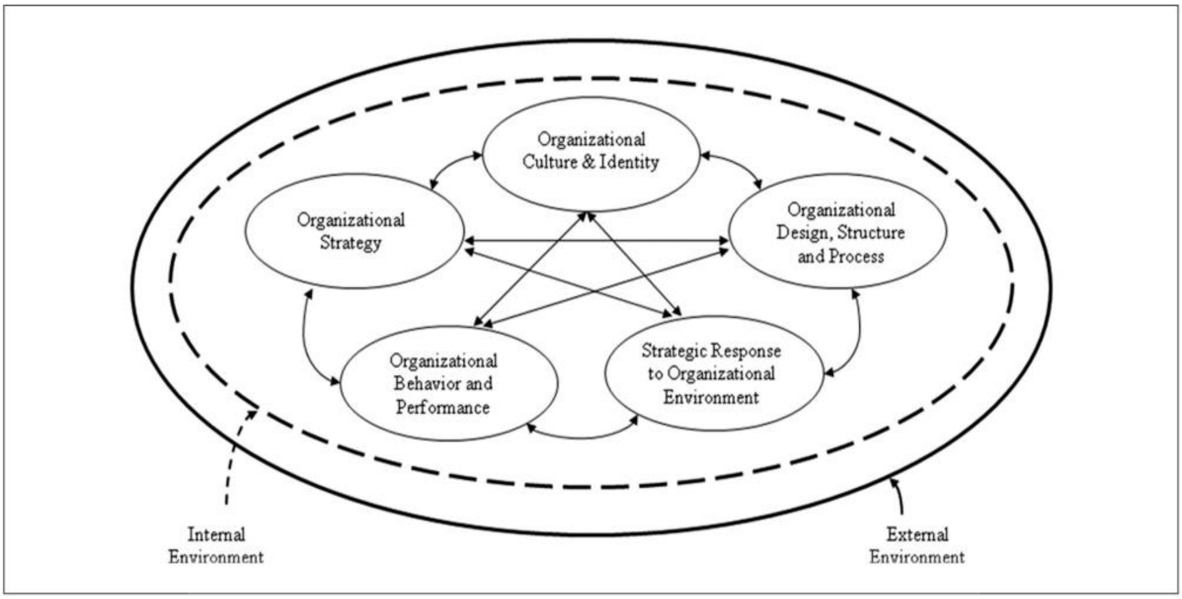

Figure 2. 16: Organizational culture model

Source: Hatch & Cunliffe (2006)

"Organisational strategy" provides rules, norms and regulations which are effected through organisational structures. Therefore, strategy belongs to an unobservable domain and can be allocated to "espoused values." "Organisational design, structure and process" as well as "organisational behaviour and performance" are those elements of an organisation that are visible to its members as well as to the external environment; that is, they represent artifacts. However, "processes" has been excluded because they define the relationships between domains (Dauber *et al*., 2012).

2.7.3 ICT KNOWLEDGE AND TOOLS

ICT plays an important role for the whole construction process including information generation, data transmission and interpretation of data for construction projects (Onyegiri *et al.,* 2011). ICT is not only about distribution of cost data but also involves communication and decision-making (Onyegiri *et al*., 2011). Some useful aspects of ICT include internet chat, emailing, information exchange, live video calls and networking through an electronic medium (Onyegiri *et al*., 2011; Chassiakos, 2007; Dainty *et al*., 2006).

Computers or laptops are used in construction firms for managing construction cost. Different hardware devices like printers, projectors for presentations to groups of people and scanners are illustrated in Figure 2.17 (Onyegiri *et al*., 2011).

Quantity surveyors work on cost control and require that ICT is used in all the stages such as cost estimation, budgeting control, cost planning, tendering, cost reporting, cost analysis, cost checking, account preparation, payment certificates and final accounts. Thus, contractors must create an ICT work environment and invest in ICT applications (Anyadike, 2001; Benjaoran, 2009).

Spreadsheet applications like Microsoft excel have been used for project cost data and presentations in daily cost activities. The cost presentations are presented in the form of S-graphs, charts and tables (Onyegiri *et al.,* 2011).

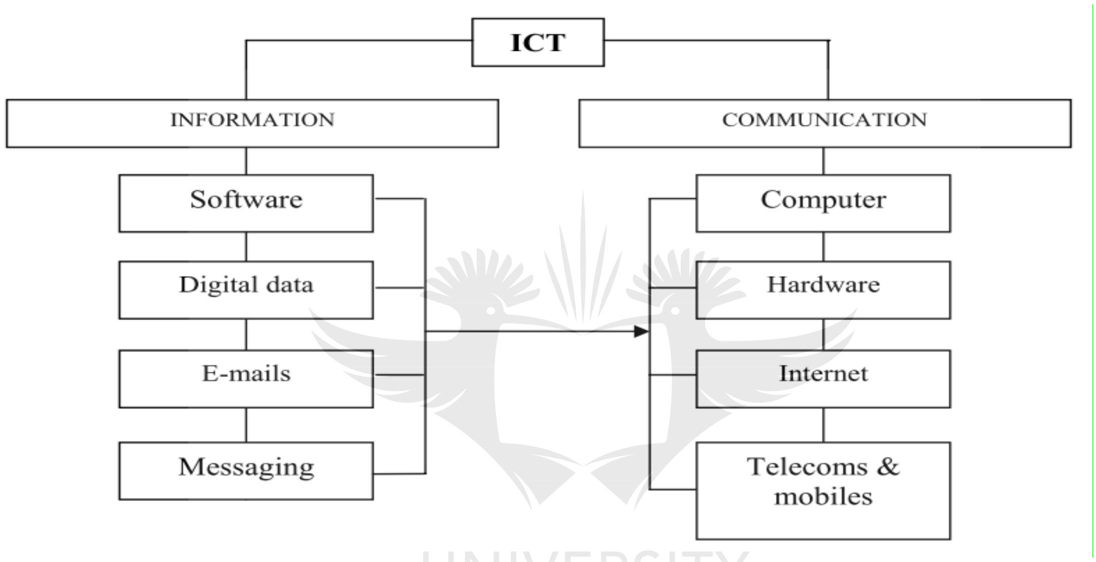

Figure 2. 17: ICT flow through an electronic medium

Source: Onyegiri *et al*., (2011)

2.7.3.1 Advantages of using ICT in cost control

The main advantage of ICT usage is to reduce the time period for data processes, information communication and to yield more results in productivity. It also improves the communication flow among construction project participants (Onyegiri *et al.,* 2011; Hosseini *et al.,* 2012).

ICT usage improves construction project cost performance during the execution of projects, in addition, leading to client satisfaction (Kerzner, 2009; Hosseini *et al*., 2012)

According to Kivrak *et al*. (2010) and Hosseini *et al*. (2012), ICT usage has a constructive impact on the project success criteria, including project cost.

The fast information generated using ICT leads to fast construction processes in decision-making, information management (data exchange, data storage, data retrieving, data analysis), ICT communication, information flow and cost control process (Prasanna & Ramanna, 2014).

2.7.3.2 SOFTWARE PACKAGES USED FOR PCC

The works by Olawale and Sun (2010) and (2015) identify eight different types of software for PCC practice as follows:

- Primavera Sure Trak,
- Microsoft Excel,
- Bespoke/in-house systems,
- Microsoft Project,
- Project Costing System (PCS),
- Asta Power Project,
- COINS.

2.8 CONCLUSION

This chapter presents the general cost control concepts and the organisational elements for cost control. The literature findings of the cost control concepts indicate that cost control practice is a continuous process, starting at the pre-construction stage through to the construction and post construction stages. Quantity surveyors' work to manage construction cost is not only at the construction site.

The findings of the cost control systems also show that some contractors do not undertake cost control practice at all, especially in situations of using overall profit and loss accounts. In these situations, it is clear that the control awaits the final completion stage to check the status of the project cost. When the status of the cost is not known, corrective actions cannot be made to solve any cost deviation. It only informs the contractor for the improvement of other similar future projects. Notwithstanding that fact, other cost control systems, such as profit and loss at each interim payment stage and unit costing are performed as and when work progresses. The challenges of cost control are numerous and it can be concluded that problems still exist in the practice of cost control in the construction industry. These require attention to minimise or overcome the challenges to fully enjoy the benefits of cost control practice.

The findings of the organisational elements of organisational structure, organisational culture and ICT tools and knowledge further indicate that cost control is not only the application of cost control concepts but also the manner things are conducted in the firm which affects the practice of cost control either negatively or positively. The application of organisational structure, culture and ICT tools and knowledge enables construction firms to be in a good position for cost control practice.

CHAPTER THREE

COST CONTROL THEORIES

3.0 INTRODUCTION

Theories applied in this research are discussed, followed by cost control concepts. The theories pave way for the selection and combination of various factors appropriate for the proposed model for study. The theories are further unveiled to clarify the theory behind the cost control practice and how the interacting elements within the various concepts in the theory work. Three main theories are discussed in this section.

3.1 THE CONCEPT OF A THEORY

Several definitions exist for theories in research. Most theory definitions imply description, maxim, model, postulation, prediction, proposition, system, theoretical model and typology (Dubin, 1978; Kinloch, 1977; Silva, 1977). Hamilton (1997) explains that there are numerous definitions of theory across all disciplines. These terms are used as synonyms for theory but have precise and often different meanings. It is thought that a theory is crucial to systematically shape and synthesise information. It also realises the relationships among variables and gives direction to the detection of innovative proofs to move research onward (Creswell, 2003; Touliatos & Compton,1988). Without theory-based research, a discipline chaotically moves in all directions with no purpose (Mitchell & Jolley, 1992). To advance in any field of study, it is unlikely that without the understanding of theory and conceptual frameworks, research can be undertaken. It is with the understanding of a theory that engineers and scientists can communicate their discoveries with groups of agreed-upon concepts without any struggle.

To inform the model constructs for the present study of an integrated model of the factors that enhance the practice of construction project cost control, previous theoretical frameworks have been considered and reviewed. Theory development takes place through deduction or induction. In the case of deduction, the researcher moves from general to specific, from theory to fact (Guy *et al.*, 1987). Both quantitative and qualitative research methods depend on theories. According to Creswell (2003), "…deductive theory is frequently used in quantitative studies''. A theoretical framework is where the researcher advances an existing theory, gathers data to assess it, and reflects on the confirmation or disconfirmation of the theory by the results.

3.2 CONSTITUENTS OF A THEORY

According to Dubin (1978) and Whetten (1989), there are four key elements that constitute a theory. Theories are expected to answer 'what', 'how', 'why' and 'who, where, when' and sometimes the need for the combination of more than one question such as 'what is and how can'. Details are explained below:

What: What are the factors, or in other words, variables, constructs, concepts in a particular sequence in a field of study? There are two criteria that judge its inclusion. These are 'right' factors: comprehensiveness (i.e., major factors) and parsimony (i.e., minor factors that add little additional value to the understanding (Dubin, 1978; Whetten, 1989).

How: The 'how' shows how the factors, or in other words variables, constructs, concepts in a particular field of study, relate to each other. In situations where the connection of the factors is difficult then, the 'what' and 'how' are used to address the theory; they are also used in complex set of relationships (Dubin, 1978; Whetten, 1989).

Why: In this instance, the answer lies in the logic basis of the model. It calls for accuracy of essential views of human nature, organisational requisites or societal procedures delivered for the basis of judging the sensibleness of the planned conceptualisation. In the theory-development process, logic serves as a basis for the evaluation. One good part of using 'why' questions in research is that they force researchers to think about the concrete applications of establishing new or revised intelligence, and also to increase the probability that subsequent research will constitute valid tests of the author's core arguments (Dubin, 1978; Whetten, 1989).

Who, where, when: These are used in studies to deal with time, backgrounds of people and events that have occurred. Their use in prediction or to show effects varies over time, either because other time-dependent variables are theoretically important or because the theoretical effect is unstable for some reason. Observations are embedded and must be understood within a context. Researchers generate theories that have a particular responsibility for discussing limits of generalisability (Dubin, 1978; Whetten, 1989).

Wacker (1998) further details theory-building, using the four key elements. 'Who' and 'what' used for definitions of variables; 'When' and 'where' for limiting the domain; 'Why' and 'how' for showing the relationship between building; and 'could the event occur', should the event occur' and 'would the even occur' for theory predictions and empirical support as illustrated in Table 3.1 below:

Table 3. 1: General procedure for theory-building and the empirical support for theory

	Purpose of this step	Common question	'Good' theory virtues emphasised
Definition of variables	Defines who and what are included and what is specifically excluded from the definitions	'Who' and 'what'	Uniqueness and conservation
Limiting the domain	Observes and limits the conditions by when (antecedent event) and where the subsequent events are to occur	'When' and 'where'	Generalisability
The relationship (model) building	Logically assembles the reasoning for each relationship for internal consistency.	'Why' and 'how'	Parsimony, fecundity, internal consistency, abstractness.
Theory predictions and empirical support	Gives specific predictions. Important for setting conditions where a theory predicts. Test model by criteria to give empirical verification for the theory. The riskiness of the test is an important consideration.	'could the event occur', should the event occur' and 'would the event occur'	Empirical test refutability

Source: Wacker, 1998

This study uses a combination of 'what are' and 'how can' to address the theory. This is because, it establishes 'what are' the factors or in other words variables, constructs, concepts, enhancing cost control practice. It then shows the relationship of the factors for cost control practice.

3.3 CONSTRUCTION COST CONTROL THEORIES

Three main existing cost control theories are discussed in this section: (1) Abubakar (1992) cost control theoretical model, (2) Charoenngam and Sriprasert (2001) cost control theoretical framework and (3) the theory of project management. The theories are detailed below:

3.3.1 ABUBAKAR (1992) COST CONTROL THEORETICAL MODEL

The cost control concept actually starts from the contractor's functional organisation. The concept then continues to cost systems, through to estimation, budgeting, cost monitoring, cost evaluation and reporting and corrective decisions and implementation.

3.3.1.1 Contractors' functional organisation

The contractor's functional organisation is the presence of the various functional departments that seek to implement the procedures and policies in the organisation to achieve the cost control objective. The functional organisational structure is elaborated in chapter 2. A typical functional organisation has the following key sections or departments: *Administration department* that seeks to ensure that the company's policies are well adhered to by the other sections of the organisation, such as finance, personnel, contracts, etc.

Human resource department that is responsible for managing employee performance from the recruitment to retirement.

Finance/account department is responsible for all the monetary aspects of the organisation.

Purchasing/procurement department is responsible for the acquisition of all the materials, equipment and services required in material management.

Engineering/contract department has the experts required for the smooth implementation of the construction projects of the organisation.

The organisational structure is necessary because it helps in the control of costs.

3.3.1.2 Cost systems

Cost control systems provide a system of complete information of the standard way of operation by the organisation. The cost systems deal with the control processes the organisation uses for its cost control practice. It is an approach where detailed information on cost control input is fed into a process and an outcome is shown by a performance report. It deals with the inputs, process and the output measurables showing as the performance. The management functions of cost control practice are estimation, planning, budgeting, controlling and directing. The cost control system is based on the head office operations in records and financial management and how information is handled by individual project managers during the execution of the construction project.

The overall organisational cost system that is developed, based on historic data, has or shows better approaches in practical terms for the controlling of cost at the construction site.

A typical cost system for an organisation is shown in Figure 3.1 below:

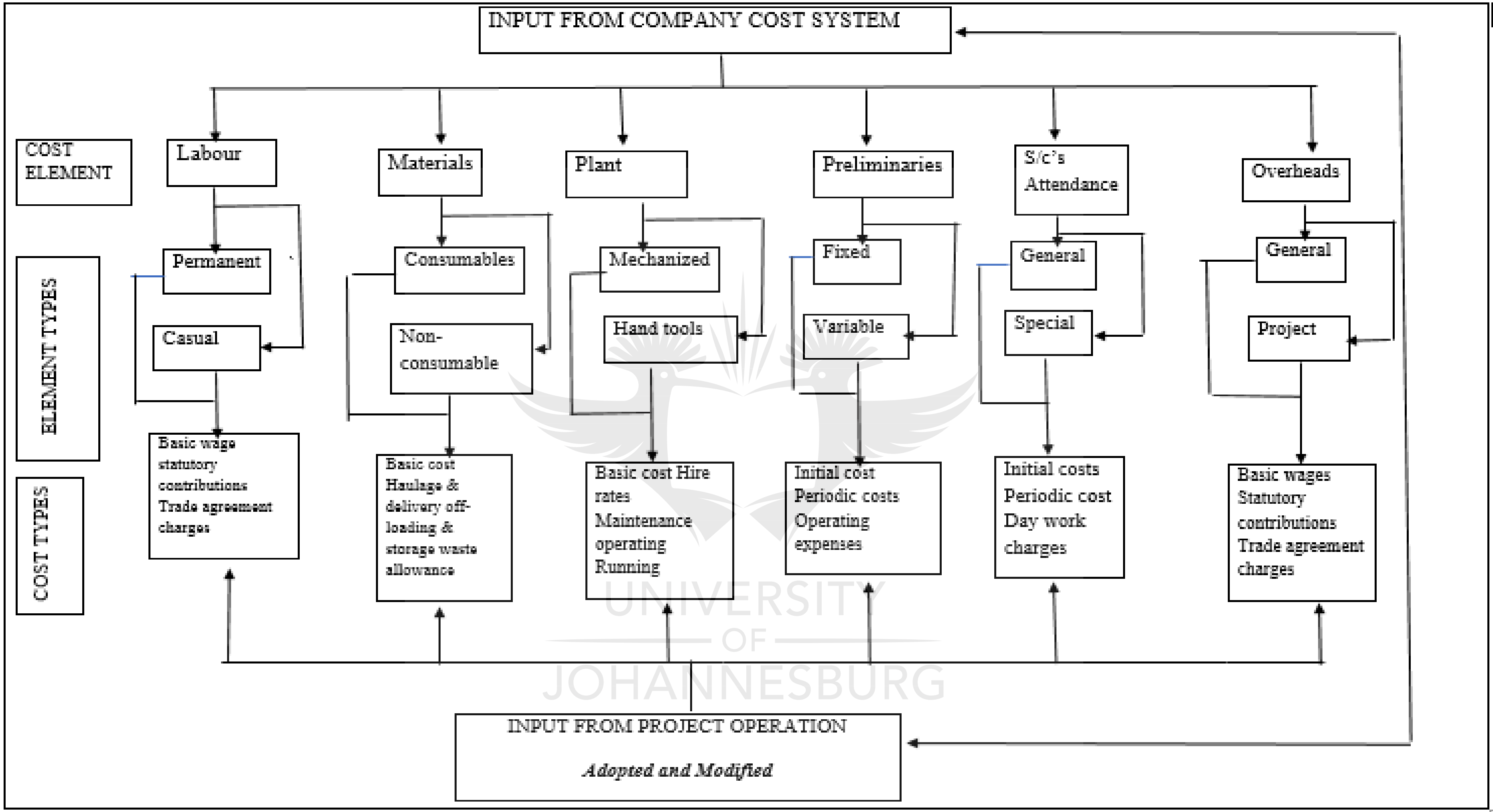

Figure 3. 1: Elements of cost control system

Source: Abubakar, (1992) adopted and modified

Table 3.2 below provides cost information required in various elements of the cost system. It is useful for estimation and performance measurement in the construction project cost.

Table 3. 2: Contents of cost information systems

S/No.	Elements	Records
1	Labour	Labour schedules, Productivity data, Training programmes, Conditions of employment, Disciplinary procedures, Trade Union agreements.
2	Materials	Materials schedules, Stock holding levels, Wastage allowances, Storage requirements, Inspection procedures, Delivery programmes.
3	Plant and equipment	Plant schedules, Productivity data, Site layout plans, Company's policy, Local requirements (noise, nuisance).
4	Subcontractor	Programme of work, Subcontract conditions, Attendance requirements, Payment procedures.
5	Cost	Bill rates, Unit cost estimates, Turnover budget, Cash flow forecast, Financial ratios.
6	Time	Programme of work and productivity data. Variation agreements, Client requirements
7	Quality	Specifications, Drawings, British standards, stamps, Building regulations, Manufacturer's data, Expectations of workmanship, etc.
8	Safety and security	Legislation on safety, Health and Welfare, Local Authorities requirements, Trade Union agreements, Company's policy, Established good practice.
9	Information	Information schedules, Programme of work, Contract and secretary requirements, Company policy on record keeping.
10	Methods	Method statements, Productivity data, Work study information, Previous experience.
11	Management	Contract requirements, Job descriptions, Management development programmes.

Source: Abubakar, (1992)

3.3.1.2.1 Project Cost Estimation

Estimating the cost of the project starts at the pre-tender stage and continues to the post-tender stage of the construction project. The quantity surveyor uses the project specifications and quantities to establish the cost of the project. The organisational management team members then meet to assess how much profit and overheads to add, to arrive at the tender figure. At the post-contract stage, the quantity surveyor, together with the contractor's top management team members, devise more economical resources and construction methods to be used in the execution of the project to achieve profitability.

The quantities for the various work sections are estimated from the first principles by using information on the prevailing labour or man hours, plant/equipment hours, materials quantities, and the subcontracting requirements in the project information. The estimates are priced and cost budgeting prepared by allocating prices to all the various cost centres of the project. At the construction site, the actual cost is prepared for the various activities such as labour, plant, materials, profit and overheads and subcontractor work and it is compared with the budgeted cost for corrective action to be taken on the cost deviation items.

3.3.1.2.2 Construction planning and scheduling

Construction planning and scheduling is an aspect of the construction project management function. The technique used in construction planning and scheduling includes cost control and monitoring at the construction project site.

The construction planning aspect looks at the sequential order and construction method of completing the project. This is indicated on the method statement without considering plans for contractors' profit and overheads. Having a good and detailed plan makes the monitoring and cost control process very effective. The steps needed to achieve a sound plan for cost control include:

1. Developing the budgeted cost from the various individual cost centres;
2. Preparing schedule plans for all the resources to be used in the project such as materials, labour, plant and equipment, subcontractors and utilities;
3. Establish the various work sections in bar chart or network analysis, indicating all the critical paths;
4. Establish the organisational structure for the project showing the key positions, channels of communication and authorities;
5. Developing the cash-flow forecast.

3.3.1.2.3 Construction Cost Budgeting

The cost budget concerns the various cost centres and shows the likely cost expenditure. The budget provides the basis for the cost monitoring and control at the post construction stage. The construction cost budget informs the contractor of the most economical and feasible costs to be used in the completion of the project. It allows for the permitted cost to be spent during construction in order for the contractor to achieve satisfactory profit cost. The budget serves as a means to control project cost. This is where the monitoring process becomes very easy by comparing actual cost with the budgeted cost and by showing areas of cost overrun. The budget helps top management in decision-making through the periodic financial progress report developed during the execution of the project. Lastly, the budget enables project managers to review the method statement to reflect the updated budget.

The following steps are the procedure for developing a budget for construction projects:

Determine the price from the plan

The estimator prices the contract plan by considering the quantities for the various work sections from the first principles by using information on the prevailing labour or man hours, plant/equipment hours, materials quantities and the subcontracting requirements in the project information. The anticipated cost must match the methods to be used in the construction shown on the method statement.

Checking Tender Allowance

The estimator, together with the project manager, must check all other financial allowances provided in the bills of quantities. These allowances include all provisional sums stated in the bills of quantities. The provisional sums are allowances made for works undefined when there are insufficient details for accurate pricing. It is usually better to compare all the allowances against the operational cost. A cost analysis must be carried out by the estimator and the project manager to reach a good price. The purpose is to avoid the tender figure exceeding the planned methods provided in the method statement.

Tender-Budget Reconciliation

In areas where the budget exceeds the provided tender allowance, necessary steps must be taken to reconcile the cost and to cross examine the method of construction provided in the method statement. Alterations should be made and an acceptable profit margin should be ensured for the successful completion of the project. The final figure must be agreed by the project manager.

Communicating the Budget

The project manager ensures that all the personnel who are to see to the implementation of the budget are aware of the various cost items so as to execute the project within the budgeted cost. It is the responsibility of the project manager to communicate the budget and to discuss it with his management team and other subordinates for their commitment to the cost centres of the budget.

3.3.1.2.4 Project cost reporting

Cost reporting is a means of recording cost performance data using computer-based or manual methods. In recording the cost data, inputs must be received from all the various functional departments of the organisation including administration, the production unit and finance offices. A template must be designed by the organisation to use in the project cost reporting. The template should indicate very detailed activities of the reportable items and all departments of the organisation must have access to it to aid the collection of the cost data and their assessment. An appropriate time period must be set for the cost data period. The predetermined time is necessary to enable the collection of detailed and necessary cost data with the least effort. The initial cost data of the resources (materials, labour, plant and equipment, subcontractor, profit and overheads and attendance cost) should show on the records to aid the analytical process.

3.3.1.2.5 Cost performance evaluation

Once the cost data is recorded, it is then processed to find out the status of the project cost. A profit and loss statement is the most common method used to determine the cost performance at a predetermined stage. The profit and loss statement of the project are prepared at a particular time. The profit and loss measures have their own shortcomings. Among these are the focus on profit accumulated at that period where the cost is analysed providing profit in the short term rather than the overall profit of the project. The cost performance is not linked to the method of construction.

Job costing is another method used for cost performance evaluation. It is also referred to as standard costing. This method shows actual cost performance better than that of profit and loss statements. Job costing shows cost data from weekly and monthly account payables and from pay-roll systems in the organisation. The payments are always in weekly and monthly cycles so that cost data can always be checked.

Performance ratios

This cost evaluation provides a more practical judgment of the cost data for effective corrective actions to be taken. The performance ratio is calculated using the formula below:

$$\text{Performance ratio} = \frac{\text{Actual performance}}{\text{Planned performance}}$$

$$\text{i.e. PR} = \frac{\text{AP}}{\text{PP}} \times 100\%$$

The above calculation is fast, precise and provides effective information when using cost codes. The acceptable cost performance is where the performance ratio result is less than or equal to one ($PR \leq 1$). If the $PR \leq 1$ then the cost performance is within the budgeted cost and no corrective measures are required. However, if the performance ratio result is greater than or equal to one ($PR \geq 1$) then the cost is outside the budgeted cost. This then calls for corrective action to be taken to solve the cost deviation. In addition, if the PR result is 96% it indicates that savings have been made on the cost of 4% of the planned cost at the date of measurement. The savings could come from using a different method of construction than the one in the method statement or the quality standard of work may have been reduced on high labour performance. The PR has a shortfall, not showing cost deviations for corrective measures to be taken.

Variance analysis

Variance analysis results from the performance ratio and enables the various resources used to be measured separately. The formula for use in the calculation of the variances:

V = (A - P) R

Where: V is the particular resource that is being measured

A is the actual amount for the resource

P is the planned amount to be used for the resource

R is planned rate/price for that resource.

The above formula is used to calculate the cost performance either daily or on a weekly basis for the various resources, namely labour rate, labour price, materials price, materials utilisation, materials yield, equipment efficiency, equipment rate overheads and total cost.

3.3.1.2.6 Corrective decision-making

The control measures in cost control can be used in situations where changes should be managed, taking into account the cost control system, the nature of the process or modifying the analytical model of the procedure to be controlled.

Some decisions for cost deviations for cost control include: changes in the resource mixes, adjusting the method statement plan or the budgeted cost, adjustment in the site organisation structure or project information, review of the activities of the project team members, cross checking changes in the market prices for materials, labour, plant and equipment, subcontractor, employing different procedures for site activities and management strategies and checking the conditions of the contract for clauses relating to claims.

The corrective actions are most effective where there is constant monitoring and updating of the cost data records, weekly meetings to check the progress of cost performance, cooperation of project team members and good communication from all the project team members. The top management team must ensure that cost control practice is a principle to be followed in the organisation.

The summary of the cost control model by Abubakar (1992) is presented in Figure 3.2 below:

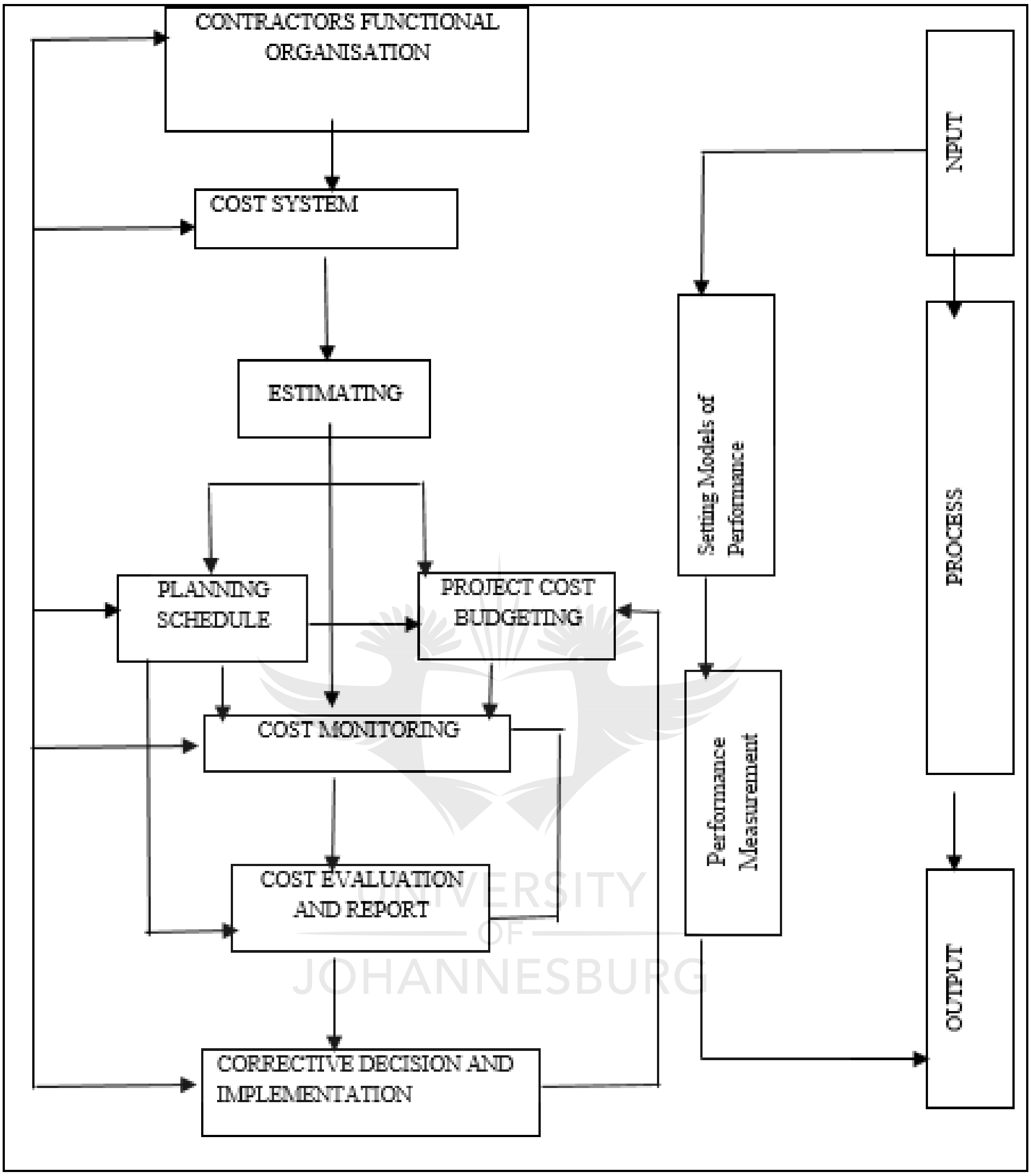

Figure 3. 2: Cost control model

Source: Abubakar, (1992)

The model above is further divided into two areas of cost control: cost modelling activities and monitoring and control activities. The sub-attributes of the cost system/estimation, planning schedule, budgeting, cost accounting and cost evaluation and corrective action is presented in Figure 3.3 below:

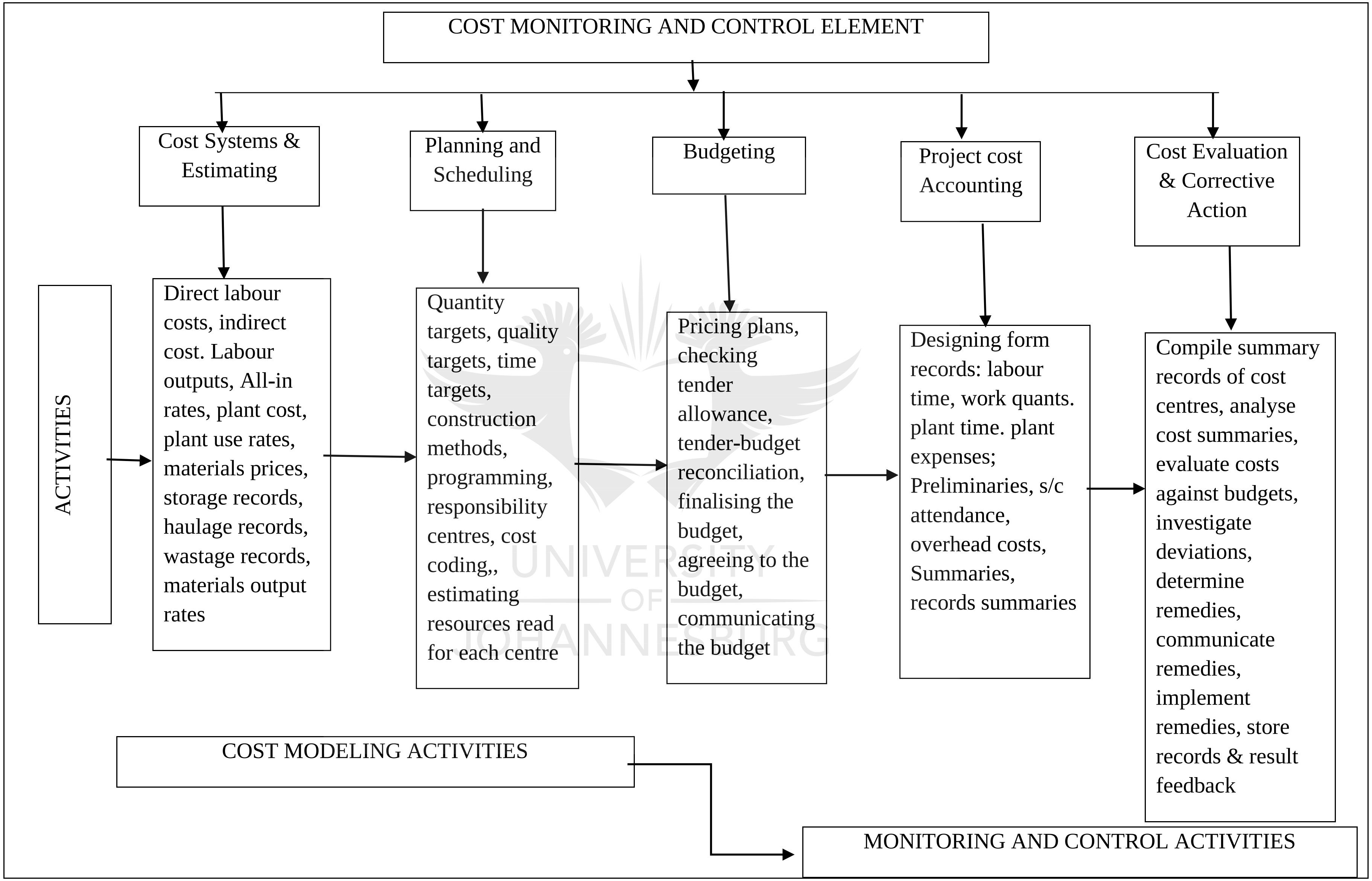

Figure 3. 3: Cost control elements and sub-attributes

3.3.2 CHAROENNGAM & SRIPRASERT (2001) COST CONTROL THEORETICAL FRAMEWORK

Cost control is a sort of information system that plans to furnish management with convenient and precise cost performance data so that opportune legitimate restorative moves can be made. The cost control system has three main areas: cost control framework, cost control functions and management information. These are shown in Figure 3.4 below:

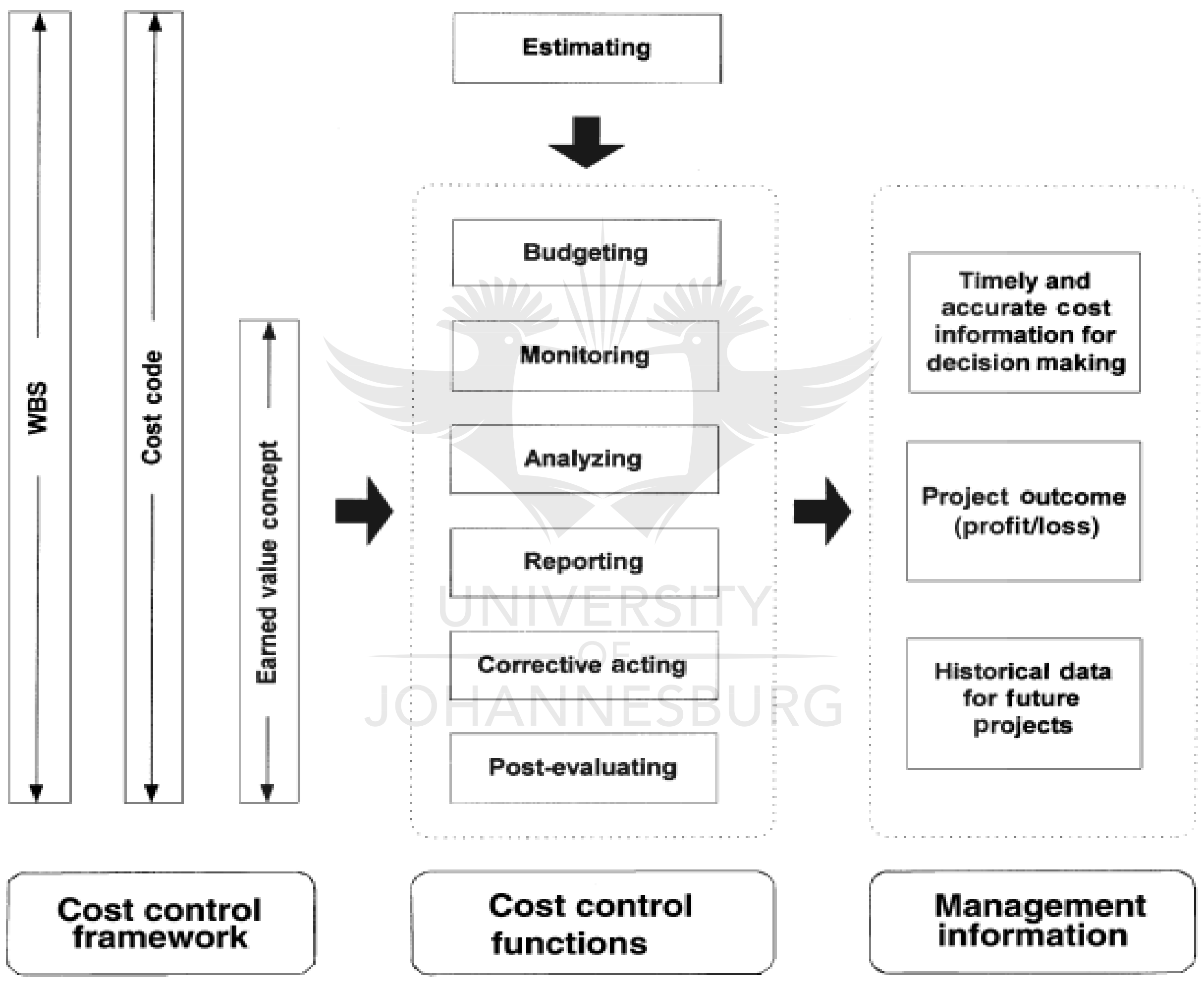

Figure 3. 4: Cost control system: an integrated view

Source: Charoenngam & Sriprasert (2001)

3.3.2.1 Cost control framework

The cost control framework has three different factors: work breakdown structures (WBS), cost code and earned value concept.

Work breakdown structure

The WBS is a structure showing all the activities of the project with their interconnections from start to finish. If the structure is developed well, it will help in cost monitoring, cost control, cost analysis and lastly, it will establish a historic cost data for future projects. The WBS has two different principles for its valuation. These are the systematic structure and the level of details of the WBS. The systematic structure has the main project cost elements from the budgeted and expenditure cost for top management to use for cost control. From the main budget, the cost elements are further broken down systematically until each work element can be controlled and reported on by other management teams of the organisational structure. Level of details of the WBS is the breakdown of the project into functional units for the different levels of management and the controlling of construction cost. For example, the executive manager will oversee the entire project which has detailed sub activities such as earthworks, foundations and superstructure. At this level, middle management team members are assigned to manage the various activities. These activities are further broken down into smaller units for field management teams to handle and control their cost.

Cost code

The quantity surveyors or the cost engineers assign cost identifications, presented in cost code form as the cost breakdown structure of the project. The cost codes must be stored for record keeping and for references to them at any time. All the members of the project team from top management to bottom level management team members must be given the cost codes or should have access to the systematic control of the costs. Numerical and alphabetical digits are used for the cost codes. Some numerical digits can be repeated. The degree of flexibility may be high, medium or low for cost codes with two or more digits, one in the same level & two digits in some level and each level has one digit respectively.

Examples of cost codes are: Example 1

M230 for Material cost of formwork. **M** – Material cost, **2** – Structural work, **3** – Formwork as a resource, **0** – Formwork as a sub resource

Example 2

S2043 for Subcontract labour cost of formwork for beams. **S** – Structural work that is the major work. **20** – Subcontract cost. The labour cost will be a subcontract type. **4** – Formwork **3** – Beam element. The beam task to perform.

Earned value concept

Earned value is a performance measurement used to show the status of the project cost. The formula for the earned value is: [Earned value = Budget unit price x Actual quantity in place]. At a predetermined stage of the project, the earned value is known before the project is completed. Actual site measurement must be done to know the actual quantities of work done. The differences are reported with regard to the actual expenditure and the budgeted cost. Calculations are done on the earned value and the status of the project cost.

3.3.2.2 Cost control functions and management information

The cost control process involves estimation, budgeting, monitoring and analysing, reporting, corrective actions and post project evaluation. This process has three divisions of the project phases, bidding, construction and termination of project. This is illustrated in Figure 3.5 below:

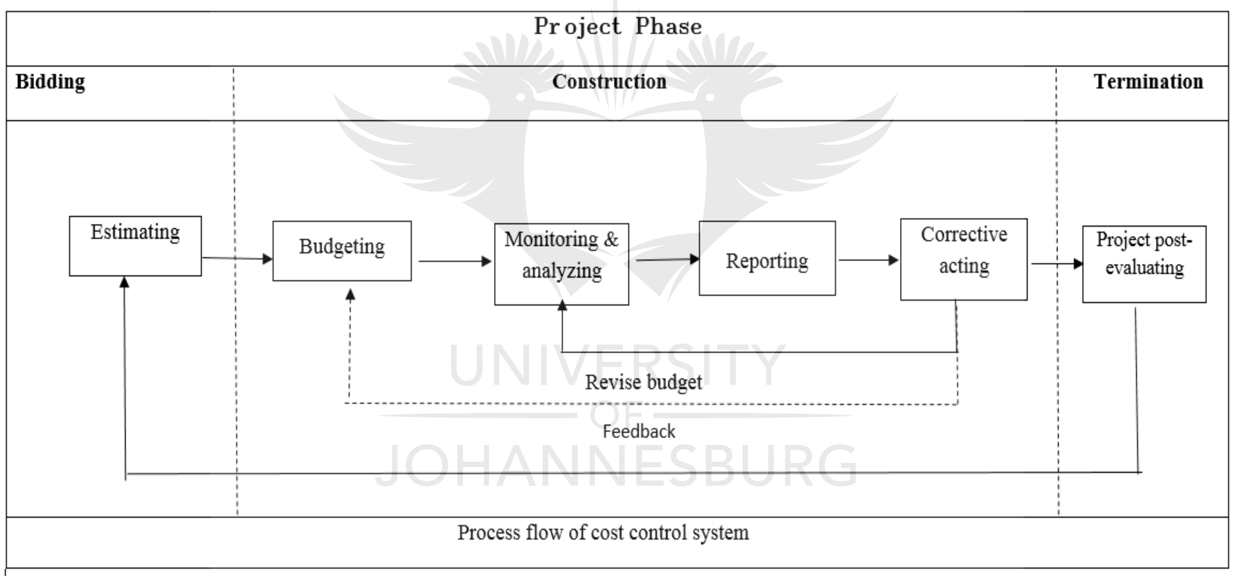

Figure 3. 5: Cost control process

Source: Charoenngam & Sriprasert (2001)

The construction phase of the cost control process, which includes budgeting, monitoring, analysing, reporting and corrective action, is further broken down into sub attributes as illustrated in Figure 3.6 below:

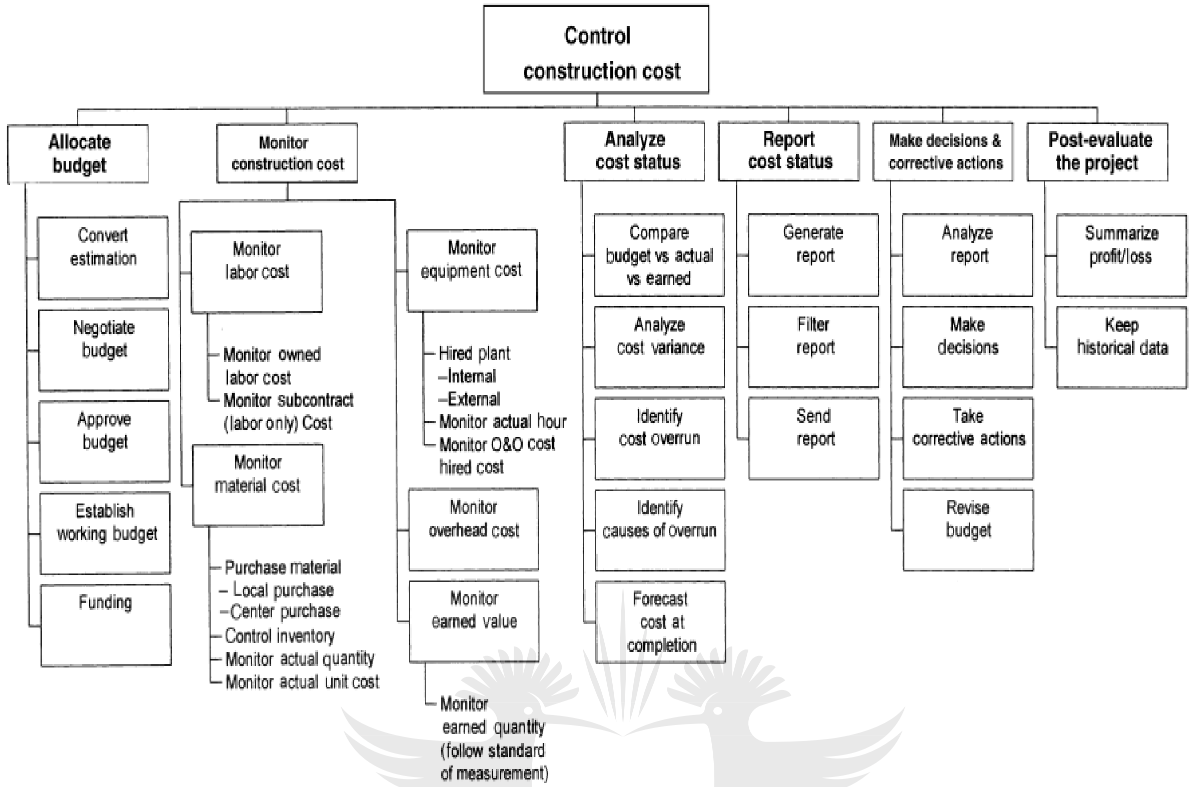

Figure 3. 6: Cost control function breakdown

Source: Charoenngam & Sriprasert (2001)

Budgeting

Budgeting is the allocation of all the resources, thus money, labour, plant and equipment, and materials to the various cost areas so that they can be compared with actual site resources used. It is designed by the quantity surveyor for the project manager at the head office to finalise the decisions on the budget. The site project manager must be part of the decision-making for the various cost allocations in order to achieve a realistic budget and to assist in controlling cost at site level. There is, therefore, a need for the site cost manager to report, monitor and analyse the cost status for corrective measures to be taken on either a daily or weekly basis by the management team.

Monitoring

The resource time and distribution cards with the cost codes assist in the monitoring of the construction cost. The actual expenditure at the site should be monitored at a predetermined progress point to know the cost status. At the progress point with large cost data, there should be a standard process to ease the cost data collection. Cost data are monitored daily from different sources.

Analysing

The essence of cost analysis is to make meaning of the cost data collected. The basic methods used are variances and trend analysis. The earned value principle enables the variance and trend analysis to be performed as and when an activity is completed, to discover the cost status for corrective measures to be taken. Some causes of the variances include errors arising from the estimation, variations, price fluctuation and extreme wastage of materials. These should be identified to facilitate the decision-making process.

Reporting

Organisations must devise current means of capturing information such as ICT tools and software to generate different reports. All levels of management must have the updated cost data of all the cost centres of the project cost performance. The management team members use the updated cost performance to solve cost variances that require attention.

Corrective measures

The key objective of the cost control system is the corrective action to be taken. After the analysis, decisions are made by top management and they are communicated to the subordinates to solve the deviations from the budgeted cost. There should be continual budget revision to maintain a realistic cost plan.

Post-evaluation of project

Post-evaluation is the final assessment of the project cost data, showing either profit or loss. The contractor gathers all the cash flow, budgeted cost and lessons learnt from all the actions taken. This helps the organisation to be more competitive in bidding and undertaking future similar construction projects. The cost information is kept as historical cost data for the organisation and should be stored in a proper place for future reference.

3.4 THEORY OF PROJECT MANAGEMENT

Project management theory is the main underlying theory of this study. Project management is the utility of knowledge, competencies, tools and strategies to task activities to fulfil the prerequisites of the project undertaken (Bortolussi, 2016; PMI, 2013).

The basis of project management is further explicated by the Project Management Body of Knowledge (PMBOK). According to Howell and Koskela (2002a), the concept of project management is viewed in two different theories: the theory of project and the theory of management.

3.4.1 Theory of project

The PMBOK guide shows that projects are activities and tasks to be performed that serve as a unit of analysis. The project management institute (PMI) classifies projects in two main areas, temporal and uniqueness. Every construction project is temporal due to the fact that it requires a specific commencement and finish period with a defined range of activities and construction resources (Bortolussi, 2016; PMI, 2013). Every construction project is unique on the grounds that exercises and activities used to achieve each project are explicit and not ordinary (Bortolussi, 2016; PMI, 2013).

According to Koskela and Howell, (2002a), a project can also be viewed as transformational in its activities. In a transformation of activities, a task is conceptualised as a change of inputs to outcomes. There are various standards and methods for which projects are overseen. These standards recommend, for instance, breaking down all the output changes progressively into littler changes and assignments and limiting the expense of each activity autonomously.

3.4.2 Theory of management

Project management processes are initiating, planning, execution, monitoring and controlling, and closing, according to the PMBOK guide. The primary process is centralised on planning, executing and controlling, as illustrated in Figure 3.7 below. The planning process provides a baseline to be followed during the execution stage. Deviations from the plan or changes have to be corrected or controlled. This leads to the development of a new plan to be followed (Koskela & Howell, 2002b).

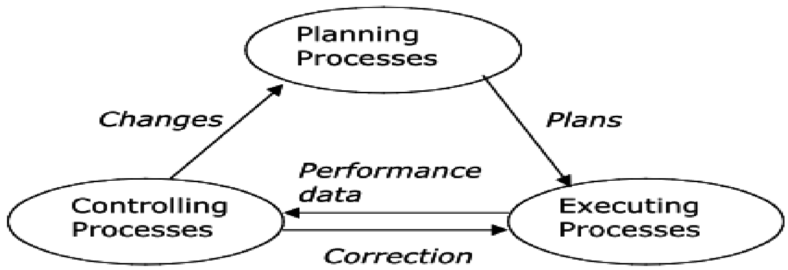

Figure 3. 7: Closed loop of project management process

Source: PMI, (2013)

Planning: the plan eventually becomes the roadmap for the execution of the project (Bortolussi, 2016; PMI, 2013). The work of Koskela and Howell, (2002a) shows planning as part management work. It is the plan that is translated into action or that is put into process when orders are given by management in organisations. The plan is implemented to render organisational outcomes (Lousberg, 2006; Koskela & Howell, 2002a; Koskela & Howell, 2002b). Maintaining an updated plan is very important in management practice (Lousberg, 2006). Some areas that require project planning include scope planning, work breakdown structure, project cost estimation, project cost budgeting, resource planning, risk management planning and performance measures (Bortolussi, 2016; PMI, 2013). The plans become an input for the execution process.

Cost control practice is also seen to use the theory of planning in project management. The cost control practice involves project cost estimation and project cost budgeting, prepared as cost plans. The estimates or budget become the baseline for checking the project cost during construction.

Executing: the executing stage is when the actual work commences. The site manager and other members of his team plan systematic activities or tasks for the week and other days when the plan is put into actions (Koskela & Howell, 2002a). Resources are allocated to projects and coordinated with a view to achieving the project objectives from the plan (Bortolussi, 2016; PMI, 2013). Some areas of execution include quality assurance, human resources development, project performance reports, and status report (Bortolussi, 2016; PMI, 2013). The executing process ensures that the work is done in the right way and the right period with the right resources (PMI, 2013). The executing process has two main elements: decisions and communication. The tasks which are ready for execution are decided on and communicated to the people involved to commence the work, either by written or oral communication (Koskela & Howell, 2002b).

Controlling: the control stage focuses on the activities of monitoring and checking the work performance and progress to make sure that the project objectives or plan are achieved (Bortolussi, 2016; PMI, 2013). Some areas of the controlling process include managing changes to meet project requirements, performance measurement for cost and time to identify deviations from the plan and scope verification and control. The object of the control process is to measure and check the variations from the project management plan and to use corrective actions to resolve the variances (Bortolussi, 2016; PMI, 2013). The causes of the deviations from the plan must be identified for improvements to be made to the task executed (Lousberg, 2006; Koskela & Howell, 2002a). The PMBOK refers to control as performance reporting, while Koskela and Howell (2002a) refer to it as the thermostat model. The thermostat model includes the standard of performance, performance measurement, variances identified and feedback control. The controlling process has two main elements, performance reporting and managing the identified changes (Koskela & Howell, 2002b; Adjei *et al.*, 2016).

Cost control practice follows the theory of management, using the same elements in the controlling process. Cost control practice includes project cost monitoring elements where the project cost is monitored. The project cost at site is measured and checked. The cost monitoring process includes the monitoring of all the resources used, such as material, labour, plant and equipment, as well as the performance reports. There is also the activity of cost analysis. The cost analysis element involves calculations conducted on the status of the cost and identifying cost changing factors or checking cost variations for corrective actions to be taken to correct the deviations. Cost control uses different performance reporting formats, as discussed in this thesis. Decisions are taken about what corrective measures should be undertaken to bring the deviations back to the plan or to maintain the cost within the approved budgeted cost. The theory of control of project management is in line with the concepts of cost control practice.

3.5 CONCLUSION

The literature reviewed on cost control theories indicates that the research of Abubakar (1992) and Charoenngam and Sriprasert (2001) are the major works which provide an all-inclusive conceptual model of the cost control practice for the construction industry.

Their findings further reveal the primary factors of cost control practice as: project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis, decision-making and post evaluation. There exist inter-connections between the factors presented in this chapter. Aside the above major works on cost control theories, Olawale & Sun (2015) work also drawn and used similar constructs which are project cost monitoring, project cost reporting and project cost analysis.

The underlying theory of the cost control theory is the project management theory. PCC falls under the theory of management which includes planning, execution and control. The theory of control covers performance reporting and managing the changes which serve as the basis for this study. Although all the previous trends of cost control are useful, there exist limitations in the use of the concepts. Therefore, the next chapter discloses the gaps in the existing theories, which must be addressed using the existing theories as a strong theoretical foundation.

CHAPTER FOUR

GAPS IN COST CONTROL PRACTICE

4.0 INTRODUCTION

This chapter presents the gaps revealed in the literature related to cost control practice, which have not been examined as primary factors (constructs) by the prevailing cost control frameworks, models and procedures. The primary factors and related factors (variables) presented relate to the current structures which have been created from studies of western advanced nations. This investigation distinguishes the gaps as research inquiries to be tended to since they have not been completely addressed or analysed by past researchers of the cost control practice.

4.1 THE RESEARCH GAPS IDENTIFIED

The revealed gaps were extracted from a review of literature on cost control. The study found the main, as well as related, factors as gaps that need to be filled. Filling the gaps will contribute to the body of knowledge of cost control practice. The primary factors of cost control revealed to be gaps are change management and project cost communication. The related factors of cost monitoring (primary factor) for the gaps and are further developed and presented in this study. The study further presents cost control factors and practices of both developed and developing countries.

4.2 GAPS IN COST CONTROL CONCEPTUAL FRAMEWORK

This chapter explores prevailing cost control theories that frame the foundation for cost control practice reflections. Despite the fact that this investigation is in agreement with cost control practices revealed in the literature, the materials used basically covered western advanced nations such as the Thailand and UK presented by Charoenngam and Sriprasert (2001) and Abubakar (1992).

The concept of cost control practice goes back to the past decade and seems not to have shown any improvement over the years. Nevertheless, the concepts are relevant for the present construction industry, as agreed by Olawale & Sun, (2015) who presented some deficiency of the cost control principles to be considered in future studies. Despite the existence of the cost control theories, Adbul Azis *et al*. (2013) and Sriprasert (2000) relate cost overruns in construction projects to factors including inefficient conventional cost control systems.

Ghana's construction industry plays a key role in the country's economy. Therefore, substantial funds are devoted to construction projects which require successful project cost delivery by contractors. Project cost management and delivery of construction projects in developing countries, of which Ghana is no exception, may have similar or different primary factors (constructs) because of differences in operations. This study considers cost control as a project management soft skill (PMI, 2008). The significance of the outcomes and cost control applications is not constant in developing nations, Ghana, for example, has its personal uniqueness for cost control practice (Aigbavboa, 2013). However, this investigation reveals the gaps in the prevailing frameworks as the innovative primary components of the current examination.

The primary factors of cost control are project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis and decision-making. The primary factors of cost control need to be adopted are change management and project cost communication. Notwithstanding, the related factors (variables) have their personal uniqueness in developing countries, of which Ghana is no exception. The advancement of the cost control system for Ghana will consider the identified gaps and their variables.

.4.3 GAP 1: APPROACH FOR CONDUCTING PROJECT COST MONITORING PROCESS

The approach to conducting a cost monitoring process is not robust. It is mainly conducted by gathering information for presentation in the cost report format. The cost monitoring concept of Charoenngam and Sriprasert (2001) includes cost monitoring of all the resources used in the project. For example, materials, labour, plant/equipment, sub-contractors' work and profit and overheads. Olawale & Sun's (2015) studies include a recommendation for upcoming studies of the cost monitoring approach to have a clear and well-developed typical approach for monitoring project costs. The robust approach should provide guidance to deal with project cost monitoring challenges. Charoenngam and Sriprasert (2001) further buttress the fact that as the cost data becomes too big for collection, a clearer and better-developed typical approach is required for monitoring the project costs.

The following are twelve (12) steps proposed for the cost monitoring process:

(1) *Planning milestone monitoring process*: construction projects with good cost plans achieve good cost performance (Tom & Sachin, 2013). According to Olawale & Sun (2015), the monitoring process must be planned with key milestones for conducting the monitoring process either weekly, monthly or at any predetermined period.

(2) *Selection of appropriate techniques for cost monitoring*: selecting the appropriate cost monitoring technique suitable for the cost manager or firm is essential for the cost monitoring process. Several cost monitoring techniques are available for cost monitoring. Notably, PERT, earned value analysis, cost variances, cost performance index (Raut & Pimplikar, 2014; Aliverdi *et al*., 2013; Pajares & López-Paredes, 2011).

(3) *Selecting appropriate tools for tracking project cost*: project cost monitoring is not only the understanding of its content, having the right skills and techniques but it also requires the use of the appropriate tools (Tom & Sachin, 2013). Control charts and software applications are the basic tools for cost monitoring (Tom & Sachin, 2013; Ahuja & Thiruvengadam, 2004).

(4*) Monitoring cost data (material, labour, plant, overheads, subcontractor cost)*: Charoenngam and Sriprasert (2001) provide a detailed list of monitoring of cost data: monitor labour cost for both owned and labour-only works, monitor material cost from purchasing, control inventory of materials, monitoring of the right quantity of materials used, monitoring the right unit rate cost of materials, monitoring equipment in terms of those hired, monitoring the right hours used by plants/equipment, monitoring of overhead cost of hired or owned plant cost and monitoring of earned value in terms of quantities measured from the cost performance.

(5) *Cost data verification*: cost monitoring is not only the collection of information for further tasks but also the verifying of the cost payment invoices or vouchers corresponding to the budgeted cost. All cost payments made to the various divisions within the organisation fall within the project budgeted cost (Charoenngam & Sriprasert, 2001). The purpose of cost verification is to ensure that there is accuracy in cost documentation, cost calculations and that actual costs reflect work progress (Cunningham, 2017; Charoenngam & Sriprasert, 2001).

(6) *Monitoring cost performance*: the cost performance is monitored to check the planned cost estimates or spending against project time. The traditional or widely known practice is the graphical representation of the 'S' graph to show progress of cost against time, to identify cost deviations for future forecasting. At the construction stage, the cost manager or quantity surveyor is expected to follow each work activity to check the specifications used, advise and where necessary, point out the cost implications. Monitoring cost performance is about cost progress and technical performance (Aliverdi *et al.*, 2013; Khamidi *et al*., 2011; European Commission, 2005)

(7) *Monitoring updated cost records*: the cost data used for cost control must be monitored or checked to ensure that it is always up to date. Cost monitoring should not only collect cost data from other divisions of the organisation but the quantity surveyor should monitor to see that the cost records are intact. This enables comparison with the cost plan, decisions to be made on the cost deviations and it serves as historic cost data (Tom & Sachin, 2013; Ahuja & Thiruvengadam, 2004).

(8) *Monitoring reported cost information*: according to Ogunlana & Butt (2000), quantity surveyors establish the project cost status by gathering the relevant cost information for the top management team to make corrective measures to solve the cost variations. The feedback information should also be recorded and monitored to ensure that there is clear communication between the top management team and those of lower rank, relating to cost control issues. A feedback structure is important in an organisation for successful project cost delivery.

(9) *Detecting early warning signs*: the focus of cost control and monitoring is to give signals of cost divergence at an early stage to the top management team so that they can take necessary steps for successful project cost delivery. All identified warnings must be monitored to prevent the situation occurring and re-occurring, despite all corrective measures taken (Aliverdi *et al*., 2013; Khamidi *et al*., 2011; Charoenngam & Sriprasert, 2001).

(10) *Identifying cost changing factors*: the cost monitoring process is also to identify all the factors affecting the project cost. Monitoring project cost simply to know the pattern or status of the cost, to show that cost is deviating from the planned cost, is not enough for effective decision-making to take place to solve the variances. The quantity surveyor or cost engineer should, as much as possible, provide specific areas of cost divergence and its associated factor(s) causing the changes within the construction project cost. Many factors affect the construction

project cost, such as direct cost, indirect cost and internal and external factors. Subsequently, the cost monitoring should also seek to identify the cost changing factors for effective cost control practice. The continuous monitoring helps avoid the occurrence and re-occurrence of the cost changing factors (Byung-Cheol & Reinschmidt, 2011; Khamidi *et al.*, 2011; Al-jibouri, 2003).

(11) *Provision of manuals for site monitoring team to refer to*: according to Olawale & Sun, (2015) there should be cost control manuals provided at the construction site during the execution of the project, to guide the cost monitoring process. Any worker or manager to should be able to refer to it when the need arises. This guards against challenges of construction project cost as well as ensuring a clear flow procedure.

(12) *Training site personnel in monitoring process*: Olawale & Sun (2015) further advocate that there should be training for all site personnel dealing with cost monitoring to understand and provide all relevant information and support the concept of cost control by the organisation. The site personnel should be trained in a step-by-step approach for the practice of cost monitoring and control by the firm. This should be supplemented by a manual.

Cost monitoring is clearly elaborated in the literature review in chapter two of this thesis.

4.4 GAP 2: MANAGING CHANGES IN COST CONTROL

PCC is a procedure involving observing, assessing and contrasting the arranged outcome with real outcome to decide the status of the construction cost, duration and specialised execution targets (Cleland & Ireland, 2002). It is vital for contractors to operate an effective cost control procedure during the post contract stage of projects to keep the cost of the scheme within the building budget (Sanni & Hashim, 2013).

According to Al-Jibouri (2003), during the construction stage, divergences from the initial plan of cost will occur. Notwithstanding that fact, construction projects should have a control cycle as follows, with the aim of completing the project within an acceptable time frame and budget: (1) Make a plan, (2) implement the plan, (3) monitor the actual output and record it, (4) report the actual parameters, the planned parameters and their variations and (5) take corrective action on the variation.

Existing frameworks on cost control have six main functions for cost control: budgeting, monitoring, analysing, reporting, corrective action and post-evaluating (Charoenngam &

Sriprasert, 2001). The concept of cost control is well managed by taking good decisions which act as corrective measures in order to bring the cost on track.

Researchers like Adjei *et al*, (2017), Khamidi *et al*. (2011), Al-Jibouri (2003) and Dikko (2002) have wholly endorsed the fact that there is the likelihood of cost variances, thus changes need to occur within the original budgeted cost. Notwithstanding, these changes can be managed using the change management concept. Hafez *et al*. (2015) buttressed the fact that a project cost control system should consist of project cost estimation, project cost monitoring, project cost reporting, project cost forecasting, as well as a change management process which encompasses assessing the impact of change, reporting on the change decisions and implementing the change into the scope of the work. Zou and Lee, (2008) further support the fact that construction projects with change management principles achieve better in cost performance than those lacking its application. In addition, they show that change management is one of the best and most important practices in project management. However, this is infrequently seen in construction project cost control. There is therefore the need for the change management concept to be incorporated into construction project cost control.

4.4.1 Definition of change management

Change management is a structured and strategic approach to initiate and manage the change process in an organisation's structure and culture, as well as in individual/team behaviour and attitude towards change transition in the field of business processes, technology implementation or any other policy of an enterprise. Change management is about modifying or transforming organisations in order to maintain or improve their effectiveness (Hayes, 2007; Adjei *et al.*, 2018b).

Lazarus and Clifton (2001) and Erdogan *et al*. (2005) observe change in a construction project in six different directions, namely: 1) The scope of the project, 2) the capital cost, whole-life cost or value of the project, 3) the time required to design or construct the project, 4) The project team relationships and appointments, 5) Project-associated risk allocation or scope and 6) the form of procurement.

4.4.2 change management process: theories and frameworks

According to Motawa *et al*. (2007) and Owusu (2015), change management systems have five principles: 1) promote a balanced change culture, 2) recognise changes, 3) evaluate change, 4) implement change and 5) continuously improve from experience. Jaworski and Scharmer (2000) also identify the core practices for successful change processes as: 1) observing: seeing reality with new eyes, 2) sensing: turning the observed reality into emerging patterns that inform future possibilities, 3) envisioning: crystallising vision and intent and 4) executing: acting in an instant to capitalise on new opportunities.

For the change management process to be effective, the project management team must identify the changes in the project and future possible changes (Gharaee Moghaddam, 2012). Change should then be reviewed and responsibilities assigned to members for the tasks to be carried out. The change should be communicated to other members of the organisation, in other words, the various disciples who are going to see to the change process (Gharaee Moghaddam, 2012). Matkó *et al.* (2015) also add that, for successful change management, the top management team support is critical. The team should be assigned the task and given all the powers for the change process. The team then outlines the visions and strategies for the change and implements it in the organisation (Matkó *et al.*, 2015; Adjei *et al*., 2018b). Additional change management processes from four different authors are presented and summarised in Table 1 below:

Table 4. 1: Summary of change management process

Jacobsen, 2013	Kotter, 2012	Motawa *et al.*, 2007	Jaworski & Scharmer, 2000
(1) Diagnosis: realising that there is a need for change (2) Solution: realising what needs to be accomplished and create a plan (3) Implementation: performing the plan (4) Evaluation: evaluate whether the change has been successful	(1) Create a sense of urgency (2) Create coalition (the size of team to power change) (3) Formulate a compelling vision (4) Expand the vision more widely (5) Allow employees to achieve vision (6) Design and build a short-term success plan (7) Consolidate the results, planning future changes (8) Institutionalising new approaches	(1) Anticipate change; (2) Recognise changes; (3) Evaluate change; (4) Resolve change; and (5) Learn from change.	(1) Observing: seeing reality with new eyes. (2) Sensing: turning the observed reality into emerging patterns that inform future possibilities. (3) Envisioning: crystallising vision and intent. (4) Executing: acting in an instant to capitalise on new opportunities.

Source: Literature review

4.4.3 Leadership in change management

A leader in change management t is the one who is solely responsible for making the change process as smooth as possible (Rosén, 2014).

Leadership styles

Managers practising change management have several options as to which leadership style to adopt: charismatic, operational, Theory E, Theory O, combination of Theories E & O or transformational leadership (Rosén, 2014; Dessler *et al.,* 2004; Landrum *et al*., 2000). In charismatic leadership, the leader combines three core elements for successful leadership. These are vision, inspiration and empowerment of people (Dessler *et al.,* 2004). The leader communicates the vision and gathers the momentum needed for improvement in the change management process (Landrum *et al.,* 2000). For an operational leader to be effective, planning, organising and controlling are the core elements for the change management process (Dessler *et al.,* 2004). Both charismatic and operational leadership styles are natural forms of transformational leadership (Rosén, 2014; Dessler *et al.,* 2004). Studies by Beer and Nohria (2000) and Rosén (2014) present a detailed description of the leadership styles of theories E, O and its combination (See table 2). Theory E's success in change management is best seen in the use of shareholders' value, managing change at top management level, with very little involvement of the lower level management. The theory O considers employee engagement to manage change. It encourages individuals of the organisation to take initiative and to solve problems at the lower levels of the organisation. The combination theories use both hard and soft leadership styles and are illustrated in Table 4.2:

Table 4. 2: Leadership styles for the dimensions of change

Dimensions of change	Theory E	Theory O	Theories E and O combination
Goals	Maximum shareholder value	Develop organisational capabilities	Explicitly embrace the paradox between economic value and organisational capabilities
Leadership	Manage change from the top down	Encourage participation from bottom up	Set directions from the top and engage the people below
Focus	Emphasise structure and systems	Build up corporate culture: employees' behaviour and attitudes	Focus simultaneously on the hard (structure and systems) and soft (corporate culture)
Process	Plan and establish programmes	Experience and evolve	Plan for spontaneity
Reward	Motivate through	Motivate through	Use incentives to reinforce

systems	financial incentives	commitment – use pay as fair exchange	change but not to drive it
Use of consultants	Consultants manage problems and shape solutions	Consultants support management in shaping their own solution	Consultants are expert resources which empower employees

Source (Beer & Nohria 2000; Rosén, 2014)

Leader's role in change management

Higgs and Rowland (2000) identify the leader's role and behaviour in the change process in five broad areas as:

(1) Creating the situation for change: effectively engaging others in recognising the need for change;

(2) Creating structural change: ensuring that the change is built on depth of understanding of the matters and supported by a constant set of tools and processes;

(3) Engaging others in the whole change process and building commitment;

(4) Implementing and sustaining changes: developing effective plans and ensuring that good monitoring and review practices are developed;

(5) Facilitating and developing capability: ensuring that people are challenged to find their own answers and that they are supported in doing this.

Higgs and Rowland (2000) and Denzin and Lincoln (2000) further explore leadership behaviours through detailed emerging themes relating to change management. They explicate nine roles necessary for leaders to perform effectively in change management:

(1) What leaders say and do: The communication and actions of leaders relate directly to the change;

(2) Making others accountable for the change;

(3) Thinking about the change;

(4) Using an individual focus;

(5) Establishing 'starting points' for the change;

(6) Designing and managing the change journey;

(7) Communicating guiding principles for the change;

(8) Creating individual and organisational capabilities;

(9) Communicating and creating connections.

4.4.4 MOTIVATING STAFF FOR CHANGE

According to Korbi (2015), motivating staff for change is to influence the employees of an organisation to eradicate their resistance to change; motivation is efficient and provides the necessary vigour to conquer all anticipated challenges. Employees expect from the leader, a vision and the motivation to fulfil the vision. The motivation assists and inspires the employees to achieve the change objectives within the organisation (Duluc, 2000; Adjei *et al.*, 2018b).

4.5 GAP 3: PROJECT COST COMMUNICATION

Project cost communication is required in every single stage of construction projects, through the design stage, the execution and the management of the project. The cost control stage of project cost management also requires effective cost communication for successful delivery of the project cost (Tipili *et al.*, 2014). The Project Management Institute (PMI, 2013) shows the effect of project communication on the delivery of projects as meeting project goals and the ability to work within the project budget. According to Korke *et al.* (2017), cost control is a management information system that requires cost data collection, processing of the data and providing top management with the right cost information through communication to aid in the taking of corrective measures to solve cost deviations. Abubakar (1992**)** adds that it is the responsibility of the project manager to communicate the project cost budget, discuss the budget with his management team and other subordinates for their commitment to the cost centres of the budget.

All the sections of cost control processes require cost communication. The measurable attributes applied to cost control, peculiar to Ghana and other developing countries, ae not known. For example, how to communicate, what modern methods to use, setting feedback channels, context of communication, are not addressed in existing cost control theories. However, having a good cost report does not necessarily mean that the cost control process will be carried out efficiently. Thus, project cost communication one of the gaps gap in cost control practice, which this study seeks to address.

The following section presents the definition, process, channels and models for PCC.

4.5.1 Definition of communication

According to Eddie *et al*. (2001), communication simply refers to the transmission of resources (e.g. information and other meanings, including ideas, knowledge, specific skills and technology) from one party to another through the use of shared symbols and media. It is also defined by Keyton (2011) as the process of transmitting information and common understanding from one person to another.

4.5.2 Communication process

Figure 4.1: reflects the definition and identifies the important elements of the communication process.

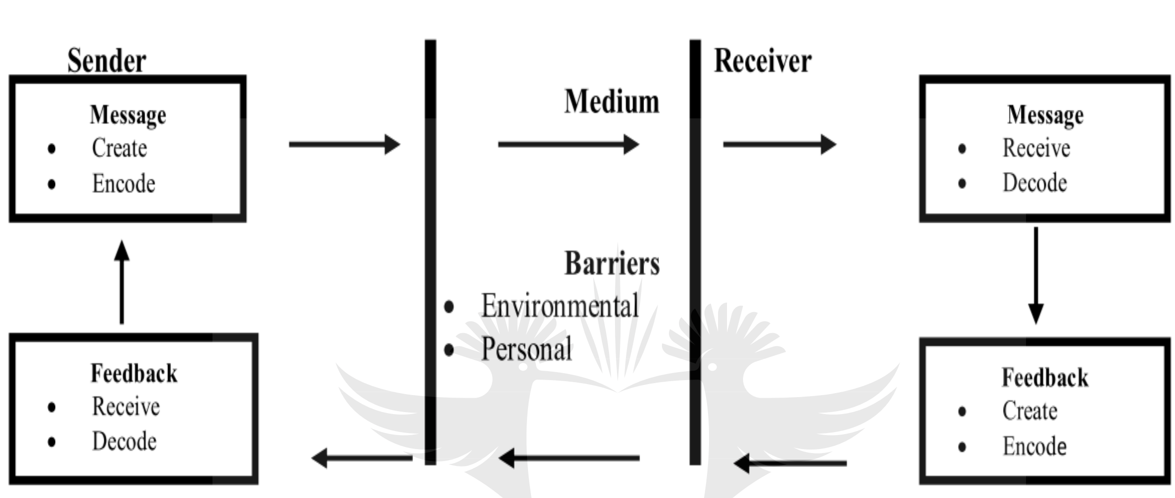

Figure 4. 1: Communication process

Source: McShare & Von Glinow, (2003); Adu-Oppong & Agyin-Birikorang, (2014)

The sender initiates the communication process. A sender uses words and symbols to translate information into a message for the receiver - the individual(s) receiving the message. In the workplace, the sender is the person who has a need or desire to convey an idea or concept to others, a person, department or unit of an organisation or system who originates the message to be sent. The sender encodes the idea by selecting words, symbols, or gestures with which to compose the message. The message is the outcome of the encoding, which takes the form of verbal, non-verbal or written language. Encoding is the process of converting feelings, ideas and thoughts into words, numbers or phrases to express oneself (Burke, 2007; Zulch, 2012; Adu-Oppong &Agyin-Birikorang, 2014). The receiver is the individual to whom the message is sent, the receiver decodes the received message into meaningful information. Accurate decoding of the message by the receiver is critical for effective communication. The closer the decoded message gets to the intent of the sender, the more effective the communication. However, environmental and personal barriers can hamper the communication process. A barrier is anything that distorts the message. Different perceptions of the message, language barriers, interruptions, emotions and attitudes are examples of barriers of communication (Adu-Oppong & Agyin-Birikorang, 2014).

Finally, feedback occurs when the receiver responds to the sender's message and returns a message to the sender (McShare & Von Glinow, 2003; Adu-Oppong & Agyin-Birikorang, 2014). The feedback allows the sender to determine whether the message has been received and understood (Lunenburg, 2010).

4.5.3 Communication channels/tools

A message is sent through a medium or channel, i.e. the carrier of the communication (Adu-Oppong & Agyin-Birikorang, 2014). Selection of the particular medium for transmitting the message is critical, because there are many choices. The medium may be verbal, nonverbal, written, computer-aided or electronic. For written media, administrators or other organisation member may choose from memos, letters, reports, bulletin boards, handbooks, newsletters e-mail and the like. For verbal media, choices include face-to-face conversations, telephone, computer, public address systems, closed-circuit television, tape-recorded messages, sound or slide shows and so on. Nonverbal gestures, facial expressions, body position, and even clothing, can transmit messages. It should be noted that people decode information selectively (Adu-Oppong &Agyin-Birikorang, 2014; Keyton, 2010).

In the execution of a construction project, communication occurs in various directions, depending on who is communicating. There is upward communication to management from members of the organisation. Lateral communication takes place among employees of the same hierarchy or colleagues in similar roles. Mechanisms need to be put in place for further communication to take place, either downward communication, thus, from superior to subordinate, horizontal communication between colleagues and or upward communication from subordinates to superior (Keyton, 2011; Tipili *et al*., 2014). The upward, downward and lateral channels of communication are illustrated in Figure 4.2 below:

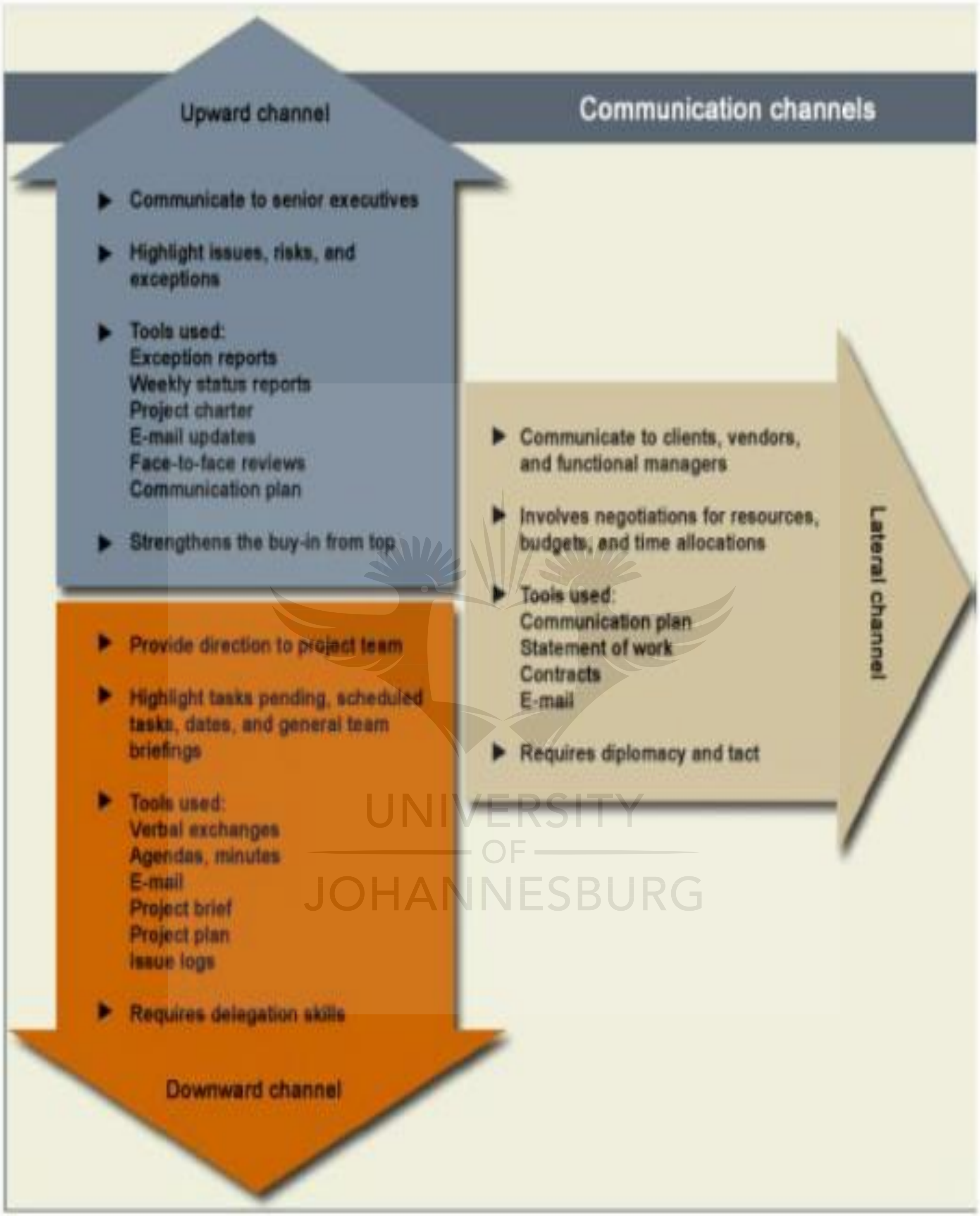

Figure 4. 2: The Three Communication Channels

Source: Keyton, (2011); Tipili *et al*., (2014) Cheng *et al*. (2001) add that the choice of a particular channel of communication depends on four main criteria:

(1) *Amount of information required to be communicated*: Different communication channels convey different amounts of information. Face-to-face communication (such as meetings and visits) is one of the richest media because it offers a variety of cues, including verbal and written words, tone of voice, facial expression, body language and other non-verbal signals. Other media such as telephone, e-mail, and memos are less rich media.

(2) *Instant information required*: In the case where instant information has to be transmitted, the most accessible and promptly transmitted media are given the first priority. Telephone and fax afford the transmission of fast instant information. E-mail is less instant, while meetings, teleconferencing, letters, and visits are the least instant media.

(3) *Effective communication required*: Effective communication refers to the accuracy of the information transmitted. It is always associated with terms such as misleading, misinterpretation, and misunderstanding. Thus, face-to-face communication is the best as it allows more opportunities for the receiver to clarify meanings, thus reducing misleading, misinterpretation, and misunderstanding. Two-way communication has to be created for it to be effective.

(4) *Efficient communication required.* Efficient communication refers to the speed of transmission of messages. However, it is not to say that using a computer to transmit the messages will be faster than using media for close contacts. It depends on the distance of transmission. In meetings and visits, the use of words is mostly the fastest way of communication, when the parties are just several inches apart. At a distance, using telephones and computers are both efficient.

4.5.4 Communication models/framework

There exist communication models developed in the past decades but only the current model is reviewed for the purposes of this study. Neher (1997) developed an organisational communication model presented in Table 4.3. The model considers internal communication factors that are very useful. Kitchen and Daly (2002) add the main factors as context, shape and form, the message, methods and modalities of communication and the resultant activities.

Table 4. 3: A model of organisational communication

1	Context
	Organisations exist in context provided by: Environment – history (time) – ecology Culture Technology Material and economic conditions People and goals People or members
2	Shape and form
	These factors largely influence: Organisational culture Patterns of interaction Relationships within the organisation Networks for organisational communication
3	Communication within organisations is studied in terms of:
	Message Content Symbols Codes (verbal and non-verbal)
4	Methods and modalities of communication
	Channels Media and technologies of communication
5	Communication activities
	Organising, coordinating, or controlling Leading or motivating Problem-solving and decision-making Conflict managing, negotiating and bargaining Influencing organisational change and development

Source: (Kitchen and Daly, 2002)

Te'eni *et al.* (2001) developed a communication model which identifies three major complexities in the communication process. They contend that, in any communication setting or context, the attributes of the communication inputs (sender), communication impact (receiver), the communication process (goal, medium and strategies) and the communication context (project environment) must be able to resolve and overcome all the threats of the complexities to achieve communication effectiveness in the context, as illustrated in Figure 4.3 below.

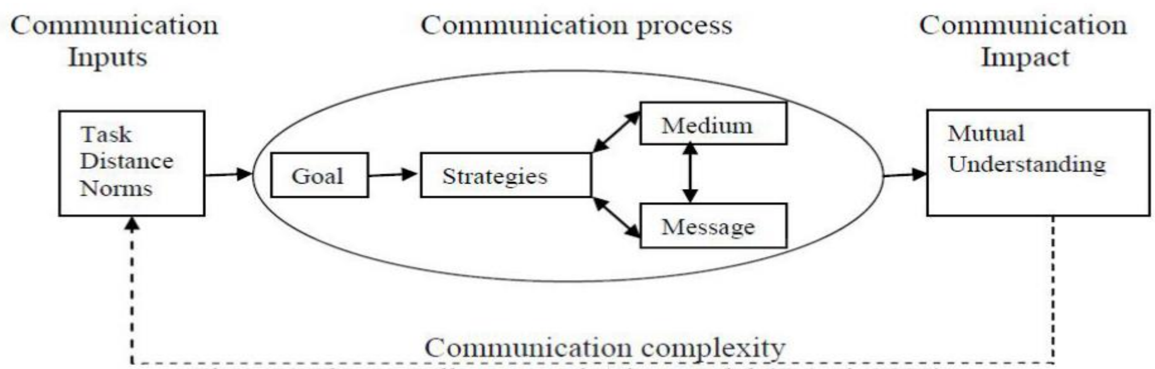

Figure 4. 3: Communication model

Source: Te'eni *et al.*, (2001); Kwofie, (2015)

Te'eni *et al*. (2001) note that the ability of the communicators to exhibit equal levels of understanding of the information communicated, as well as giving accurate feedback, greatly relies on the deeper understanding of the context (project environment), contextual knowledge and skills for the communicated actions. Definitely, these are attributes perceived to have the propensity to reduce the complexities in the communication context (Te'eni *et al.*, 2001). This is because a reduction in communication complexities results in producing effective communication among the members of the organisation and also increases the level of understanding and relationships among the team members (Te'eni *et al.*, 2001; Kwofie, 2015).

4.6 CONCLUSION

This chapter presents the gaps identified in the existing cost control frameworks and also the constructs which are do not appear in the theories. This study introduces new conceptual framework through the use of the identified gaps.

The gaps identified are: *the cost monitoring process*. The approach for conducting cost monitoring does not follow a robust process. The cost control concept of Charoenngam and Sriprasert (2001) uses cost monitoring of all the resources used in the project: materials, labour, plant/equipment, sub-contractors' work and profit and overheads. Olawale & Sun's (2015) studies include a recommendation for upcoming studies to include a new cost monitoring approach for a clear and well-developed typical approach for monitoring project cost. In addressing this gap, different, related works have been drawn on to formulate a new cost monitoring process. Twelve (12) steps are proposed to be followed for cost monitoring: 1) planning milestone monitoring process, 2) selection of appropriate techniques for cost monitoring, (3) selecting appropriate tools for tracking project costs, (4) monitoring cost data, (5) cost data verification, (6) monitoring cost performance, (7) monitoring updated cost records, (8) monitoring reported cost information, (9) detecting early warning signs, (10) identifying cost changing factors, (11) provision of manuals for site monitoring team to refer to and (12) training site personnel in the monitoring process.

The second gap is change management. The concept of cost control is effectively managed by making good decisions which act as corrective measures to bring the cost back on track. Construction projects with change management principles accomplish better in cost performance than those lacking their application. A new change management concept to be incorporated into the construction project cost control practice is presented in this chapter.

The last gap is cost communication. Cost control is a management information system that requires cost data collection, processing of the data and providing top management with the right cost information through communication, to aid the taking of corrective measures to solve cost deviations. Additionally, project managers are required to communicate the project cost budget, discuss the budget with their management teams and other subordinates for commitment to the cost centres of the budget. All the sections of cost control processes require cost communication.

CHAPTER FIVE

AFRICAN LITERATURE ON COST CONTROL PRACTICE

5.0 INTRODUCTION

This chapter presents construction project cost control practices from the African continent, in five countries, namely Egypt, South Africa, Uganda, Nigeria and Ghana. These countries were selected because their geographical location on the continent. Thus, the countries selected represent Northern, Southern, Eastern and Western zones of the African continent. Moreover, the countries use similar, related cost control practices in the construction industry.

The views of contractors, consultants, site engineers, subcontractors, developers and project managers on cost control practices are presented in this chapter. The areas of cost control presented include cost control knowledge, cost control techniques and the challenges faced in controlling construction cost.

5.1 COST CONTROL PRACTICE IN NIGERIA

The Nigerian construction industry has enjoyed several benefits regarding the practice of practical cost control, despite the fact that some construction projects face challenges, such as neglect of projects for a long time as a result of lack of the application of cost control principles, while others, too, have failed to meet their project cost objectives (Anyanwu, 2013).

5.1.1 Cost control knowledge

The knowledge of cost control principles in the Nigerian construction industry were elicited from consultants, contractors, site engineers, subcontractors, developers and project managers (Haruna *et al*., 2017; Ojedokun *et al*., 2012). Haruna *et al*. (2017) categorise the level of knowledge of cost control system from 'totally understand to totally do not understand'. Haruna *et al*. (2017) found that the majority of the respondents, 52%, had 'average' understanding of cost control systems. This was followed by 37% who 'understand 'the cost control system. Only a few 'totally understand', 8%, and 'do not understand', 4%. 'Totally do not understand' had no respondents (Haruna *et al*., 2017). Ojedokun *et al*. (2012) also found that the level of understanding of cost control systems ranged from 'totally understand' to 'do not understand.

Ojedokun *et al*. (2012) found all of the respondents namely 100%, registered 'totally understand' for cost control systems. This shows that the understanding of cost control systems is well able to aid the practice of cost control. The practice of cost control at the construction stage is carried out from monthly to yearly periods. Most organisations prepare cost control systems on a quarterly basis.

5.1.2 Cost control techniques

Experts practising cost control do project cost planning using Network Analysis, such as the Gantt chart or bar chart. The initial cost plan assists in the implementation and cost control practice during the construction stage of the project. Contractors are able to employ cost control systems during the execution of the construction project (Anyanwu, 2013). Forty per cent do not utilise cost control practice at all for projects at the construction stage, while the rest, 60%, indicate that they either use it sometimes or always (Haruna *et al.,* 2017). The project quantity surveyor leads the project team members to apply the concept of cost management techniques because of his training and technical know-how (Anyanwu, 2013).

Cost control is carried out using programmes of work, inspection, monitoring and evaluation of the project, record keeping, reports and site meetings (Haruna *et al,* 2017). The programme of work, inspection, monitoring and evaluation of the project are the most common methods used by respondents to control construction project costs (Haruna *et al.,* 2017). This means that cost plans are developed first during the initial stage of the project to serve as a target to measure cost deviations. The project quantity surveyor in charge thereafter assesses the cost at various stages of the project to determine the status of the project cost.

5.1.3 Factors affecting construction cost

Contractors face problems in controlling construction cost. Haruna *et al*. (2017) identify sixteen problem areas for contractors: duration of project, labour and material shortages, increase in prices of materials, wastage of construction materials, delays in delivery of items, theft and vandalisation, insecurity, unclear and incomplete drawings, bad weather, interference by clients, over-lapping of work activities and delay by the client to release money for payment. Among the factors, four were identified to be critical. These are, increases in prices of construction materials, material wastage, theft and vandalisation, and clients' delay in releasing money. Sanni and Hashim (2013) further identify problems faced in cost control as improper contract documents, engagement of inexperienced staff, unstable market conditions, complexity of the project, unstable government regulations, choice of procurement method, lack of research and innovation, price and design risk, quality factors of cost information, non-provision of training of young professionals, inadequate access to software packages, non-clarity of exclusions and ineffectiveness of professional bodies.

6.2 COST CONTROL PRACTICE IN EGYPT

The Egyptian construction industry has similar cost control practices to other countries. The cost control practice is viewed from the perspective of the contractors. Contractors understand and use cost control systems in the execution of construction projects (Hafez *et al*., 2015).

5.2.1 Cost control techniques

Most experienced contractors who have worked for ten years and more, use profitability of the work and unit cost of the cost control techniques (Hafez *et al*., 2015). Morsy (2014) identifies three cost control strategies most used by contractors. These are the overall profit or loss account, profit or loss at valuation date and unit costing. Unit costing is the preferred technique of the contractors. Other cost control techniques used by contractors, according to Morsy (2014), are: pre-construction arranging of activities, assignments and possessions required, monitoring work and cost execution, evaluation of tasks completed, frequent coordination between the members of the project team, checking of the works, use of experienced subcontractors and suppliers, regular progress meetings on progress of work and programmes of work and record keeping. Of the nine techniques, the most frequently used are: pre-construction arranging of activities and assignments and possessions required, monitoring work and cost execution, evaluation of tasks completed and frequent coordination between the project team members (Morsy, 2014).

5.2.2 Cost control mitigation measures

Mitigation actions were found to have been used by contractors to solve cost escalations in the execution of construction projects (Hafez *et al*., 2015). Preventive actions: the preventive actions are the actions established to serve as resistance against any factor that may affect the cost of the project. Predictive actions: these are similar to preventive actions, although there are some differences. Predictive actions are the measures set at the on-set of the project stage to foresee the cost control likely challenging areas so as to prevent them from occurring or to prepare for them in future. Corrective actions: an action an organisation should consider eliminating or reduce the effect of project cost variances on construction cost, by acting as a remedy. Corrective actions are therefore considered decision-making concepts to be used to resolve the variances that occur in the construction cost. Alternative solutions must be considered and undertaken to solve the identified cost problems. Organisational actions: these are measures organisations take to control construction variations should they occur. A typical example is the management style adopted by the organisation to solve cost variations (Hafez *et al*., 2015).

5.2.3 Cost control framework using activity-based costing

Hafez *et al*. (2015) have developed a framework for use in the Egyptian construction industry for cost control practices. The framework includes different areas of cost control reasoning for construction projects, using the activity-based costing techniques. These techniques were conducted during a contextual analysis in Egypt, demonstrating the effect of using ABC ideas with respect to the cost of the over-head activities.

The key is to understand that a model for cost and value management in the execution of construction projects includes a precise, life-cycle reasoning in view of the combination of cost and value management and is employed as a continuous component. In this manner, cost control standards and instruments can be connected to the construction industry to regulate the results through the control of the whole production process. The accomplishment of cost control techniques in the construction procedure found a way to decrease the general duration of the procedure by enhancing its method of administration.

5.2.4 Factors affecting construction cost

Contractors and project managers face problems in controlling construction project cost. The problems identified in Egypt that create trouble in controlling task costs are issues that incorporate change orders, changes within the plan, errors within the design, the deterioration of the current economic state of affairs, delayed construction projects and materials cost increases (Hafez *et al*., 2015). In addition, Morsy (2014) identifies variables that affect construction project cost as assessed by contractors to include, off-base or poor estimation of initial costs and unsuitable planning. Price increases of project costs and construction cost under-estimation share the third position, unanticipated site conditions and oversights and blunders in the bills of quantities fourth, faults in the design are in the fifth position, contractual claims in the sixth position, absence of experience of contractors in seventh place, changes in clients' briefs came eighth, force majeure in the ninth position and inadmissible construction equipment and methods in the tenth position. It was identified that poor estimation in construction costs is the principle factor that adds to cost overruns. The contractors do not see errors in the design as a serious issue, when they are compared with the other variables affecting construction cost. However, under-estimation is the fundamental issue, but contractors see that problem as the principle action to mitigate cost escalation via regulatory project costing (Morsy, 2014).

5.3 COST CONTROL PRACTICE IN UGANDA

Cost control practice is seen from the point of view of the contractors. The contractor's points of view are mostly interrogated because they suffer greater losses in the absence of the practice of cost control than the owners of the projects (Otim *et al*., 2011). Most contractors in the Ugandan construction industry are not familiar with the practice of pre-contract cost control but rather use post-contract stage cost control, especially when the bid has been successful (Tindiwensi, 1999).

5.3.1 Cost control techniques

Otim *et al.* (2011) identifies seven different cost control techniques from the point of view of the contractors. These are: pre-construction arranging of work activities for the project, checking of the work activities on site, project cost targets, regular meetings on progress of work, record keeping on work activities and reports. Monitoring work and cost execution and the evaluation of tasks completed is made possible through the use of bills of quantity. Of the techniques identified, the most commonly used are: pre-construction arranging of work activities for the project and possessions required, monitoring work and cost execution, evaluation of tasks completed by checking the sum allocated for each task.

All the techniques used for cost control practice have been further elaborated. According to Otim *et al*. (2011), contractors use timetables to screen advance and monetary execution. It is an effective strategy since work advancement can be estimated and the cost activities identified. Review of works and correlation with the financial plan, is sometimes subjective to judgment, henceforth inadequate. Cost connected to obligation, focuses on work targets to be refined. Its utilisation in connection with plans makes it the best method for cost control. Periodic meetings are conducted to audit the advancement of work and contrast it with the set targets for the forecast cost. This sounds positive as it inspires the workforce, and all the stakeholders, to be up and coming in the execution of work. Documentation of exercises completed is important to empower early recognition of deviations from the target guidelines. The project team members observe timetables, spending plans, assessment and criticisms to keep a watch on the cost execution. With the utilisation of the correct instruments of control, satisfactory outcomes are delivered. It is useful to evaluate works and to contrast them with the expenses in the bills of quantity. Work activities were investigated to assess their efficacy. These actions help to assess the advancement of the work.

Other construction sites considered did not use any specific technique for cost control.

5.4 COST CONTROL PRACTICE IN SOUTH AFRICA

The South African construction industry has similar cost control practices to the countries mentioned earlier. The cost control practice is viewed from the perspective of the contractors and their personnel.

5.4.1 Cost control knowledge

The knowledge of cost control in the South African construction industry has been identified from middle level management team members of contractors. They are the project quantity surveyors, contracts managers, site foremen, clerks of works and health and safety officers (Muthelo & Talukhaba, 2018). Muthelo and Talukhaba (2018) classify the level of knowledge of cost control systems from 'below average' to 'average' to 'above average'. The project quantity surveyors had the greatest cost control knowledge, 'above average' with 63%. This is not surprising as quantity surveyors are the key persons and leaders of the project teams responsible for managing and controlling construction costs. Although the quantity surveyors require the involvement of the other team members, they serve as facilitators for keeping the cost records and cost analysis to manage the project cost. Most of the contract managers had 'average' knowledge of cost control. According to Muthelo and Talukhaba (2018), the contract managers' competencies include an understanding of cash flow for the management of work activities in construction projects. Lastly, the majority of the site foremen, clerks of works and the health and safety officers scored 'below average' on the knowledge of cost control. These experts manage work operations of projects with little concern for cost control issues.

5.4.2 Cost control reporting system

Muthelo & Talukhaba's (2018) studies further show project cost report systems used by contractors for cost control. The six various reports for cost control are: materials, labour, plant, preliminaries, sub-contractors and variations reports. These reports are prepared manually to inform the top management team of the cash flow of the project for corrective measures to be taken to solve any deviations in the project cost. Figure 5.1 shows the various areas of cost information required and their rankings as used by contractors for cost control:

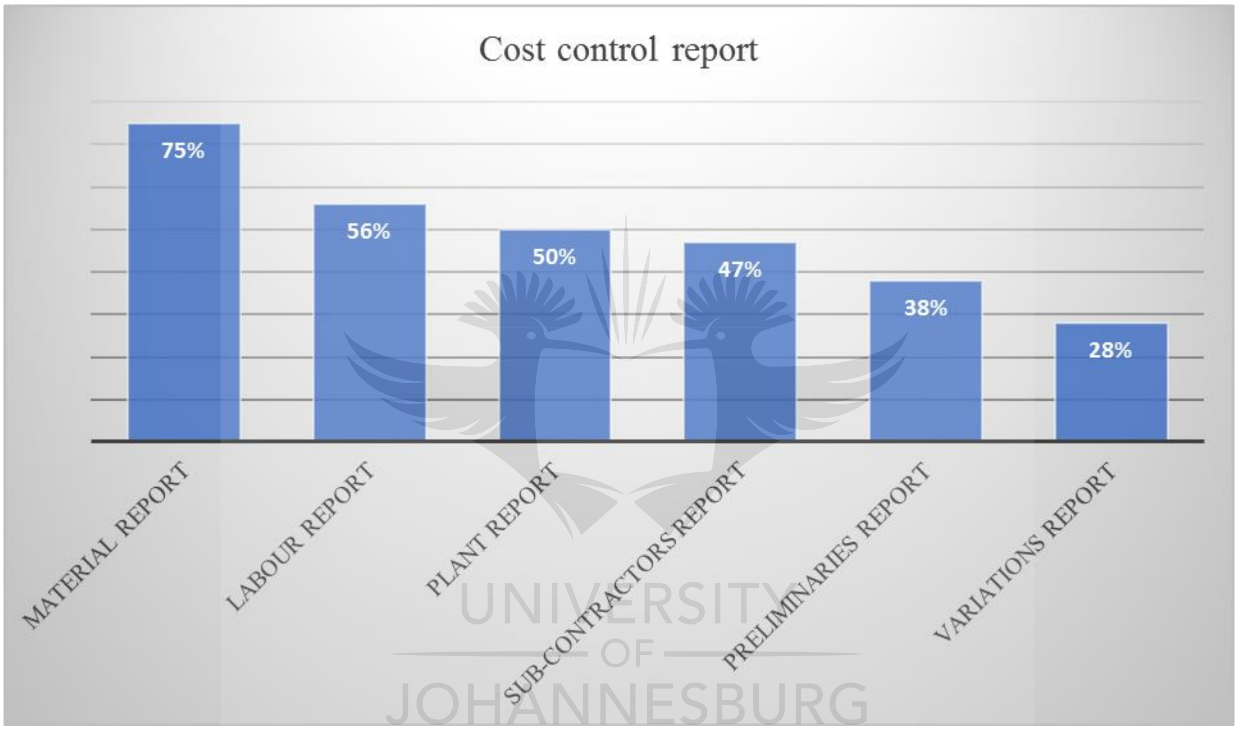

Figure 5. 1: Cost control report

Source: Muthelo & Talukhaba's (2018)

Ademola's (2012) studies found new straightforward structures of tracking site possessions and their corresponding expenses to be undertaken, using a computer-aided tool, like a spreadsheet application (Microsoft excel) for cost control. Its purpose is to serve as a strategy for the keeping of records, to oversee and control site possession costs within the development phase of the construction.

The various cost control reports were developed through the case study of a road developmental project in Limpopo Province.

Labour report: A labour sheet designed for the everyday work designation was used to report the workforce present and their genders. They were apportioned to a foreman for his specific undertaking of work activity for the day's operations. It was intended to indicate the work strength intended for the works by uncovering those who participated in the appointed work. The labour to be used by each foreman is planned for at the initial stage by the programme of works. A typical labour sheet report is presented in Table 5.1 below:

Table 5. 1: Labour sheet

Company's name, address and logo							
DAILY LABOUR ALLOCATION							
Project information: project name, contract number, client, consultants							
Date:				Location:			
Description of work:							
Labour required							
S/No.	Surname	Middle name	First name	Gender		Attendance	
				M	F	Present	Absent
1.							
2.							
3.							
SUMMARY		MALE	FEMALE	TOTAL			
ALLOCATED							
PARTICIPATED							
………………………………. Foreman						………………………………. Site Agent	

Source: Ademola, (2012)

PLANT REPORT

The day-to-day plant distribution list was used to assign and check site plants in all areas of the work. It was intended to uncover the plants used by every foreman for the specific work assignment done on daily basis. The plant administrator documents the measure of fuel received by each of the designated plants for the day. Furthermore, he reports on work missed because of collapses of plants. This affects every foreman's task. The aggregate work length for every plant is documented as the aggregate time the plant was engaged with profitable work. The period missed because of breakdowns was excluded from the profitable period. A misfortune in gainful time longer than the normal everyday working hours brought about the hardware being supplanted by the plant provider. A typical plant sheet report is presented in Table 5.2 below:

Table 5. 2: Plant sheet

<table>
<tr><td colspan="10">Company’s name, address and logo</td></tr>
<tr><td colspan="10">DAILY PLANT ALLOCATION AND REGISTER</td></tr>
<tr><td colspan="10">Project information: project name, contract number, client, consultants</td></tr>
<tr><td colspan="6">Date:</td><td colspan="4">Location:</td></tr>
<tr><td colspan="10">Description of work:</td></tr>
<tr><td colspan="10">Plant assigned</td></tr>
<tr><td rowspan="3">No.</td><td rowspan="3">Plant/
Equipment</td><td rowspan="3">Model</td><td rowspan="3">Registration</td><td rowspan="3">Operator</td><td rowspan="3">Hours of work</td><td colspan="3">Fuel received</td><td rowspan="3">comments</td></tr>
<tr><td colspan="2">Meter reading</td><td>Qty (liters)</td></tr>
<tr><td>Before</td><td>After</td><td></td></tr>
<tr><td>1.</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3.</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4.</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>5.</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="10">Plant breakdown report</td></tr>
<tr><td colspan="2">Plant/Equipment</td><td>Model</td><td>Time of</td><td colspan="2">Reason for</td><td colspan="2">Duration of</td><td colspan="2">Recommendation</td></tr>
</table>

		breakdown	breakdown	breakdown (hrs)	Repair	Replacement
Other comments:						
………………………… Plant administrator		……………………. Foreman		……………………. Site Agent		

Source: Ademola, (2012)

MATERIALS REPORT

The material demand and dispatch record, as illustrated in Table 5.3 is, designed as a store report to be used by every foreman to demand and gather a stock of construction materials, as well as consumables, needed to complete the day-to-day activities. The report of construction materials supplied to every foreman should be with the store man, until the time when it is given to the clerk of works or the site agent, at every management team meeting. After that, it is recorded on the cost control database (Ademola, 2012). The construction materials used for the task are added to the undertaking's immediate expenses. The various quantities are extracted from the specifications provided in the bills of quantity. The unused construction materials are sent back to the store and, when needed, the foreman will make requisition for them.

Table 5. 3: Materials sheet

Company's name, address and logo	
MATERIAL REQUISITION AND DISPATCH	
Project information: project name, contract number, client, consultants	
Date:	Location:
Requisition by foreman:	Requisition No.
Description of work:	
Materials needed	

No.	Material description	Unit	Quantity				Collected by		Remarks
			Requested	Dispatch	Returned	Used	Name	Signature	
1.									
2.									
3.									
4.									
5.									
Other comments:									
………………………… Store man			……………………. Foreman				……………………. Site Agent		

Source: Ademola, (2012)

DAILY WORK REPORT

The day-to-day record of work sheet in Table 5.4 records arranged and real work for each day. At the management team meeting, every foreman determines the foreseen work for the next day on the sheet, with all the resources assigned to accomplish the arranged work appropriately. The possible real work done toward the finish of the working day is recorded on another part of the sheet which is noted as well as the predetermined work plan. More often than not, the foreman's goal is to surpass the arranged calendar with regard to a specific end goal to take care of his day-to-day expenses and to benefit from the activities completed. The extra work achieved leads to the making of more money for the organisation. This will possibly be helpful in times when his foreseen income is not achieved (Ademola, 2012).

Table 5. 4: Work done sheet

Company’s name, address and logo	
DAILY WORK DONE	
Project information: project name, contract number, client, consultants	
Date:	Location:
Foreman/Quantity surveyor:	
A.Tool box talk: Yes ……. No …………	
B. Chainage: km ………………To km ………….. LHS…………. Centre:………RHS………	
C. Weather condition: Sunny………Fine: ……Cloudy:……Rainy: …………Dark…………	

Rainfall measurement: ………………….mm					
D. Delayed: Yes………… No ………… If yes: ………………………………………………………………………………………..					
PLANNED WORK FOR THE DAY					
Time to commence work: ………..hours Total time required to complete work: ………hours					
Time scheduled for work to be completed………….. hours					
Description of work to be done					
Item	Description	Unit	Qty	Chainage	Remarks
1.					
2.					
ACTUAL WORK DONE FOR THE DAY					
Time work started: ……….…..hours Total time to be completed the work: ………hours					
Time of completion of the work………….. hours					
Description of work done					
Item	Description	Unit	Qty	Chainage	Remarks
1.					
2.					
3.					
………………………………. Foreman				………………………………. Site Agent	

Source: Ademola, (2012)

All the daily reports are transferred into weekly and monthly reports, using the spreadsheet application (Microsoft Excel). The bills of quantity become the main documents for the extraction of the various resources, like materials, labour, plant, sub-contractors' work, preliminaries and profit of overheads, charges for the project. The weekly or monthly report is compared with the budgeted cost and the variances are calculated as shown in Table 5.5.

Table 5. 5: Daily, weekly, monthly budget report

Company's name, address and logo																
DAILY, WEEKLY, MONTHLY BUDGET REPORT																
Project information: project name, contract number, client, consultants																
	LABOUR				PLANT			MATERIALS			SUB-CONTRACT		MISC. EXPENSES			
RESOURCES	Top level management staff	Middle level management staff	Lower level management staff	General workers	Plant 1	Plant 2	Plant 3	Material 1	Material 2	Material 3	Nomi1nated supplier items	Nominated work list	overheads	Other expenses		
No. of hrs	1	1	1	1	1	1	1	1	1	1	1				Rate	Amount
TOTAL SITE COST PER DAY, WEEK OR MONTH																

The total site cost calculated is then transferred to the profit and loss account to check the variance for the week or month of tracking the construction project cost. Table 5.6 below is used to determine the variance:

Table 5. 6: Profit and loss analysis

PROFIT AND LOSS ANALYSIS		
Total cost from the day/month (actual)		
Total projected cost for the day/month		
Total projected cost to date		
Total revenue claimed from previous day/month		
Total projected revenue from claims this day/month		
Total projected revenue from claims to date		
Projected variance for this day/month		
Projected variance to date		
Target profit	Previous	Present
	%	%
Projected target profit to date	%	

Source: Ademola, (2012)

5.5 COST CONTROL PRACTICE IN GHANA

Cost control practice is seen from the point of view of the contractors (Adu-Yeboah, 2013; Ofori *et al.*, 2017). The contractors' points of view are mostly sought because they suffer more losses in the absence of the practice of cost control than the owner of the project. The post-contract stage cost control practices were elicited from the contractors.

5.5.1 Cost control techniques

Adu-Yeboah (2013) identifies four different cost control techniques from the point of view of the contractors: overall profit or loss accounts, unit costing, profit or loss based on progress payment and standard costing. Of the techniques identified the most frequently used are: overall profit or loss account, 31% and unit costing, 24%. The least used cost control techniques are profit or loss based on progress payment and standard costing with 23% and 22% respectively. Ofori *et al*.

(2017) further found three cost control techniques. The most used is unit costing, followed by profit or loss based on progress payment and standard costing.

5.5.2 Factors affecting construction cost

Contractors face problems in controlling construction project costs. Adu-Yeboah, (2013) identifies and ranked 22 variables that affect construction project cost as assessed by contractors to include: firstly, information delay by nominated sub-contractor to the main contractor. The construction method was ranked second; location of site was third; qualified expertise, profit cost, additional cost required to carry out the project and availability of labour were fourth, fifth, sixth and seventh. Three factors ranked eighth: exchanging the environment of construction work, availability of material and nature of consultants. Other less important factors identified were unstable plant rate, quality control or demand, contractor's profit margin, nature of client, unstable labour rate, unrealistic budget, availability of plant, programme of work, difficulty in collecting cost data, client financial resources, duration of project and material prices.

The delay of and misinformation about cost data by a nominated subcontractor is the major hindrance to the use of cost control systems. Such cost data which form part of the main contractor's cost information becomes a challenge to access. The construction method to use, for instance precast method of construction, affects the cost of the project (Adu-Yeboah, 2013). Ofori *et al.* (2017) also add that the economic situation is the most challenge to cost control practice in Ghana.

5.6 LESSONS LEARNT FROM AFRICAN COST CONTROL PRACTICE

The following lessons can be learnt from the African cost control practice:

The knowledge of cost control practice is of an average level, although all the countries understand and practise cost control.

The most common cost control method used in the countries researched is the profit or loss account at each interim payment stage. This shows that the cost managers prepare cost control practice as and when money is paid to the contractors, where the status of the cost is prepared at that level reached of the construction project. Cost control practice is expected to be a continuous process once the contract is awarded to the contractor. Thus, daily or weekly practice is the best practice, depending on the magnitude of the project.

There are numerous factors that affect construction cost and that make cost control practice difficult for contractors. These include the duration of the project, labour shortage, material prices or unstable market conditions, inexperienced staff, design errors and change orders. These factors differ from country to country, since each country's construction project is unique. However, almost all the countries share the factors affecting construction cost.

The Egyptian construction industry uses corrective measures which are classified under organisational, preventative and predictive measures. Potential areas of cost deviations at the initial stage of the construction projects are identified. The identification idea is to identify possible measures that should overcome difficulties should they occur. Most often, decisions are taken during the execution of the project when the status of the cost is known and the factors leading to the cost change. However, where the potential areas are identified at the initial stage, it is good practice to inform project team members or management of the likely events or situations so they can strategise to keep the construction project cost.

Lastly, different cost report templates exist for the practice of cost control. The developed cost report templates for material, labour, plant, daily/weekly/monthly cost and profit or loss are the key areas where cost data is required for the practice of cost control. The cost report templates serve as a basis for cost data collection for contractors or cost managers during the execution of construction projects.

5.7 CONCLUSION

This chapter presents and discusses cost control practices in the African context of five countries, namely: South Africa, Ghana, Egypt, Uganda and Nigeria. The literature review focuses on the major areas under cost control. The cost control areas are knowledge, techniques and factors affecting cost control practice.

The South African literature stresses the need for project cost reporting and develops several project cost reporting formats for cost control practice. The Egyptian construction industry has developed a cost control framework. The cost control framework used is similar to cost control frameworks of advanced countries. The Ugandan construction industry focuses on the cost control techniques, while the Ghanaian and Nigerian construction industries focus on cost control techniques and factors affecting the cost control practice.

The study concludes that the factors affecting project costs are similar in practice which means that there is little difference in cost control practices within the various African countries studied.

CHAPTER SIX

REASEACH METHODOLOGY

6.0 INTRODUCTION

This chapter discusses the methodology used in carrying out this study. It shows the systematic process which the research work relied on in accomplishing the research objectives. The research strategy, data collection and sampling framing are presented. The data analysis process is also presented. The latter part deals with research ethical issues and summarises the chapter.

6.1 PHILOSOPHICAL CONSIDERATIONS IN RESEARCH

The role of philosophical considerations in research is to impact on the procedure and decisions of the research strategy. A philosophical thought in social research legitimises the reasons and requirements for the examination, as well as the moral-political qualities and research conduct (Neuman, 2014). Elective methodologies fill in wide frameworks for directing an investigation. Along these lines, inquiries about systems will in general be affected by two wide philosophical methodologies, to be specific, epistemology and ontology (Neuman, 2014; Flick, 2014).

Furthermore, research works have demonstrated that even if assumptions change, the studies still incline to the general philosophical territories of epistemology and ontology (Crotty, 1998; Aigbavboa, 2013). This research study explores the epistemological and ontological positions as different methods.

6.1.1 Epistemological considerations

Epistemology considers satisfactory learning relating to a particular field of study, social, community or normal sciences, ought to be viewed as utilising similar standards and methods (Bryman, 2003). Further, it is concerned with the making of facts and centres around ‘how’ and ‘what’ we know, and includes the greatest substantial approaches to achieve reality (Neuman, 2014). Epistemology values the presence of an observational creation, contending that social situations exact proof prompts for a portion of the thoughts regarding the truth being checked. The other values are disposed of as attributable to non-strong observational proof.

There exist two noteworthy refinements related to epistemology: positivism, which stresses the exact social community, and interpretivism which bargains with individuals' association to the physical world and subjective system of knowledge (Gupta & Awasthy, 2015). Authors whose confidence is in this epistemological position connect with 'positivism' through the supposed 'standard view' of science obtained specifically from this philosophical methodology.

Positivism builds up an esteem-free model and thus finds easy going law that is grasped by numerous social studies (Robson, 2011). Outhwaite (1987) suggests that there are three distinct generations of ideas related to positivism: Auguste Comte's (1798-1857) position suggesting progress, Hebert Spencer's coherent positivism and Carl Hempel's value-free proof and tough real facts.

Research works recommend that exploration mirroring the logic of positivism is probably going to embrace the philosophical position of the normal researcher. Specialists lean toward undertakings with a recognisable social reality and sum up their discoveries as those created by physical and characteristic researchers (Remenyi *et al.*, 1998:32; Bryman, 2003).

Robson (2011) believes goal learning (facts) can be increased just from straight understanding or perception and that science isolates facts from qualities. Positivism contends that science should be directed equitably. Information touches base through the social event of realities (Bryman, 2003).

Positivism looks for the presence of a consistent connection between two related factors, certainties without the analysts' and members' qualities. This methodology has been observed to be valuable for examining the connection between cost control practice and its related factors. Nevertheless, this methodological point of view takes philosophical critiques. The scrutinisers trust that realities and qualities can not be isolated and that immediate experience forming a reason for logical learning is flawed and dismissed, thus the necessity to think about an alternative methodology (Blaikie, 2009). This is supported by Gupta and Awasthy's (2015) statement that researchers could take distinctive philosophical positions that could manage the approach. The investigation along these lines considers a different methodology.

6.1.2 Ontological considerations

The study reflects on ontology as a post-positivism position. The theoretical position of ontology is about the idea of actuality, or what is in existence. The central idea of nature is also considered (Neuman, 2014). This work recognises objectivism as a place to depict the social substances that exit as a general rule outside social on-screen characters, and subjectivism as social wonders that are created by the recognitions and resulting activities of those social performing artists worried about their reality (Saunders, 2011). The statement above infers that social phenomena have a presence that is autonomous of their performers (Bryman, 2003). This objectivist view of the fact of the matter is nearer to the positivist hypothetical position (Crotty, 1998; Aigbavboa, 2013). Subsequently, the world exists as an arrangement of factors hanging tight to be uncovered. Bryman (2003) specifies constructionism as another ontological position whereby authors trust that social marvels are accomplished by their on-screen characters. Neuman (2014) further adds that the two positions in philosophy to be considered are the pragmatism and nominalism.

The realities of the present age are what one views it to be and the available facts. The nominalist accepts that people never straightforwardly encounter a reality as unconventional. Bryman (2003) specifies objectivism and constructionism to be part of ontological considerations. The philosophical methodology perceives the reactions and proposes the following:

• The speculations, theories, foundation learning and estimations of the analyst can impact what is viewed;

• There is a promise of objectivity which is, in any case, drawn closer by perceiving the conceivable impacts of these possible favoritisms; and

• Though a reality exists, it very well may be known just incompletely and probabilistically inferable from the scientist's restriction.

This investigation looks for components and connections for cost control practices and cost management, yet recognises that a specialist's qualities and foundation can impact on the examination result. Nevertheless, the ‘I am’ focuses on objectivity, including esteem-free and autonomy of performing artists.

Bryman (2004) suggests that quantitative and subjective research speaks to various research techniques with striking contrasts, depending on the hypothesis and epistemological issues. This study uses both research techniques.

6.1.3 Axiological considerations

Axiology is an aspect of philosophy in research that deals with values or right decisions. According to Creswell (2009), axiology looks at the responsibility values play in research.

It includes characterising, assessing and understanding ideas of good and bad conduct identifying with the examination. Axiology involves the consideration of the values credit to the diverse parts of the investigation, the respondents, the information and the group of onlookers to which reporting of the findings of the examination are required (Kivunja & Kuyini, 2017). The axiological position looks at the "value free" or "value laden" qualities of the examination in research (Creswell, 2009). According to Creswell (2009), it portrays a 'value free' inquiry as one in which the wonder under investigation is exposed to an evaluative target criterion. In opposition to 'value free' axiological consideration, the 'value laden' axiological position, is driven by subjective conditions.

There is a relationship between a positivist paradigm, value free and value laden suspicion and the interpretivist worldview (Bryman, 2009; Creswell, 2009). This examination fixes itself not on just a single of the two axiological suppositions; the investigation concedes that qualities assume a substantial job in translating the results, hence, the analyst, by embracing mutually subjective and objective perspectives, empowers responding to the exploration as it addresses research questions, as opposed to receiving one viewpoint.

Pathirage *et al*. (2005) provide different components of insight of research methods and the positions that may be taken in every one of the philosophies, epistemology and the axiology rationalities, and they depict the theories in some kind of fundamentally unrelated circumstance. It is essential that, as opposed to receiving one specific position in the two fundamental alternatives under every one of the theories as delineated in Figure 7.1, the investigation embraces the two positions in every logic as that which is important so as to respond to the exploration questions suitably.

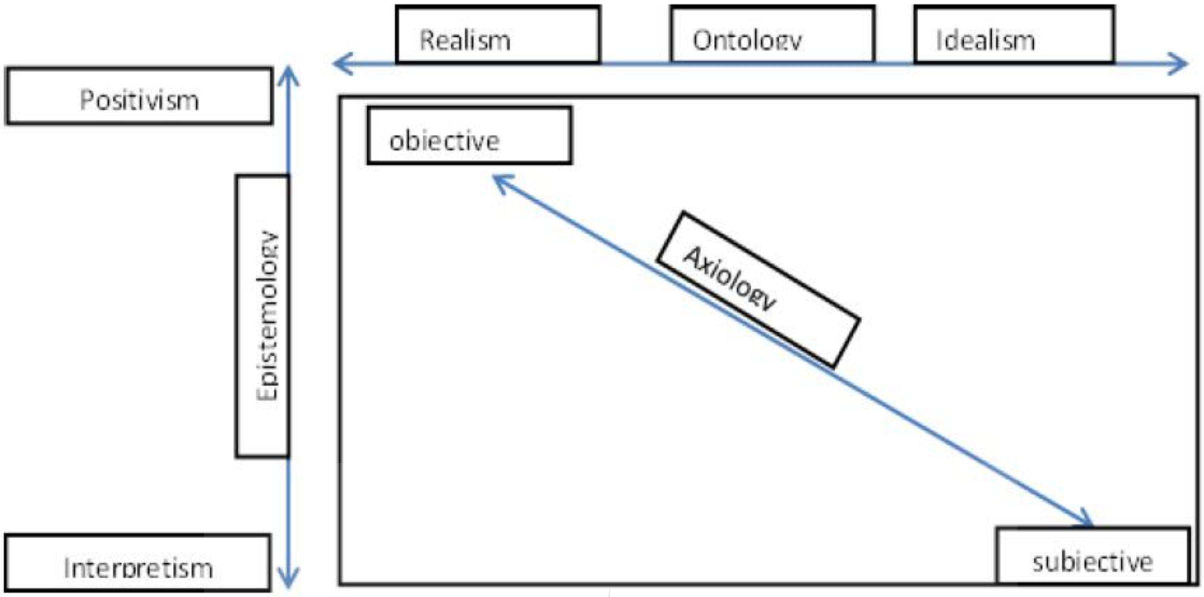

Figure 6. 1: Dimensions of research philosophy

Source; Pathirage (2005)

6.1.4 Quantitative vs Qualitative Methodology

The discussion on whether social research should be considered as quantitative or subjective research has been bantered among numerous researchers. Layder (1993) insists that the refinement is vague and that that which is considered as the essential contrast between the two methodologies is not utilised once more. Furthermore, Trochim (2004) recommends that the outrageous positions are ineffective.

Trochim (2004) further maintains that the many-sided issue needs more consideration than trivialising. He debates the attestation that the quantitative methodology is deductive and validating in principle, as against subjective which is inductive and exploratory. There are numerous research issues that can be inspected utilising the subjective or quantitative strategy. Or maybe, the two strategies both have components of inductive, deductive, supportive and exploratory methodologies. Thus, Blumberg *et al.* (2014) state that there are no pre-determinates for the suitability of both methodologies. Nonetheless, Bryman (2003) confirms that numerous scholars think that its valuable to recognise the two methodologies. Additionally, accessible proof demonstrates that the distinction is winding up rather than diminishing. The expansion in the talk is credited to the valuable methods for grouping the distinctive strategies and routine with regard to social research. Bryman (2003) contends that quantitative research underscores evaluation in information gathering and investigation, while subjective research stresses words and is diverse with respect to tendency to hypothesis.

According to Creswell (2009), in utilising a quantitative methodology, examiners fundamentally use post-positivist cases for advancing information. Scientists therefore embrace analyses and overviews for information accumulation utilising the aforementioned instrument for measurable information. Then again, scientists in general make information claims dependent on productive viewpoints. The revelation is reinforced by analysts recommending that the quantitative strategy is deductive and positivist situated, while the subjective is viewed as inductive and constructionist. In spite of the fact that there are contrasts with respect to the examination technique, there is a need to look into moving past the distinctions to consolidate the two unmistakable methodologies (Bryman, 2003).

On procedures, Creswell (2009) maintains that the qualitative methodology embraces systems of request, including accounts, phenomenology and case studies. Quantitative methodology additionally utilises techniques, for example, explorations and overviews, for factual information utilising pre-set instruments. In investigating methodological choices, scientists are affected by the points of the examination and the kind of information required. Exploration study may embrace one of the two wide philosophies or join the two, as impacted by the research paradigm (Aigbavboa, 2013).

Mwanaumo (2014) cites Seymour and Rooke (1995) in their declaration that numerous things have turned out badly in the construction sector since learning has been overwhelmed by unbending methodological ideal models endorsing an evaluation and factual methodology. Further, they claim that inflexible methodology adversely influences pertinent issues that should have been tended for the business' advancement. They suggest the need to think about the two ways to deal with the limited assessment from one methodology. In this manner, the pressure and discussion in the epistemological, ontological, methodological, quantitative and subjective research are overcome, utilising blended strategies (Tashakkori & Creswell, 2007).

The use of qualitative data offers a point-by-point comprehension of an exploration issue while quantitative information brings about an increasingly broad comprehension (Creswell & Plano

Clark, 2011; Ngulube & Ngulube, 2015). Specialists are deciding on numerous examination systems as methodological pluralism gives better quality information than a solitary methodology (Creswell & Garrett, 2008; Ngulube and Ngulube, 2015). It employs methodologies of request that include gathering information, either continuously or consecutively, to best comprehend inquiry about issues (Creswell, 2009).

Teddlie and Tashakkori (2012) advocate for a blended strategy inquiry into using qualitative and quantitative methodologies in a single report. The current investigation, thus, employs a blended strategy approach, utilising both quantitative and quantitative techniques, widely known to be the best to address the exploration question and to provide the correct information and results. The blended technique is clarified in detail under the research methods section.

Combining Qualitative and Quantitative Approaches

A mixture of both quantitative and qualitative methods in studies has the full support of numerous writers: Tashakkori & Teddlie, 1998; Greene & Caracelli, 1997; Creswell *et al.,* 2003 and Flick, 2011. The two different approaches can complement each other, although differences may exist in practice (Tashakkori & Teddlie, 1998). Additionally, the utilisation of the two methods reinforces the field of study (Greene & Carcelli, 1997). However, some writers have criticised the use of the two methods in one research project: Smith 1983 and Smith & Heshusius, 1986. The arguments rest on the fact that, the two methods have various ontological and epistemological stances and separate paradigms (Bryman & Bell, 2007; Blumberg *et al.*, 2014). Some researchers also supported the combined use of quantitative and qualitative methods massively: Tashakkori & Teddlie 1998, Creswell *et al.*, 2003 and Bryman & Bell, 2007. According to Blumberg *et al.* (2014), the utilisation of the two methods strengthens the establishment and testing of the hypothesis.

The utilisation of both quantitative and qualitative methods in a research study is known as mixed methods (Bryman & Bell, 2007; Creswell *et al.*, 2003). The current research work employs a mixed methods approach.

6.2 Mixed-Method Approach

The mixed-method (MM) approach includes the gathering or investigation of both quantitative and qualitative information in a single report (Creswell *et al.*, 2003; Bryman & Bell, 2007). Additionally, Tashakkori and Teddlie (2003) characterise a MM inquiry as one that consolidates qualitative and quantitative ways of dealing with the exploration technique of a single report or a multi-staged examination. Information is gathered simultaneously, consecutively or by transformation according to the need and includes the coordination of the information, at least one phase of it, during the time spent in research (Tashakkori & Teddlie, 2003: 687; Creswell &Plano Clark, 2007: 85). As indicated by Flick (2011), Tashakkori and Teddlie (2003) propose MM as a third procedural development with quantitative and qualitative as first and second developments respectively.

A few components affect the accumulation and blend of quantitative and qualitative information in research. Consolidating both quantitative and qualitative information is progressively accessible for use for sociology examination. Additionally, on the grounds that every single separate strategy for information accumulation has impediments, the utilisation of MM can offset a portion of the hindrances of specific techniques (for example, the detail of qualitative information can give bits of knowledge not accessible through general quantitative reviews) (Jick, 1979). Subsequently, there is wide agreement that blending diverse techniques can fortify an investigation (Greene & Caracelli, 1997).

There are numerous methods for joining and presenting mixed method research (MMR) (Bryman & Bell, 2007). Hammersley (1996) explains three mixed approaches as triangulation, assistance and reciprocal. Bryman and Bell (2007) clarify that an open-finished or semi-organised subjective apparatus may be utilised to gather information, give topics, ideas and speculations and, after that, a quantitative strategy with the organised review device may be employed. Additionally, MM is utilised to help estimation as an inside and out subjective learning of social settings. It is also utilised to structure quantitative study questions. Moreover, in view of need and arrangement of the choice of the lead technique and primary information gathering apparatus, Morgan (1998b) recommends four methodologies. Flick (2011) states that there are two fundamental methodologies: joining techniques in subjective and quantitative research and a qualitative and quantitative investigation in a single report.

According to Edwards *et al.* (1998) in Bryman and Bell (2007), the qualitative technique is utilised to advise quantitative methodology. It takes facilitates access to members' viewpoints and implications on issues, while factors and topics are investigated. By utilising a subjective methodology, connections between factors are investigated with respect to cause and impacts. Along these lines, the specialist can recognise autonomous, reliant and interceding factors. This is valuable for the present investigation as it looks for the variables referenced above which are in charge of cost control practice. The cost control procedure likewise, impacts on the construction project cost delivery. Having decided the constructs and related-factors, a quantitative technique is used to assess the all-inclusive statement of the qualitative discoveries. The utilisation of a MMR is supported by numerous researchers (Bryman & Bell, 2007).

The MMR is regarded as one of the greatest creative and most broadly used research strategies to address difficult questions (Tashakkori & Teddlie, 2003; Cameron, 2009). Moreover, it is helpful in both exploratory and corroborative inquiries, which this proposition tries to accomplish. As indicated by Tashakkori & Teddlie (2003), request choice and applied hypotheses are the most basic and pertinent issues. They further recommend that, in MMR, both quantitative and subjective methodologies are viewed as either parallel/simultaneous or successive; information blending happens in the strategy area of the investigation. Further, information gathering and examination are not just imperceptibly blended. Following exhaustive typology studies, Tashakkori and Teddlie (2003) identify six unique kinds of multi-strand structures as observed in Table 6.1 below:

Table 6. 1: Mixed method approaches

Procedure	**Mixed method**	**Mixed method study**
Concurrent	Concurrent mixed method design	Concurrent mixed model design
Sequential	Sequential mixed method design	Sequential mixed model design
Conversion	Conversion mixed method design	Conversion mixed model design

(Source: Tashakkori & Teddlie, 2003; Cameron, 2009)

The procedures are concurrent, sequential and conversional, which applies to using mixed methods. This research study applies the sequential approach in establishing and settling on the variables, ideology and system that relate to cost control practice in the Ghanaian construction industry.

6.2.1 Justification for using the mixed method approach

The use of the mixed method curbs the weaknesses in theory, hypothesis and model development of both approaches (Bryman & Bell, 2007: Flick, 2011). It also helps to achieve the reliability of the data in a single research study (Tashakkori & Teddlie, 2003).

The prediction of the factors enhancing cost control practice in Ghana, requires knowing the influential variables. The experts in Ghana have determined the variables using a qualitative technique, as supported by Bryman (2003). The existing cost control theories of Abubakar (1992) and Charoenngam and Sriprasert (2001) were explored and confirmed by the experts. Researchers have supported the use of a small sample size, setting research objectives, data collection, open-ended questions and grouping the data to develop hypotheses in studies where a similar approach was used (Flick, 2011; Bryman & Bell, 2007; Bryman, 2003). The idea was to develop theories using qualitative means. The constructivist philosophy was applied to the study. This is in line with Creswell (2013). The Delphi qualitative survey technique was used for the concept of cost control practice.

The epistemology, ontology and paradigm positions impact on the choice of the research approach. A hypothesis has been developed, in which the researcher employs a positivist and deductive methodology, trusting that objectivity is basic for master request, learning is approximate and measurable information shapes learning (Creswell, 2013). The author views summing up discoveries and replicating the findings using a methodology without subjectivity judgement. A substantial number of circumstances, including a specific gathering and "hard information" for a top level of generalisability were estimated for unwavering reliability and validity. Both the dependent and independent variables were studied and used.

The quantitative data paves a way to deal with the hypothesis and speculations, to inquire about structure and estimation, to determine tests, accumulate information and examine discoveries (Bryman, 2007). The hypothesis and speculations created for the study utilises a deliberate direct way for the key factors and related factors of cost control practice, as well as the outcomes of cost control practice (Neuman, 2014). In this manner, the estimation, causality, speculation and replication were accomplished (Bryman & Bell, 2007). The mixed method technique was utilised in preference to either of the two normal methodologies. The investigation talks about planning, gauging, blending and estimating of the two methodologies (Creswell, 2003; 2009). The subject was investigated (qualitative) and issues created (qualitative). At that point, subjective information was examined, together with the quantitative information accumulated, and lastly, the hypothesis was approved using the quantitative information.

6.3 RESEARCH PROCESS

The current study concentrates on the factors that enhance cost control practice in the construction industry. Literature on cost control practice as cost management was extracted for the research process. The findings from the literature review led to the Delphi study to develop the theoretical and conceptual frameworks. Data collection was conducted in line with the research objectives set.

Existing theories on cost control practice have been elaborated and the key gaps have been identified. The relevant theory and theoretical underpinnings that stimulated this study provide the fundamentals to design the research strategy. The Delphi survey technique has been used to establish the main and sub attributes of what influences cost control practice to meet objectives three to five. The last stage is data collection which was conducted in the form of a survey questionnaire to meet objectives six to eight

The research process is summarised in Table 6.2 below:

Table 6. 2: Summary of research objectives and methods

Stage	Research Objective	Data Collection method	Data Analysis Method	Output
1.0	**RO1**: To establish the current theories and literature on cost control practice in construction with the view to identifying gaps for further studies	Literature review	Content Analysis	Information on current theories on cost control and gaps that have not been attended to and its related construct (factors)
2.0	**RO2**: To determine the main and sub attributes that influence cost control practice and examine whether the attributes that determine cost control practice in other cultural contexts are the same in Ghana	Delphi Survey Technique	Descriptive Statistics	Consensus on the influence and impact levels of the various attributes on cost control practice and factors that affect cost control practice precisely in the Ghanaian context
	RO3: To develop a holistic cost control conceptual framework for contractors in Ghana	Literature review, Delphi survey Technique	Theory	Holistic integrated cost control conceptual model developed for contractors
	RO4: To determine the organisational elements that influence cost control practice in Ghana.	Delphi Survey Technique	Descriptive Statistics	Consensus on organisational elements that affect cost control practice precisely in the Ghanaian context
3.0	**RO5**: To determine the cost control challenges for contractors in Ghana	Questionnaire Survey	Descriptive Statistics	Ranking critical challenges that affect cost control practice by contractors in Ghana
	RO6: To predict the factors that determine cost control practice for contractors in Ghana	Questionnaire Survey	Regression Analysis	Information to validate conceptual model; validate best-fit model

Source: Author’s construct

6.3.1 Data collection methods

Gathering and examining information require the determination of a suitable technique (Flick, 2011). Systems for information accumulation and examination were chosen to suit the arrangement of criteria for answers to the research questions: validity, reliability and replicability (Bryman & Bell, 2007). The works of Kumar (2005) and Agumba (2013) show that there are two broad ways to deal with information gathering about a concept or issue, in particular, primary and secondary information. The main part includes the accumulation of optional information through a writing survey of institutional resources, databases and online papers, including conference and journal papers. The use of the experience of the researcher also helps to achieve the collection of data.

This information has been used for hypothetical writing on the theme, observational writing about prior research and methodological research on the utilisation of the strategy (Flick, 2009). In addition, essential information was gathered through interviews, the Delphi survey and fieldwork survey reviews (See Figure 7.1). Denzin and Lincoln (2008) claim that a blend of techniques gives a better understanding when deciding on strategy. This examination chose a mixed method strategy in information accumulation at various stages.

6.3.2 Literature Review

The literature review part of a research study always becomes an integral part of the study

Neuman (2014) supports the notion that the literature review gathers knowledge relating to a particular field of study. The current state of cost control practice was reviewed. It was gathered from existing textbooks such as Harris and McCaffer, (2013). In addition, the PMBOK cost control was also used. The steps in getting the relevant literature proposed by Boote and Beile (2005) have been used. These are:

(1) A search for wide titles, keywords and abstracts with words like 'cost management', 'cost control', 'project cost management', 'pre-cost control', and 'post cost control' through the electronic databases because this platform has a large collection of texts and therefore, provides a more extensive coverage of texts than of individual journals.

The electronic databases used include: Google Scholar, Google search engine, Ebscohost web of science (ISI) and Engineering value (EV). Different papers identified as relevant were scanned with the keywords above. The papers include research articles that principally focus on cost control practice, as well as others that relate to cost control practice.

(2) An appraisal of the abstracts of these papers was conducted to sieve out the less related

papers. This was carried by means of selecting technical papers and reviews, eliminating duplicate articles and ignoring papers which were not directly related to the topic of the study.
(3) All the outstanding papers were read, analysed and numerous descriptive words were identified. The parts of the paper that relate to cost control were singled out for further examination.
(4) Writing the literature review chapters

The literature reviewed enabled the researcher to gather cost control theories, revelations of other theories and gaps and to establish the factors that determine cost control practice in the construction industry, from both international and African perspectives. This led to the development of variables relating to the Ghanaian construction industry through the Delphi process.

6.3.3 DELPHI SURVEY TECHNIQUE

The Delphi Survey Method developed over the past decades. The Delphi method is defined by Linstone and Turoff (1975) as *a method for structuring a group communication process so that the process is efficient in allowing a group of individuals, as a whole, to deal with a critical problem.* Delphi surveys attempt to bring out responses to the question 'what?' as well as to 'what could be or what should be?' (Miller, 2006; Hsu & Sandford, 2007).

6.3.3.1 Delphi process

The Delphi survey process is conducted in three different rounds (Keeney *et al.*, 2011). Ameyaw *et al*. (2016) explain the rationale for every round as follows: round one is to solicit ideas about a particular field of study in open-ended questions for expert members, round two is to question the panelists to grade the variables of the study in line with their experience, and the last round , requires that the panelists reconsider the evaluations from the assessment of the outcomes from the second round, although other rounds may continue until a consensus is reached by the panelists to meet some necessity. However, the literature extracted from the review may serve as round one and the researcher may go to the second round directly. Thus, the Delphi survey can be done in two rounds with the literature review as round one (Ke *et al.*, 2011; Hon *et al.*, 2012).

The Delphi process used follows that described by Hallowell & Gambatese (2010) and illustrated in Figure 6.2 below. The various stages are: to identify the research question, to identify potential experts, to select experts based on predetermined criteria, to validate expert status and to inform panelists of the study requirements, to develop a questionnaire using ways of minimising biases, to transmit the survey to the specialist panel, to collect and analyse round responses, to evaluate the consensus, to report feedback and build feedback for panelists of subsequent rounds, until consensus is achieved.

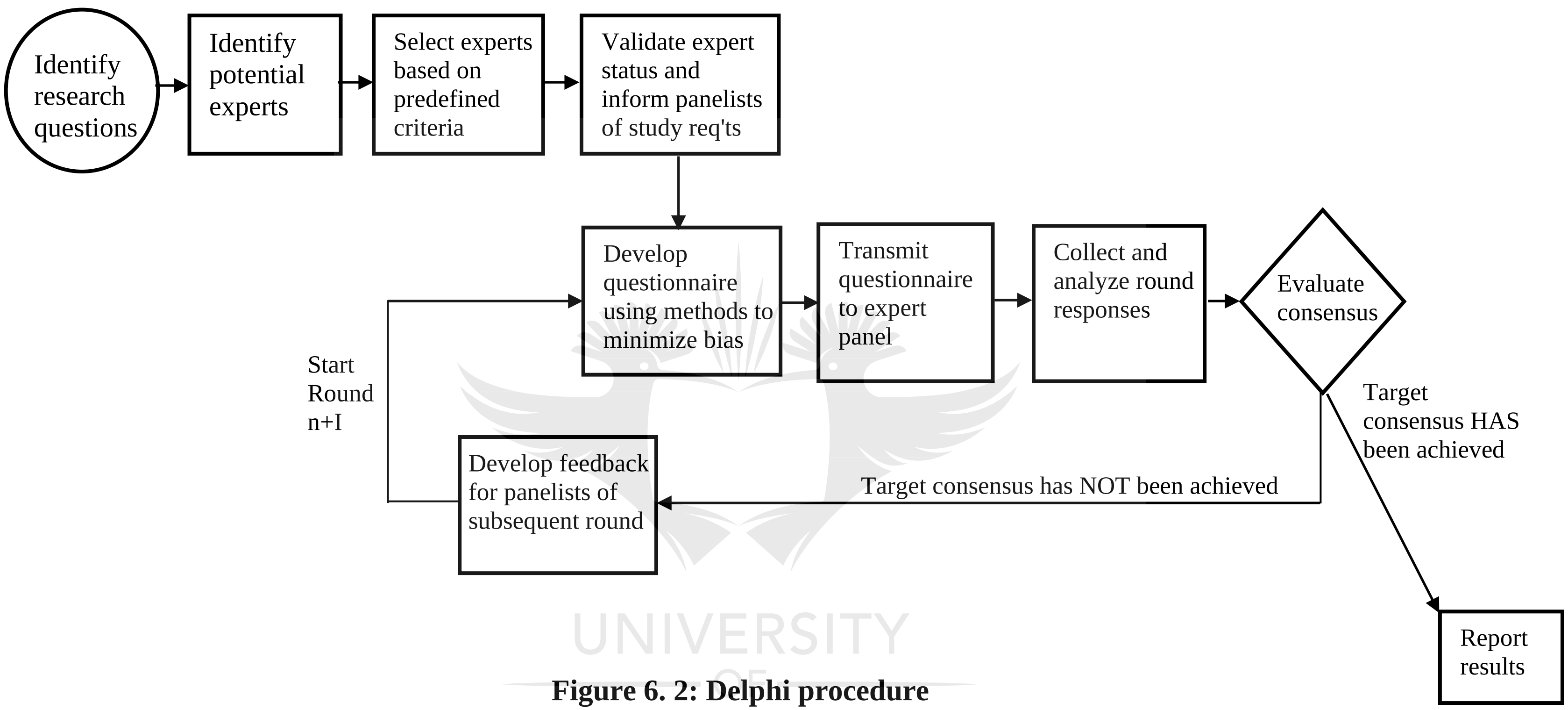

Figure 6. 2: Delphi procedure

Source: Hallowell & Gambatese (2010)

6.3.3.2 Experts in Delphi

A definition of expert has been discussed at length by researchers (Rogers & Lopez, 2002; Adler & Ziglio, 1996; Dalkey & Helmer, 1963). It is clear from the literature that an ‘experts’ knows a particular field through academic qualification and working experience in the industry. The construction industry is no exception (Rogers & Lopez, 2002; Adler & Ziglio, 1996; Dalkey & Helmer, 1963). Knowledge can be acquired or demonstrated through forums, seminars, conferences and workshops. There are always avenues for continuous professional development in the industry (Rogers & Lopez, 2002; Adler & Ziglio, 1996; Dalkey & Helmer, 1963).

Veltri's (1985) flexible points system is set in the area of knowledge and working experience for the expert to meet the set criteria. The measures include academic qualification, conferences/journal papers, years of working experience, professional body registration and professional practice, book or chapter publications and level of management position. The flexible points for selecting the experts were used for the study, as suggested by Hallowell and Gambatese (2010).

Experts must score a minimum of eleven points from four compulsory areas to qualify to participate in the study (Hallowell & Gambatese, 2010). The four compulsory areas are: academic qualification, professional body registration, at least five years of experience, and being a member of a project committee in the Ghanaian construction industry. The key points set are: membership of a professional body, years of professional experience, conference presentation, member of a committee, chair of a committee, peer-reviewed journal article, faculty member at an accredited university, writer or editor of a book, writer of a book chapter and an academic qualification of at least a Bachelor's degree (Hallowell & Gambatese 2010). Refer to Table 6.3 below for the flexible point system:

Table 6. 3: Flexible point system to qualify as expert

No.	Requirements	Score
1	Professional body registration	3
2	Years of professional experience	1
3	Conference presentation	0.5
4	Member of a committee	1
5	Chair of a committee	3
6	Peer-reviewed journal article	2
7	Faculty member at an accredited university	3
8	Writer/editor of a book	4
9	Writer of a book chapter	2
10	Academic degrees Doctorate Masters Bachelor	 4 2 4
	Minimum score to qualify	**11**

Source: (Hallowell & Gambatese, 2010)

6.3.3.3 Number of experts

The required sample size of experts for the Delphi process is influenced by factors that include scope of the study, size of the problem and the resources available (Hallowell & Calhoun 2011; Manoliadis *et al.*, 2006; Chan *et al.*, 2001; Hasson *et al.*, 2000). Researchers have made recommendations for the sample size. According to Ameyaw *et al.* (2016), it ranges from 3 to

93 where most research works have a sample size of between 8 and 20. A study by Hallowell and Gambatese (2010) suggests 8 to 12 experts. Thus, fourteen (14) experts were used for this study with the expectation that some of them might drop out by not meeting the minimum criteria set for selecting the experts. Surprisingly, all the 14 experts contacted qualified for the Delphi survey. This is shown by Table 6.4 below.

Table 6. 4: Experts' backgrounds

No.	**Requirements**	**score**	**Experts' backgrounds**													
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	Professional body registration	**3**	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2	Years of professional experience	**1**	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	Conference presentation	**0.5**		0.5					0.5					0.5		
4	Member of a committee	**1**	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	Chair of a committee	**3**	3					3		3			3	3		3
6	Peer-reviewed journal article	**2**					2				2	2				
7	Faculty member at an accredited university	**3**	3	3		3	3		3	3			3	3		
8	Writer/editor of a book	**4**														
9	Writer of a book chapter	**2**		2	2			2			2				2	2
10	<u>Academic degrees</u> Doctorate Masters Bachelor	**4** **2** **4**	2	4	4	4	2	2	4	4	2	4	2	2	4	2
	Minimum score to qualify	**11**	**13**	**14.5**	**11**	**12**	**12**	**12**	**12.5**	**15**	**11**	**11**	**13**	**13.5**	**11**	**12**

6.3.3.4 Delphi analysis

The five-point Likert scale can be used for the Delphi survey as well as the 10-point. The 10-point scale has been widely used by researchers (Amoyaw, 2016; Aigbavboa, 2013). The 10-point Likert scale was used to analyse the data for this study. The levels of impact were 'very high impact', to 'no impact', where, 1-2 is 'no impact', 3-4 is 'low impact', 5-6 is 'medium impact', 7-8 is 'high impact' and 9-10 is 'very high impact'. Table 6.5 illustrates the range and various percentages.

Table 6. 5: Probability scale (likelihood in percentages)

1-10%	11-20%	21-30%	31-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100%
1	2	3	4	5	6	7	8	9	10

Descriptive statistics, in the form of mean or median, was used for the round two results. This is according to the recommendations of Amoyaw *et al*. (2016). The means and SDs show that there is agreement among the variables (Rayens & Hahn, 2000). The inter-quartile deviation (IQD) was used in the Delphi survey to achieve consensus (Aigbavboa, 2013; Rayens & Hahn, 2000; Hallowell & Gambatese, 2010). Other works also use percentages to achieve consensus (Olawale & Sun, 2015: Hallowell & Gambatese, 2010). The inter-quartile deviation (IQD) was used to assess the consensus criterion. If IQD of 2 of the 10-point scale, means that there is consensus (Von der Gracht, 2012; Von der Gracht & Darkow, 2010; Gracht, 2012), it also indicates that IQD of 0.00 to 1.00 ($0.00 \leq IQD \geq 1.00$) is a strong consensus, while IQD greater than two ($IQD>2$) is a weak consensus. The cut off point for IQD is ($IQD \geq 2.1 \leq 3$) (Von der Gracht, 2012; Von der Gracht, & Darkow, 2010).

6.3.3.5 Delphi Survey Design

The main aim of conducting the Delphi was to seek for factors and sub variables in the field of study, in the absence of a model to test (Adler & Ziglio, 1996; Skulmoski & Hartman 2002). Based on that, open- and closed-ended questions were set for the experts, to assist developing the factors and variables which might influence cost control practice in the Ghanaian construction industry. Refer to *Appendix 1 and 2* for the Delphi survey questions.

The initial step was to extract an extensive literature review for round one. It was structured in the main constructs (factors) of cost control practice. It is followed by the related factors of each construct. There is also a section that deals with the organisational elements and outcomes of cost control practice.

6.4.3.6 Reliability and validity of the Delphi process

As indicated by Creswell (2014) and Els and De la Rey (2006), "Reliability is the degree to which a strategy produces comparable outcomes under consistent situations consistently." This sort of factual reliability is not suited to a Delphi survey on the grounds that experts may achieve different ends, contingent upon their insight into the branch of knowledge and intrigue. Attention was paid to credibility which appeared in honesty. Fittingness was displayed in relevance, checking was evident, evenness and comparability were shown in the reactions of all members to achieve dependability. Validity was guaranteed through the choice of the experts. All expert or specialist individuals separated themselves, dependent on the set criteria for the choice of experts of specialists, the profundity of their insight and experience, as introduced in Table 6.4. Validity was ensured by the expulsion of previously established inclinations or impacts of different individuals by keeping all individuals totally unknown from each other and henceforth, taking out the 'fleeting trend' impact, which is one of the qualities of the Delphi strategy.

The internal legitimacy of the experts was improved through the quantity of emphases that involved in the Delphi survey. In this manner, the professionals were allowed to change their assessments or keep them up with a composed clarification or contention for contradicting ideas. Reactions to the researcher's including persistence correspondence among the experts was another method of guaranteeing inside legitimacy of the investigation.

The external validity of an examination manages the degree to which the outcomes from the investigation can be extrapolated to a bigger populace. This is generally dictated by how members are chosen to be a part of the investigation. The choice of members for the Delphi survey ensured external validity as a logical criterion. The board contained individuals from different areas, all with inside and outside learning on practical development. Every one of the individuals from the board of specialists lived in one of the significant urban communities in Ghana. They were exceptionally experienced, with sound working backgrounds. The investigation along these lines satisfied the necessities for external validity in accordance with standard research morals.

6.4 QUESTIONNAIRE SURVEY

The use of a questionnaire survey in studies forms an essential section which influences the results of the studies (Sekaran & Bougie, 2016; Bryman, 2009; Trochim, 2005). The questionnaire survey method is used to seek for information from large clusters of industry players or samples of the population (Creswell, 2013; Pinsonneault & Kraemer, 1993). It is for this reason, that the study collected quantitative data through a well-structured questionnaire to gather views of industry players about cost control factors as presented in *Appendix 3*. It was administered personally, and also through the use of electronic media. This is supported by Sekaran & Bougie, 2016.

The questionnaire survey was designed in three main sections and included a cover letter. The sections are as follows:

Section A: is the first part of the questionnaire which deals with the respondents' backgrounds. It elicits general information about the respondents, such as class of the company, region in the country (Ghana) of operation, how long the company has been in operation, highest qualification, nature of the business, the key person who undertakes project cost control, working experience in the company, category of project usually undertaken, category of project duration and when cost control systems are normally prepared.

Section B: focuses of factors influencing project cost control practice. The factors that influence project cost control practice related to project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis, decision-making, project cost communication and change management. A part of the questionnaire was designed to examine the influence of the identified constructs on successful outcomes of cost control practice in the construction industry.

Section C: investigates application and challenges of project cost control practices. The software used for cost control was identified and presented in this section in relation to the extent of usage. Cost control techniques used were identified for industry players to evaluate the extent of their application. The challenges affecting cost control practice were presented for data collection.

The five-point Likert scale, indicating the extent to which the respondents agree with the factors that influence successful outcomes of cost control in the construction industry, was used.

In all, 123 questions were set to be answered by the respondents. The setting of the wording and the technical principles follow those of Sekaran & Bougie (2016), who proposed that:

• the substance of the inquiries ought to be suitable;

• questions ought to be worded utilising basic and effectively comprehended dialect;

• appropriate sort and shape be utilised;

• grouping of the inquiries and

• the specific information looked for from the members ought to be considered all around.

Along these lines, to accomplish the above standards, this examination utilised the ordinal scale, as it looked for target research objectives. Openheim (2003) further adds that the questions should be clear, simple and short, unbiased and easy to answer, and analysed to accomplish the research objective.

6.4.1 The measurement variables

The data collection for this study was required to measure the variables comprising: Project Cost Estimation (PCE); Project Cost Budgeting (PCB); Project Cost Reporting (PCR); Project Cost Analysis (PCAN); Project Cost Monitoring (PCM); Decision-Making (DM); Change Management (CM); Project Cost Communication (PCCM) and Outcomes of Cost Control (OCC).

These factors were conjectured to be portrayed by indicator variables, which restoratively comprised the survey responses separated from the respondents' and firms' qualities, which were likewise measured by the survey questionnaire. A thorough summation of the latent and indicator factors is introduced in Table 6. 6 below:

Table 6. 6: Conceptual model indicator variables

Latent variable construct	**Measurement variables**
Project Cost Estimation (PCE)	Appropriate method of estimation Standard procedure for estimation Experience of the estimator Available project information Available cost indices Conducting market survey Provision of standard tender documentation Availability of client financial management plans Firms' bidding strategies Use of local work force Unpredicted weather conditions Flooding of the site Air pollution Water pollution Erosion from road construction Disposal of hazardous waste
Project Cost Budgeting (PCB)	Allocation of activity budget Negotiation of the main budget

	Approval of master and functional budgets Establishing a realistic working budget Periodic revision of the budget Ensuring that project team members understand the budget
Project Cost Reporting (PCR)	Planning for the cost report Developing various types of cost control report Reporting cost variances from analysis Distribution of the cost control reports to appropriate sections Reporting on feedback or actions taken
Project Cost Analysis (PCAN)	Collection of relevant and detailed cost data Calculating actual project cost Comparing budgeted cost with actual cost Comparing actual cost with forecast cost Analysing cost variance Identifying causes of cost overrun Updating cost status of the project
Project Cost Monitoring (PCM)	Planning milestone monitoring process Selection of appropriate technique for cost monitoring Selecting appropriate tools for tracking project cost Monitoring cost data (material, labour, plant, overheads, subcontractor cost, etc.) Cost data verification Monitoring cost performance Monitoring updated cost records Monitoring reported cost information Detecting early warning signs Identifying cost changing factors Provision of manuals for site monitoring team to refer to Training site personnel in monitoring process
Decision-Making (DM)	Identifying the root/main cause of the cost variances Analysing the problem Categorising the causes of the problem Developing alternative measures for cost variances Selection of the relevant corrective measures Implementation of the selected measures Evaluation of the corrective measures used
Change Management (CM)	Establishing the sense of urgency for change Developing a vision for cost change Developing strategies for cost change Designing a short-term success plan Promoting a balanced change Implementing the change Evaluating the change

	Continuous improvement from lessons learnt Empowering others to act on the vision Selecting appropriate leadership style Motivating for change
Project Cost Communication (PCCM)	The context of communication (adopted) in the organisation Form of communication (adopted) within the organisation (verbal, written) Identification of the sender and receiver Formulating a clear message Appropriate methods of communication (emails, text messages, etc.) Clear communication activity Appropriate feedback channel Standardisation of communication documents Access to information Reduction of barriers to communication
Outcomes of cost control (OCC)	Achieving accurate cost information for decision making Establishing project cost outcome (profit/loss) Obtaining historic cost data for future projects Enhancement of the targeted profitability Prevention of wasted resources Increased efficiency of work

Source: Author created from the literature review and Delphi survey

6.4.2 The data collection

The point of convergence and an imperative part of the examination procedure is to respond to the research objectives set for this investigation. The methods through which this is accomplished lie in the information gathering process. Effective execution of the information gathering process envelops various exercises which are embraced preceding, amid and after the data collection. Creswell (2009) and Yin (2009) list a large range of exercises, including the distinguishing proof of reasonable and potential respondents, the foundation and depiction of the fitting examining outline, the medium and the method of leading the survey work and, lastly, how the information gathered is obtained, altered, coded and broken down.

The understanding of the information gathering process has an extremely important place in every study, as this is basic to streamlining and enhancing the legitimacy and the dependability of the data collection process (Azmy, 2012; Liu, 2009; Xie, 2002). The statement by Creswell (2009) and Openheim (2003) that the nature of research discoveries is dictated by the nature of information gathered, legitimises the endeavours that must be made to expand the validity and reliability of the information gathered. For this obvious reason, the information gathering process comprises the steps, which are displayed in the following areas:

6.4.2.1 Study respondents' identification

An issue of basic significance in the data collection is the person who is suitable to partake in the activity (Bryman, 2009; Cresswell, 2009). It is basic, in light of the fact that the reasonableness and fittingness of respondents in the information accumulation process expands both the validity and reliability of the outcomes. That contention underlines the fact that the recognisable proof of the certified population for this examination, is actually needed.
The fundamental aim of the examination seeks to investigate cost control practice at the construction stage. This brings construction firms to the focal point of the investigation. The top management team members who handle cost control issues were used because such people established the unit of investigation, given that they are bound to precisely better appraise and assess through their reactions to the promotion of exercises in the activities of cost control.

6.4.2.2 Sampling frame determination

It is important to recognise the certified population for this examination. It is constantly emphasised that examining is important in any exploration because of the imperatives of time, cost and comfort (Cresswell, 2009). The respondents chosen show that top class contractors (D1K1 and D2K2) are the fundamental members of this examination. These contractors' different management levels deal with cost management and, for that matter, cost control as well as good organisational structure with core cost management functions (Cicmil & Nicholson, 1998; Yisa *et al.*, 1995).
Neuman (2006) and Cooper and Schindler (2006) characterise an examination population as alluding to the whole gathering of objects in which the researcher is interested. The population for this investigation comprises all the top-class contractors in Ghana (D1K1 and D2K2). The size of the population for the examination was conducted on those operating in the urban areas in Ghana (Accra and Kumasi). The work by Kyei, (2014) points out that the population of the D1K1 and D2K2 contractors in Accra and Kumasi, who are registered with the Ministry of Works, Housing and Water Resources, is 604. The urban communities are situated in the Greater Accra and Ashanti Regions of Ghana, the two largest cities in the country. Contractors with live projects were contacted, firms with the most recent ten years registration with the

Ministry of Works, Housing and Water Resources. The firms were selected using purposive sampling. This sampling technique was considered appropriate because it allows the researcher to sample respondents who have knowledge and experience in the field of study to meet the research aim (Kyei, 2014; Etikan *et al*., 2016).
Research assistants were trained to assist in the data collection.

6.4.2.3 Sample size determination

A sample size is a subgroup formed from a population for the collection of data (Sekaran & Bougie, 2016; Field, 2009). There are other factors that are required in the consideration of the suitable number of respondents to be used in a research work (Neuman, 2006; Malhotra, 1999). Some of these factors include the nature of the data, the accuracy of the sample size and features of the population (Neuman, 2006). Malhotra (1999) further adds that the data analysis method used for the study also affects the suitability of the sample size.

This study uses the data analysis techniques in the determination of the sample size. Regression analysis, according to Nunnally (1978), recommends a sample size of 300 – 400. This is a reasonable size to predict variables for multiple regression analysis. Scott (2000) suggests that a sample size of at least 150 be used for regression analysis. Most researchers justify this. The sample size becomes appropriate when researchers match the sample size to the predictor's method (Scott, 2000; Knofczynski & Mundfrom, 2008). Knofczynski and Mundfrom (2008) established that the minimum sample size for good prediction is 100 for all predictors and they recommend that for excellent prediction, the sample size for 7 predictors should be 280, while for 9 predictors, it should be 350. A ratio of 10:1 for sample size to predictor has been argued and is considered sufficient (Scott, 2000; Miller & Kunce, 1973). The minimum sample size for this study is three hundred (300). Three hundred and sixty (360) questionnaires were distributed and three hundred and ten (310) were retrieved. This is a good response rate.

6.5 DATA ANALYSIS

All the completed questionnaires were analysed. This indicates that not only the positive responses were analysed, as researchers need to avoid reporting only positive or negative responses. There is, therefore, the need to report all the responses from the fieldwork survey (Creswell, 2013). In all, 310 questionnaires were collected and 10 were found to be incomplete. Thus, 300 completed questionnaires were analysed, using SPSS version 25 with the help of the Statistical Department of the University of Johannesburg. The analysis was performed in three stages: (1) descriptive statistics, (2) factor analysis and (3) regression analysis.

6.5.1 Descriptive statistics

The descriptive statistics provide a general overview of the quantitative data and define the key characteristics of the entire sample (Ko, 2015; Naoum, 2007; Mann, 2006). Descriptive statistics presents results in the form of frequencies, percentages, means and standard deviations. All the sections of the questionnaires were analysed using the descriptive statistics from the SPSS output results.

6.5.2 Factor analysis

Factor analysis endeavours to recognise basic factors, or factors that clarify the example of relationships inside as set of related factors (Rehbinder, 2011; Conway & Huffcutt, 2003). In addition, factor analysis is also use in information decrease to recognise the few factors that clarify most of the differences seen in a larger number of factors (Rehbinder, 2011; Conway & Huffcutt, 2003). The reason for information decrease is to evacuate excess or very related factors from the information (Rehbinder, 2011).

In the current study, the principal components of the factors were analysed to explore the factors (EFA) and later to confirm the factors (CFA). The KMO, Bartlett's test of sphericity approx. chi-square, df at the significance of .000, was used to measure the significance level of the variables in each construct (Byrne, 2013; Field, 2009). The KMO value set was 0.6, although all the KMO values exceeded the limit. The Cronbach's alpha was set at 0.7 to test for the reliability of the data 7 (Pallant, 2013; Khine, 2013; Kline, 2010). All the factors had Cronbach's alpha above 0.7. The communality and anti-image matrices tests were conducted. The factor loading with communalities below 0.3 dropped. The pattern matrix, scree plots and the total variance explained were conducted. The result of the factor analysis is presented in chapter 10 of this study.

6.5.3 Regression analysis

Regression analysis depicts and assesses the inter-connections between the dependent and independent variables. Regression analysis is used to affirm or disconfirm the chosen hypothesis of the study (Rehbinder, 2011).

Regression analysis was first conducted by checking the normality test for the constructs. In addition, the ANOVA and regression coefficient results were conducted and are presented in Chapter 10 of this study.

The multiple linear regression method was applied for the study, since there is more than one predictor (Fellows & Liu, 2008). The regression examination relates changes in the dimensions of *y* to changes in dimensions of *x*. The multiple linear regression estimates the anticipated result variable *y* is seen as relying upon the catch on the y-hub, and the estimations of the indicator factors *x1, x2, x3, xk* and so on, multiplied by a coefficient *β* picked, practically speaking, in order to minimise the total of the squared errors between the anticipated and received estimations of *y*. A term *c* is added to depict the disparity between a specific estimation of y and the anticipated y figure (Fellows & Liu, 2008).

Hence, for two indicator factors, *x1* and *x2*, the condition is:

$$y = \alpha + \beta 1x1 + \beta 2x2 + c \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 7.1$$

6.6 ETHICAL CONSIDERATIONS

Ethics are considered in studies to decide the best possible way of conducting the examination. This exploration has adhered to its duty to secure the interests of the study respondents. With respect to the overview respondents, nobody was compelled to provide answers to the questions used in this study. The respondents were solicited to take part in the investigation of their personal will. They were made aware of their right not to take part in or to withdraw from the investigation if they so wished. Likewise, they were advised about the motivation behind the examination and how or why they were selected. All things considered, they were free from any misinformation or stress resulting from their cooperation in this exploration. Further, the respondents were assured of anonymity and that all data that might reveal their identity would be held in strict confidence.

6.7 CONCLUSION

This section of the studies presents and discusses the approaches employed in this examination to accomplish the research objectives. Further, the rationale for using any aspect of the research design is elaborated. The mixed method approach was considered necessary for this study through the use of the literature review, Delphi survey and quantitative fieldwork.

The questionnaire with the various sections is also presented. The data analysis is grouped under descriptive analysis, factor analysis and regression analysis.

The reliability and validity of the model measures are considered.

CHAPTER SEVEN

DELPHI SURVEY RESULTS AND DISCUSSION

7.0 INTRODCTION

The chapter presents the background of the Delphi survey, findings of the Delphi survey, discussion of the Delphi survey results and the conclusions, based on the objectives set for undertaking the Delphi survey.

The Delphi survey technique was used to solicit the views of experts on cost control factors applicable to the Ghanaian construction industry. Thus, identifying the determinant attributes that influence cost control practice. The experts' backgrounds and formation are also presented in this chapter. The level of influence (probability) each factor has on cost control practice was based on their knowledge and work experience. The results of the three rounds were analysed using median, mean, SD and IQD. The consensus reached for the factors is also presented.

7.1 THE BACKGROUND OF THE DELPHI SURVEY

The six specific objectives set for the Delphi survey are outlined as follows:

DS01: To establish the attributes (main and sub) that determine the practice of cost control and to examine whether these factors influencing cost control practice in other cultural locations are the same in Ghana.

DS02: To confirm or otherwise whether the factors seen as gaps from the literature review influence the practice of cost control.

DS03: To determine the elements of organisational structure that affect cost control practice.

DS04: To determine the elements of organisational culture that affect cost control practice.

DS05: To determine the elements of ICT tools and knowledge that affect cost control practice.

DS06: To evaluate project cost control output as a result of the practice of cost control.

The above objectives were defined to focus the conversation about cost control practice in the Ghanaian construction industry. This led to the identification and determination of both the primary and connected factors of PCC. Additionally, the Delphi process lead to a PCC conceptual framework that is holistic in its nature.

Fourteen experts were invited and all the experts agreed to participate in the Delphi survey process. The motivation in selecting 14 experts was that if some dropped out, the number would still be within the proposed size of 8-12. Hallowell and Gambatese (2010) suggest that the number can be 8-12 experts. However, all the 14 experts who were approached participated, representing 100% response rate. The four main mandatory criteria used in selecting the experts were: academic qualifications, work experience, professional body affiliation and residence area or geographical location. The experts' backgrounds were balanced with academic and industrial experience, choosing participants who worked in the field of construction project cost.

The survey method used was questionnaire. The extraction of groups of primary and related factors with relevance to cost control practice, was presented from a detailed literature review which served as round one for the Delphi process. Closed- and open-ended questions were used in round one. The rationale behind the second round was to give the experts a chance to review, comment, approve or reject, simplify the proposed main and sub attributes that determine cost control practice in the Ghanaian construction industry.

The outcome of the round two showed that the professionals were all in agreement and that led to round three to finalise the dialogue to a stage where clear points were achieved and consensus could be reached. Consequently, round four was redundant. Descriptive statistics in the form of median, mean, SD, IQD were used to analyse the data and reach consensus.

Consensus was attained at the end of round three of the Delphi survey technique relating to the primary and related factors that form cost control practice in Ghana. The factors identified confirmed that a new conceptual framework is required for a comprehensive study. This was in line with the objectives set for the Delphi survey technique.

7.2 FINDINGS OF THE DELPHI STUDY

The findings of the Delphi survey are presented by each objective set to achieve the cost control main and sub attributes.

DS01*: To establish the attributes (main and sub) that determine the practice of cost control and to examine whether these factors influencing cost control practice in other cultural locations are the same in Ghana.*

Table 7. 1: Key factors of cost control

CODE	MAIN FACTORS	M	MEAN	SD	IQD
PCE	Project cost estimation	9	9.07	0.73	0.75
PCB	Project cost budgeting	10	9.00	1.62	1.00
PCM	Project cost monitoring	10	9.21	1.31	1.00
PCAN	Project cost analysis	9	9.29	0.61	1.00
PCR	Project cost reporting	9	9.14	0.53	0.00
DM	Decision-making	9	9.29	0.61	1.00

Table 7.1 above illustrates the main attributes of cost control practice. The medians and means of the attributes attained high scores. The medians were between 9 - 10 with means of 9.00 - 9.29 and IQD scores of between 0.00 - 1.00. All the six (6) main attributes namely '*Project cost estimation*', '*Project cost budgeting*', '*Project cost monitoring*', '*Project cost analysis*', '*Project cost reporting*' and '*Decision-making*', have very high impact (VHI 9.00 -10.00) in the determination of the cost control practice. All the attributes have strong consensus with IQDs of up to 1.00 (IQD≤1.00).

Table 7. 2: Project cost estimation related factors

CODE	RELATED FACTORS	M	MEAN	SD	IQD
PCE 1	Appropriate method of estimation	9	9.14	0.53	0.00
PCE 2	Availability of cost indexes average	9	8.21	1.63	1.00
PCE 3	Experience of the estimator	9	9.14	0.53	0.00
PCE 4	Standard procedure for estimation	8	7.93	1.07	0.75
PCE 5	Appropriate method for contingency sum determination	8	7.57	1.16	1.00
PCE 6	Availability of productivity standards	10	8.93	1.59	1.00
PCE 7	Conducting market survey	10	9.21	1.31	1.00
PCE 8	Calculating the unit rates for the project	10	9.21	1.31	1.00
PCE 9	Provision of standard tender documentation	9	8.14	1.88	1.00
PCE 10	Converting the estimates to tender	9	8.14	1.88	1.00
PCE 11	Method of construction	10	9.21	1.31	1.00
PCE 12	Complexity of the project	8	7.57	1.22	0.75
PCE 13	Site constraints (site conditions)	8	7.93	1.07	0.75
PCE 14	Client financial position	9	8.14	1.88	1.00
PCE 15	Location of the project	10	9.21	1.31	1.00
PCE 16	Type of contract	8	7.93	1.07	0.75
PCE 17	Duration of project	8	8.07	1.00	0.00
PCE 18	Content of project specification	9	8.50	1.40	0.75
PCE 19	Quality of firm's planning principles	8	7.93	1.21	0.75
PCE 20	Quality of firm's management strategy	8	7.50	1.29	0.75
PCE 21	Attitude towards change	8	8.07	1.00	0.00

PCE 22	Nationality of labour	10	9.21	1.31	1.00
PCE 23	Social impact	8	7.64	1.22	0.00
PCE 24	Culture impact	8	7.57	1.16	1.00
PCE 25	Environmental issues	8	7.93	1.07	0.75
PCE 26	Identification of number of competitors	10	8.93	1.59	1.00
PCE 27	Level of competition	5	5.07	2.64	3.50
PCE 28	Time availability before bid opening	5	5.07	2.64	3.50
PCE 29	Accuracy of bidding documents	8	7.86	0.86	0.00
PCE 30	Accuracy of estimated cost	8	7.57	1.22	0.75
PCE 31	Current exchange fluctuation average	9	8.14	1.88	1.00
PCE 32	Availability of financial management plans	8	7.50	1.29	0.75
PCE 33	Punctuality of periodic payment	8	8.07	1.00	0.00
PCE 34	Inflation pressure	8	7.64	1.22	0.00
PCE 35	Economic instability	8	7.64	1.22	0.00
PCE 36	Uncertainty of taxes	8	7.57	1.22	0.75
PCE 37	Knowing the state of the market	10	9.21	1.31	1.00

Of the 37 factors identified (refer Table 7.2), eight factors, namely, '*Appropriate method of estimation*', '*Experience of the estimator*', '*Conducting market survey*', '*Calculating the unit rates for the project*', '*Method of construction*', '*Location of the project*', '*Nationality of labour*' and '*Knowing the state of the market*' have very high impact (VHI 9.00 -10.00). Twenty-seven factors have high impact (HI 7.00 - 8.99) for cost control practice. Thirty-five related factors of project cost estimation have strong consensus with IQDs of up to 1.00 (IQD≤1.00). Only two related factors of project cost estimation dropped out, namely '*Level of competition*' and '*Time availability before bid opening*'. Consensus (IQD≥3.0) was not reached for these factors, although they scored medium impact (MI 5.00 – 6.99).

Table 7. 3: Project cost budgeting related factors

CODE	RELATED FACTORS	M	MEAN	SD	IQD
PCB 1	Allocation of activity budget	9	8.50	1.22	1.00
PCB 2	Negotiation of the main budget	8	8.14	1.35	1.00
PCB 3	Approval of master and functional budgets	8	7.36	1.39	1.00
PCB 4	Establishing the realistic working budget	8	7.50	1.56	0.75
PCB 5	Periodic revision of the budget	8	7.86	0.86	0.00
PCB 6	Ensuring that project team members understand the budget	9	8.50	1.40	0.75

Table 7.3 above indicates the related factors of project cost budgeting for cost control practice. The medians and means of the attributes attained high scores. The medians were between 8 – 9, with means of 7.36 – 8.50 and IQD scores of between 0.00 - 1.00. All the six related factors have high impact (HI 7.00 – 8.99) in the determination of the cost control practice. All the six related factors of the PCB have strong consensus with IQDs of up to 1.00 (IQD≤1.00).

Table 7. 4: Project cost monitoring related factors

CODE	RELATED FACTORS	M	MEAN	SD	IQD
PCM 1	Planning milestone monitoring process	10	9.21	1.31	1.00
PCM 2	Selection of appropriate technique for cost monitoring	9	8.07	1.77	1.00
PCM 3	Selecting appropriate tools for tracking project cost	9	8.43	0.65	1.00
PCM 4	Monitoring cost data (material, labour, plant, overheads, subcontractor cost, etc.)	10	9.21	1.31	1.00
PCM 5	Cost data verification	9	8.43	1.28	0.75
PCM 6	Monitoring cost performance	10	9.21	1.31	1.00
PCM 7	Monitoring updated cost records	9	8.36	1.28	0.75
PCM 8	Monitoring reported cost information	9	8.79	0.97	0.00
PCM 9	Detecting early warning signs	9	8.36	1.28	0.75
PCM 10	Identifying cost changing factors	9	9.14	0.53	0.00
PCM 11	Provision of manuals for site monitoring team to refer to	9	8.43	0.65	1.00
PCM 12	Training of site personnel in monitoring process	9	9.14	0.53	0.00

Table 7.4 above indicates the related factors of project cost monitoring for cost control practice. Of the 12 factors identified, four factors, namely, '*Planning milestone monitoring process*', '*Monitoring cost data (material, labour, plant, overheads, subcontractor cost, etc.)*', '*Monitoring cost performance*' and '*Training of site personnel in monitoring process*' have very high impact (VHI 9.00 -10.00). The other eight factors (PCM 2, PCM 3, PCM 5, PCM 7, PCM 8, PCM 9, PCM 10 and PCM 11) have high impact (HI 7.00 - 8.99) for cost control practice. All the 12 related factors of project cost monitoring have strong consensus with IQDs of up to 1.00 (IQD≤1.00).

Table 7. 5: Project cost analysis related factors

CODE	RELATED FACTORS	M	MEAN	SD	IQD
PCAN 1	Collection of relevant and detailed cost data	8	8.57	0.94	1.00
PCAN 2	Calculating actual project cost	8	7.93	1.00	0.75
PCAN 3	Comparing budgeted cost with actual cost	9	8.36	1.28	0.75

PCAN 4	Comparing actual cost with forecast cost	9	8.36	1.28	0.75
PCAN 5	Analysing cost variance	9	8.50	1.16	1.00
PCAN 6	Identifying the causes of cost overrun	9	8.79	0.97	0.00
PCAN 7	Updating cost status of the project	10	8.93	1.59	1.00

Table 7.5 above indicates the related factors of project cost analysis for cost control practice. The medians and means of the attributes attained high scores. All the seven related factors (PCAN 1 - PCAN 7) have high impact (HI 7.00 – 8.99) in the determination of the cost control practice. All the seven related factors of the PCAN have strong consensus with IQDs of up to 1.00 (IQD≤1.00).

Table 7. 6: Project cost reporting related factors

CODE	RELATED FACTORS	M	MEAN	SD	IQD
PCR 1	Planning the cost report	9	8.50	1.40	1.00
PCR 2	Developing various types of cost control report	9	9.14	0.53	0.00
PCR 3	Reporting cost variances from analysis	8	7.79	1.31	0.00
PCR 4	Distribution of the cost control report to appropriate sections	9	8.21	1.37	1.00
PCR 5	Reporting on feedback or actions taken	10	9.00	1.62	1.00

Of the five factors identified, two factors, namely, ‘*Developing various types of cost control report’*, and *‘Reporting on feedback or actions taken’* have very high impact (VHI 9.00 -10). The other three (PCR 1, PCR 3 and PCR 4) have high impact (HI 7.00 - 8.99) for cost control practice. None of the five related factors of project cost reporting dropped out. All attained strong consensus of IQDs of up to 1.00 (IQD≤1.00) as shown in Table 7.6

Table 7. 7: Decision-making related factors

CODE	RELATED FACTORS	M	MEAN	SD	IQD
DM 1	Identifying the root or main cause of the cost variances	9	8.79	0.97	0.00
DM 2	Analysing the problem	8	8.14	0.95	0.75

DM 3	Categorising the causes of the problem	8	7.57	1.28	1.00
DM 4	Developing alternative measures for cost variances	8	8.07	1.54	1.00
DM 5	Selection of the relevant corrective measures	9	8.79	0.97	0.00
DM 6	Implementation of the selected measure	9	8.79	0.97	0.00
DM 7	Evaluation of the corrective measure used	9	8.79	0.80	0.75

All the seven related factors (DM 1 - DM 7) have high impact (HI 7.00 – 8.99) in the determination of the cost control practice. All the seven related factors of the DM have strong consensus with IQDs of up to 1.00 (IQD≤1.00) as shown in Table 7.7.

DS02*: To confirm or otherwise whether the factors revealed as gaps from the literature review influence the practice of cost control.*

Table 7. 8: Key factors identified as gaps

CODE	KEY FACTORS IDENTIFIED AS GAPS	M	MEAN	SD	IQD
CM	Change management	10	9.79	0.43	0.00
PCCM	Project cost communication	9	9.14	0.53	0.00

Both the two proposed factors, namely, '*Change management'* and '*Project cost communication'* were confirmed as key factors by the experts that impact the cost control practice. Both attained very strong consensus with IQDs of 0.00, as illustrated in Table 7.8 above. The factors also had a very high impact factor (VHI 9.00 - 10.00). No factor dropped out.

Table 7. 9: Change management related factors

CODE	RELATED FACTORS	M	MEAN	SD	IQD
CM 1	Establishing the sense of urgency for change	10	9.00	1.62	1.00
CM 2	Developing a vision for cost change	8	7.93	0.62	0.00
CM 3	Developing strategies for cost change	9	9.14	0.53	0.00
CM 4	Designing short term success plan	9	8.79	0.97	0.75
CM 5	Promoting a balanced change	9	8.36	1.60	1.00
CM 6	Implementing the change	9	8.43	0.85	1.00
CM 7	Evaluating the change	9	8.21	1.48	1.00
CM 8	Continuous improvement from lessons learnt	9	8.79	0.97	0.00
CM 9	Communicating guiding principles for the change.	5	5.07	2.64	3.50

CM 10	Empowering others to act on the vision	9	8.79	0.97	0.00
CM 11	Selecting appropriate leadership style	9	9.14	0.53	0.00
CM 12	Motivating for change	9	9.14	0.53	0.00
CM 13	Creating individual and organisational capabilities	5	5.07	2.64	3.50

Of the 13 factors identified, four factors, namely, '*Establishing the sense of urgency for change', 'Designing short term success plan', 'Selecting appropriate leadership style'* and *'Motivating for change'* have very high impact (VHI 9.00 -10.00). Seven factors (CM 2, CM 4, CM 5, CM 6, CM 7, CM 8 and CM 10) have high impact (HI 7.00 - 8.99) for cost control practice. Eleven factors have strong consensus with IQDs of up to 1.00 (IQD≤1.00). Only two related factors of change management dropped out, namely, '*Communicating guiding principles for the change*' and '*Creating individual and organizational capabilities*'. Consensus (IQD≥3.0) was not reached for these factors, although they scored medium impact (MI 5.00 – 6.99).

Table 7. 10: Project cost communication related factors

CODE	RELATED FACTORS	M	MEAN	SD	IQD
PCCM 1	The context of communication (adopted) in the organisation	8	8.64	0.84	1.00
PCCM 2	Form of communication within the organisation (verbal, written)	10	9.00	1.62	1.00
PCCM 3	Identification of the sender and receiver	9	8.79	0.97	0.00
PCCM 4	Formulating a clear message	9	9.14	0.53	0.00
PCCM 5	Appropriate methods communication (emails, text messages, etc.)	9	8.21	1.76	1.00
PCCM 6	Clear communication activity	8	7.79	0.97	0.75
PCCM 7	Appropriate feedback channel	9	9.14	0.53	0.00
PCCM 8	Standardisation of communication documents	9	8.50	1.51	0.75
PCCM 9	Access to information	9	8.79	1.48	1.00
PCCM 10	Reducing barriers in communication	9	8.21	1.76	1.00

Of the ten factors identified, three factors, namely, '*Form of communication within the organisation (verbal, written)'*, '*Formulating a clear message*' and *'Appropriate feedback channel'* have very high impact (VHI 9.00 -10.00). Seven factors (PCCM 1, PCCM 3, PCCM 5, PCCM 6, PCCM 8, PCCM 9 and PCCM 10) have high impact (HI 7.00 - 8.99) for cost control practice. All ten factors have strong consensus with IQDs of up to 1.00 (IQD≤1.00) as illustrated in Table 7.10.

***DS03**: To determine the elements of organisational structure that affect cost control practice.*

Table 7. 11: Key factors of organisational factors

CODE	RELATED FACTORS	M	MEAN	SD	IQD
POS	Contractor's organisational structure	9	9.07	0.73	0.75
POC	Contractor's organisational culture	9	8.79	0.97	0.00
ICT	ICT tools and knowledge	9	8.71	0.83	0.00

Table 7.11 shows three organisational factors that affect cost control practice. Of the three factors identified, one factor, namely, '*Contractor's organisational structure'* had a very high impact (VHI 9.00 -10.00). The other two factors, '*Contractor's organisational culture*' and '*ICT tools and knowledge*' have high impact (HI 7.00 - 8.99) for cost control practice. All three factors have strong consensus with IQDs of up to 1.00 (IQD≤1.00).

Table 7. 12: Contractor's organisational structure related factors

CODE	RELATED FACTORS	M	MEAN	SD	IQD
POS 1	Roles and positions of the departments	8	7.79	1.42	0.75
POS 2	Formal relationship	8	7.93	0.73	0.00
POS 3	Nature of formation/number of layers	7	6.86	1.35	0.75
POS 4	Specialisation/professionalism	8	7.43	1.02	1.00
POS 5	Centralisation of authority	6	5.21	2.39	1.75
POS 6	Decentralisation of authority	9	8.57	1.28	1.00
POS 7	Level of horizontal integration	7	6.93	0.92	1.00
POS 8	Patterns of communication	7	7.29	0.99	1.00
POS 9	Easy coordination among members	9	8.29	1.77	1.50
POS 10	Personnel ratio (e.g. core employees to supporting staff)	6	5.86	2.63	2.75
POS 11	Mechanisms for problem solving	8	7.29	1.27	1.00
POS 12	Accountability channels in the organisation	9	7.93	2.13	1.75
POS 13	Set of policies/procedures and standards	8	7.86	1.35	0.75
POS 14	Organisational knowledge	10	9.36	1.15	1.00
POS 15	Organisational prestige	7	6.57	2.21	2.25
POS 16	Corporate governance	7	7.00	1.71	2.00

Table 7.12 shows the contractor's organisational structure related factors that affect cost control practice. Of the sixteen factors identified, one factor, namely, *'Organisational knowledge'* had a very high impact (VHI 9.00 -10.00). Ten related factors (POS 1, POS 2, POS 4, POS 6, POS 8, POS 9, POS 11, POS 12, POS 13 and POS 16) have high impact (HI 7.00 - 8.99) for cost control practice. Five factors (POS 3, POS 5, POS 7, POS 10, and POS 15) had medium impact (MI 5.00 – 6.99). Ten factors have strong consensus with IQDs of up to 1.00 (IQD≤1.00). Four factors have good consensus with IQDs of up to 2.00 (IQD≤2.00). Lastly, two factors have weak consensus with IQDs of up to 3.00 (IQD≤3.00).

DS04*: To determine the elements of organisational culture that affect cost control practice.*

Table 7. 13: Contractors' organisational culture related factors

CODE	RELATED FACTORS	M	MEAN	SD	IQD
POC 1	Setting clear goals	8	7.79	1.42	0.75
POC 2	Setting actions to match organisational goals	9	8.21	1.76	1.00
POC 3	Developing clear approach to succeed	9	8.36	1.34	1.00
POC 4	Emphasis on team contribution	8	7.79	1.42	0.75
POC 5	Amicable opinions and ideas exchange	9	8.36	1.34	1.00
POC 6	Members commitment to team	9	8.36	1.34	1.00
POC 7	Resolve internal problems effectively	9	8.21	1.53	1.00
POC 8	Resolve conflict that arise	8	8.36	1.50	1.00
POC 9	Encourage inter-department collaboration	9	8.43	1.65	0.75
POC 10	Encourage information sharing	9	8.36	1.34	1.00
POC 11	Guidance for performance improvement	9	8.36	1.34	1.00
POC 12	Emphasis on good performance	9	8.21	1.53	1.00
POC 13	Explicit set of performance standards	8	8.21	1.05	0.75
POC 14	Accept adventurous ideas for sustaining competitiveness	9	8.79	0.89	1.00
POC 15	Welcome alternative solutions	9	8.36	1.34	1.00
POC 16	Encourage creative and innovative ideas	9	8.21	1.53	1.00
POC 17	Allocate resources for implementing innovative ideas	8	7.43	1.45	1.00
POC 18	Value employees' ideas	7	7.29	1.54	0.75
POC 19	Employees' input on major decisions	7	7.50	1.65	1.00
POC 20	Employees' participation in decision-making process	8	7.64	1.08	1.00
POC 21	Loyalty of employees	9	8.36	1.28	1.00

POC 22	Emphasis on team accountability	9	8.36	1.34	1.00
POC 23	Emphasis on reward instead of punishment	9	8.21	1.53	1.00
POC 24	Creation of trust atmosphere	9	8.79	0.89	1.00
POC 25	Performance-based rewards	9	8.43	1.65	1.00
POC 26	Accept criticism and negative feedback	9	8.79	0.89	1.00
POC 27	Sharing the responsibility of the things that go wrong	9	8.64	1.08	0.75
POC 28	Recognise and reward members' performance	9	8.43	1.45	1.00
POC 29	Equitable reward	9	8.14	1.29	1.00

All 29 related factors (POC 1 - POC 29) have high impact (HI 7.00 – 8.99) in the determination of the cost control practice. All the related factors of the POC have strong consensus with IQDs of up to 1.00 (IQD≤1.00) as shown in Table 7.13.

DS05*: To determine the elements of ICT tools and knowledge that affect cost control practice.*

Table 7. 14: ICT tools and knowledge related factors

CODE	RELATED FACTORS	M	MEAN	SD	IQD
ICT 1	Acceptance of ICT usage	9	8.79	0.89	1.00
ICT 2	Perceived usefulness of ICT (Data exchange, Data storage, Data retrieving, Data analysis)	9	9.14	0.53	0.00
ICT 3	Using ICT for communication (Internet chat, Emailing information exchange, Live video calls)	8	7.29	1.27	1.00
ICT 4	Availability of specific software for cost control	8	7.29	1.27	1.00
ICT 5	Provision of technical support	9	8.29	1.49	0.75
ICT 6	Supportive workplace environment	9	8.71	1.07	0.00
ICT 7	ICT training and continuous development of staff	9	8.79	0.89	1.00
ICT 8	Setting investment for ICT	9	8.86	0.86	0.75

Of the eight factors identified in Table 7.14, one. namely, '*Perceived usefulness of ICT (Data exchange, Data storage, Data retrieving, Data analysis)'* has very high impact (VHI 9.00 - 10.00). Seven factors (ICT 1, ICT 3, ICT 4, ICT 5, ICT 6, ICT 7, and ICT 8) have high impact (HI 7.00 - 8.99) for cost control practice. All eight factors have strong consensus with IQDs of up to 1.00 (IQD≤1.00).

***DS06**: To evaluate the project cost control output as a result of the practice of cost control.*

Table 7. 15: Project cost control output

CODE	RELATED FACTORS	M	MEAN	SD	IQD
OCC 1	Achieving accurate cost information for decision making	9	8.79	0.89	1.00
OCC 2	Establishing project cost outcome (profit/loss)	9	9.14	0.53	0.00
OCC 3	Obtaining historic cost data for future projects	9	8.79	0.89	1.00
OCC 4	Enhancement of the targeted profitability	10	9.21	1.31	1.00
OCC 5	Prevention of wasted resources	9	8.29	1.49	0.75
OCC 6	Increased efficiency of work	9	8.29	1.49	0.75

Of the six related factors, two, namely, '*Establishing project cost outcome (profit/loss)*' and '*Enhancement of the targeted profitability*' have very high impact (VHI 9.00 - 10.00) for the output of cost control practice. The remaining four factors have high impact (HI 7.00 – 8.99) on cost control practice. All six related factors of the output of cost control practice have strong consensus with IQDs of up to 1.00 (IQD≤1.00) as shown in Table 7.15.

7.3 DISCUSSION OF THE DELPHI RESULTS

OBECTIVE 1: To establish the attributes (main and sub) that determine the practice of cost control and to examine whether these factors influencing cost control practice in other cultural locations are the same in Ghana.

The six main attributes of cost control, '*Project cost estimation*', '*Project cost budgeting*', '*Project cost monitoring*', '*Project cost analysis*', '*Project cost reporting*' and '*Decision-making*' are applicable in the Ghanaian construction industry. The experts were used in the determination of the key factors of cost control practice which had very high impact (VHI 9.00 -10.00) and strong consensus with IQDs of up to 1.00 (IQD≤1.00). The primary factors coincide with works by Olawale & Sun (2015), Charoenngam & Sriprasert (2001) and Abubakar (1992). Other cost control studies, such as those of Anyanwu (2013), Jayaraman (2016), Korke *et al.* (2017), Bahaudin *et al.* (2012) and Benjaoran *et al*. (2012) also support the primary constructs. Notwithstanding the fact that, all the main factors had very high impact and strong consensus, some of the related factors of the sub attributes had very high impact, high impact, medium impact and consensus was not reached for some of the related factors.

The differences in the influence level of the related factors point to the fact that, in the determination of the factors, some are not peculiar to the Ghanaian context.

The eight factors of project cost estimation, namely, '*Appropriate method of estimation*', '*Experience of the estimator*', '*Conducting market survey*', '*Calculating the unit rates for the project*', '*Method of construction*', '*Location of the project*', '*Nationality of labour*' and '*Knowing the state of the market*' have very high impact (VHI 9.00 -10.00).

Twenty-seven factors have high impact (HI 7.00 - 8.99) for cost control practice. Thirty-five related factors of project cost estimation have strong consensus with IQDs of up to 1.00 (IQD≤1.00). Only two related factors of project cost estimation dropped out, namely, '*Level of competition*' and '*Time availability before bid opening*'. Consensus (IQD≥3.0) was not reached for these factors, although they scored medium impact (MI 5.00 – 6.99).
There are many factors that affect the accuracy of project cost estimation and construction cost. This concurs with works by Bshait and Al-Juwairah (2002) and Akintoye and Fitzgerald (2000). Enshassi *et al*. (2013) state that the success of any construction project depends on the accuracy of several estimations. The study by Chan and Park (2005) emphasises the importance of comprehensive knowledge about the construction estimation process by both the project client and contractor so they can accurately calculate the tender price. Further, Akintoye and Fitzgerald (2000) also identify influencing factors, project complexity, scale and scope of construction, market conditions and method of construction, which affect the project cost estimates.

Furthermore, all the related factors of project cost budgeting as sub attributes had high impact. The allocation of activity budget, negotiation of the main budget, approval of master and functional budgets and establishing a realistic working budget support works by Charoenngam and Sriprasert (2001) and Abubakar (1992). Periodic revision of the budget and ensuring that project team members understand the budget also coincide with findings of Olawale & Sun (2015).

Moreover, the result of project cost monitoring as a sub attribute determined that 12 related factors for cost control practice have strong consensus. Four factors, namely, '*Planning milestone monitoring process', 'Monitoring cost data (material, labour, plant, overheads, subcontractor cost, etc.)', 'Monitoring cost performance'* and *'Training of site personnel in monitoring process'* have very high impact (VHI 9.00 -10.00). The planning milestone for the monitoring process supports findings by Tom & Sachin, (2013) that a good cost plan achieves good cost performance, while Olawale & Sun (2015) add that the monitoring process must be planned, with key milestones for conducting the monitoring process, either weekly, monthly or at any predetermined period. The monitoring of the cost data of the resources (material, labour, plant, overheads, subcontractor cost) used corresponds with Charoenngam & Sriprasert, (2001). Monitoring cost performance is about cost progress and technical performance (Aliverdi *et al.*, 2013; Khamidi *et al*., 2011). Training of site personnel in the monitoring process is supported by Olawale & Sun (2015), namely that all site personnel should be trained to understand and provide all relevant information to support the concept of cost control practised by the organisation.

The other eight factors: selection of appropriate techniques for cost monitoring, selecting appropriate tools for tracking project cost, cost data verification, monitoring updated cost records, monitoring reported cost information, detecting early warning signs, identifying cost changing factors, and provision of manuals for site monitoring team to refer to, have high impact (HI 7.00 - 8.99) for cost control practice. Selecting the appropriate cost monitoring technique suitable for the cost manager or firm is essential for the cost monitoring process (Raut & Pimplikar, 2014; Aliverdi *et al*., 2013; Pajares & López-Paredes, 2011). Control charts and software applications are the basic tools for cost monitoring (Tom & Sachin, 2013; Ahuja & Thiruvengadam, 2004). The purpose of cost data verification is to ensure exit accuracy in cost documentation, cost calculations, progress cost data records and up-to-date records (Cunningham, 2017; Tom & Sachin, 2013; Ahuja & Thiruvengadam, 2004; Charoenngam & Sriprasert, 2001). The identification of cost changing factors for effective cost control practice corresponds with the works of Byung-Cheol and Reinschmidt, (2011) Khamidi *et al*. (2011) and Al-jibouri (2003). Provision of manuals for site monitoring concurs with Olawale & Sun, (2015).

Charoenngam and Sriprasert, (2001) identified the same related project cost analysis factors as: collection of relevant and detailed cost data, calculating actual project cost, comparing budgeted cost with actual cost, comparing actual cost with forecast, analysing cost variance, identifying the causes of cost overrun and updating cost status of the project.

Additionally, the result of decision-making as a sub attribute, determine seven related factors for cost control practice as having strong consensus. These are: identifying the root or main cause of the cost variances, analysing the problem, categorising the causes of the problem, developing alternative measures for cost variances, selection of the relevant corrective measures, implementation of the selected measures and evaluation of the corrective measures used. Decision-making is a process in which all the factors were determined for cost control practice. The list of related factors corresponds with works by Adjei *et al*. (2017), Haidar (2016), Tomić and Spasojević Brkić (2011) and the Performance Review Institute (2006).

OBJECTIVE 2: To confirm or otherwise whether the factors seen as gaps from the literature review influence the practice of cost control.

The two proposed factors, namely, '*Change management'* and '*Project cost communication'* were confirmed as key factors impacting on cost control practice. Both factors had very high impact factor (VHI 9.00 - 10.00).

The change management concept supports the studies of Adjei *et al*. (2017), Khamidi *et al.* (2011) Al-Jibouri (2003) and Dikko, (2002) who agree that there is the likelihood of cost variances, thus changes, occurring within the original budgeted cost. Therefore, the experts agree that the changes in the construction project cost could be managed using change management concepts. This supports the findings of Hafez *et al*. (2015) that change management processes applied in construction projects should impact project delivery. Furthermore, Zou and Lee, (2008) found that construction projects with the application of the change management principles accomplish healthier cost performance and that this practice is important in construction project management.

Related factors of change management concepts were also identified. The 11 factors identified are as follows:

- Establishing the sense of urgency for change (very high impact VHI 9.00 -10.00);
- Developing a vision for cost change (high impact HI 7.00 - 8.99);
- Developing strategies for cost change (very high impact VHI 9.00 -10.00);
- Designing a short-term success plan (high impact HI 7.00 - 8.99);
- Promoting a balanced change (high impact HI 7.00 - 8.99);
- Implementing the change (high impact HI 7.00 - 8.99);
- Evaluating the change (high impact HI 7.00 - 8.99);
- Continuous improvement from lessons learnt (high impact HI 7.00 - 8.99);

- Empowering others to act on the vision (high impact HI 7.00 - 8.99);
- Selecting appropriate leadership style (very high impact VHI 9.00 -10.00);
- Motivating for change (very high impact VHI 9.00 -10.00).

According to Kotter (2012), Motawa *et al*. (2007) and Owusu (2015), change management system has five principles: 1) promote a balanced change culture, 2) recognise changes, 3) evaluate change, 4) implement change and 5) continuously improve from experience. Jaworski and Scharmer (2000) further identify core practices for successful change process as: 1) observing: seeing reality with new eyes, 2) sensing: turning the observed reality into emerging patterns that inform future possibilities, 3) envisioning: crystallising vision and intent and 4) executing: acting to capitalise on new opportunities.

For the change management process to be effective, the project management team must identify the changes in the project and future possible changes (Gharaee Moghaddam, 2012). Following that, change should be reviewed, and responsibilities assigned to members for the tasks to be done. In addition, Matkó *et al*. (2015) add that for successful change management, top management team support is critical. The team should be assigned with the task, given all the powers for the change process, outline the visions and strategies and implement it in the organisation (Matkó *et al*., 2015). Several leadership styles exist for the cost managers involved in change management to adopt, for example, charismatic, operational, Theory E, Theory O, combination of Theories E & O and transformational leadership (Rosén, 2014; Dessler *et al.*, 2004; Landrum *et al.*, 2000; Beer & Nohria (2000). The importance motivation of staff in change management corresponds with findings of with Korbi (2015) and Duluc, (2000) in that it assists and stimulates workers to achieve the project cost change objectives within the organisation.

Project cost communication: ten factors were identified as having strong consensus, three factors, namely, '*Form of communication within the organisation (verbal, written)'*, '*Formulating a clear message*' and *'Appropriate feedback channel'* have very high impact (VHI 9.00 -10.00). Seven factors,, '*The context of communication (adopted) in the organisation', 'Identification of the sender and receiver', 'Appropriate methods communication (emails, text messages, etc.)', 'Clear communication activity', 'Standardisation of communication documents', 'Access to information' and 'Reducing barriers in communication'* have high impact (HI 7.00 - 8.99) for cost control practice.

Te'eni *et al*. (2001) note that the ability of the communicators to exhibit equal levels of understanding to the information communicated, as well as giving accurate feedback, greatly enhances the deeper understanding of the context, contextual knowledge and skills for the communicated actions.

Appropriate feedback occurs when the receiver responds to the sender's message and returns the message to the sender (McShare & Von Glinow, 2003; Adu-Oppong & Agyin-Birikorang, 2014). The feedback allows the sender to determine whether the message has been received and understood (Lunenburg, 2010).

Selection of the particular medium for transmitting the message can be critical, because there are many choices. The medium may be verbal, nonverbal, written, computer-aided or electronic. Written communication may be in the form of memos, letters, reports, bulletin boards, handbooks, newsletters and the like. For verbal media, choices include face-to-face conversations, telephone, computer, public address systems, closed-circuit television, tape-recorded messages, sound or slide shows, e-mail, and so on. Nonverbal gestures, facial expressions, body position, and even clothing can also transmit messages. People decode information selectively (Adu-Oppong & Agyin-Birikorang, 2014; Keyton, 2010).

Cheng *et al*. (2001) add that the choice of a particular channel of communication depends on four main criteria: (1) *Amount of information required to be communicated*: Different communication channels convey different amounts of information. Face-to-face communication (such as meetings and visits) is one of the richest media because it offers a variety of cues, including verbal and written words, tone of voice, facial expression, body language and other non-verbal signals. Other media such as telephone, e-mail, and memos are less rich media. (2) *Instant information required*: In cases where instant information has to be transmitted, the most accessible and promptly transmitted media are given the first priority. Telephone and fax afford the transmission of fast instant information. E-mail is less instant, while meetings, teleconferencing, letters, and visits are the least instant media. (3) *Effective communication required*: Effective communication refers to the accuracy of the information transmitted. It is always associated with terms such as misleading, misinterpretation, and misunderstanding. Thus, face-to-face communication is the best as it allows more opportunities for the receiver to clarify meanings, reducing misleading, misinterpretation, and misunderstanding. Two-way communication has to be created for effective communication. (4) *Efficient communication required:* Efficient communication refers to the speed of transmission of messages. Using computers to transmit messages will not necessarily be faster than using other media for close contacts. It depends on the distance of transmission. In meetings and visits, the use of verbal words is probably the fastest way of communication when the parties are just several inches away. At a distance, using telephones and computers are both efficient.

Definitely, these attributes perceived to have the reduction in communication complexities results in offering effective communication among the members of the organisation and also increases the level of understanding and relationship among the team (Te'eni *et al*., 2001; Kwofie, 2015).

OBJECTIVE 3: To determine the elements of organisational structure that affect cost control practice.

Sixteen elements of organisational structure were identified as affecting cost control practice. '*Roles and positions of the departments', 'Formal relationship', 'Nature of formation/number of layers', 'Specialisation/professionalism', 'Decentralisation of authority', 'Level of horizontal integration', 'Patterns of communication', 'Mechanism for problem solving', 'Set of policies/procedures and standards' and 'Organisational knowledge'*, all had strong consensus. which corresponds with works by Zaki *et al.* (2015) and Greenberg (2011). Organisational knowledge had very high impact. This indicates that creation, dissemination, storing, processing of knowledge, using IT tools, and evaluation of knowledge in the organisation affect the cost control practice. This coincides with findings of Torabi and El-Den (2017). In setting an organisational structure for cost control practice the guiding policies set by the organisation should be conscientiously followed. The management should be the professionals to handle cost control. There should be decentralisation rather than centralisation in the organisation for cost control practice. The various roles and lines of communication and problem-solving mechanism all affect cost performance. This concurs with findings of Latifi and Shooshtarian (2014).

'*Personnel ratio'* (e.g. core employees to supporting staff) and *'Organisational prestige*' had weak consensus. This shows that in the cost controlling process, organisational prestige in not all that important for the practice of cost control. The way people see the organisation or' in other words, the organisational image is not necessary in cost control practice. Probably, the experts viewed internal control issues for cost control rather than the external view of the organisation. The personnel ratio issue in cost control is more technical, in that it requires the support of other non- technical staff. It shows that cost control practice will solely be handled by experts at various levels of management who have the authority to do so.

OBJECTIVE 4: To determine the elements of organisational culture that affect cost control practice.

All 29 related factors (POC 1 - POC 29) have high impact (HI 7.00 – 8.99) in the determination of the cost control practice, with strong consensus. The related factors are: '*Setting clear goals', 'Setting actions to match organisational goals", "Developing a clear approach to succeed', 'Emphasising team contributions', 'Amicable opinions and ideas exchange', 'Members' commitment to team', 'Resolve internal problems effectively', 'Resolve conflict that arises', 'Encourage inter-departmental collaboration', 'Encourage information sharing', 'Guidance for performance improvement', 'Emphasis on good performance', 'Explicit set of performance standards', 'Accept adventurous ideas for sustaining competitiveness', 'Welcome alternative solutions', 'Encourage creative and innovative ideas', 'Allocate resources for implementing innovative ideas', 'Value employees' ideas', 'Employees' input on major decisions', 'Employees' participation in decision-making processes', 'Loyalty of employees', 'Emphasis on team accountability', 'Emphasis on reward instead of punishment', 'Creation of trust atmosphere', 'Performance-based rewards', 'Accept criticism and negative feedback', 'Sharing the responsibility for things that go wrong', 'Recognize and reward members' performance', and 'Equitable reward'.*

Ankrah *et al*. (2009) explain organisational culture as "the way we do things around here to succeed'. The above factors which have strong influence on organizational performance were categorised into four by Denison (2000): (i) involvement, (ii) consistency, (iii) adaptability and (iv) mission. 'Empowerment.' 'Team orientation.' 'Capability development' and 'Coordination and integration. 'Core value' measures a set of values that creates a sense of identity that members share. 'Agreement' measures the extent that members of the organisation are able to reach agreement on critical issues (Cheung *et al.*, 2011). According to Hatch and Cunliffe (2006), organisational culture has four elements or domains; (1) organisational culture and identity; (2) organisational strategy; (3) organisational design, structure and processes; and (4) organisational behaviour and performance.

OBJECTIVE 5: To determine the elements of ICT tools and knowledge that affect cost control practice.

Of the eight factors identified, one factor, namely, '*Perceived usefulness of ICT (Data exchange, Data storage, Data retrieving, Data analysis)'* has a very high impact (VHI 9.00 - 10.00). The '*Perceived usefulness of ICT'* indicates that ICT plays an important role in the whole construction process, including information generation, data transmission and interpretation of data for construction projects (Onyegiri *et al.,* 2011). Some usefulness of ICT includes internet chat, emailing, information exchange, live video calls and networking through an electronic medium (Onyegiri *et al.,* 2011; Chassiakos, 2007; Dainty *et al.,* 2006).

The seven factors: '*Acceptance of ICT usage, Data storage, Data retrieving, Data analysis)', 'Using ICT for communication (Internet chat, Emailing information exchange, Live video calls)', 'Availability of specific software for cost control', 'Provision of technical support', 'Supportive workplace environment', 'ICT training and continuous development of staff'* and *'Setting investment for ICT' had high impact* (HI 7.00 - 8.99) for cost control practice.

ICT usage reduces the time period for data processes, information communication and yields more results in productivity. It also improves the communication flow among construction project participants. (Onyegiri *et al.*, 2011; Hosseini *et al.*, 2012).

Quantity surveyors who work on cost control require specific ICT software for use in all the stages, such as cost estimation, budgeting control, cost planning, tendering, cost reporting, cost analysis, cost checking, account preparation, payment certificates and final accounts. Thus, contractors must create an ICT workplace environment, support staff training and also invest in ICT applications (Anyadike, 2001; Benjaoran, 2009).

OBJECTIVE 6: To evaluate the project cost control output as a result of the practice of cost control.

The study evaluated six cost control outputs: *'Achieving accurate cost information for decision-making', 'Establishing project cost outcome (profit/loss)', 'Obtaining historic cost data for future projects', 'Enhancement of the targeted profitability', 'Prevention of wasted resources'* and *'Increased efficiency of work'*. Two cost control outputs came out as very high impact; '*Establishing project cost outcome (profit/loss)' and 'Enhancement of the targeted profitability'*. The top management roles of construction firms include meeting and brainstorming about the status of the project cost at predetermined periods to achieve the targeted profitability (Akeem, 2017; Siyanbola & Raji, 2013). Similar cost control techniques have been recommended by Adjei *et al*. (2015), Sanni & Hashim (2013) and Olawale & Sun (2010) as the tools to use to identify, track and keep the project cost within the targeted cost. The status of the project cost is identified by the practice of cost control which is normally either profit or loss on the account of the construction project (Charoenngam & Sriprasert, 2001).

Other factors which render accurate cost information for decision-making, obtaining historic cost data for future projects, prevention of wasted resources, and increased efficiency of work also have high impact as outputs of cost control practice. The accomplishment of construction project cost control practices and judgements principally depend on very rigid decision-making taken from the accurate cost information during the execution of the construction projects (Bahaudin *et al*., 2012). Furthermore, cost information is kept as historical cost data by the organisation and is stored at a proper place for future reference (Charoenngam & Sriprasert, 2001). Cost control practice assists organisations by eliminating or reducing unnecessary wastage of resources in the execution of construction projects (Adjei *et al*., 2017; Akeem, 2017; Siyanbola & Raji, 2013; Bahaudin *et al*., 2012). Cost reports at predetermined periods show the methods of construction used for the activities, logistics at the construction site, whether they are improving on productivity and profit margins and a more or better efficient way of construction to increase work performance (Omar & Mangin, 2002). The cost report further enables the management team to apply efficient use of all the resources available, while maintaining a good standard of performance (Akeem, 2017; Siyanbola & Raji, 2013).

7.4 CONCLUSION

The feedback from the Delphi survey technique conducted for the study is presented in this chapter. The level of influence and impact of primary and sub attributes that predict cost control practice in Ghana are presented. The gaps and related factors are also confirmed for effective cost control practice. The results include organisation factors, such as organisational structure, culture, and ICT tools and knowledge, that are required for carrying out cost control practice.

The discussion of the results in the latter part of the conclusion of the chapter is based on the objectives set for the Delphi survey technique. The succeeding chapter shows the outcome of the Delphi survey and is used to develop the conceptual framework for cost control practice, showing the interconnections between the main and sub attributes.

CHAPTER EIGHT

CONCEPTUAL FRAMEWORK

8.0 INTRODUCTION

The review of the theories applied in this research have been discussed, followed by cost control concepts. The theories paved way for the selection and combination of various factors appropriate for the proposed conceptual model of the study. The theories were further unveiled to clarify the theory behind cost control practice and how the interacting elements within the various concepts of the theory work. Both the independent and dependent variables of the cost control model are now discussed.

8.1 SELECTION OF VARIABLES FOR COST CONTROL PRACTICES

The selection of the variables for cost control practice is categorised under the independent and the dependent variables. The details are presented below.

8.1.1 INDEPENDENT VARIABLES

The primary factors (main constructs) used come from the work of Charoenngam and Sriprasert (2001) and Abubakar (1992) who used similar constructs for cost control practice. The key six factors of cost control practice identified from these two theories are: cost estimation, cost budgeting, cost monitoring, cost reporting, cost analysis and decision-making/corrective actions.

Current research on cost and time control practice has been carried by Olawale & Sun (2015), who identify and group cost control into four major factors, namely, cost planning (cost estimation and cost budgeting), cost monitoring, cost reporting and cost analysis. Bahaudin *et al*. (2012) and Korke *et al*. (2017) also postulate cost control practice to have six key factors: project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis and decision-making/corrective measures.

This study uses the primary factors of Charoenngam & Sriprasert, (2001) and Abubakar (1992), who present similar constructs for cost control practice. The primary factors of cost control practice used are project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis and decision-making/corrective actions.

Similarly, the primary factors of cost control practice have been established by the Delphi study conducted to identify the main and sub attributes of cost control practice from experts from the Ghanaian construction industry. They provided the key factors of cost control practice, namely, project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis and decision-making/corrective actions as relevant. The Delphi survey was completed in three rounds. All the key factors had strong consensus scores.

The two other primary factors of change management and project cost communication were identified as gaps and have been elaborated in this study. These factors were confirmed by the Delphi survey.

The primary factors of cost control practice variables, identified for use in this study, emerged from both the literature review and the Delphi study. Table 8.1 below summarises the latent variable constructs and their relative measurable variables for the conceptual cost control framework.

Table 8. 1: Table of latent constructs

Latent variable construct	Measurement variable
Project Cost Estimation (PCE)	PCE 1 Appropriate method of estimation PCE 2 Standard procedure for estimation PCE 3 Experience of the estimator PCE 4 Available project information PCE 5 Available cost indices PCE 6 Conducting market survey PCE 7 Provision of standard tender documentation PCE 8 Availability of client financial management plans PCE 9 Firms' bidding strategies PCE 10 Use of local work force PCE 11 Unpredicted weather conditions PCE 12 Flooding of the site PCE 13 Air pollution PCE 14 Water pollution PCE 15 Erosion from road construction PCE 16 Disposal of hazardous waste
Project Cost Budgeting (PCB)	PCB 1 Allocation of activity budget PCB 2 Negotiation of the main budget PCB 3 Approval of master and functional budgets PCB 4 Establishing a realistic working budget PCB 5 Periodic revision of the budget PCB 6 Ensuring that project team members understand

	the budget
Project Cost Reporting (PCR)	PCR 1 Planning for the cost report PCR 2 Developing various types of cost control report PCR 3 Reporting cost variances from analysis PCR 4 Distribution of the cost control reports to appropriate sections PCR 5 Reporting on feedback or actions taken
Project Cost Monitoring (PCM)	PCM 1 Planning a milestone monitoring process PCM 2 Selection of appropriate techniques for cost monitoring PCM 3 Selecting appropriate tools for tracking project cost PCM 4 Monitoring cost data (material, labour, plant, overheads, subcontractor cost, etc.) PCM 5 Cost data verification PCM 6 Monitoring cost performance PCM 7 Monitoring updated cost records PCM 8 Monitoring reported cost information PCM 9 Detecting early warning signs PCM 10 Identifying cost changing factors PCM 11 Provision of manuals for site monitoring team to refer to PCM 12 Training site personnel in monitoring process
Project Cost Analysis (PCAN)	PCAN 1 Collection of relevant and detailed cost data PCAN 2 Calculating actual project cost PCAN 3 Comparing budgeted cost with actual cost PCAN 4 Comparing actual cost with forecast cost PCAN 5 Analysing cost variance PCAN 6 Identifying causes of cost overrun PCAN 7 Updating cost status of the project
Decision Making (DM)	DM 1 Identifying the root/main cause of the cost variances DM 2 Analysing the problem DM 3 Categorising the causes of the problem DM 4 Developing alternative measures for cost variances DM 5 Selection of the relevant corrective measures DM 6 Implementation of the selected measures DM 7 Evaluation of the corrective measures used

8.1.1.1 Project Cost Estimation (PCE)

Project cost estimation is the first step to be taken before the other cost control processes can follow. It is taken at the pre-construction stage to establish the overall cost of the project (Cunningham, 2015; Brook, 2008). This supports Dysert's (2006) finding that the project cost estimation leads to the establishment of a realistic project budget to check whether the project cost estimate is economically feasible to execute, to develop project cost alternatives and finally, if the project cost if accepted to serve as a basis for cost control. The study by Chan and Park (2005) emphasises the importance of both the project client and contractor having comprehensive knowledge about the construction estimation process to calculate the tender price accurately.

There are numerous factors that influence the practice of project cost estimation. The sub-variables are categorised in seven main categories: project characteristics, client characteristics, contractor characteristics, tendering-related issues, consultant-related issues, external factors and estimation procedure (Arif *et al*., 2015; Cong *et al*., 2014; Asal, 2014). Akintoye and Fitzgerald (2000) identify the following influencing factors which affect the project cost estimation: project complexity, scale and scope of construction, market conditions and method of construction. The client characteristic-related factors include: financial provision of the client, clear project briefing, type of client, setting timelines for project and setting quality requirements for the project (Arif *et al.*, 2015; Cong *et al.*, 2014). The project characteristics-related factors include: location of the project, method of construction, duration of the project, size of the project, type of structure, access to the site, storage facilities for the project, magnitude and scope of the construction, buildability, environmental issues, weather conditions, nationality of labour, social and cultural impact, site conditions, firm planning and management strategy (Arif *et al.*, 2015; Cong *et al.*, 2014; Asal, 2014). The contractor characteristics-related factors include: experience from similar related projects, contractor's management team members, previous relationship with owners, current work execution, urgency for the project, and planning abilities for projects (Cong *et al.*, 2014). Tender-related issues include: standard tender documentation, setting tendering period and good analysis for tenders (Cong *et al*., 2014; Asal, 2014). The external factors include: level of competition, market prices, number of tenderers and interest/inflation rate (Arif *et al.*, 2015; Cong *et al.*, 2014; Asal, 2014). The consultant-related factors include: completeness of project information, procurement method used, type of contract, tendering method used and attitude of consultants (Arif *et al*., 2015; Cong *et al*., 2014). The final factor is estimation procedure. The related factors include the availability of project cost information, standard procedure for updating the cost, setting time limits for the estimates, method of determining the contingency, profit or overheads' calculation method, experience of the estimator, estimation method used and available cost indices (Arif *et al*., 2015; Asal, 2014).

The Delphi survey findings using experts found 35 related factors for project cost estimation which had strong consensus (Refer to Table 8.2). These factors were further contracted to 16 variables. The contraction was considered necessary because of the groupings of most of the variables. There were 16 related factors that influence project cost estimation as shown in Table 9.1.

8.1.1.2 Project Cost Budgeting (PCB)

Project cost budgeting is a significant aspect of the cost control practice. It is the final stage of establishing the project cost plan to be followed. The studies of Olawale and Sun (2015), Charoenngam and Sriprasert (2001) and Abubakar (1992) stress it as a relevant construct in cost control practice. According to Charoenngam & Sriprasert (2001) and Abubakar (1992), the cost estimates are converted to cost budget which includes the various cost centres that show the likely cost expenses. Abubakar (1992) adds that the budget provides the basis for the cost monitoring and control at the post construction stage. The monitoring process is made easy by comparing actual cost with the budgeted cost and by showing areas of cost overrun. In addition, the budget helps the top management team in decision-making through the periodic financial progress report, developed during the execution of the project.

Charoenngam & Sriprasert (2001) outline the project cost budgeting-related factors. These include the budgeting allocation, where all the resources, money, labour, plant and equipment and materials are assigned to various cost areas so that they can be compared with actual site resources used during the execution of the construction project. Charoenngam & Sriprasert (2001) stress that decision-making is focused on the establishment of a realistic working budget with the involvement of site personnel. Olawale & Sun (2015) add that a historic project cost data serves as a basis for the setting of a realistic working budget. The top management team i approves the master and functional budgets to be used (Charoenngam & Sriprasert, 2001). The cost budget must be communicated to and discussed with the management team members and other subordinates for optimal commitment and understanding (Olawale & Sun, 2015; Abubakar, 1992) The site cost manager then reports, monitors and analyses the cost status for corrective measures to be taken on either a daily or weekly basis by the management team. (Charoenngam & Sriprasert, 2001).

8.1.1.3 Project Cost Reporting (PCR)

Many former studies on cost control practice acknowledge project cost reporting as a key factor (Muthelo & Talukhaba, 2018; Korke *et al.*, 2017; Olawale & Sun, 2015; Ademola, 2012; Charoenngam & Sriprasert, 2001). The purpose of cost control documentation is to inform the management team of the status of the project cost. To be effective, the reports used for cost control should be brief, timely, factual and limited to pertinent information (Liang, 20015; Dekker, 2005). Olawale and Sun (2015) support the notion that planning for the cost report is necessary in the project execution, to determine the timelines for cost reporting.

There are various types of cost control reports that should be developed for use by construction firms. According to Dekker (2005), different cost reports, including material requisition status, subcontractor status, fabrication status and quality trends reports, are necessary. In addition, Ademola (2012) has developed several cost control reports or templates. Among these are labour cost reports, material cost reports, plant cost reports, daily, weekly, monthly work done cost reports and profit and loss cost reports. Every construction project is a unique situation and each has its own specific project cost reporting requirements (Dekker, 2005). Dekker (2005) and Charoenngam & Sriprasert (2001) provide guidance for the distribution of cost reports. According to them, it is necessary to decide whether the reports are needed for general information only or whether they are required for decision-making, and at what level those decisions are made.

The Delphi survey findings support the five related factors for project cost reporting. They are planning for the cost report, developing various types of cost control report, reporting cost variances from analysis, distributing the cost control reports to appropriate sections and reporting on feedback or actions taken. These are shown in Table 9.1.

8.1.1.4 Project Cost Monitoring (PCM)

Studies established that project cost monitoring influences the cost control practice (Olawale & Sun, 2015; Charoenngam & Sriprasert, 2001; Abubakar, 1992). Charoenngam and Sriprasert's (2001) study on cost control had project cost monitoring as its main construct. Its related factors were monitoring of cost of labour, material, plant and equipment, overheads cost and earned value. The study also added project cost monitoring at a predetermined stage of progress to be aware of its the cost status.

There is a strong recommendation by scholars like Olawale & Sun, (2015) and Charoenngam & Sriprasert, (2001) to develop a more standard and robust project cost monitoring process to assist cost data monitoring from different day-to-day sources. This is a challenge for cost control practice (Adjei *et al*., 2017). This has led to the identification of 12 indicator variables for project cost monitoring. They are: Training site personnel in the monitoring process, Provision of manuals for site monitoring team to refer to, Planning milestone monitoring processes, Monitoring updated cost records, Selection of appropriate techniques for cost monitoring, Monitoring cost performance, Selecting appropriate tools for tracking project costs, Identifying cost changing factors, Detecting early warning signs, Monitoring cost data (material, labour, plant, overheads, subcontractor costs, and the like), Cost data verification and Monitoring reported cost information.

Planning of the monitoring process, provision of cost monitoring manuals and training of the team in the site monitoring are confirmed by Olawale & Sun (2015) and Tom & Sachin (2013) as important issues. The key monitoring variable of monitoring is the monitoring of cost data. In other words, the monitoring of all the resources used in the project. This involves the monitoring of cost data, i.e. monitor labour cost for both owned and labour only works, monitor material costs purchasing and a control inventory of materials, monitoring of the right quantity of materials used, monitoring the right unit rate cost of materials, monitoring equipment in terms of what is hired, monitoring the right hours used by plants/equipment, monitoring of overhead costs of hired or owned plant cost, and the monitoring of earned value in terms of quantities measured from the cost performance (Olawale & Sun, 2015; Charoenngam & Sriprasert, 2001; Abubakar, 1992; Anyanwu, 2013). Looking to select appropriate techniques for cost monitoring reveals that there are several cost monitoring techniques available for cost monitoring. Notable among these are the PERT, earned value analysis, cost variances and the cost performance index for monitoring project cost (Raut & Pimplikar, 2014; Aliverdi *et al.*, 2013; Pajares & López-Paredes, 2011).

Project cost monitoring is not only the collection of information for further tasks but also verifying that the cost payment invoices or vouchers correspond to the budgeted cost by the various divisions of the organisation (Charoenngam & Sriprasert, 2001; Cunningham, 2017). The purpose of cost verification is to ensure accuracy in cost documentation, cost calculations and actual cost reflecting work progress (Cunningham, 2017; Charoenngam & Sriprasert, 2001). At the construction stage, the cost manager or quantity surveyor is expected to follow each work activity to check the specifications used and give advice, where necessary, about the cost implications. Monitoring cost performance is about cost progress and technical performance (Aliverdi *et al.*, 2013; Khamidi *et al.*, 2011; European Commission, 2005).

The cost information and updated cost records must be monitored to ensure that the cost data used for cost control is always up to date (Ogunlana & Butt, 2000; Tom & Sachin, 2013; Ahuja & Thiruvengadam, 2004).

The goal of project cost monitoring is to detect early warning signs and to identify cost changing factors for corrective measures to be taken and to prevent their future reoccurrence. This corresponds with the findings of numerous authors, including Aliverdi *et al*. (2013), Khamidi *et al*. (2011), Charoenngam and Sriprasert (2001), Byung-Cheol and Reinschmidt (2011), Khamidi *et al*. (2011) and Al-Jibouri, (2003).

The Delphi survey technique outcome supports the 12 related factors for project cost monitoring. These are illustrated in Table 9.1.

8.1.1.5 Project Cost Analysis (PCAN)

The essence of cost analysis is to provide meaning to the cost data collected. Project cost analysis is an important construct of cost control where the calculations are made to discover the status of the project cost. The basic methods used are variances and trend analysis (Charoenngam & Sriprasert, 2001; Abubakar 1992). The earned value principle requires the variance and trend analysis to be performed as and when an activity is completed to find out the cost status so that corrective measures can be taken. Errors arising from the estimation and variations cause variances. Price fluctuation and extreme wastage of materials should be investigated to facilitate the decision-making process (Charoenngam & Sriprasert, 2001). Cost analysis uses the relevant and detailed cost data to calculate actual project cost, to compare budgeted cost with actual cost, to compare actual cost with forecast cost, to analyse cost variance, to identify causes of cost overrun and to update the cost status of the project (Venkataraman & Pinto, 2008; Charoenngam & Sriprasert, 2001, Al-Jibouri, 2003; Abubakar, 1992).

The Delphi survey outcome supports the 7 related factors for project cost analysis provided in Table 9.1.

8.1.1.6 Decision Making (DM)

Studies by scholars have established that decision-making influences cost control practice (Olawale & Sun, 2015; Charoenngam & Sriprasert, 2001; Abubakar, 1992). The views of these researchers with regard to the impact of decision-making on the practice of cost control have been supported by others like: Okunbor, (2013), Adjei *et al*. (2017), Haji-Kazemi *et al*. (2012), Veronika *et al*. (2006). The seven variables of decision-making found by the current study are: selection of the relevant corrective measures, identifying the root/main cause of the cost variances, evaluation of the corrective measures used, developing alternative measures for cost variances, implementation of the selected measures, categorising the causes of the problems and analysing the problems.

The decision-making process is explicated by Lepadatu (2011), Beecroft *et al.* (2003), Patel and Patel (2013) and *Adjei* et al. (2017). The project cost manager should know how to act promptly under conditions of uncertainty and, for this, he needs to use a decision-making model (Lepadatu, 2011). Corrective measures in project cost control involve a decision-making process where measures are taken to solve or overcome any problem in cost variances. In a simplified approach, all the work activities of the various work sections can be controlled by corrective measures (Adjei *et al.*, 2017; Haji-Kazemi *et al.*, 2012; Veronika *et al*., 2006).

According to Abubakar (1992), some decisions for cost deviations for cost control include: changes in the resource mixes, adjusting the method statement plan or the budgeted cost, adjustment in the site organisation structure and or project information, review of the activities of the project team, cross checking changes in the market prices for materials, labour, plant and equipment, subcontractor, employing different procedures for site activities and management strategies and checking the conditions of the contract for clauses relating to claims.

The Delphi survey outcome supports the seven related factors for project cost monitoring outlined in Table 8.1.

Table 8. 2: Conceptual model: latent constructs using CM and PCCM

Latent variable construct	Measurement variable
Change Management (CM)	CM 1 Establishing the sense of urgency for change CM 2 Developing a vision for cost change CM 3 Developing strategies for cost change CM 4 Designing a short-term success plan

	CM 5 Promoting balanced change CM 6 Implementing the change CM 7 Evaluating the change CM 8 Continuous improvement from lessons learnt CM 9 Empowering others to act on the vision CM 10 Selecting an appropriate leadership style CM 11 Motivating for change
Project Cost Communication (PCCM)	PCCM 1 The context of communication (adopted) in the organisation PCCM 2 Form of communication (adopted) within the organisation (verbal, written) PCCM 3 Identification of the sender and receiver PCCM 4 Formulating a clear message PCCM 5 Appropriate methods of communication (emails, text messages, etc.) PCCM 6 Clear communication activity PCCM 7 Appropriate feedback channel PCCM 8 Standardisation of communication documents PCCM 9 Access to information PCCM 10 Reduction of barriers in communication

The above two latent constructs, CM and PCCM, form the conceptual framework and have been explicated in Chapter 4 of this thesis. Change management has 11 and project cost communication has ten related variables, as presented in Table 8.2 above.

8.1.2 DEPENDENT VARIABLES

The views of different authors on cost control practice are presented below:

8.1.2.1 Enhancement of targeted profitability

Every construction firm desires to make a profit from their operations (Adjei *et al.*, 2017; Omar & Mangin, 2002). It is the responsibility of the top management team to meet and brainstorm on the status of the project cost at predetermined periods (Akeem, 2017; Siyanbola & Raji, 2013). Cost control techniques are the tools to use to identify, track and keep the project cost within the targeted cost (Adjei *et al*., 2015; Sanni & Hashim, 2013; Olawale & Sun, 2010). The targeted costs are established through a realistic working budget for the execution of the construction project (Akeem, 2017; Siyanbola & Raji, 2013).

8.1.2.2 Prevention of wastage of resources

One of the key aspects in performing cost control is to control the construction resources used in the project. The construction resources include the 4Ms: the materials, men, machine and money. All these resources are assessed separately, before putting the resources costs together to establish the overall cost of the project as work progresses. Otim *et al*. (2011) identify different cost control measures used for checking the work activities onsite as: project cost targets, regular meeting on the progress of work, record keeping on work activities and reports. Monitoring work and cost execution and the evaluation of tasks completed is made possible through the use of bills of quantity. Haruna *et al*. (2017) and Morsy (2014) further explain that cost control is carried out using programmes of work, inspections, monitoring and evaluation of the project, record keeping, reports and site meetings. Cost control practice helps organisations by eliminating or reducing unnecessary wastage of resources in the execution of construction projects (Adjei *et al*., 2017; Akeem, 2017; Siyanbola & Raji, 2013; Bahaudin *et al*., 2012). Problems of cost arise when there is poor management of the construction resources (Otim *et al*., 2011).

8.1.2.3 Increase efficiency of work

According to Omar and Mangin (2002), the efficiency of work depends on many items. These include the construction methods used, the way resource cost is controlled, project supervision, management style, to mention a few. Cost reports at predetermined periods show the construction method used for the activities, whether the logistics at the construction site are improving on the productivity and profit margins, leading to a more efficient way of construction and increased work performance (Omar & Mangin, 2002). The project quantity surveyor is not only mindful of profitability levels, but also the way the various activities are carried out in terms of their efficiency and its related cost. In addition, the cost report enables the management team use of all the resources available efficiently, while maintaining their standard of performance (Akeem, 2017; Siyanbola & Raji, 2013). Controlling the initial budget requires efficient use of the available resources to keep to the cost plan (Akeem, 2017; Siyanbola & Raji, 2013).

8.1.2.4 Obtaining historic data for future projects

Obtaining historic data is the final assessment of the project cost data’s profit or loss account. The contractor gathers all the cost reports - cash flows, budgeted cost and lessons learnt from all the actions taken. This helps the organisation be more competitive in bidding and undertaking future similar construction projects. C cost information is kept as historical cost data by the organisation and is stored in a proper place for future reference (Charoenngam & Sriprasert, 2001).

8.1.2.5 Establishment of project cost outcomes

Another key objective of undertaking project cost control practice is to identify the project cost outcome. Two main outcomes are expected after the cost control practice: either profit or loss on the construction project (Charoenngam & Sriprasert, 2001). The profitability level of the project cost can only be seen by practising cost control. The quantity surveyor is the key person who checks the status of the project cost, including profit and losses in problematic areas, for corrective active actions to be taken if necessary (Adjei *et al*., 2017; Bahaudin *et al.,* 2012; Ojedokum *et al.,* 2012). If organisations ignore the practice of cost control, they will lose substantial profit in the long run (Bahaudin *et al*., 2012). The overall profit or loss account, a typical account system to show the status of the project cost, is most used by contractors in their operations (Hafez *et al*., 2015; Morsy, 2014).

8.1.2.6 Accurate cost information for decision-making

The accomplishment of construction project cost control practices and judgements principally depends on very rigid decision-making resulting from accurate cost information during the execution of construction projects (Bahaudin *et al*., 2012). Decisions to be taken are one of the key objectives of the cost control system. After the analysis, decisions are made by top management and they are communicated to the subordinates to resolve the deviations from the budgeted cost (Charoenngam & Sriprasert, 2001). Decision-making is effective where there is constant monitoring and updating of the cost data records, weekly meetings to check the progress of cost performance, cooperation of project team members and good communication between all the project team members. The top management team should ensure that cost control practice is a principle that is followed within the organisation (Abubakar, 1992).

The Delphi survey findings found the six outcomes of cost control practice to be: enhancement of targeted profitability, prevention of wastage of resources, increased efficiency of work, obtaining historic data for future projects, establishment of project cost outcome (profit/loss) and accurate cost information for decision-making. Table 8.3 below shows the summary of the cost control output:

Table 8. 3: Output of cost control

Output of cost control (OCC)	Akeem, (2017)	Siyanbola and Raji, (2013)	Omar and Mangin (2002)	Charoenngam and Sriprasert, (2001)	Abubakar (1992)
Enhancement of targeted profitability	x	x	x	x	
Establishment of project cost outcome (profit/loss)				x	
Accurate cost information for decision-making				x	x
Prevention of wastage of resources	x	x	x		
Increased efficiency of work	x	x	x		
Obtaining historic data for future projects				x	

8.2 MODEL SPECIFICATION AND JUSTIFICATION

The goal of this work is to develop a model to predict the factors of cost control practice. The theoretical framework for this study builds on the scholarly works of Charoenngam & Sriprasert (2001), and Abubakar (1992) - models of cost control practice as presented and elaborated in Chapter three. Charoenngam & Sriprasert (2001) conceptualised that cost control constructs are: project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis and decision-making. The study by Charoenngam & Sriprasert (2001) is considered relevant in terms of its constructs for any cost control studies. Therefore, the conceptual framework used by this study is principally based on the work of Charoenngam & Sriprasert (2001). Moreover, Abubakar (1992) further determined cost control practice to include project cost estimation, project cost budgeting, project cost monitoring, project cost evaluation and reporting and corrective decisions and implementation. These studies provide the basis for the current study having a variety of cost control studies within the wide theories. The new conceptual framework has eight factor constructs: project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis, decision-making, change management and project cost communication. These variables are considered exogenous variables. The variables are used to predict the endogenous variable, thus the overall outcome of cost control practice.

In addition, a literature review was conducted considering the variables that lead to the successful implementation of cost control practice. The variables were taken from the cost control models used by both Charoenngam & Sriprasert (2001) and Abubakar (1992). Studies by Akeem (2017), Siyanbola and Raji (2013) and Omar & Mangin (2002) were also reviewed. The variables identified are: enhancementof targeted profitability, establishment of project cost outcome (profit/loss), accurate cost information for decision-making, prevention of wastage of resources, increased efficiency of work and obtaining historic data for future projects. These are presented in Table 9.3 above.

The objective and subjective indicators contained in various models are bolstered by general studies. The objective indicators may be misdirecting and similarly, subjective indictors are inadequate to provide guidance for strategy (Aigbavboa, 2013). According to Rajan and Reichelstein (2009), both the objective and subjective indicators can be used as supplements. This study considers the primary and related factors of cost control practice. Information from the literature review and the Delphi survey technique established the determinants of cost control and the outcomes of cost control practice. Along these lines, the applied model hypothesises that cost control practice is accomplished by the link between the objective and subjective measurements. The conceptual framework is developed for the Ghanaian construction industry and suggests that the outcomes of cost control practice support the delivery of construction project cost.

8.3 STRUCTURAL COMPONENT OF THE NEW COST CONTROL MODEL

A well-developed measurement system is essential for accomplishment of cost control practice in project cost management for enhanced undertaking of project cost delivery. The measurement system ought to be able to pattern and screen the cost control indicators (constructs). The study suggests a conceptual PCC model, having the correct components and driving pointer measurements that impact PCC output. This is illustrated in the Figure 8.1 below:

The structural component of the cost control model has eight factor constructs: project cost estimation (PCE), project cost budgeting (PCB), project cost monitoring (PCM), project cost reporting (PCR), project cost analysis (PCAN), decision-making (DM), change management (CM) and project cost communication (PCCM).

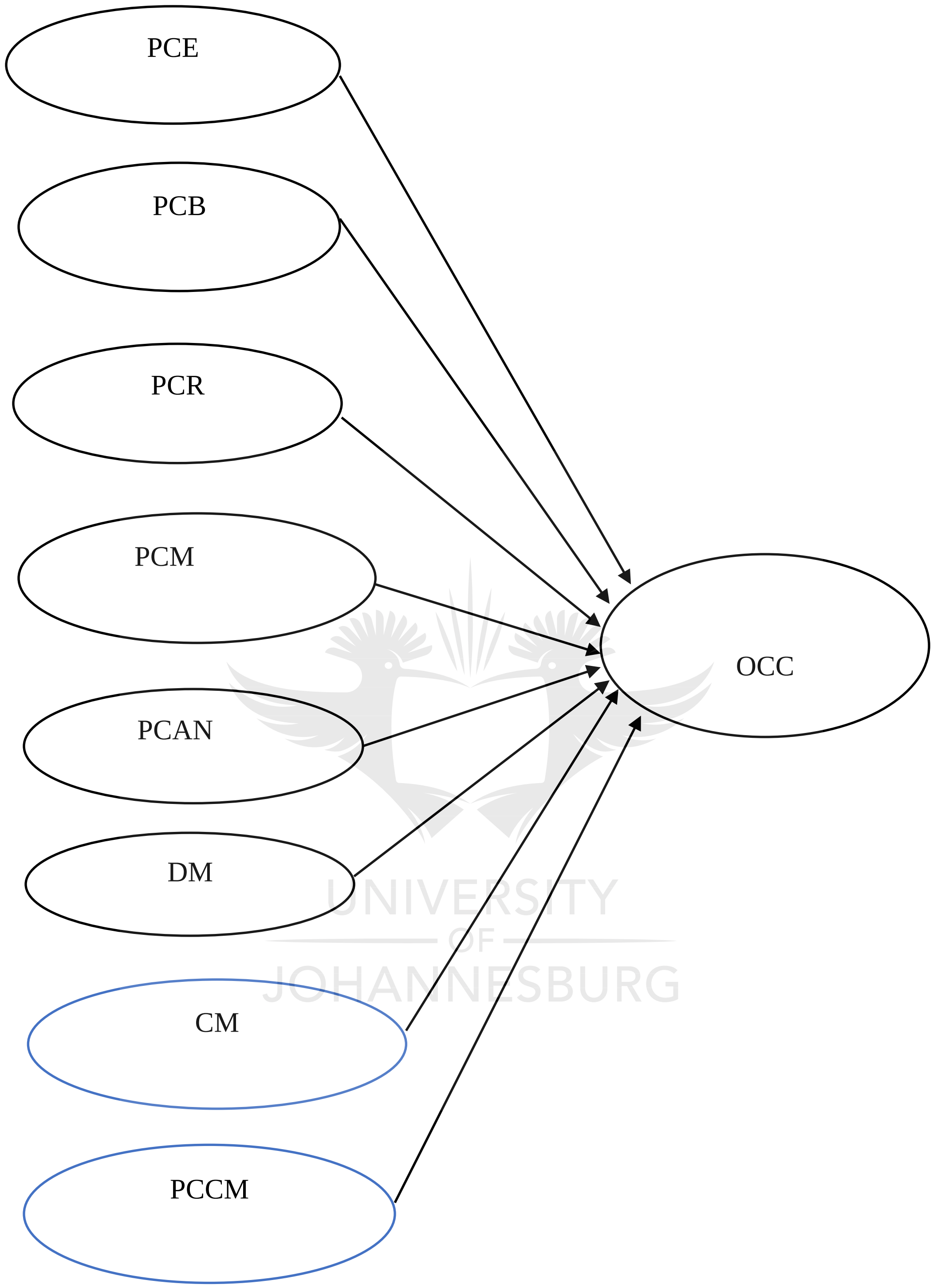

Figure 8.1: Cost control conceptual model

8.4 MEASUREMENT OF THE COMPONENTS OF THE MODEL

This section presents the measurement of the components of the cost control model developed to have the following breakdown of factors:

PCE = 16 measurement variables; PCB = six measurement variables; PCM = 12 measurement variables; PCR = five measurement variables; PCAN = seven measurement variables; DM = seven measurement variables; CM = 11 measurement variables and PCCM = ten measurement variables. The dependent variable (OCC) had six measurement variables.

8.5 CONCLUSION

This chapter presents and examines the theories and concepts supporting the new conceptual cost control framework. It highlights the relevant theories as determinants and assessment of the framework. The literature review and the Delphi survey technique support the development of the conceptual framework for cost control as being determining and confirming the factors and related factors.

The conceptual framework has eight factor constructs: project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis, decision-making, change management and project cost communication. The six outcomes of cost control practice discussed are: enhancement of targeted profitability, prevention of wastage of resources, increased efficiency of work, obtaining historic data for future projects, establishment of project cost outcome (profit/loss) and accurate cost information for decision making.

The cost control conceptual framework is presented in a structural form with its components and links to influence the practice of cost control in the construction industry.

The next chapter presents the fieldwork data presentation and analysis.

CHAPTER NINE

FIELDWORK DATA PRESENTATION AND ANALYSIS

9.0 INTRODUCTION

The quantitative data is analysed and presented in this chapter. The results are presented in three forms: descriptive statistics, factor analysis and finally, the regression modelling. Reliability and validity tests have also been conducted. The test for the hypothesis of the cost control practice and its direct relationships with the primary constructs have been determined for the outcomes of cost control practice in the Ghanaian construction industry. The data analysis is presented using tables, charts and graphs.

9.1 DATA COLLECTION AND PRESENTATION

The initial raw data received from the field survey were 313 in number. They were screened to remove any incomplete questionnaire that might disturb the validity of the outcomes. This led to the removal of 13 questionnaires leaving 300 for use in the study. The version twenty-five (25) of the Statistical Package for Social Sciences (SPSS) was used for the data analysis. Comfrey and Lee (1992) state that a sample size of 300 is good, while 50 is very poor, 500 is very good, 200 is fair and 100 poor. Descriptive statistics, factor analysis and the normality test were conducted.

9.2 RESPONDENTS' BACKGROUNDS

The respondents' backgrounds are presented as follows: class of company, regions of operation, years the companies have been in operation, highest qualification of respondents, nature of business performed, key person undertaking cost control practice, working experience in the company, category of projects undertaken, how long the category of project takes to complete and finally, how often the cost control system is prepared.

9.2.1 Distribution of sample by class of company

Figure 9.1 indicates that 193 of the respondents, representing 64%, fell into the D2K2 class of contractors, while the other 38% were D1K1 contractors. This means that there are fewer large-scale contractors than medium scale in the Ghanaian construction industry. This has no effect on the results of the study.

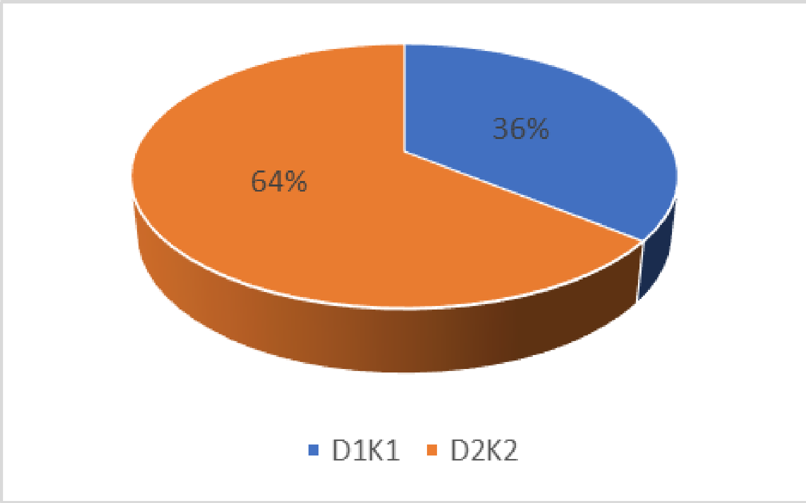

Figure 9.1:Class of company

9.2.2 Distribution of sample by region of operation

The distribution by the regions in which the contractors operate were: Greater Accra region, 148 responses, representing 49%, while the Ashanti region had 152 responses, representing 51% as illustrated in Figure 9.2. The distribution is very even which indicates that contractors are widespread in both these two regions.

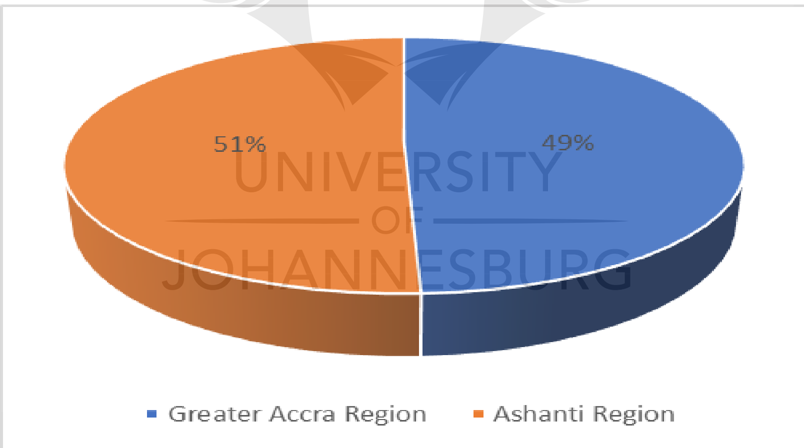

Figure 9. 1: Region of operation

9.2.3 Distribution of sample by years the companies have been in operation

The distribution of the sample by years the companies have been in operation is illustrated in the Figure 9.3 below. The years the companies have operated were grouped under 1-5, 1-6, 11-15, 16-20 and longer than 21 years of operation. The result shows that 107 of the companies (36%) had been in operation for 6-10 years. The next range of years (11 -15) of operation had 34% of the responses. The result points out that more experienced companies' views were accessed which will have a positive effect on the outcome of the study.

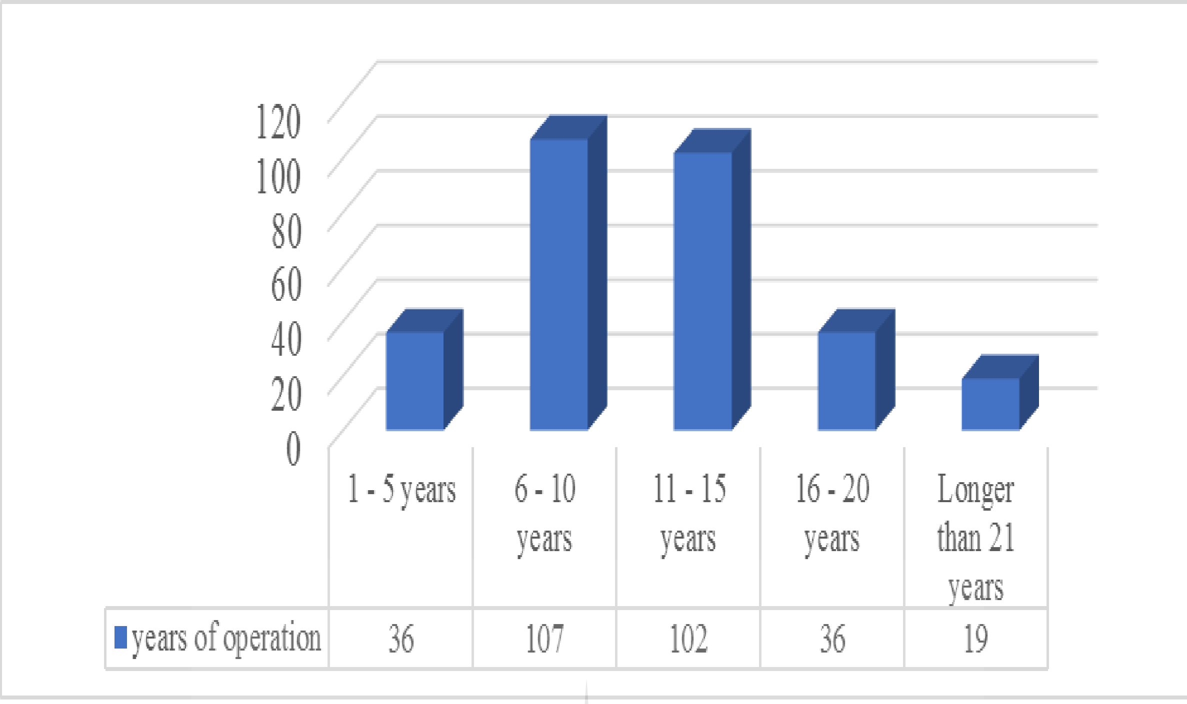

Figure 9. 2: Years the companies have been in operation

9.2.4 Distribution of sample by highest qualification of respondents

The data obtained has 1 missing value of 0.3%, which is minimal and will not have any effect on the results. In all, 299 respondents were used for the analysis, representing 99.7%. The results presented in Figure 9.4 show that 100 (34%) respondents, the majority, had bachelor's degrees. This was followed by 29% of the respondents who were Higher National Diploma holders. Master's degree holders ranked third at 21%. The fewest respondents had diplomas or doctoral degrees – 14% and 2% respectively. These results are illustrated below:

Figure 9. 3: Highest qualification of respondents

9.2.5 Distribution of sample by nature of business

The data obtained had two missing values representing 0.7%. This is minimal and will not have any effect on the results. In all, 298 responses were used for the data analysis, representing 99.3%. The result presented in Figure 9.5 shows that for the majority of respondents, 134 or 45% the nature of their business was building works. This was followed by civil works, with 40% of the responses. Electrical works ranked third with 10% of the responses. The least represented nature of business was plumbing works with 5%. These results are illustrated in Figure 9.5 below:

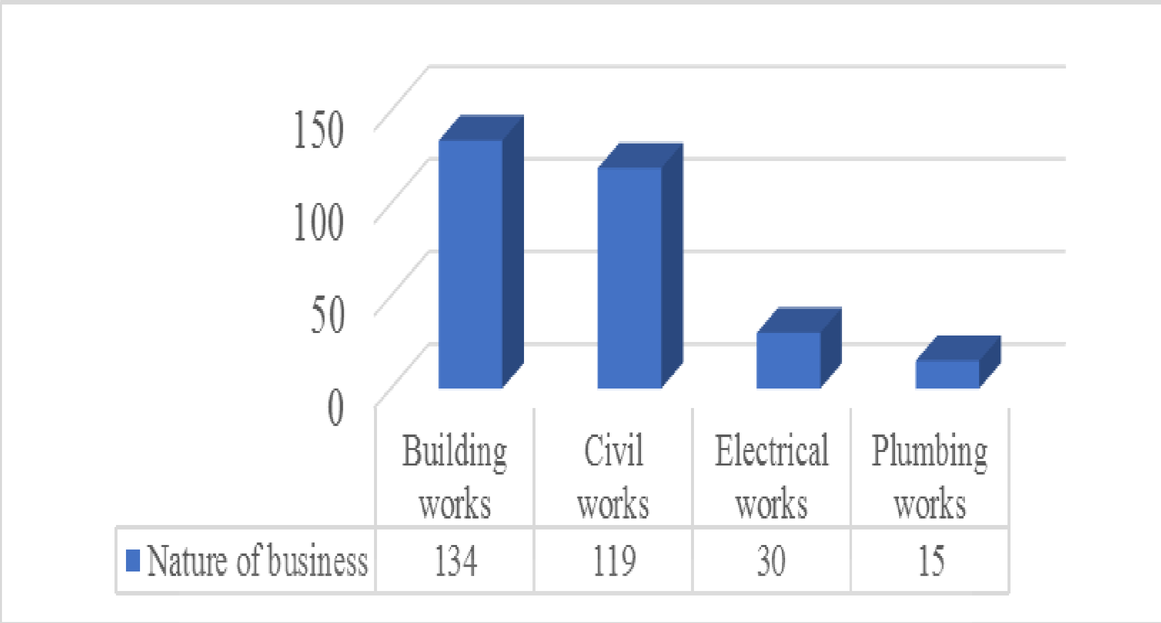

Figure 9. 4: Nature of business

9.2.6 Distribution of sample by key person who undertakes project cost control

The distribution of the sample by the key person who undertakes project cost control at the construction stage is presented in Table 9.7. The data obtained had 1 missing value, representing 0.3%, which is minimal and will not have any effect on the outcome. In all, 299 responses were used for the analysis, representing 99.7%. Most of the respondents, 120, representing 40%, answered that the quantity surveyor is the key person undertaking project cost control systems in the organisation. This was followed by project managers, constituting 29% of the responses. The third ranked key person in project cost control systems is the managing director, with 55 respondents, representing 18%. The least common person to undertake project cost control is the construction manager, 38 respondents (13%).

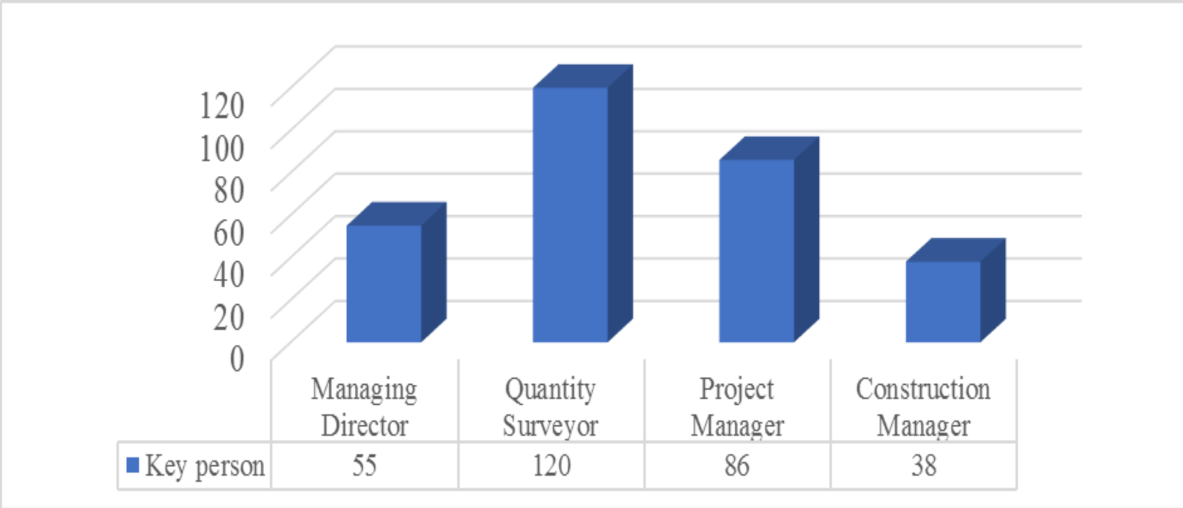

Figure 9. 5: Key person who undertakes project cost control

9.2.7 Distribution of sample by years of working in the companies

The distribution of the sample by years of working in the companies is shown by Figure 9.7. The years of working in the companies were grouped under 1-5, 1-6, 11-15, 16-20 and longer than 21 years. Most of the respondents,129 (43%) had worked in their company for 6-10 years. The second range of years was 1-5 years, with 126 respondents. The third range was 11-15 years. The fewest were 3 and 2 respondents of 16-20 and longer than 21 years respectively. The results show that more experienced personnel views were elicited, which will affect the outcome of the study.

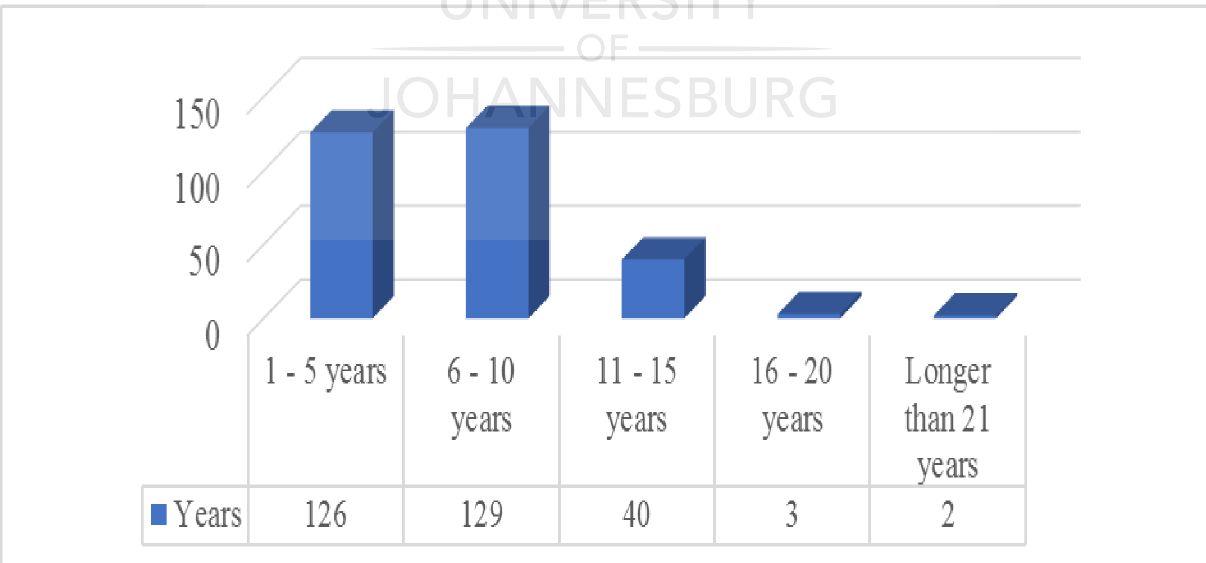

Figure 9. 6: Years of working in the company

9.2.8 Distribution of sample by category of projects undertaken

The distribution of the sample by category of project undertaken is presented in Figure 9.8. A total of 130 (43%) of the respondents fall into the residential buildings category of project. They are followed by educational buildings with 25% of the responses. The third ranked category was highway construction with 14% of the responses. The fewest were industrial and recreational buildings with 12% and 6% respectively.

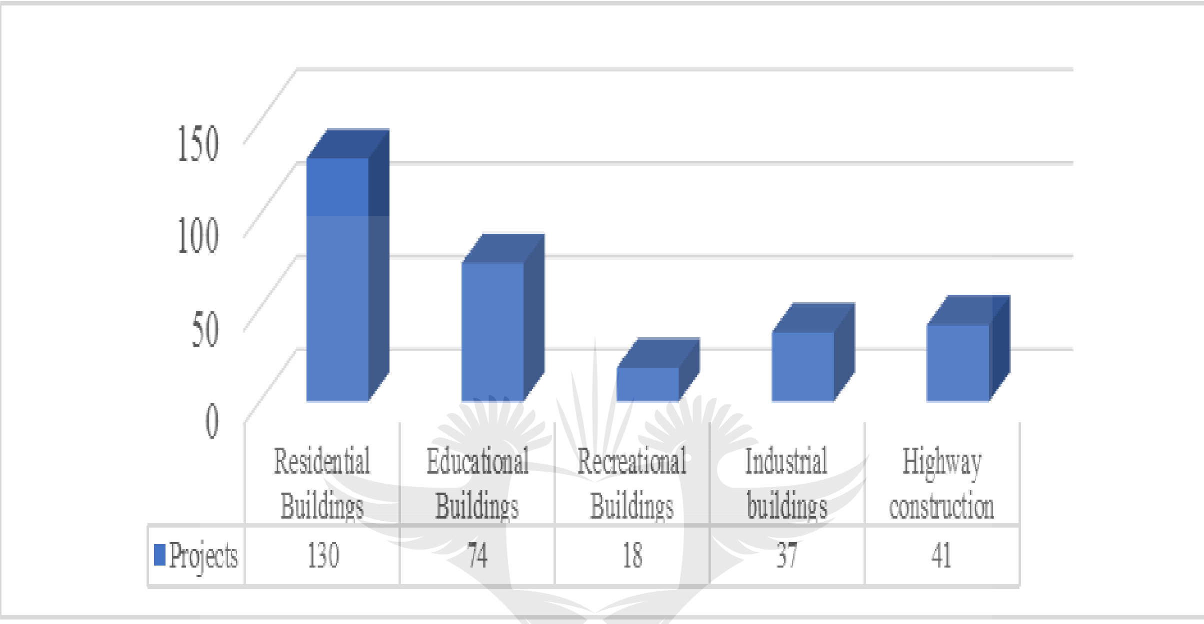

Figure 9. 7: Category of projects undertaken

9.2.9 Distribution of sample by months project take to complete

The data obtained had two missing values, 0.7%, which is minimal and will not have any effect on the result. In all, 298 responses were used for the data analysis, representing 99.3%. The distribution of the sample by months projects take to complete is presented in Figure 9.9. The months projects take to complete were grouped under 1-12, 13-24, 25-36, 37-48 and more than 49 months. The result in Figure 9.9 shows that the majority of responses, 132 representing 44%, took 13-24 months to complete. This was followed by 1-12 months, with 118 responses, representing 39%. The third ranked was 25-36 months with 12% of the responses. The fewest were 37- 48 months with 10 responses and more than 49 months with one. The result shows most projects are completed within the first 24 months.

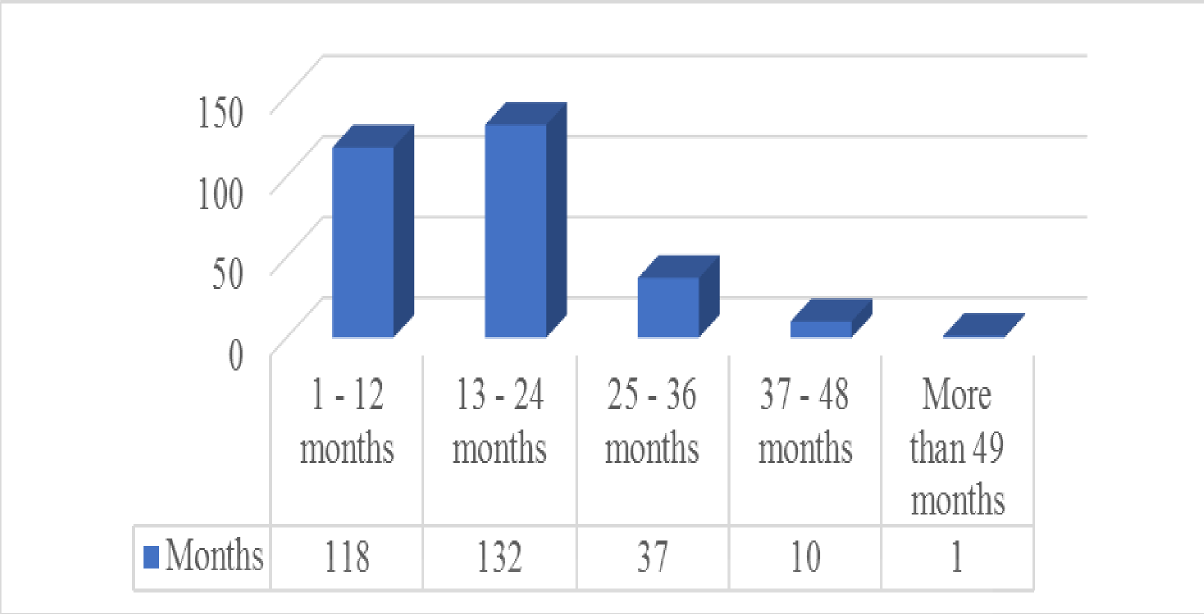

Figure 9. 8: Duration projects take to complete

9.2.10 Distribution of sample by how often cost control system is prepared

The distribution of the sample by how often cost control systems are is prepared is shown in Figure 9.10. The result presented Figure 9.10 shows that the majority of the respondents, 144 (48%) prepare cost control system quarterly. This is followed by weekly preparation (30%) The third ranked frequency of cost control preparation is annually with 8% of the responses. The least were daily and twice a year which each had 7%.

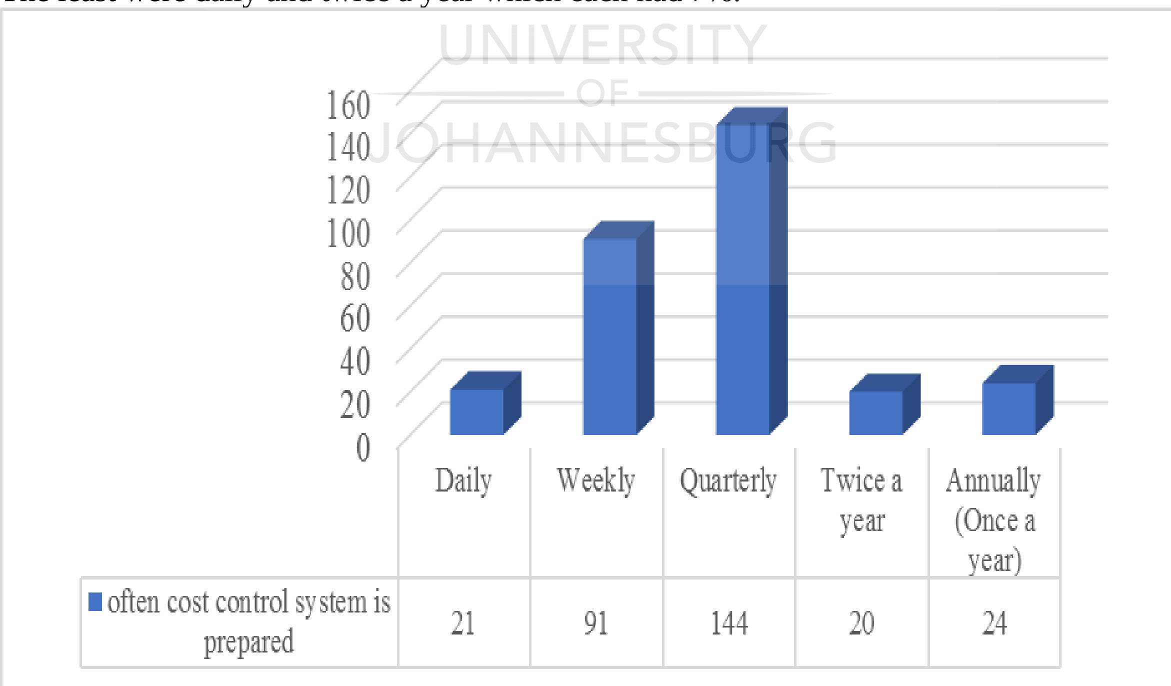

Figure 9. 9: How often cost control system is prepared

9.3 FACTORS EHANCING COST CONTROL PRACTICE

The factors enhancing cost control practice in the Ghanaian construction industry are presented in this section. The results of the descriptive statistics, exploratory factor analysis (EFA), normality test and correlation and regression statistics are presented in this section.

The descriptive statistics presented offer the ranks, from highest to lowest, of the all the related factors. The mean item score (MIS) and SD are used for the descriptive statistics.

The EFA is usually carried out at the initial stage of the data analysis to enable researchers to know the interrelationships between the related factors (Pallant, 2007). The SPSS software of version 25.0 was used for all the analysis, including the EFA. The sample size of 300 was adequate to progress to the factor analysis.

The Pallant (2007) determinants of a factor were used for the correlation matrix. Bartlett's test, Kaiser-Meyer-Olkin (KMO) and Cronbach's alpha values were also employed. The correlation matrix demonstrates relationships of $r = 0.3$ or more; Bartlett's test of sphericity ought to be factually critical at $p < 0.5$ and the KMO proportion of examining ought to be 0.6 or more. To affirm appropriateness, the unwavering quality of the examination instrument, Cronbach's alpha figures, which should be over 0.7, are viewed as adequate. However, values over 0.8 are most ideal (Pallant, 2007). The suggested range for the inter-item correlation ought to be between 0.2 and 0.4 (Briggs & Cheek, 1986) in situations where Cronbach's alpha figures fall beneath 0.7.

The results were run for the principal component analysis (PCA), using the varimax rotation. Its purpose was to check the quantity of variables to separate, utilising the Kaiser's rule, the aggregate number of segments with an eigenvalue of at least 1 or above stand resolved and embraced. The eigenvalue is depicted as a scientific property of a framework conveyed both as a foundation of setting up the quantity of variables to remove and as a proportion of change represented by a given measurement (Dainty *et al*., 2003; Ahadzie *et al*., 2008). Additionally, the graphical screen test is utilised to reject variables with the screen plot demonstrating the limit point when the eigenvalues levelled off (Dainty *et al.*, 2003).

9.3.1 RESULTS OF THE PROJECT COST ESTIMATION (PCE)

The descriptive statistics and factor analysis results of the PCE are presented below.

9.3.1.1 Descriptive statistics of PCE

The outcome of the descriptive statistics of the PCE factors is presented in Table 9.1 below:

Table 9.1: Descriptive statistics of PCE factors

Descriptive Statistics		Mean	SD	Rank
PCE 4	Available project information	4.26	0.819	1
PCE 1	Appropriate method of estimation	4.21	0.754	2
PCE 6	Conducting market survey	4.14	0.838	3
PCE 3	Experience of the estimator	4.13	0.824	4
PCE 5	Available cost indices	4.12	0.852	5
PCE 2	Standard procedure for estimation	4.11	0.876	6
PCE 7	Provision of standard tender documentation	4.10	0.787	7
PCE 8	Availability of client financial management plans	4.08	0.832	8
PCE 10	Use of local work force	3.99	0.927	9
PCE 9	Firms' bidding strategy	3.93	0.921	10
PCE 16	Disposal of hazardous waste	3.84	1.204	11
PCE 11	Unpredicted weather conditions	3.83	1.097	12
PCE 15	Erosion from road construction	3.76	1.185	13
PCE 14	Water pollution	3.74	1.232	14
PCE 12	Flooding of the site	3.74	1.099	14
PCE 13	Air pollution	3.67	1.216	15

Table 9.1 shows the ranks of the factors which might influence PCE for construction cost control practice by contractors in the Ghanaian construction industry. The findings indicate that 'A*vailable project information'* ranked first, an MIS of 4.26 and SD of 0.819; '*Appropriate method of estimation'* came second, also with a mean score of 4.21 and SD of 0.754; the third ranked factor was '*Conducting market survey'* with a mean score of 4.14 and SD of 0.838; '*Experience of the estimator'* ranked fourth, having a mean score of 4.13 and SD of 0.824; the fifth was '*Available cost indices'* with a mean score of 4.12 and SD of 0.852. The sixth ranking factor was '*Standard procedure for estimation'*, having a mean score of 4.11 and SD of 0.876; '*Provision of standard tender documentation'* was seventh, having a mean score of 4.10 and SD of 0.787; '*Availability of client financial management plans'* was the eighth ranked factor, with a mean score of 4.08 and SD of 0.832. Following this, the ninth ranked

factor was '*Use of local work force'*, having a mean score of 3.99 and SD of 0.927; and '*Firms' bidding strategy*' had the tenth position with a mean score of 3.93 and a SD of 0.921. In addition, '*Disposal of hazardous waste'* was ranked eleventh having a mean score of 3.84 and SD of 1.204; the twelfth ranked factor was '*Unpredicted weather conditions'* with a mean score of 3.83 and a SD of 1.097; '*Erosion from road construction'* was the thirteenth having a mean score of 3.76 and a SD of 1.185. The fourteenth factors were '*Water pollution'* and '*Flooding of the site'*, both having mean scores of 3.74, and SD of 1.232 and 1.099 respectively. Lastly, the least ranked factor was fifteenth, '*Air pollution'* with a mean score of 3.67 and SD of 1.216.

9.3.1.2 Results of Exploratory Factor Analysis for PCE

The results of the EFA of project cost budgeting are presented in Tables 9.2 to 9.6 and Figure 9.11. Of the 16 variables enumerated, PCE 3 'experience of the estimator' was eliminated. The 15 variables were acknowledged as possible factors that might influence the practice of cost control in the Ghanaian construction industry. The definitions of the identified variables are presented in Table 9.2:

Table 9.2: Definition of identified project cost estimation

Variable	Definition
PCE 1	Appropriate method of estimation
PCE 2	Standard procedure for estimation
PCE 4	Available project information
PCE 5	Available cost indices
PCE 6	Conducting market survey
PCE 7	Provision of standard tender documentation
PCE 8	Availability of client financial management plans
PCE 9	Firms' bidding strategies
PCE 10	Use of local work force
PCE 11	Unpredicted weather conditions
PCE 12	Flooding of the site
PCE 13	Air pollution
PCE 14	Water pollution

PCE 15	Erosion from road construction
PCE 16	Disposal of hazardous waste

The fundamentals for conducting factor analysis as bases were performed for the appropriateness of the data. This led to the undertaking of the PCA of the data. The correlation matrix was checked and had the coefficient values above 0.3, presented in Table 9.3. Furthermore, Table 9.4 illustrates the KMO degree of sampling suitability. The KMO value for the PCE was 0.878 which exceeded the minimum recommended figure of 0.6, while the Bartlett's test of sphericity also shows that the data is statistically significant, indicating 0.000 which is less than 0.05 and it is in support of the factorability of the correlation matrix.

The PCA was conducted using the Oblimin rotation with Kaiser Normalisation for the data. The eigenvalue was fixed to predictable high values of 1.0. Table 9.5 indicates that two factors were extracted for the PCE, having eigenvalue of more than 1.0. This is in support of the scree plot in Figure 9.11 that indicates the factor limit point at which the eigenvalues become level. The total variance, explained in Table 9.6, also indicates that two which was factors were extracted. Factor 1 extracted had 37%, and Factor 2 extracted had 12%. The last statistics of the extracted factors and PCA were 49% approximately halve of the total cumulative variance.

Table 9.3: Correlation matrix of the factor analysis - PCE

Correlation	PCE 1	PCE 2	PCE 4	PCB 5	PCB 6	PCE 7	PCE 8	PCE 9	PCE 10	PCE 11	PCE 12	PCE 13	PCE 14	PCE 15	PCE 16
PCE1	**1.000**	0.391	0.290	0.256	0.131	0.123	0.294	0.211	0.111	0.174	0.224	0.132	0.203	0.229	0.130
PCE 2	0.391	**1.000**	0.217	0.178	0.245	0.251	0.268	0.247	0.217	0.255	0.250	0.220	0.256	0.298	0.263
PCE 4	0.290	0.217	**1.000**	0.511	0.267	0.219	0.127	0.221	0.026	0.205	0.182	0.115	0.138	0.177	0.079
PCE 5	0.256	0.178	0.511	**1.000**	0.289	0.200	0.153	0.225	0.075	0.269	0.273	0.257	0.241	0.351	0.172
PCE 6	0.131	0.245	0.267	0.289	**1.000**	0.300	0.184	0.225	0.177	0.220	0.163	0.259	0.229	0.269	0.173
PCE 7	0.123	0.251	0.219	0.200	0.300	**1.000**	0.305	0.253	0.094	0.322	0.262	0.267	0.245	0.261	0.260
PCE 8	0.294	0.268	0.127	0.153	0.184	0.305	**1.000**	0.255	0.177	0.139	0.269	0.264	0.241	0.309	0.311
PCE 9	0.211	0.247	0.221	0.225	0.225	0.253	0.255	**1.000**	0.445	0.413	0.400	0.567	0.400	0.405	0.414
PCE 10	0.111	0.217	0.026	0.075	0.177	0.094	0.177	0.445	**1.000**	0.438	0.301	0.447	0.334	0.383	0.447
PCE 11	0.174	0.255	0.205	0.269	0.220	0.322	0.139	0.413	0.438	**1.000**	0.562	0.527	0.481	0.497	0.491
PCE 12	0.224	0.250	0.182	0.273	0.163	0.262	0.269	0.400	0.301	0.562	**1.000**	0.689	0.618	0.649	0.598
PCE 13	0.132	0.220	0.115	0.257	0.259	0.267	0.264	0.567	0.447	0.527	0.689	**1.000**	0.717	0.670	0.669
PCE 14	0.203	0.256	0.138	0.241	0.229	0.245	0.241	0.400	0.334	0.481	0.618	0.717	**1.000**	0.739	0.642
PCE 15	0.229	0.298	0.177	0.351	0.269	0.261	0.309	0.405	0.383	0.497	0.649	0.670	0.739	**1.000**	0.678
PCE 16	0.130	0.263	0.079	0.172	0.173	0.260	0.311	0.414	0.447	0.491	0.598	0.669	0.642	0.678	**1.000**

Table 9.4: KMO and Bartlett's test - PCE

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.878
Bartlett's Test of Sphericity	Approx. Chi-Square	176.400
	df	10
	Sig.	0.000

Table 9 5: Rotated factor matrix - PCE

	Factor	
	1	2
PCE13 Air pollution	0.904	
PCE16 Disposal of hazardous waste	0.838	
PCE14 Water pollution	0.828	
PCE15 Erosion from road construction	0.800	
PCE12 Flooding of the site	0.750	
PCE11 Unpredicted weather conditions	0.575	
PCE9 Firms' bidding strategies	0.513	
PCE10 Use of local work force	0.508	
PCE4 Available project information		0.663
PCE5 Available cost indices		0.593
PCE1 Appropriate method of estimation		0.477
PCE2 Standard procedure for estimation		0.414
PCE6 Conducting market survey		0.375
PCE7 Provision of standard tender documentation		0.305
PCE8 Availability of client financial management plans		0.302
Extraction Method: Principal Axis Factoring. Rotation Method: Oblimin with Kaiser Normalisation.		
a. Rotation converged in 5 iterations.		

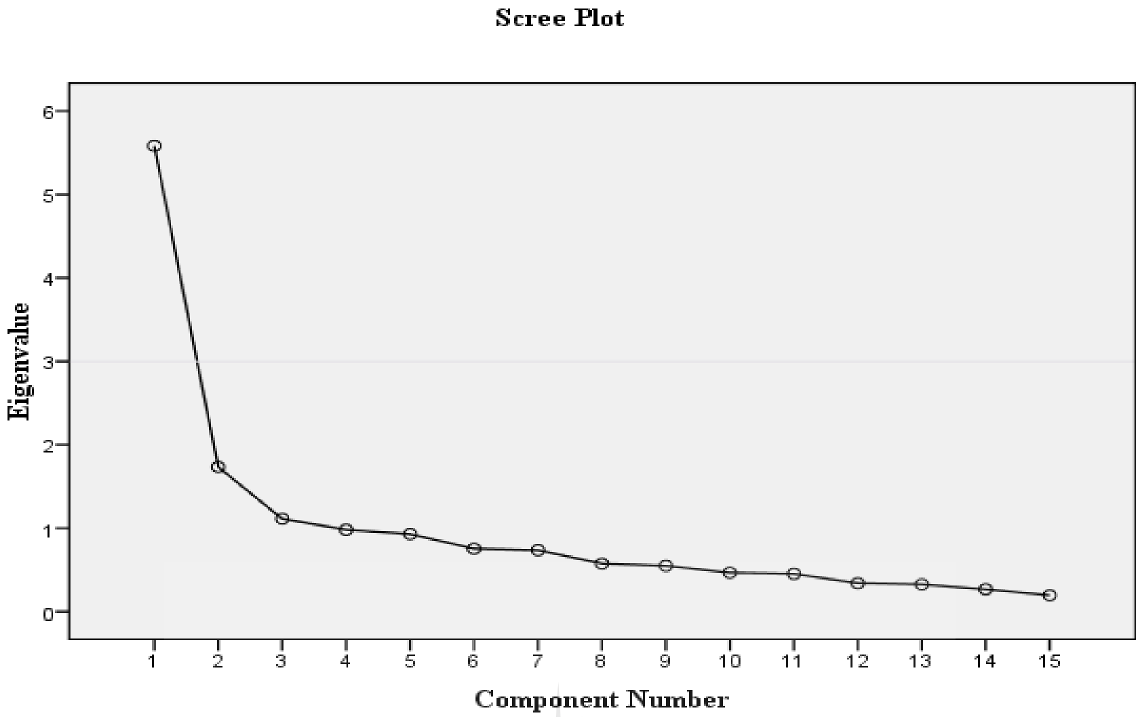

Figure 9. 10: Scree plot for the factor analysis - PCE

Table 9.6: Variance Explained - PCE

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.582	37.216	37.216	5.582	37.216	37.216
2	1.734	11.557	48.773	1.734	11.557	48.773
3	1.112	7.414	56.187			
4	.981	6.542	62.730			
5	.929	6.193	68.923			
6	.753	5.023	73.946			
7	.736	4.908	78.853			
8	.575	3.830	82.684			
9	.549	3.658	86.342			
10	.466	3.105	89.447			
11	.453	3.018	92.464			
12	.341	2.275	94.739			
13	.327	2.179	96.919			
14	.267	1.782	98.700			
15	.195	1.300	100.000			
Extraction Method: Principal Component Analysis						

Table 9.5 indicates that two factors were extracted for the PCE having eigenvalues of more than 1.0, using the principal component analysis. The factors extracted were examined in view of the inherent interrelationships among the factors. They were then given common names. The two factors which were extracted are termed as Factor 1: **Appropriate planning and environmental issues** and Factor 2: **Provision of contract documentation**. The naming of the factors was obtained from an examination of the variables that defined the factors and also from checking the top variables with the highest loading factors. The fundamental indicators of the extracted factors are clarified below, and with an itemised portrayal of the idea of how each was presented by the field survey.

Factor 1: Appropriate planning and environmental issues

Factor 1 extracted had eight variables as illustrated in Table 9.5: *Air pollution* (90.4%), *Disposal of hazardous waste* (83.8%), *Water pollution* (82.8%), *Erosion from road construction* (80.0%), *Flooding of the site* (75.0%), *Unpredicted weather conditions* (57.5%), *Firms' bidding strategy* (51.3%) and *Use of local work force* (50.8%).

Factor 2: Provision of contract documentation

Factor 2 extracted had seven variables as illustrated in Table 9.5: *Available project information* (66.3%), *Available cost indices* (59.3%), *Appropriate method of estimation* (47.7%), *Standard procedure for estimation* (41.4%), *Conducting market survey* (37.5%), *Provision of standard tender documentation* (30.5%) and *Availability of client financial management plans* (30.2%). The cluster amounted to 49% of the total variance.

9.3.2 RESULTS OF THE PROJECT COST BUDGETING (PCB)

The descriptive statistics and factor analysis results of the PCE are presented below.

9.3.2.1 Descriptive statistics of PCB

The outcome of the descriptive statistics of the PCB factors is presented in Table 9.7 below:

Table 9.7: Descriptive statistics of PCB factors

	Descriptive Statistics	Mean	SD	Rank
PCB4	Establishing realistic working budget	4.11	0.849	1
PCB6	Ensuring that project team members understand the budget	4.11	0.863	1
PCB5	Periodic revision of the budget	4.05	0.987	2
PCB1	Allocation of activity budget	4.00	0.894	3
PCB3	Approval of master and functional budgets	4.00	0.909	3
PCB2	Negotiation of the main budget	3.98	0.938	4

Table 9.7 above ranks the factors which could influence PCB for cost control practice by contractors in the Ghanaian construction industry. It indicates that '*establishing realistic working budget*' and '*ensuring that project team members understand the budget'* ranked first with both MIS of 4.11 and SD of 0.849, 0.863 respectively; *'periodic revision of the budget'* was second, with a mean score of 4.05 and SD of 0.987; the third ranked factors were *'allocation of activity budget'* and *'approval of master and functional budgets'* with a mean score of 4.00 and, SD of 0.894 and 0.909 respectively; Lastly, the lowest ranked factor was '*negotiation of the main budget'* having a mean score of 3.98 and SD of 0.938.

9.3.2.2 Results of Exploratory Factor Analysis for PCB

The results of the EFA of project cost budgeting are presented in Tables 9.8 to 9.12 and Figure 9.12. Of the six variables enumerated, PCB 6 '*ensuring that project team members understand the budget*' dropped. The five *(5)* variables were acknowledged as possible factors that might influence the practice of cost control in the Ghanaian construction industry. The definitions of the identified variables are presented in Table 9.8 below:

Table 9.8: Definition of identified project cost budgeting

Variable	Definition
PCB 1	Allocation of activity budget
PCB 2	Negotiation of the main budget
PCB 3	Approval of master and functional budgets
PCB 4	Establishing a realistic working budget
PCB 5	Periodic revision of the budget

The fundamentals for conducting factor analysis as bases were performed for the appropriateness of the data which lead to the undertaking of the PCA of the data. The correlation matrix was checked and coefficient values above 0.3 are presented in Table 9.9. Furthermore, Table 9.10 illustrates the KMO degree of sampling suitability. The KMO value for the PCB was 0.803, which exceeded the minimum recommended figure of 0.6, while the Bartlett's test of sphericity also shows that the data is statistically significant at 0.000 which is less than 0.05 and it is in support of the factorability of the correlation matrix.

The PCA was conducted using the varimax rotation for the data. The eigenvalue was fixed at predictable high values of 1.0. Table 9.11 indicates that only one factor was extracted for the

PCB having an eigenvalue of more than 1.0. This is in support of the scree plot in Figure 9.12 that indicates the factor limit point at which the eigenvalues become level. The total variance explained in Table 9.12 also indicates that only one factor was extracted. Factor 1 extracted scored 56.279%. The last statistics of the extracted factors and PCA were 56%, approximately halve of the total cumulative variance.

Table 9.9: Correlation matrix of the factor analysis - PCB

Correlation	PCB1	PCB2	PCB3	PCB4	PCB5
PCB1	**1.000**	0.535	0.457	0.427	0.383
PCB2	0.535	**1.000**	0.432	0.377	0.421
PCB3	0.457	0.432	**1.000**	0.490	0.440
PCB4	0.427	0.377	0.490	**1.000**	0.572
PCB5	0.383	0.421	0.440	0.572	**1.000**

Table 9.10: KMO and Bartlett's test - PCB

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.803
Bartlett's Test of Sphericity	Approx. Chi-Square	442.488
	df	10
	Sig.	0.000

Table 9.11: Rotated factor matrix - PCB

	Factor
	1
PCB4 Establishing a realistic working budget	0.702
PCB5 Periodic revision of the budget	0.677
PCB3 Approval of master and functional budgets	0.676
PCB1 Allocation of activity budget	0.664
PCB2 Negotiation of the main budget	0.647
Extraction Method: Principal Axis Factoring.	
a. 1 factors extracted. 5 iterations required.	

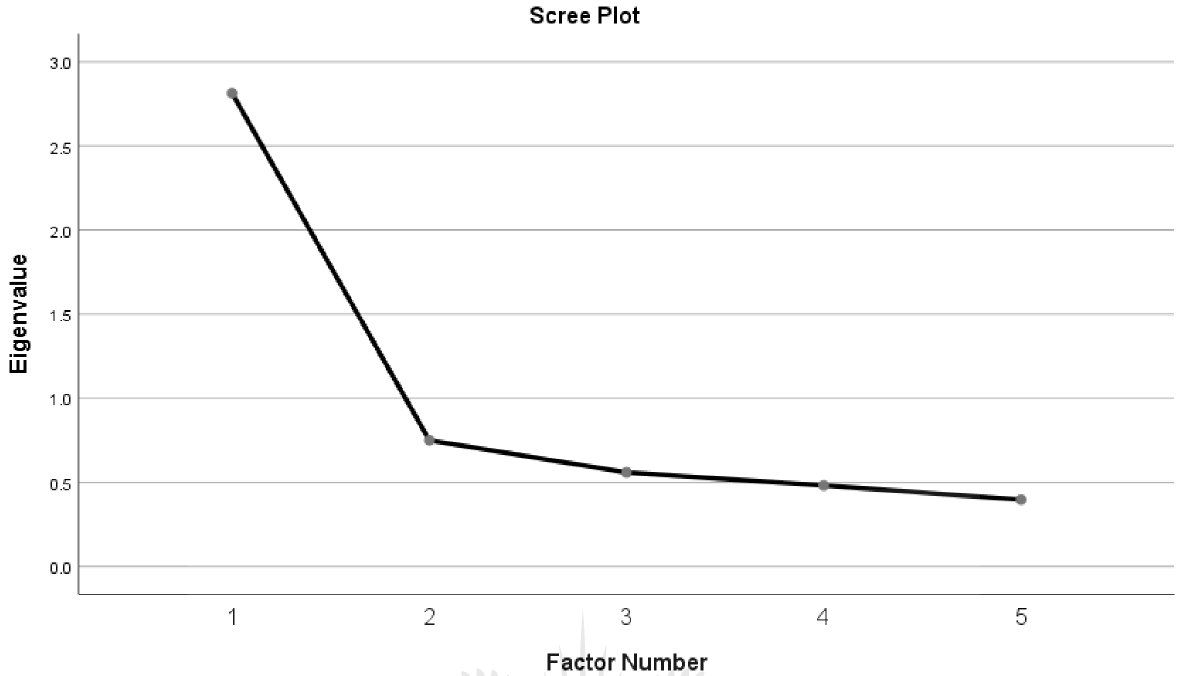

Figure 9. 11: Scree plot for the factor analysis - PCB

Table 9 12: Variance Explained - PCB

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.814	56.279	56.279	2.269	45.372	45.372
2	0.750	14.996	71.275			
3	0.558	11.169	82.445			
4	0.481	9.627	92.072			
5	0.396	7.928	100.000			
Extraction Method: Principal Axis Factoring.						

Table 9.12 indicates that only one factor was extracted for the PCB, having an eigenvalue of more than 1.0, using the principal axis factoring. The one factor extracted is termed **preparation of project cost budgets**. The naming of the factor was obtained from an examination of the variables that defined the factor and also from checking the top variables with the highest loading factor. The fundamental indicators of the extracted factor are clarified beneath and with an itemised portrayal of the idea of how each was presented by the field survey.

Factor 1: preparation of project cost budgets

The Factor 1 extracted has five variables as illustrated in Table 9.11: *Establishing the realistic working budget* (70.2%), *Periodic revision of the budget* (67.7%), *Approval of master and functional budgets* (67.6%), *Allocation of activity budget* (66.4%) and *Negotiation of the main budget* (64.7%). The percentages in brackets show the factor loadings of each variable and the definitions of the variables are presented in Table 9.8. The cumulative percentage of the total variance is 56.3%.

9.3.3 RESULTS OF THE PROJECT COST REPORTING (PCR)

The descriptive statistics and factor analysis results of the PCR are presented below.

9.3.3.1 Descriptive statistics of PCR

The outcome of the descriptive statistics of the PCR factors is presented in Table 9.13 below:

Table 9.13: Descriptive statistics of PCR factors

	Descriptive Statistics	Mean	SD	Rank
PCR5	Reporting on feedback or actions taken	4.05	0.926	1
PCR4	Distribution of the cost control reports to appropriate sections	3.97	0.934	2
PCR3	Reporting cost variances from analysis	3.90	0.950	3
PCR2	Developing various types of cost control report	3.86	0.974	4
PCR1	Planning for the cost report	3.85	1.035	5

Table 9.13 shows the ranks of the factors which could influence PCR for cost control practice by contractors in the Ghanaian construction industry. It shows that '*reporting on feedback or actions taken*' ranked first, with MIS of 4.05 and SD of 0.926; '*distribution of the cost control reports to appropriate sections'* came second, with a mean score of 3.97 and SD of 0.934; the third ranked factor was '*reporting cost variances from analysis'* with a mean score of 3.90, SD of 0.950; '*Developing various types of cost control report*' was fourth, having a mean score of 3.86 and SD of 0.974. Fifthly, the lowest ranked factor was '*planning for the cost report'*, with a mean score of 3.85 and SD of 1.035.

9.3.3.2 Factor analysis of PCR

The results of the EFA of project cost reporting are presented in Tables 9.14 to 9.18 and Figure 9.13. Of the five variables, none dropped out. The five variables were acknowledged as possible factors that might influence the practice of cost control in the Ghanaian construction industry. The definitions of the identified variables are presented in Table 9.14 below:

Table 9.14: Definition of identified project cost reporting

Variable	Definition
PCR 1	Planning for the cost report
PCR 2	Developing various types of cost control report
PCR 3	Reporting cost variances from analysis
PCR 4	Distribution of the cost control reports to appropriate sections
PCR 5	Reporting on feedback or actions taken

The fundamentals for conducting factor analysis as bases were performed for the appropriateness of the data which led to the undertaking of the PCA of the data. The correlation matrix was checked and the coefficient values above 0.3 are presented in Table 9.15. Furthermore, Table 9.16 illustrates the KMO degree of sampling suitability. The KMO value for the PCR was 0.848, which exceeds the minimum recommended figure of 0.6, while the Bartlett's test of sphericity also shows that the data is statistically significant showing 0.000, which is less than 0.05 and is in support of the factorability of the correlation matrix.

The PCA was conducted using the varimax rotation for the data. The eigenvalue was fixed to predictable high values of 1.0. Table 9.17 indicates that only one factor was extracted for the PCR, having an eigenvalue of more than 1.0. This is in support of the scree plot in Figure 9.13 that indicates the factor limit point at which the eigenvalues become level. The total variance, explained in Table 9.18, also indicates that only one factor was extracted. The Factor 1 extracted scored 63.53%. The last statistics of the extracted factors and PCA were 64% of the total cumulative variance.

Table 9.15: Correlation matrix of the factor analysis - PCR

Correlation	PCR 1	PCR 2	PCR 3	PCR 4	PCR 5
PCR 1	**1.000**	0.528	0.584	0.561	0.504
PCR 2	0.528	**1.000**	0.448	0.507	0.562
PCR 3	0.584	0.448	**1.000**	0.588	0.525
PCR 4	0.561	0.507	0.588	**1.000**	0.627
PCR 5	0.504	0.562	0.525	0.627	**1.000**

Table 9.16: KMO and Bartlett's test - PCR

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.848
Bartlett's Test of Sphericity	Approx. Chi-Square	609.986
	df	10
	Sig.	0.000

Table 9.17: Rotated factor matrix - PCR

	Factor
	1
PCR4 Distribution of the cost control reports to appropriate sections	0.788
PCR5 Reporting on feedback or actions taken	0.757
PCR1 Planning for the cost report	0.736
PCR3 Reporting cost variances from analysis	0.726
PCR2 Developing various types of cost control report	0.680
Extraction Method: Principal Axis Factoring.	
a. 1 factors extracted. 5 iterations required.	

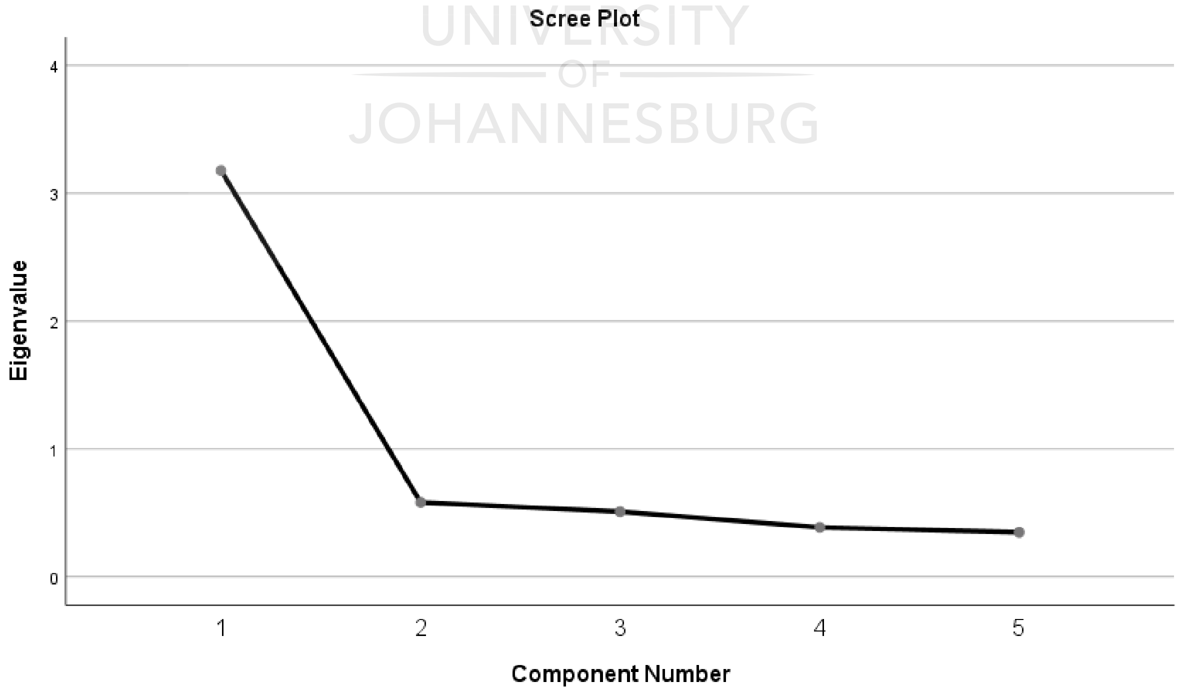

Figure 9. 12: Scree plot for the factor analysis - PCR

Table 9.18: Variance explained - PCR

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.176	63.525	63.525	2.725	54.504	54.504
2	0.581	11.623	75.148			
3	0.509	10.189	85.337			
4	0.386	7.711	93.048			
5	0.348	6.952	100.000			
Extraction Method: Principal Axis Factoring.						

Table 9.18 indicates that only one factor was extracted for the PCR having an eigenvalue of more than 1.0, using the principal axis factoring. The one factor extracted is termed **project cost report process**. The naming of the factor was obtained from an examination of the variables that defined the factor and also from checking the top variables with the highest loading factor. The fundamental indicators of the extracted factor are clarified below with an itemized illustration of the idea of how each was presented by the field survey.

Factor 1: **project cost report process**

The Factor 1 extracted has five variables, as illustrated in Table 10.24. They are: *Distribution of the cost control reports to appropriate sections* (78.8%), *Reporting on feedback or actions taken* (75.7%), *Planning for the cost report* (73.6%), *Reporting cost variances from analysis* (72.6%) and *Developing various types of cost control report* (68.0%). The percentages in brackets show the factor loadings of each variable; the definitions of the variables are presented in Table 9.14. The cumulative percentage of the total variance is 64%.

9.3.4 RESULTS OF THE PROJECT COST ANALYSIS (PCAN)

The descriptive statistics and factor analysis results of the PCAN are presented below.

9.3.4.1 Descriptive statistics of PCAN

The outcome of the descriptive statistics of the PCAN factors are presented in Table 9.19 below:

Table 9.19: Descriptive statistics of PCAN factors

	Descriptive Statistics	Mean	SD	Rank
PCAN2	Calculating actual project cost	4.16	0.895	1
PCAN7	Updating cost status of the project	4.12	0.857	2

PCAN5	Analysing cost variance	4.12	0.890	2
PCAN4	Comparing actual cost with forecast cost	4.10	0.803	3
PCAN6	Identifying causes of cost overrun	4.06	0.916	4
PCAN1	Collection of relevant and detailed cost data	4.05	0.915	5
PCAN3	Comparing budgeted cost with actual cost	4.00	0.909	6

Table 9.19 shows the ranks of the factors which could influence PCAN for cost control practice by contractors in the Ghanaian construction industry. It shows that '*calculating actual project cost*' was first in the ranking with MIS of 4.16 and SD of 0.895; '*updating cost status of the project*' and *'analysing cost variance'* were second, also with both mean scores of 4.12 and SD of 0.857 and 0.890 respectively. Furthermore, the third ranked factor was '*comparing actual cost with forecast cost'* with a mean score of 4.10 and SD of 0.803; *'identifying causes of cost overrun'* was fourth with a mean score of 4.06 and SD of 0.916. '*Collection of relevant and detailed cost data*' was the fifth with a mean score of 4.05 and SD of 0.915. The lowest ranked factor was sixth, '*comparing budgeted cost with actual cost'* having a mean score of 4.00 and SD of 0.909.

9.3.4.2 Factor analysis of PCAN

The results of the EFA of project cost reporting are presented in Tables 9.20 to 9.24 and Figure 9.14. Of the seven variables enumerated, none dropped out. The seven variables were acknowledged as possible factors that might influence the practice of cost control in the Ghanaian construction industry. The definitions of the identified variables are presented in Table 9.20 below:

Table 9.20: Definition of identified project cost analysis

Variable	Definition
PCAN 1	Collection of relevant and detailed cost data
PCAN 2	Calculating actual project cost
PCAN 3	Comparing budgeted cost with actual cost
PCAN 4	Comparing actual cost with forecast cost
PCAN 5	Analysing cost variance
PCAN 6	Identifying causes of cost overrun
PCAN 7	Updating cost status of the project

Factor analysis was performed for the appropriateness of the data which led to the undertaking of the PCA of the data. The correlation matrix was checked and the coefficient values above 0.3 are presented in Table 9.21. Furthermore, Table 9.22 illustrates the KMO degree of sampling suitability. The KMO value for the PCAN was 0.834 which exceeds the minimum recommended figure of 0.6, while the Bartlett's test of sphericity also shows that the data are statistically significant with a reading of 0.000, which is less than 0.05 and it supports the factorability of the correlation matrix.

The PCA was conducted using the varimax rotation for the data. The eigenvalue was fixed to predictable high values of 1.0. Table 9.23 indicates that only one factor was extracted for the PCAN, having an eigenvalue of more than 1.0. This is in agreement with the scree plot in Figure 9.14 which indicates the factor limit point at which the eigenvalues become level. The total variance explained in Table 9.24 also indicates that only one factor was extracted. The Factor extracted scored 52.16%. The last statistics of the extracted factors and PCA approximately 52%of the total cumulative variance.

Table 9.21: Correlation matrix of the factor analysis - PCAN

Correlation	PCAN 1	PCAN 2	PCAN 3	PCAN 4	PCAN 5	PCAN 6	PCAN 7
PCAN 1	**1.000**	0.543	0.474	0.421	0.473	0.380	0.423
PCAN 2	0.543	**1.000**	0.308	0.354	0.451	0.378	0.433
PCAN 3	0.474	0.308	**1.000**	0.508	0.285	0.355	0.296
PCAN 4	0.421	0.354	0.508	**1.000**	0.540	0.544	0.395
PCAN 5	0.473	0.451	0.285	0.540	**1.000**	0.533	0.547
PCAN 6	0.380	0.378	0.355	0.544	0.533	**1.000**	0.589
PCAN 7	0.423	0.433	0.296	0.395	0.547	0.589	**1.000**

Table 9.22: KMO and Bartlett's test - PCAN

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.834
Bartlett's Test of Sphericity	Approx. Chi-Square	765.125
	df	21
	Sig.	0.000

Table 9.23: Rotated factor matrix - PCAN

	Factor
	1
PCAN 5 Analysing cost variance	0.729
PCAN 6 Identifying causes of cost overrun	0.711
PCAN 4 Comparing actual cost with forecast cost	0.696
PCAN 7 Updating cost status of the project	0.682
PCAN 1 Collection of relevant and detailed cost data	0.673
PCAN 2 Calculating actual project cost	0.612
PCAN 3 Comparing budgeted cost with actual cost	0.541
Extraction Method: Principal Axis Factoring.	
a. 1 factors extracted. 5 iterations required.	

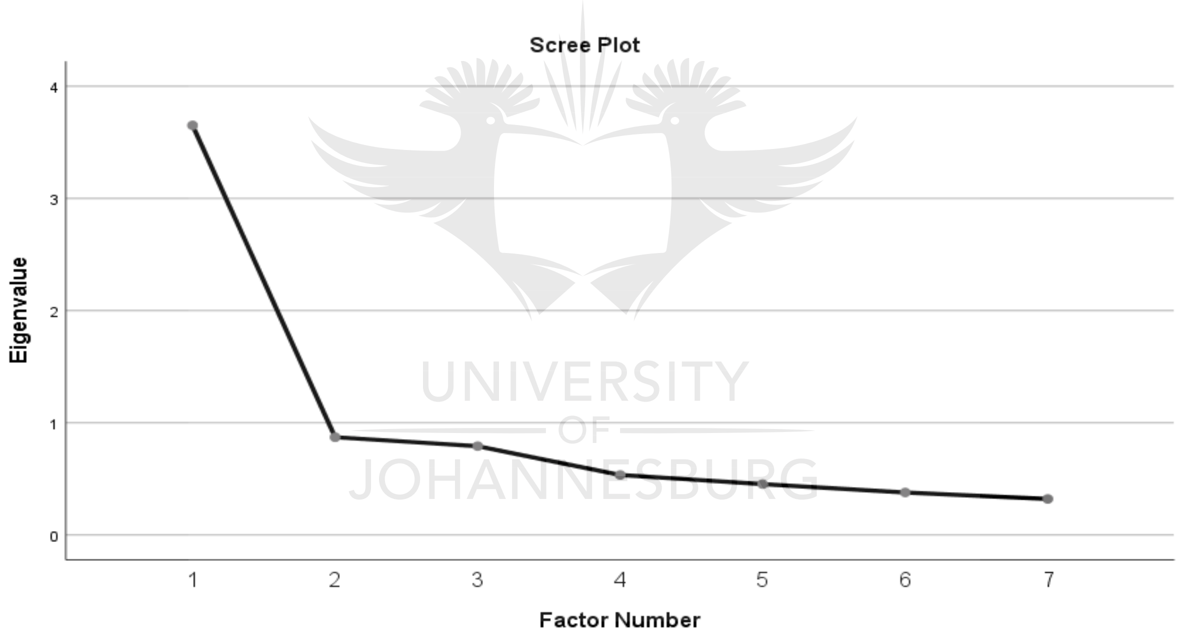

Figure 9. 13: Scree plot for the factor analysis - PCAN

Table 9.24: Variance explained - PCAN

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.651	52.156	52.156	3.106	44.376	44.376
2	0.871	12.444	64.601			
3	0.791	11.304	75.905			

4	0.534	7.634	83.538			
5	0.453	6.470	90.009			
6	0.378	5.404	95.413			
7	0.321	4.587	100.000			
Extraction Method: Principal Axis Factoring.						

Table 9.24 indicates that only one factor was extracted for the PCAN, having an eigenvalue of more than 1.0, using the principal axis factoring. The one factor extracted is termed **project cost analysis**. The naming of the factor was obtained from an examination of the variables that defined the factor and also from checking the top variables with the highest loading factor. The fundamental indicators of the extracted factor are clarified below and with an itemised illustration of the idea of how each was presented by the field survey.

Factor 1: **Project cost analysis**

The Factor 1 extracted has seven variables as illustrated in Table 10.36. They are: *Analysing cost variance* (72.9%), *Identifying causes of cost overrun* (71.1%), *Comparing actual cost with forecast cost* (69.6%), *Updating cost status of the project* (68.2%), *Collection of relevant and detailed cost data* (67.3%), *Calculating actual project cost* (61.2%) and *Comparing budgeted cost with actual cost* (54.1%). The percentages in brackets show the factor loadings of each variable. The definitions of the variables are presented in Table 9.20, the cumulative percentage of the total variance is 52%.

9.3.5 RESULTS OF THE PROJECT COST MONITORING (PCM)

The descriptive statistics and factor analysis results of the PCM are presented below.

9.3.5.1 Descriptive statistics of PCM

The outcome of the descriptive statistics of the PCM factors is presented in Table 9.25 below:

Table 9.25: Descriptive statistics of PCM factors

	Descriptive Statistics	Mean	SD	Rank
PCM2	Selection of appropriate technique for cost monitoring	4.20	0.903	1
PCM12	Training site personnel in monitoring process	4.11	0.866	2
PCM4	Monitoring cost data (material, labour, plant, overheads, subcontractor cost, etc.)	4.11	0.783	2
PCM10	Identifying cost changing factors	4.11	0.843	2
PCM9	Detecting early warning signs	4.07	0.815	3

PCM6	Monitoring cost performance	4.02	0.857	4
PCM1	Planning milestone monitoring process	4.01	0.881	5
PCM7	Monitoring updated cost records	4.01	0.805	5
PCM11	Provision of manuals for site monitoring team to refer to	4.01	0.865	5
PCM3	Selecting appropriate tools for tracking project cost	4.01	0.886	5
PCM5	Cost data verification	3.91	0.897	6
PCM8	Monitoring reported cost information	3.75	0.991	7

Table 9.25 above ranks the factors which might influence PCM for cost control practice by contractors in the Ghanaian construction industry. It shows that 'S*election of appropriate technique for cost monitoring*' was first on the ranking scale with MIS of 4.20 and SD of 0.903; 'T*raining site personnel in monitoring process*', '*Monitoring cost data*' and '*Identifying cost changing factors'* were second, with all the mean scores of 4.11 and SD of 0.866, 0.783 and 0.843 respectively. Furthermore, the third ranked factor was '*Detecting early warning signs'* with a mean score of 4.07 and SD of 0.815; '*Monitoring cost performance*' was fourth having a mean score of 4.02 and SD of 0.857. Four factors, namely, *'Planning milestone monitoring process', 'Monitoring updated cost records', 'Provision of manuals for site monitoring team to refer to'* and '*Selecting appropriate tools for tracking project cost'* were fifth having a mean score of 4.01 and SD of 0.881, 0.805, 0.865 0.886 respectively. The sixth ranked factor was '*Cost data verification*' with a mean score of 3.91 and SD of 0.897. Lastly, '*Monitoring reported cost information'* ranked seventh with a mean score of 3.75 and SD of 0.991.

9.3.5.2 Factor analysis of PCM

The results of the EFA of project cost reporting are presented in Tables 9.26 to 9.40 and Figure 9.15. Of the 12 variables enumerated for PCM in Table 9.26, none dropped out. The variables were all acknowledged as possible factors that might influence the practice of cost control in the Ghanaian construction industry. The definitions of the identified variables are presented in Table 9.26 below:

Table 9.26: Definition of identified project cost monitoring

Variable	**Definition**
PCM 1	Planning milestone monitoring process

PCM 2	Selection of appropriate technique for cost monitoring
PCM 3	Selecting appropriate tools for tracking project cost
PCM 4	Monitoring cost data (material, labour, plant, overheads, subcontractor cost, etc.)
PCM 5	Cost data verification
PCM 6	Monitoring cost performance
PCM 7	Monitoring updated cost records
PCM 8	Monitoring reported cost information
PCM 9	Detecting early warning signs
PCM 10	Identifying cost changing factors
PCM 11	Provision of manuals for site monitoring team to refer to
PCM 12	Training site personnel in monitoring process

The fundamentals for conducting factor analysis were performed for the appropriateness of the data which led to the undertaking of the PCA of the data. The correlation matrix was checked and the coefficient values above 0.3 are presented in Table 9.27. Furthermore, Table 9.28 illustrates the KMO degree of sampling suitability. The KMO value for the PCM was 0.896 which exceeds the minimum recommended figure of 0.6, while the Bartlett's test of sphericity also shows that the data is statistically significant reading 0.000, which is less than 0.05. This supports the factorability of the correlation matrix.

The PCA was conducted using the varimax rotation for the data. The eigenvalue was fixed to a predictable high value of 1.0. Table 9.29 indicates that only one factor was extracted for the PCM, having an eigenvalue of more than 1.0. This is coincides with the scree plot in Figure 9.15 which indicates the factor limit point at which the eigenvalues become level. The total variance explained in Table 9.30 also indicates that only one factor was extracted. The Factor extracted scored 40.1%. The last statistics of the extracted factors and PCA were approximately 40% of the total cumulative variance.

Table 9.27: Correlation matrix of the factor analysis - PCM

Correlation	PCM 1	PCM 2	PCM 3	PCM 4	PCM 5	PCM 6	PCM 7	PCM 8	PCM 9	PCM 10	PCM 11	PCM 12
PCM 1	**1.000**	0.543	0.445	0.250	0.247	0.395	0.401	0.169	0.334	0.309	0.465	0.415
PCM 2	0.543	**1.000**	0.390	0.276	0.291	0.388	0.405	0.261	0.253	0.323	0.407	0.446
PCM 3	0.445	0.390	**1.000**	0.340	0.275	0.375	0.393	0.193	0.319	0.249	0.362	0.412
PCM 4	0.250	0.276	0.340	**1.000**	0.366	0.422	0.321	0.233	0.228	0.286	0.254	0.356
PCM 5	0.247	0.291	0.275	0.366	**1.000**	0.378	0.330	0.325	0.265	0.185	0.217	0.336
PCM 6	0.395	0.388	0.375	0.422	0.378	**1.000**	0.413	0.346	0.223	0.271	0.362	0.416
PCM 7	0.401	0.405	0.393	0.321	0.330	0.413	**1.000**	0.302	0.360	0.269	0.374	0.453
PCM 8	0.169	0.261	0.193	0.233	0.325	0.346	0.302	**1.000**	0.292	0.288	0.199	0.321
PCM 9	0.334	0.253	0.319	0.228	0.265	0.223	0.360	0.292	**1.000**	0.441	0.421	0.410
PCM 10	0.309	0.323	0.249	0.286	0.185	0.271	0.269	0.288	0.441	**1.000**	0.557	0.464
PCM 11	0.465	0.407	0.362	0.254	0.217	0.362	0.374	0.199	0.421	0.557	**1.000**	0.560
PCM 12	0.415	0.446	0.412	0.356	0.336	0.416	0.453	0.321	0.410	0.464	0.560	**1.000**

Table 9.28: KMO and Bartlett's test - PCM

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.896
Bartlett's Test of Sphericity	Approx. Chi-Square	1110.977
	df	66
	Sig.	0.000

Table 9.29: Rotated factor matrix - PCM

	Factor
	1
PCM 12 Training site personnel in monitoring process	0.754
PCM 11 Provision of manuals for site monitoring team to refer to	0.701
PCM 1 Planning milestone monitoring process	0.670
PCM 7 Monitoring updated cost records	0.669
PCM 2 Selection of appropriate technique for cost monitoring	0.668
PCM 6 Monitoring cost performance	0.659
PCM 3 Selecting appropriate tools for tracking project cost	0.632
PCM 10 Identifying cost changing factors	0.614

PCM 9 Detecting early warning signs	0.596
PCM 4 Monitoring cost data (material, labour, plant, overheads, subcontractor cost, etc.)	0.564
PCM 5 Cost data verification	0.537
PCM 8 Monitoring reported cost information	0.494
Extraction Method: Principal Component Analysis.	
a. 1 component extracted.	

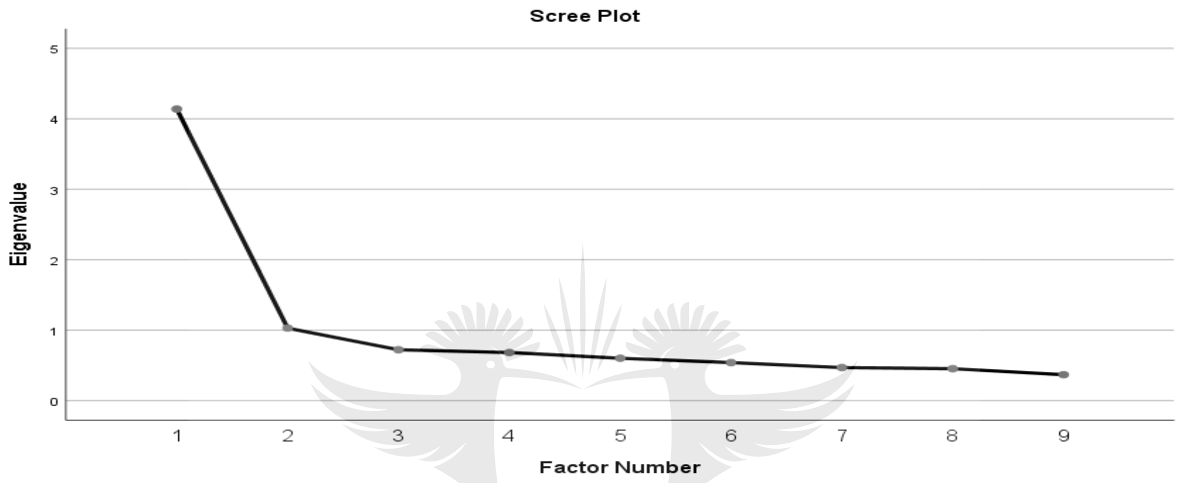

Figure 9. 14: Scree plot for the factor analysis - PCM

Table 9.30: Variance explained - PCM

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.812	40.102	40.102	4.812	40.102	40.102
2	1.155	9.627	49.730			
3	1.016	8.463	58.192			
4	0.777	6.473	64.665			
5	0.721	6.010	70.675			
6	0.633	5.277	75.952			
7	0.596	4.969	80.921			
8	0.547	4.561	85.482			
9	0.530	4.419	89.901			
10	0.441	3.676	93.577			
11	0.411	3.425	97.002			
12	0.360	2.998	100.000			
Extraction Method: Principal Axis Factoring.						

Table 9.30 indicates that one factor was extracted for the PCM, although some of the eigenvalues are more than 1.0, using the principal axis factoring. The factor extracted is termed **project cost monitoring**. The naming of the factor was obtained from an examination of the variables that defined the factor and also from checking the top variables that had the highest loading factor. The fundamental indicators of the extracted factor are clarified below and with an itemised explanation of the idea of how each was presented by the field survey.

Factor 1: P**roject cost monitoring**

The Factor extracted has 12 variables, as illustrated in Table 10.42. They are: *Training site personnel in monitoring process* (75.4%), *Provision of manuals for site monitoring team to refer to* (70.1%), *Planning milestone monitoring process* (67.0%), *Monitoring updated cost records* (66.9%), *Selection of appropriate technique for cost monitoring* (66.8%), *Monitoring cost performance* (65.9%), *Selecting appropriate tools for tracking project cost* (63.2%), *Identifying cost changing factors* (61.4%), *Detecting early warning signs* (59.6%), *Monitoring cost data (material, labour, plant, overheads, subcontractor cost, etc.)* (56.4%), *Cost data verification* (53.7%) and *Monitoring reported cost information* (49.4%). The percentages in brackets show the factor loadings of each variable. The definitions of the variables are presented in Table 9.26, the cumulative percentage of the total variance is 40%.

9.3.6 RESULTS OF THE DECISION-MAKING (DM)

The descriptive statistics and factor analysis results of the DM are presented below.

9.3.6.1 Descriptive statistics of DM

The outcome of the descriptive statistics of the DM factors is presented in Table 9.31 below:

Table 9.31: Descriptive statistics of DM factors

	Descriptive Statistics	Mean	SD	Rank
DM 2	Analysing the problem	4.20	0.860	1
DM 7	Evaluation of the corrective measure used	4.18	0.789	2
DM 6	Implementation of the selected measure	4.13	0.801	3
DM 5	Selection of the relevant corrective measures	4.10	0.864	4
DM 1	Identifying the root/main cause of the cost variances	4.07	0.935	5
DM 4	Developing alternative measures for cost variances	4.05	0.812	6
DM 3	Categorising the causes of the problem	3.96	0.837	7

Table 9.31 shows the ranks of the factors which might influence DM for cost control practice by contractors in the Ghanaian construction industry. It shows that '*Analysing the problem'* was first in the ranking with MIS of 4.20 and SD of 0.860; '*Evaluation of the corrective measure used'* was second, with a mean score of 4.18 and SD ofs 0.789. Furthermore, the third ranked factor was '*Implementation of the selected measure'* with a mean score of 4.13 and SD of 0.801; '*Selection of the relevant corrective measures'* was the fourth, having a mean score of 4.10 and SD of 0.864. '*Identifying the root/main cause of the cost variances'* was the fifth having a mean score of 4.07 and SD of 0.935. The sixth, '*Developing alternative measures for cost variances*' has a mean score of 4.05 and SD of 0.812. Lastly, the seventh, '*Categorising the causes of the problem'* had a mean score of 3.96 and SD of 0.837.

9.3.6.2 Factor analysis of DM

The results of the EFA of decision-making are presented in Tables 9.32 to 9.36 and Figure 9.16. Of the seven variables enumerated, none dropped out. The seven) variables were acknowledged as possible factors that might influence the practice of cost control in the Ghanaian construction industry. The definitions of the identified variables are presented in Table 9.32 below:

Table 9.32: Definition of identified decision-making

Variable	Definition
DM 1	Identifying the root/main cause of the cost variances
DM 2	Analysing the problem
DM 3	Categorising the causes of the problem
DM 4	Developing alternative measures for cost variances
DM 5	Selection of the relevant corrective measures
DM 6	Implementation of the selected measure
DM 7	Evaluation of the corrective measure used

Factor analysis was performed for the appropriateness of the data leading to the undertaking of the PCA of the data. The correlation matrix was checked and the coefficient values above 0.3 are presented in Table 9.33. Furthermore, Table 9.34 illustrates the KMO degree of sampling suitability. The KMO value for the DM was 0.843 which exceeds the minimum recommended figure of 0.6, while the Bartlett's test of sphericity also shows that the data is statistically significant, reading 0.000, which is less than 0.05 and it correlates with the factorability of the correlation matrix.

The PCA was conducted using the varimax rotation for the data. The eigenvalue was fixed to a predictable high value of 1.0. Table 9.35 indicates that only one factor was extracted for DM, having an eigenvalue of more than 1.0. This coincides with the scree plot in Figure 9.16 which indicates the factor limit point at which the eigenvalues become level. The total variance explained in Table 9.36 also indicates that only one factor was extracted. The Factor extracted scored 48.93%. The last statistics of the extracted factors and PCA were approximately 49% of the total cumulative variance.

Table 9.33: Correlation matrix of the factor analysis - DM

Correlation	DM 1	DM 2	DM 3	DM 4	DM 5	DM 6	DM 7
DM 1	**1.000**	0.492	0.460	0.391	0.429	0.356	0.426
DM 2	0.492	**1.000**	0.322	0.303	0.374	0.368	0.273
DM 3	0.460	0.322	**1.000**	0.470	0.376	0.237	0.360
DM 4	0.391	0.303	0.470	**1.000**	0.537	0.351	0.404
DM 5	0.429	0.374	0.376	0.537	**1.000**	0.526	0.523
DM 6	0.356	0.368	0.237	0.351	0.526	**1.000**	0.462
DM 7	0.426	0.273	0.360	0.404	0.523	0.462	**1.000**

Table 9.34: KMO and Bartlett's test - DM

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.843
Bartlett's Test of Sphericity	Approx. Chi-Square	629.563
	df	21
	Sig.	0.000

Table 9.35: Rotated factor matrix - DM

	Factor
	1
DM5 Selection of the relevant corrective measures	0.750
DM1 Identifying the root/main cause of the cost variances	0.667
DM7 Evaluation of the corrective measure used	0.650
DM4 Developing alternative measures for cost variances	0.650
DM6 Implementation of the selected measure	0.604
DM3 Categorising the causes of the problem	0.576
DM2 Analysing the problem	0.546
Extraction Method: Principal Axis Factoring.	
a. 1 factors extracted. 5 iterations required.	

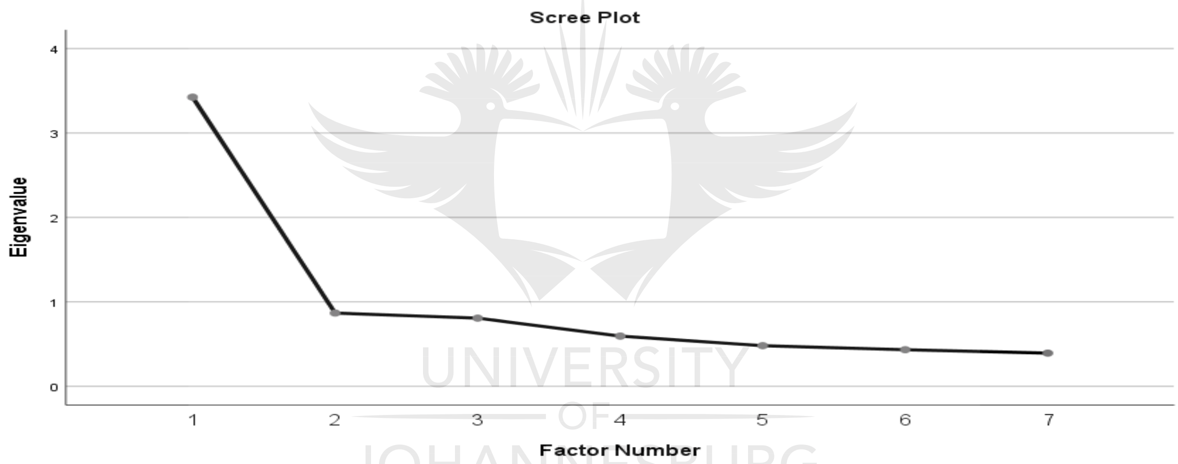

Figure 9. 15: Scree plot for the factor analysis – DM

Table 9.36: Variance explained - DM

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.425	48.925	48.925	2.845	40.637	40.637
2	0.867	12.388	61.313			
3	0.807	11.531	72.845			
4	0.594	8.490	81.334			
5	0.481	6.869	88.203			
6	0.433	6.187	94.390			
7	0.393	5.610	100.000			
Extraction Method: Principal Axis Factoring.						

Table 9.36 indicates that only one factor was extracted for the DM, having an eigenvalue of more than 1.0, using the principal axis factoring. The factor extracted is termed, **decision-making**. The naming of the factor was obtained from an examination of the variables that defined the factor and also by checking the top variables with the highest loading factor. The fundamental indicators of the extracted factor are clarified below, with an itemised description of the idea of how each was presented by the field survey.

Factor 1: **Decision-making**

The Factor extracted had seven variables as illustrated in Table 10.36. They were: *Selection of the relevant corrective measures* (75.0%), *Identifying the root/main cause of the cost variances* (66.7%), *Evaluation of the corrective measure used* (65.0%), *Developing alternative measures for cost variances* (65.0%), *Implementation of the selected measure* (60.4%), *Categorising the causes of the problem* (57.6%) and *Analysing the problem* (54.6%). The percentages in brackets show the factor loadings of each variable. The definitions of the variables are presented in Table 9.32, the cumulative percentage of the total variance is 49%.

9.3.7 RESULTS OF THE CHANGE MANAGEMENT (CM)

The descriptive statistics and factor analysis results of the CM are presented below.

9.3.7.1 Descriptive statistics of CM

The outcome of the descriptive statistics of the CM factors are presented in Table 9.37 below.

Table 9.37: Descriptive statistics of CM factors

	Descriptive Statistics	Mean	SD	Rank
CM 11	Motivating for change	4.05	0.924	1
CM 10	Selecting appropriate leadership style	4.02	0.861	2
CM 8	Continuous improvement from lessons learnt	4.01	0.871	3
CM 2	Developing a vision for cost change	3.97	0.880	4
CM 3	Developing strategies for cost change	3.97	0.849	4
CM 9	Empowering others to act on the vision	3.95	0.866	5
CM 7	Evaluating the change	3.94	0.822	6
CM 6	Implementing the change	3.90	0.864	7
CM 1	Establishing the sense of urgency for change	3.89	0.988	8
CM 5	Promoting a balanced change	3.87	0.912	9
CM 4	Designing short term success plan	3.84	0.890	10

Table 9.37 above shows the ranks of the factors which might influence CM for construction cost control practice by contractors in the Ghanaian construction industry. It indicates that '*motivating for change*' ranked first with a MIS of 4.05 and SD of 0.924; '*selecting appropriate leadership style*' was second, also with a mean score of 4.02 and SD of 0.861; the third ranked factor was '*continuous improvement from lessons learnt*' with a mean score of 4.01 and SD of 0.871; '*developing a vision for cost change' 'developing strategies for cost change*' were ranked fourth sharing a mean score of 3.97 and with SD of 0.880 and 0.849 respectively. The fifth was '*empowering others to act on the vision'* with a mean score of 3.95 and SD of 0.866; the sixth ranked factor was '*evaluating the change'* having a mean score of 3.94 and SD of 0.822; '*implementing the change'* ranked seventh, having a mean score of 3.90 and SD of 0.864; '*establishing the sense of urgency for change'* was the eighth ranked factor with a mean score of 3.89 and SD of 0.988. Moreover, the ninth ranked factor was '*promoting a balanced change'* with a mean score of 3.87 and SD of 0.912; '*firms' designing short term success plan*' ranked tenth and last with a mean score with 3.84 and SD of 0.890.

9.3.7.2 Factor analysis of change management

The results of the EFA of decision-making are presented in Tables 9.38 to 9.42 and Figure 9.17. Of the 11 variables enumerated, none dropped out. The variables were all acknowledged as possible factors that might influence the practice of cost control in the Ghanaian construction industry. The definitions of the identified variables are presented in Table 9.38 below:

Table 9.38: Definition of identified change management

Variable	Definition
CM 1	Establishing the sense of urgency for change
CM 2	Developing a vision for cost change
CM 3	Developing strategies for cost change
CM 4	Designing short term success plan
CM 5	Promoting a balanced change
CM 6	Implementing the change
CM 7	Evaluating the change
CM 8	Continuous improvement from lessons learnt
CM 9	Empowering others to act on the vision
CM 10	Selecting appropriate leadership style
CM 11	Motivating for change

Factor analysis was carried out for the appropriateness of the data. This led to undertaking the PCA of the data. The correlation matrix was checked and the coefficient values above 0.3 are presented in Table 9.39. Furthermore, Table 9.40 illustrates the KMO degree of sampling suitability. The KMO value for the CM was 0.916 which exceeds the minimum recommended figure of 0.6, while Bartlett's test of sphericity also shows that the data is statistically significant, reading 0.000 which is less than 0.05 and supports the factorability of the correlation matrix.

The PCA was conducted using the varimax rotation for the data. The eigenvalue was fixed to predictable high values of 1.0. Table 9.41 indicates that only one factor was extracted for the CM, having an eigenvalue of more than 1.0. This correlates with the scree plot in Figure 9.17 that indicates the factor limit point at which the eigenvalues become level. The total variance, explained in Table 9.42, also indicates that only one factor was extracted. The Factor extracted scored 45.67%. The last statistics of the extracted factors and PCA approximately 47% of the total cumulative variance.

Table 9.39: Correlation matrix of the factor analysis - CM

Correlation	CM 1	CM 2	CM 3	CM 4	CM 5	CM 6	CM 7	CM 8	CM 9	CM 10	CM 11
CM 1	**1.000**	0.549	0.446	0.450	0.428	0.431	0.366	0.405	0.415	0.423	0.432
CM 2	0.549	**1.000**	0.356	0.416	0.432	0.389	0.386	0.375	0.384	0.402	0.418
CM 3	0.446	0.356	**1.000**	0.413	0.266	0.220	0.275	0.407	0.271	0.385	0.394
CM 4	0.450	0.416	0.413	**1.000**	0.467	0.311	0.379	0.420	0.328	0.353	0.324
CM 5	0.428	0.432	0.266	0.467	**1.000**	0.426	0.346	0.439	0.356	0.395	0.390
CM 6	0.431	0.389	0.220	0.311	0.426	**1.000**	0.447	0.388	0.393	0.367	0.377
CM 7	0.366	0.386	0.275	0.379	0.346	0.447	**1.000**	0.487	0.423	0.366	0.335
CM 8	0.405	0.375	0.407	0.420	0.439	0.388	0.487	**1.000**	0.448	0.543	0.519
CM 9	0.415	0.384	0.271	0.328	0.356	0.393	0.423	0.448	**1.000**	0.445	0.442
CM 10	0.423	0.402	0.385	0.353	0.395	0.367	0.366	0.543	0.445	**1.000**	0.583
CM 11	0.432	0.418	0.394	0.324	0.390	0.377	0.335	0.519	0.442	0.583	**1.000**

Table 9.40: KMO and Bartlett's test - CM

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.916
Bartlett's Test of Sphericity	Approx. Chi-Square	1161.010
	df	55
	Sig.	0.000

Table 9.41: Rotated factor matrix - CM

	Factor
	1
CM8 Continuous improvement from lessons learnt	0.707
CM1 Establishing the sense of urgency for change	0.688
CM10 Selecting appropriate leadership style	0.681
CM11 Motivating for change	0.672
CM2 Developing a vision for cost change	0.649
CM5 Promoting a balanced change	0.622
CM9 Empowering others to act on the vision	0.617
CM4 Designing short term success plan	0.604
CM7 Evaluating the change	0.597
CM6 Implementing the change	0.589
CM3 Developing strategies for cost change	0.538
Extraction Method: Principal Axis Factoring.	
a. 1 factors extracted. 3 iterations required.	

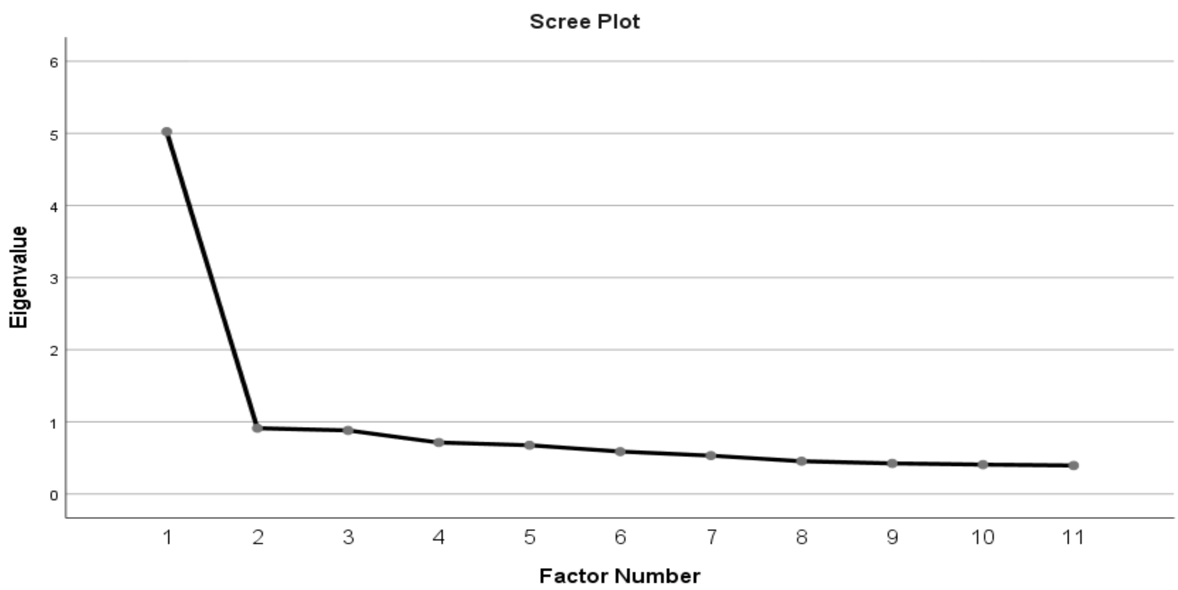

Figure 9. 16: Scree plot for the factor analysis - CM

Table 9.42: Variance explained - CM

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.024	45.674	45.674	4.436	40.325	40.325
2	0.911	8.280	53.953			
3	0.881	8.005	61.959			
4	0.713	6.481	68.440			
5	0.675	6.139	74.578			
6	0.587	5.339	79.917			
7	0.531	4.829	84.747			
8	0.453	4.122	88.869			
9	0.424	3.850	92.719			
10	0.407	3.697	96.417			
11	0.394	3.583	100.000			
Extraction Method: Principal Axis Factoring.						

Table 9.42 indicates that only one factor was extracted for the CM, having an eigenvalue of more than 1.0, using the principal axis factoring. The factor extracted is termed **control changes in project cost**. The naming of the factor was obtained from an examination of the variables that defined the factor and also from checking the top variables that had the highest loading factor. The fundamental indicators of the extracted factor are clarified below with an itemised explication of the idea of how it was presented by the field survey.

Factor 1: **Control changes in project cost**

The Factor 1 extracted had 11variables as illustrated in Table 10.54. They were : *Continuous improvement from lessons learnt* (70.7%), *Establishing the sense of urgency for change* (68.8%), *Selecting appropriate leadership style* (68.1%), *Motivating for change* (67.2%), *Developing a vision for cost change* (64.9%), *Promoting a balanced change* (62.2%), *Empowering others to act on the vision* (61.7%), *Designing short term success plan* (60.4%), *Evaluating the change* (59.7%), *Implementing the change* (58.9%) and *Developing strategies for cost change* (53.8%). The percentages in brackets show the factor loadings of each variable, the definitions of the variables are presented in Table 9.38, and the cumulative percentage of the total variance is 47%.

9.3.8 RESULTS OF THE PROJECT COST COMMUNICATION (PCCM)

The descriptive statistics and factor analysis results of the PCCM are presented below.

9.3.8.1 Descriptive statistics of PCCM

The outcome of the descriptive statistics of the PCCM factors are presented in Table 9.43 below:

Table 9.43: Descriptive statistics of PCCM factors

	Descriptive Statistics	Mean	SD	Rank
PCCM9	Access to information	4.05	0.922	1
PCCM10	Reduction of barriers in communication	4.04	0.932	2
PCCM8	Standardisation of communication documents	4.03	0.890	3
PCCM6	Clear communication activity	4.02	0.883	4
PCCM2	Form of communication (adopted) within the organisation (verbal, written)	4.02	0.983	4
PCCM5	Appropriate methods of communication (emails, text messages, etc.)	3.97	0.948	5
PCCM7	Appropriate feedback channel	3.96	0.882	6
PCCM4	Formulating a clear message	3.93	0.924	7
PCCM1	The context of communication (adopted) in the organisation	3.88	0.966	8
PCCM3	Identification of the sender and receiver	3.82	0.959	9

Table 9.43 shows the ranks of the factors which might influence PCCM for construction cost control practice by contractors in the Ghanaian construction industry. It indicates that '*access to information*' ranked first, with a MIS of 4.05 and SD of 0.922; '*reduction of barriers in communication*' was the second, with a mean score of 4.04 and SD of 0.932; the third ranked factor was '*standardisation of communication documents*' with a mean score of 4.03 and SD of 0.890; '*clear communication activity*' and '*form of communication (adopted) within the organisation (verbal, written)*' were ranked fourth having a mean score of 4.02 and SD of 0.883 and 0.983 respectively. Fifth was '*appropriate methods of communication (emails, text messages, etc*.)' with a mean score of 3.97 and SD of 0.948. The sixth ranked factor was '*appropriate feedback channel*' having a mean score of 3.96 and SD of 0.882; '*formulating a clear message*' ranked seventh, having a mean score of 3.93 and SD of 0.924; '*the context of communication (adopted) in the organisation*' was eighth with a mean score of 3.88 and SD of 0.966. Lastly, the ninth ranked factor was '*identification of the sender and receiver*' having a mean score of 3.82 and SD of 0.959.

9.3.8.2 Factor analysis of project cost communication

The results of the EFA of project cost communication are presented in Tables 9.44 to 9.48 and Figure 9.18. Of the ten variables enumerated, none dropped out. The variables were acknowledged as possible factors that might influence the practice of cost control in the Ghanaian construction industry. The definitions of the identified variables are presented in Table 9.44 below:

Table 9.44: Definition of identified project cost communication

Variable	Definition
PCCM 1	The context of communication (adopted) in the organisation
PCCM 2	Form of communication (adopted) within the organisation (verbal, written)
PCCM 3	Identification of the sender and receiver
PCCM 4	Formulating a clear message
PCCM 5	Appropriate methods of communication (emails, text messages, etc.)
PCCM 6	Clear communication activity
PCCM 7	Appropriate feedback channel
PCCM 8	Standardisation of communication documents
PCCM 9	Access to information
PCCM 10	Reduction of barriers in communication

The fundamentals for conducting factor analysis were performed for the appropriateness of the data which led to the undertaking of the PCA of the data. The correlation matrix was checked and the coefficient values above 0.3 are presented in Table 9.45. Furthermore, Table 9.46 illustrates the KMO degree of sampling suitability. The KMO value for the PCCM was 0.917, which exceeds the minimum recommended figure of 0.6, while the Bartlett's test of sphericity also shows that the data is statistically significant scoring 0.000, which is less than 0.05 and it correlates with the factorability of the correlation matrix.

The PCA was conducted using the varimax rotation for the data. The eigenvalue was fixed to a predictable high value of 1.0. Table 9.47 indicates that only one factor was extracted for the PCCM, having an eigenvalue of more than 1.0. This is coincides with the scree plot in Figure 9.18 that indicates the factor limit point at which the eigenvalues become level. The total variance explained in Table 9.48 also indicates that only one factor was extracted. The Factor extracted scored 51.52%. The last statistics of the extracted factors and PCA were approximately 52% of the total cumulative variance.

Table 9.45: Correlation matrix of the factor analysis - PCCM

Correlation	PCCM 1	PCCM 2	PCCM 3	PCCM 4	PCCM 5	PCCM 6	PCCM 7	PCCM 8	PCCM 9	PCCM 10
PCCM 1	**1.000**	0.485	0.487	0.478	0.439	0.446	0.478	0.370	0.474	0.399
PCCM 2	0.485	**1.000**	0.415	0.461	0.537	0.562	0.491	0.424	0.490	0.434
PCCM 3	0.487	0.415	**1.000**	0.530	0.458	0.459	0.388	0.364	0.425	0.424
PCCM 4	0.478	0.461	0.530	**1.000**	0.571	0.436	0.505	0.360	0.402	0.434
PCCM 5	0.439	0.537	0.458	0.571	**1.000**	0.446	0.403	0.339	0.495	0.426
PCCM 6	0.446	0.562	0.459	0.436	0.446	**1.000**	0.512	0.438	0.521	0.459
PCCM 7	0.478	0.491	0.388	0.505	0.403	0.512	**1.000**	0.466	0.448	0.486
PCCM 8	0.370	0.424	0.364	0.360	0.339	0.438	0.466	**1.000**	0.596	0.523
PCCM 9	0.474	0.490	0.425	0.402	0.495	0.521	0.448	0.596	**1.000**	0.553
PCCM 10	0.399	0.434	0.424	0.434	0.426	0.459	0.486	0.523	0.553	**1.000**

Table 9.46: KMO and Bartlett's test - PCCM

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.917
Bartlett's Test of Sphericity	Approx. Chi-Square	1270.777
	df	45
	Sig.	0.000

Table 9.47: Rotated factor matrix – PCCM

	Factor 1
PCCM 9 Access to information	0.725
PCCM 2 Form of communication (adopted) within the organisation (verbal, written)	0.708
PCCM 6 Clear communication activity	0.704
PCCM 7 Appropriate feedback channel	0.684
PCCM 4 Formulating a clear message	0.683
PCCM 10 Reduction of barriers in communication	0.677
PCCM 5 Appropriate methods of communication (emails, text messages, etc.)	0.674
PCCM 1 The context of communication (adopted) in the organisation	0.662
PCCM 3 Identification of the sender and receiver	0.642

PCCM 8 Standardisation of communication documents	0.632
Extraction Method: Principal Axis Factoring.	
a. 1 factors extracted. 4 iterations required.	

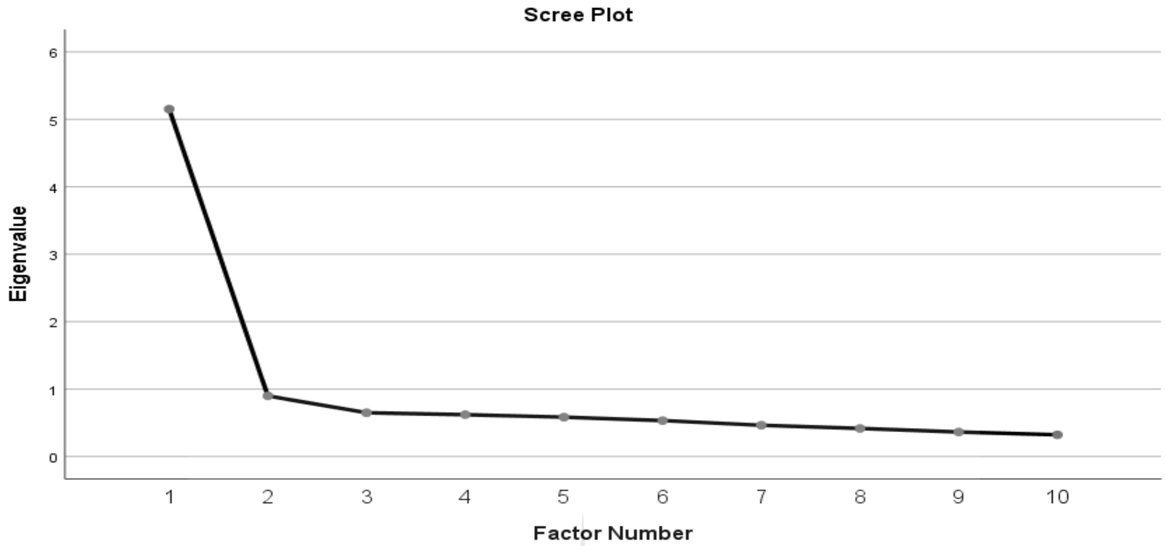

Figure 9. 17: Scree plot for the factor analysis - PCCM

Table 9.48: Variance explained - PCCM

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.152	51.523	51.523	4.617	46.166	46.166
2	0.898	8.982	60.504			
3	0.649	6.489	66.994			
4	0.620	6.201	73.194			
5	0.583	5.834	79.028			
6	0.533	5.326	84.354			
7	0.463	4.633	88.987			
8	0.416	4.163	93.150			
9	0.363	3.632	96.782			
10	0.322	3.218	100.000			
Extraction Method: Principal Axis Factoring.						

Table 9.48 indicates that only one factor was extracted for the PCCM having an eigenvalue of more than 1.0, using the principal axis factoring. The factor extracted was examined in view of the inherent interrelationships among the factors. The factor was then given a

common name, **project cost communication**. The naming of the factor was obtained from an examination of the variables that defined the factor and also from checking the top variables with the highest loading factor. The fundamental indicators of the extracted factor are clarified below with an itemised explication of the idea of how each was presented by the field survey.

9.4 Factor 1: C**ontrol changes in project cost**

The Factor extracted had ten variables as illustrated in Table 9.47: *Access to information* (72.5%), *Form of communication (adopted) within the organisation (verbal, written)* (70.8%), *Clear communication activity* (70.4%), *Appropriate feedback channel* (68.4%), *Formulating a clear message* (68.3%), *Reduction of barriers in communication* (67.7%) *Appropriate methods of communication (emails, text messages, etc.)* (67.4%), *The context of communication (adopted) in the organisation* (66.2%), *Identification of the sender and receiver* (64.2%) and *Standardisation of communication documents* (63.2%). The percentages in brackets show the factor loadings of each variable. The definitions of the variables are presented in Table 9.44; the cumulative percentage of the total variance is 52%.

9.3.9 RESULTS OF THE OUTCOMES OF COST CONTROL (OCC)

The descriptive statistics and factor analysis results of the OCC are presented below.

9.3.9.1 Descriptive statistics of OCC

The outcomes of the descriptive statistics of the CC factors are presented in Table 9.49 below:

Table 9.49: Descriptive statistics of OCC practice

	Descriptive Statistics	Mean	SD	Rank
OCC6	Increases efficiency of work	4.16	0.831	1
OCC5	Prevention of wasted resources	4.14	0.887	2
OCC2	Establishing project cost outcome (profit/loss)	4.08	0.883	3
OCC1	Achieving accurate cost information for decision-making	4.06	0.864	4
OCC3	Obtaining historic cost data for future projects	4.02	0.861	5
OCC4	Enhancement of the targeted profitability	3.97	0.857	6

Table 9.49 shows the ranks of the outcomes of cost control practice by contractors in the Ghanaian construction industry. It shows that 'I*ncreases efficiency of work*' ranked first with MIS of 4.16 and SD of 0.831; '*Prevention of wasted resources'* was second, with mean score of 4.14, SD of 0.887. Furthermore, the third ranked factor was *'Establishing project cost*

outcome (profit/loss)' with a mean score of 4.08 and SD of 0.883; '*Achieving accurate cost information for decision making'* was the fourth, having a mean score of 4.06 and SD of 0.864. '*Obtaining historic cost data for future projects*' was fifth with a mean score of 4.02 and SD of 0.861. the sixth and last ranked outcome, 'has a mean score of 3.97 and SD of 0.857.

9.3.9.2 Factor analysis of outcomes of cost control

The results of the EFA of outcomes of cost control practice are presented in Tables 9.50 to 9.54 and Figure 9.19. Of the six variables enumerated, none dropped out. The six variables are acknowledged as possible factors that could influence the practice of cost control in the Ghanaian construction industry.

The definitions of the identified variables are presented in Table 9.50:

Table 9.50: Definition of identified outcomes of cost control

Variable	Definition
OCC 1	Achieving accurate cost information for decision making
OCC 2	Establishing project cost outcome (profit/loss)
OCC 3	Obtaining historic cost data for future projects
OCC 4	Enhancement of the targeted profitability
OCC 5	Prevention of wasted resources
OCC 6	Increased efficiency of work

Factor analysis was performed for the appropriateness of the data which lead to the undertaking of the PCA of the data. The correlation matrix was checked and the coefficient values above 0.3 are presented in Table 9.51. Furthermore, Table 9.52 illustrates the KMO degree of sampling suitability. The KMO value for the OCC was 0.835 which exceeds the minimum recommended figure of 0.6, while Bartlett's test of sphericity also shows that the data is statistically significant reading 0.000, which is less than 0.05 and supports the factorability of the correlation matrix.

The PCA was conducted using the varimax rotation for the data. The eigenvalue was fixed to predictable high values of 1.0. Table 9.53 indicates that only one factor was extracted for the OCC having an eigenvalue of more than 1.0. This supports the scree plot in Figure 9.19 that indicates the factor limit point at which the eigenvalues become level. The total variance, explained in Table 9.54, also indicates that only one factor was extracted. The

Factor extracted scored 57.45%. The last statistics of the extracted factors and PCA were 58% approximately of the total cumulative variance.

Table 9.51: Correlation matrix of the factor analysis

Correlation	OCC 1	OCC 2	OCC 3	OCC 4	OCC 5	OCC 6
OCC 1	**1.000**	0.574	0.521	0.488	0.474	0.430
OCC 2	0.574	**1.000**	0.350	0.472	0.576	0.448
OCC 3	0.521	0.350	**1.000**	0.563	0.381	0.482
OCC 4	0.488	0.472	0.563	**1.000**	0.556	0.473
OCC 5	0.474	0.576	0.381	0.556	**1.000**	0.547
OCC 6	0.430	0.448	0.482	0.473	0.547	**1.000**

Table 9.52: KMO and Bartlett's test - OCC

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.835
Bartlett's Test of Sphericity	Approx. Chi-Square	692.231
	df	15
	Sig.	0.000

Table 9.53: Rotated factor matrix - OCC

	Factor
	1
OCC4 Enhancement of the targeted profitability	0.735
OCC5 Prevention of wasted resources	0.733
OCC1 Achieving accurate cost information for decision making	0.712
OCC2 Establishing project cost outcome (profit/loss)	0.694
OCC6 Increases efficiency of work	0.675
OCC3 Obtaining historic cost data for future projects	0.647
Extraction Method: Principal Axis Factoring.	
a. 1 factors extracted. 5 iterations required.	

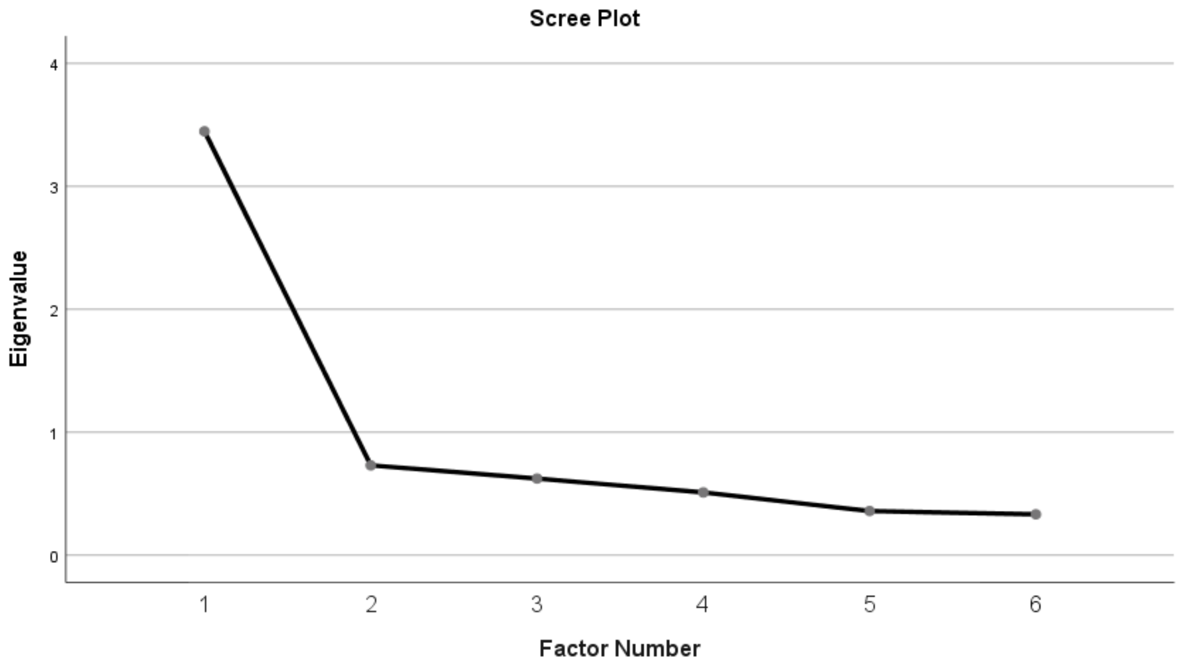

Figure 9. 18: Scree plot for the factor analysis - OCC

Table 9.54: Variance explained - OCC

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.447	57.448	57.448	2.940	49.002	49.002
2	0.730	12.170	69.618			
3	0.623	10.379	79.997			
4	0.510	8.497	88.494			
5	0.359	5.976	94.471			
6	0.332	5.529	100.000			
Extraction Method: Principal Axis Factoring.						

Table 9.54 indicates that only one factor was extracted for the OCC having an eigenvalue of more than 1.0, using the principal axis factoring. The one factor extracted is termed **output of cost control**. The naming of the factor was obtained from an examination of the variables that defined the factor and also from checking the top variables with the highest loading

factor. The fundamental indicators of the extracted factor are clarified below and with an itemized explanation of the way each was presented by the field survey.

Factor 1: **Output of cost control**

The Factor extracted had six (6) variables as illustrated in Table 9.53: *Enhancement of the targeted profitability* (73.5%), *Prevention of wasted resources* (73.3%), *Achieving accurate cost information for decision making* (71.2%), *Establishing project cost outcome (profit/loss)* (69.4%), *Increased efficiency of work* (67.5%) and *Obtaining historic cost data for future projects* (64.7%). The percentages in brackets show the factor loadings of each variable. The definitions of the variables are presented in Table 9.50, the cumulative percentage of the total variance is 58%

9.3.10 APPLICATION OF COST CONTROL RESULTS

The application of cost control practice was sought in two main areas: the cost control techniques and software used by contractors in the Ghanaian construction industry.

9.3.10.1 COST CONTROL TECHNIQUES

Table 9.55: Descriptive statistics of cost control techniques

	Mean	SD	Rank
CCT9 Labour/plant/material (actual versus forecast reconciliation)	4.22	0.806	1
CCT2 Profit or Loss at each contract stage	3.84	1.063	2
CCT1 Overall Profit or Loss account	3.83	1.011	3
CCT4 Standard costing	3.81	1.052	4
CCT5 Activity-based variance	3.79	1.092	5
CCT8 Leading parameter method	3.76	1.085	6
CCT3 Unit rate costing	3.71	1.007	7
CCT6 Earned value analysis	3.68	1.084	8
CCT7 Programme evaluation and review technique (PERT/COST)	3.68	1.186	8

Table 9.55 above shows the ranks of the CCTs used by contractors for cost control practice in the Ghanaian construction industry. The result indicates that '*Labour/plant/material (actual versus forecast reconciliation)*' was ranked first, with a MIS of 4.22 and SD of 0.806; '*Profit or Loss at each contract stage'* was the second, with a mean score of 3.84 and SD of 1.063; the third ranked factor was '*Overall Profit or Loss account'* with a mean score

of 3.83 and SD of 1.011; '*Standard costing'* was ranked fourth, having a mean score of 3.81 and SD of 1.052. The fifth was '*Activity-based variance'*, with a mean score of 3.79 and SD of 1.092. The sixth ranked factor was '*Leading parameter method'*, having a mean score of 3.76 and SD of 1.085; '*Unit rate costing'* was the seventh, with a mean score of 3.71 and SD of 1.007; '*Earned value analysis*' and '*Programme evaluation and review technique'* were the eighth and final ranked factors with mean scores of 3.68 and SD of 1.084 and 1.186 respectively.

9.3.10.2 SOFTWARE FOR COST CONTROL

The nine software packages were identified for use in cost control practice in the Ghanaian construction industry. The result is presented in Table 9.56.

Table 9.56: Extent of use of cost control software

	Descriptive Statistics	Mean	SD	Rank
S 2	Microsoft excel	4.36	.827	1
S 4	Microsoft project	4.19	.859	2
S 5	Project costing system (PCS)	3.96	1.068	3
S 3	Bespoke/in-house system	3.90	1.135	4
S 7	Construction industry software (COINS)	3.83	1.121	5
S 6	Asta power project	3.76	1.141	6
S 1	Primavera sure trak	3.62	1.140	7
S 9	WinQS	3.43	1.290	8
S 8	QSPro	3.43	1.214	8

Table 9.56 above shows the ranks of the extent of use of cost control software used by contractors for cost control practice in the Ghanaian construction industry. The result indicates that '*Microsoft excel'* ranked first with a MIS of 4.36 and SD of 0.827; '*Microsoft project'* was second, with a mean score of 4.19 and SD of 0.859; the third ranked factor was '*Project costing system* (PCS)', with a mean score of 3.96 and SD of 1.068; '*Bespoke/in-house system'* was ranked fourth, having a mean score of 3.90 and SD of 1.135. The fifth was '*Construction industry software'* with a mean score of 3.83 and SD of 1.121; the sixth ranked factor was '*Asta power projec*t' having a mean score of 3.76 and SD of 1.141; '*Primavera sure trak*' was seventh, having a mean score of 3.62 and SD of 1.140; 'WinQS' and 'QSPro' were the eighth and final ranked factors with a mean score of 3.43 and SD of 1.290 and 1.214 respectively.

9.3.11 RESULTS OF THE CHALLENGES OF COST CONTROL

The descriptive statistics and factor analysis results of the challenges of cost control are presented below.

9.3.11.1 Descriptive statistics of challenges of cost control

The outcome of the descriptive statistics of the challenges of cost control are presented in Table 9.57 below:

Table 9.57: Challenges of cost control

Descriptive Statistics	Mean	SD	Rank
CCC11 Abandonment of complicated strategies	4.11	0.859	1
CCC6 Poor attitude towards ICT usage	4.04	0.999	2
CCC7 Difficulty in monitoring different sources of day-to-day cost data	4.03	0.834	3
CCC10 Lack of knowledge about the use of available tools and technology	3.98	0.941	4
CCC4 Lack of consistent cost management practice by managers	3.98	0.827	4
CCC5 Decision-making failure	3.97	1.010	5
CCC8 No clear distinction between monitoring and reporting	3.97	0.853	5
CCC9 Lack of financial commitment in project	3.96	0.944	6
CCC2 Over-emphasising results without following the project cost control process	3.92	0.968	7
CCC1 Using outmoded methods and concepts	3.91	1.047	8
CCC3 Lack of cost control processes/systems suitable for the firm	3.84	0.933	9

Table 9.57 shows the ranks of the challenges of cost control faced by contractors in the Ghanaian construction industry. The result indicates that '*Abandonment of complicated strategies*' ranked first with a MIS of 4.11 and SD of 0.859; '*Poor attitude towards ICT* usage' was the second, with a mean score of 4.04 and SD of 0.999; the third ranked factor was '*Difficulty in monitoring different sources of day-to-day cost data*', with a mean score of 4.03 and SD of 0.834; '*Lack of knowledge about the use of available tools and technology'* and '*Lack of consistent cost management practice by managers'* were ranked fourth, having a mean score of 3.98 and SD of 0.941.and 0.827 respectively. Ranked fifth were '*Decision-making failure'* and '*No clear distinction between monitoring and reporting'* with a mean

score of 3.97 and SD of 1.010 and 0.853 respectively. The sixth ranked factor was 'having a mean score of 3.96 and SD of 0.944; '*Over-emphasising results without following the project cost control process'* was seventh, having a mean score of 3.92 and SD of 0.968; '*Using outmoded methods and concepts*' and '*Lack of cost control processes/systems suitable for the firm*' were the eighth and final ranked factors with mean scores of 3.91 and 3.84, SD of 1.047 and 0.933 respectively.

9.3.11.2 Factor analysis of the challenges of cost control

The results of the EFA of decision making are presented in Tables 9.58 to 9.62 and Figure 9.20. Of the 11 variables enumerated, none dropped out. The eleven variables were acknowledged as possible factors that challenge the practice of cost control in the Ghanaian construction industry. The definitions of the identified variables are presented in Table 9.58.

Table 9.58: Definition of identified challenges of cost control

Variable	Definition
CCC 1	Using outmoded methods and concepts
CCC 2	Over-emphasising results without following the project cost control process
CCC 3	Lack of cost control processes/systems suitable for the firm
CCC 4	Lack of consistent cost management practice by managers
CCC 5	Decision-making failure
CCC 6	Poor attitude towards ICT usage
CCC 7	Difficulty in monitoring different sources of day-to-day cost data
CCC 8	No clear distinction between monitoring and reporting
CCC 9	Lack of financial commitment in project
CCC 10	Lack of knowledge about the use of available tools and technology
CCC 11	Abandonment of complicated strategies

Factor analysis was performed for the appropriateness of the data which led to the undertaking of the PCA of the data. The correlation matrix was checked and the coefficient values above 0.3 are presented in Table 9.59. Furthermore, Table 9.60 illustrates the KMO degree of sampling suitability. The KMO value for the CCC was 0.904, which exceeds the minimum recommended figure of 0.6, while the Bartlett's test of sphericity also shows that the data is statistically significant at 0.000, which is less than 0.05 and supports the factorability of the correlation matrix.

The PCA was conducted using the rotation of Oblimin with Kaiser Normalization for the data. The eigenvalue was fixed at predictable high values of 1.0. Table 9.61 indicates that two factors were extracted for the CCC, having eigenvalues of more than 1.0. This is in support of the scree plot in Figure 9.20, that indicates the factor limit point at which the eigenvalues become level. The total variance, explained in Table 9.62, also indicates that two factors were extracted. Factor 1 extracted had 44.419%, Factor 2 extracted had 9.432%. The last statistics of the extracted factors and PCA were 54% approximately of the total cumulative variance.

Table 9.59: Correlation matrix of the factor analysis - CCC

Correlation	CCC 1	CCC 2	CCC 3	CCC 4	CCC 5	CCC 6	CCC 7	CCC 8	CCC 9	CCC 10	CCC 11
CCC 1	**1.000**	0.471	0.347	0.275	0.383	0.337	0.247	0.253	0.245	0.316	0.283
CCC 2	0.471	**1.000**	0.362	0.301	0.356	0.359	0.364	0.310	0.318	0.412	0.317
CCC 3	0.347	0.362	**1.000**	0.378	0.359	0.279	0.418	0.317	0.252	0.332	0.334
CCC 4	0.275	0.301	0.378	**1.000**	0.426	0.411	0.378	0.365	0.374	0.491	0.409
CCC 5	0.383	0.356	0.359	0.426	**1.000**	0.577	0.398	0.400	0.412	0.444	0.401
CCC 6	0.337	0.359	0.279	0.411	0.577	**1.000**	0.494	0.382	0.446	0.530	0.436
CCC 7	0.247	0.364	0.418	0.378	0.398	0.494	**1.000**	0.418	0.294	0.447	0.386
CCC 8	0.253	0.310	0.317	0.365	0.400	0.382	0.418	**1.000**	0.332	0.499	0.479
CCC 9	0.245	0.318	0.252	0.374	0.412	0.446	0.294	0.332	**1.000**	0.501	0.518
CCC 10	0.316	0.412	0.332	0.491	0.444	0.530	0.447	0.499	0.501	**1.000**	0.598
CCC 11	0.283	0.317	0.334	0.409	0.401	0.436	0.386	0.479	0.518	0.598	**1.000**

Table 9.60: KMO and Bartlett's test - CCC

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.904
Bartlett's Test of Sphericity	Approx. Chi-Square	1124.844
	Df	55
	Sig.	0.000

Table 9.61: Rotated factor matrix - CCC

	Factor	
	1	2
CCC10 Lack of knowledge about the use of available tools and technology	0.812	
CCC11 Abandonment of complicated strategies	0.808	
CCC9 Lack of financial commitment in project	0.670	
CCC8 No clear distinction between monitoring and reporting	0.586	
CCC6 Poor attitude towards ICT usage	0.578	
CCC4 Lack of consistent cost management practice by managers	0.518	
CCC5 Decision-making failure	0.443	
CCC7 Difficulty in monitoring different sources of day-to-day cost data	0.439	
CCC1 Using outmoded methods and concepts		0.692
CCC2 Over-emphasising results without following the project cost control process		0.603
CCC3 Lack of cost control processes/systems suitable for the firm		0.434
Extraction Method: Principal Axis Factoring. Rotation Method: Oblimin with Kaiser Normalization.		
a. Rotation converged in 6 iterations.		

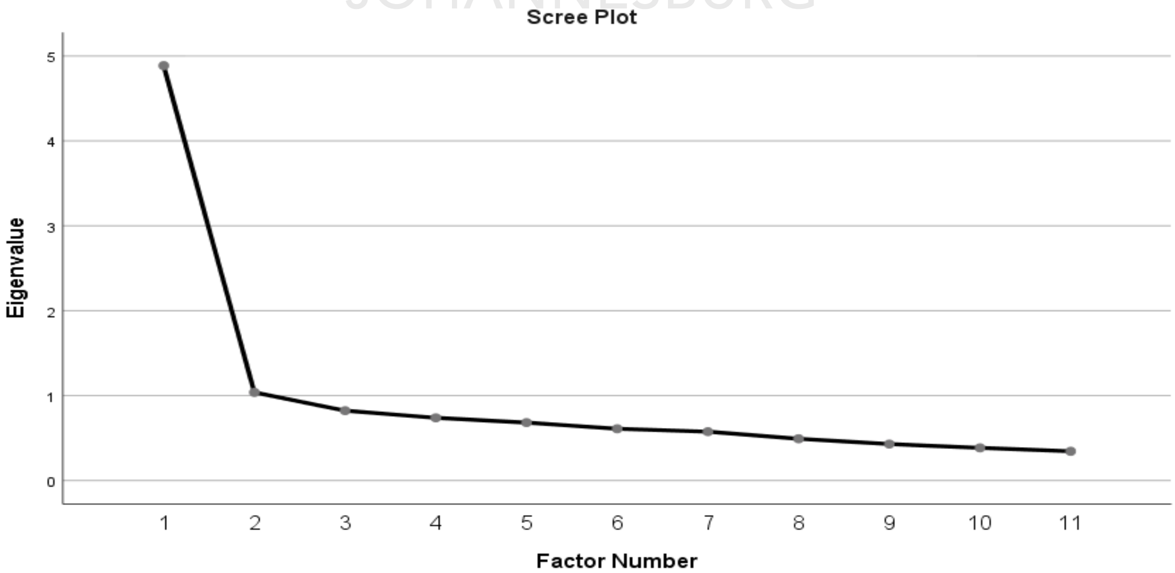

Figure 9.19: Scree plot for the factor analysis - CCC

Table 9.62: Variance explained - CCC

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.886	44.419	44.419	4.337	39.431	39.431
2	1.038	9.432	53.851	0.478	4.350	43.780
3	0.822	7.475	61.326			
4	0.738	6.712	68.039			
5	0.682	6.200	74.239			
6	0.609	5.538	79.777			
7	0.575	5.224	85.001			
8	0.492	4.470	89.471			
9	0.429	3.904	93.375			
10	0.385	3.496	96.871			
11	0.344	3.129	100.000			
Extraction Method: Principal Axis Factoring.						

Table 9.62 indicates that two factors were extracted for the CCC having eigenvalues of more than 1.0, using the principal axis factoring. The factors extracted were examined in view of the inherent interrelationships among the factors. The factors were then given a common name. The two factors extracted are termed Factor 1, A**bandonment of modern cost control methods** and Factor 2, **Lack of cost control knowledge and concept**. The naming of the factors was obtained from an examination of the variables that defined the factors and also from checking the top variables with the highest loading factor. The fundamental indicators of the extracted factors are clarified below and with an itemised portrayal of the way was presented by the field survey.

Factor 1: **Abandonment of modern cost control methods**

Factor 1 extracted had eight) variables as illustrated in Table 9.61: *Lack of knowledge about the use of available tools and technology* (81.2%), *Abandonment of complicated strategies* (80.8%), *Lack of financial commitment in project* (67.0%), *No clear distinction between monitoring and reporting* (58.6%), *Poor attitude towards ICT usage* (57.8%), *Lack of consistent cost management practice by managers* (51.8%), *Decision-making failure* (44.3%) and *Difficulty in monitoring different sources of day-to-day cost data* (43.9%).

Factor 2: **Lack of cost control knowledge and concept**.

Factor 2 extracted had three variables as illustrated in Table 9.61:

Using outmoded methods and concepts (69.2%), *Over-emphasising results without following the project cost control process* (60.3%) and *Lack of cost control processes/systems suitable for the firm* (43.4%). The percentages in brackets show the factor loadings of each variable. The definitions of the variables are presented in Table 9.58, the cumulative percentage of the total variance is 54%.

9.4 THE RESULTS OF THE NORMALITY TESTS

Normality tests were conducted to determine whether the results are normally distributed or not normally distributed. The significance level was set at a 0.05 limit for a normal distributed test results for the study. The Kolmogorov-Smirnov statistics results were used, since they are used for a sample size of 50 and above, whereas for a sample size of below 50 the Shapiro-Wilk statistics results are used.

To recognise the invalid hypothesis and the elective hypothesis in order to examine whether there is a contrast among the groups, to affirm whether the factors are ordinarily appropriated or not regularly dispersed, the accompanying conditions are mandatory.

H_0: For normally distributed. There exists no difference among the groupings.

If *p-value* is more than 0.05 then it means H_0 should not be rejected (accept H_0). It also means that the grouping is normally distributed.

H_1: for not normally distributed. There exists a difference among the groupings.

If *p-value* is less than 0.05 then it means H_0 should be rejected (accept H_1). It also means that the grouping is not normally distributed.

9.4.1 Normality test for the factors enhancing cost control practice

The normality test is presented for the factors enhancing cost control practice through the use of the Kolmogorov-Smirnov statistics and not Shapiro-Wilk statistics. Because the sample size is more than 50, Shapiro-Wilk statistics was not carried out. Table 9.63 indicates the results of the test for the factors enhancing cost control practice and the output of cost control:

Table 9.63: Normality test for the factors enhancing cost control practice

Normality test	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
PCE_F1 Appropriate Planning and Environmental Issues	0.184	300	0.000
PCE_F2 Provision of Contract Documentation	0.172	300	0.000
PCB_F1 Project Cost Budgeting	0.172	300	0.000
PCR_F1 Project Cost Reporting	0.178	300	0.000
PCA_F1 Project Cost Analysis	0.171	300	0.000
PCM_ F1 Project Cost Monitoring	0.152	300	0.000
DM_ F1 Decision-Making	0.191	300	0.000
CM_F1 Control Changes in Project Cost	0.196	300	0.000
PCCM_ F1 Project Cost Communication	0.167	300	0.000
OCC_F1 Output of Cost Control	0.174	300	0.000

Table 9.63 indicates that the normality test for the factors enhancing cost control practice had a *p-value* of less than 0.05, consequently the null hypothesis (H_0) is not met and the hypothesis (H_1) is accepted. Thus, the data is not normally distributed.

Conclusion: The null hypothesis (H_0) is rejected. It means that there exist differences among the groups on the way *project cost estimation* (appropriate planning and environmental issues and provision of contract documentation) is viewed.

The normality test for *project cost budgeting* had a *p-value* of less than 0.05, consequently the null hypothesis (H_0) is not met and the hypothesis (H_1) is accepted. So, the data is not normally distributed.

Conclusion: The null hypothesis (H_0) is rejected. It means that there exist differences among the views in the way *project cost budgeting* is viewed.

The normality test for *project cost reporting* had a *p-value* of less than 0.05, consequently the null hypothesis (H_0) is not met and the hypothesis (H_1) is accepted. So, the data is not normally distributed.

Conclusion: The null hypothesis (H_0) is rejected. It means that there exist differences among the views of the way *project cost reporting* is viewed.

The normality test for project cost analysis had a *p-value* of less than 0.05, consequently the null hypothesis (*H_0*) is not met and the hypothesis (*H_1*) is accepted. So, the data is not normally distributed.

Conclusion: The null hypothesis (*H_0*) is rejected. It means that there exist differences among the views of *project cost analysis*.

The normality test for *project cost monitoring* had a *p-value* of less than 0.05, consequently the null hypothesis (*H_0*) is not met and the hypothesis (*H_1*) is accepted. thus, the data is not normally distributed.

Conclusion: The null hypothesis (*H_0*) is rejected. It means that there exist differences among the views of *project cost monitoring*.

The normality test for decision-making had a *p-value* of less than 0.05, consequently the null hypothesis (*H_0*) is not met and the hypothesis (*H_1*) is accepted. Thus, the data is not normally distributed.

Conclusion: The null hypothesis (*H_0*) is rejected. It means that there exist differences among the views of *decision-making*. The normality test for *control changes in project cost* had a *p-value* of less than 0.05, consequently the null hypothesis (*H_0*) is not met and the hypothesis (*H_1*) is accepted. Thus, the data is not normally distributed.

Conclusion: The null hypothesis (*H_0*) is rejected. It means that there exist differences among the views of *changes are controlled in project cost*.

The normality test for *project cost communication* had a *p-value* of less than 0.05, consequently the null hypothesis (*H_0*) is not met and the hypothesis (*H_1*) is accepted. So, the data is not normally distributed.

Conclusion: The null hypothesis (*H_0*) is rejected. It means that there exist differences among the views of *project cost communication*.

The normality test for *output of cost control* had a *p-value* of less than 0.05, consequently the null hypothesis (*H_0*) is not met and the hypothesis (*H_1*) is accepted. Thus, the data is not normally distributed.

Conclusion: The null hypothesis (*H_0)* is rejected. It means that there exist differences among the views of *output of cost control.*

9.4.2 Skewness and kurtosis test results

Measures of skewness are based on mean and median while kurtosis measures the peakedness of the curve of the frequency distribution (Kothari & Garg, 2014). The results presented in Table 9.64 show that the skewness coefficient ranges between -0.864 and -1.586 and a kurtosis coefficient of 0.293 to 3.277. Based on these results, it was concluded that some of the data was normally distributed, since their statistic values were between -1 and +1.

Table 9.64: Skewness and Kurtosis test for appropriate cost control practice

		Skewness		Kurtosis	
	N	Statistics	Std Error	Statistics	Std Error
Planning and Environmental Issues	300	-0.99	0.141	0.293	0.281
Provision of Contract Documentation	300	-0.864	0.141	0.815	0.281
Project Cost Budgeting	300	-1.158	0.141	1.597	0.281
Project Cost Reporting	300	-1.320	0.141	1.274	0.281
Project Cost Analysis	300	-1.586	0.141	3.277	0.281
Project Cost Monitoring	300	-1.176	0.141	1.308	0.281
Decision-Making	300	-1.086	0.141	1.135	0.281
Control Changes in Project Cost	300	-1.309	0.141	1.606	0.281
Project Cost Communication	300	-1.338	0.141	2.172	0.281
Output of Cost Control	300	-0.984	0.141	0.815	0.281

With regard to normality, each variable of the data was analysed, using skewness and kurtosis, but this cannot be generalised, so the Durbin-Watson test, as well as the graph plot, is employed to further check the normality of each variable in the data set.

9.5 REGRESSION ANALYSIS

9.5.1 Durbin-Watson Test Results

A high degree of correlation among residuals of the regression data sets may produce inefficient results. For this reason, the presence of serial correlation among the OLS regressions is checked using Durbin and Watson's test statistic (Yupitun, 2008). The result of the Durbin and Watson test statistic is presented in Table 9.65.

Table 9.65: Durbin-Watson (Autocorrelation) results

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	**.514[a]**	**.264**	**.242**	**.56985**	**2.905**

a. Predictors: (Constant), PCC project cost communication, PCE-F1 appropriate planning and environmental issues, DM decision making, PCA project cost analysis, PCM project cost monitoring, PCB project cost budgeting, PCR project cost reporting, PCE-F2 provision of contact documentation, CM control changes in project cost.
b. Dependent Variable: OCC output of cost control

The Durbin-Watson statistic ranges in value from 0 to 4 with an ideal value of 2, indicating that errors are not correlated, although values from 1.75 to 2.25 may be considered acceptable. Some authors consider Durbin-Watson value between 1.5 and 2.5 as acceptable, indicating no presence of collinearity (Makori & Jagongo, 2013).

The Durbin-Watson value of 2.905 indicates that some of the variables suffer from autocorrelation.

Therefore, the Spearman correlation is employed to determine the correlation matrix of the variable. The statistics indicate that only three of the variables are able to fit the model. This is shown showed in Table 9.66 below.

Table 9.66: Variables are able to fit the model

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	Std. Error	Beta		
1	(Constant)	0.950	0.078		12.104	**0.000**
	PCE_F1 Appropriate Planning and Environmental Issues	0.015	0.011	0.088	1.381	0.168
	PCE_F2 Provision of Contract Documentation	-0.044	0.020	-0.152	-2.198	0.029
	PCB Project cost Budgeting	0.017	0.014	0.080	1.182	0.238
	PCR Project Cost Reporting	0.006	0.014	0.028	0.408	0.684
	PCA Project Cost Analysis	-0.034	0.017	-0.138	-1.987	0.048
	PCM Project Cost Monitoring	-0.056	0.017	-0.212	-3.264	**0.001**
	DM Decision Making	-0.043	0.016	-0.175	-2.665	**0.008**
	CM Control Changes in Project Cost	-0.020	0.018	-0.080	-1.124	0.262
	PCC Project Cost Communication	-0.009	0.016	-0.039	-0.565	0.573

Table 9.66 displays the regression coefficient results of family characteristics OCC = Output of Cost Control, PCE_F1 = Appropriate Planning and Environmental Issues, PCE_F2 = Provision of Contract Documentation, PCB = Project cost Budgeting, PCR = Project Cost Reporting, PCA = Project Cost Analysis, PCM = Project Cost Monitoring, DM = Decision Making, CM = Control Changes in Project Cost, PCC = Project Cost Communication). Output of Cost Control (supported by β= 0.000, p-value =0.000), Project Cost Monitoring (supported by β=-0.212, p-value = 0.001), and Decision-Making (supported by β= -0.175, p-value = 0.008) are statistically significant. This implies that other variables are rejected, since their p-values are more than 0.01

9.5.2 Cost control correlations results

Correlation analysis was used to establish the strength and nature of the relationship between OCC Output cost control measures, DM decision making, and PCM project cost monitoring in Ghana.

Table 9.67 shows the correlation matrix with the correlation analysis with varied degrees of interrelationship between Output cost control (OCC), Decision-making (DM) and Project cost monitoring (PCM).

Table 9.67: Nonparametric correlations

Nonparametric correlations			OCC Output of Cost Control	PCM Project Cost Monitoring	DM Decision Making
Spearman's rho	OCC Output of Cost Control	Correlation Coefficient	1.000	.414**	.406**
		Sig. (2-tailed)		0.000	0.000
		N	300	300	300
	PCM Project Cost Monitoring	Correlation Coefficient	.414**	1.000	.467**
		Sig. (2-tailed)	0.000		0.000
		N	300	300	300
	DM Decision Making	Correlation Coefficient	.406**	.467**	1.000
		Sig. (2-tailed)	0.000	0.000	
		N	300	300	300
**. Correlation is significant at the 0.01 level (2-tailed).					

The Pearson correlation coefficient was generated at 0.01 significance level (2 tailed). The output indicates a strong positive relationship between Output of cost control, Project cost monitoring and Decision-making in Ghana, *P* =0.000. The p-value<0.01 is significant at 0.01

level, as the correlation matrix indicates. Output of cost control, Project cost monitoring and Decision-making are therefore very important factors in cost control practice.

9.5.3 Dependent variable results

The dependent variable was analysed using the SPSS software. Figure 9.21 illustrates the regression standardised histogram to show that the dependent variable distribution data is normally distributed.

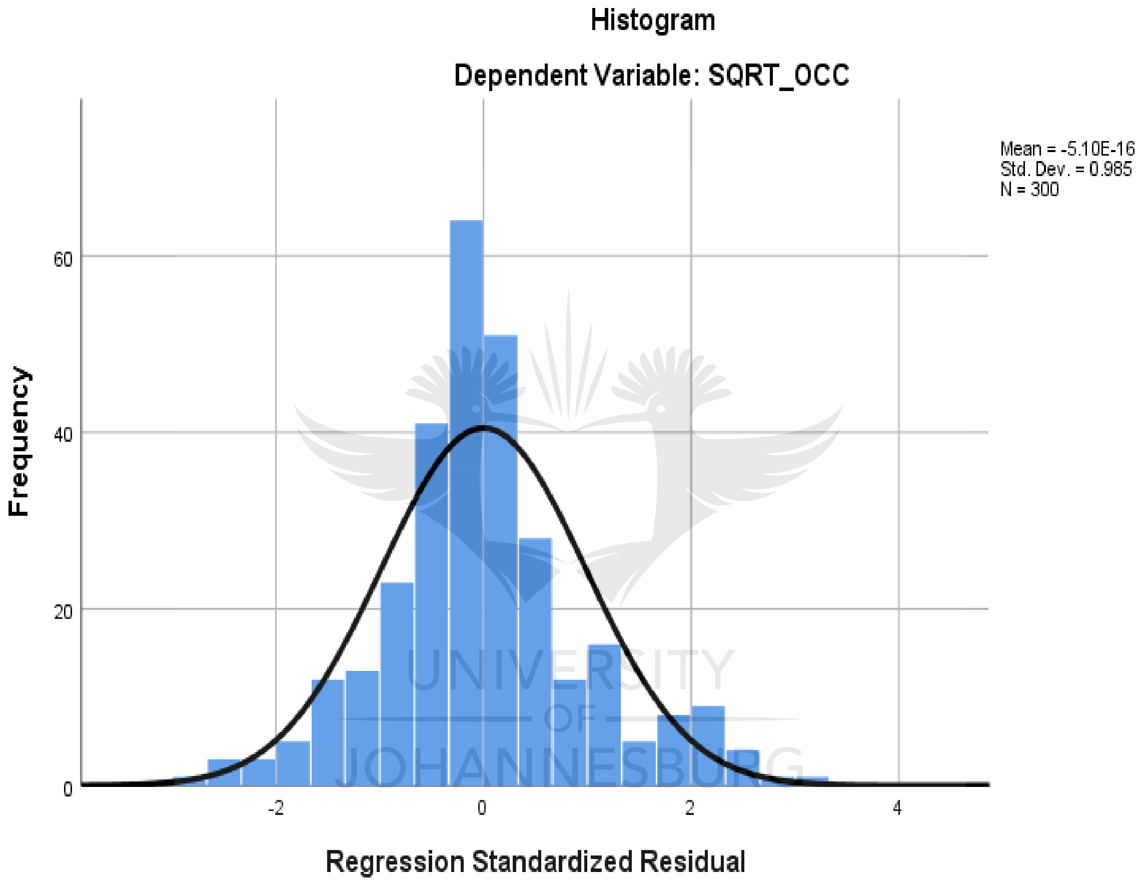

Figure 9. 20: Histogram of frequency and regression standardised residual

Figure 9.22 shows the normal probability plot (Normal P–P plot), given the extent of the points in relation to the straight line. The residuals indicate that the dependent variable data is approximately normally distributed, although other tests were further conducted to correct the errors.

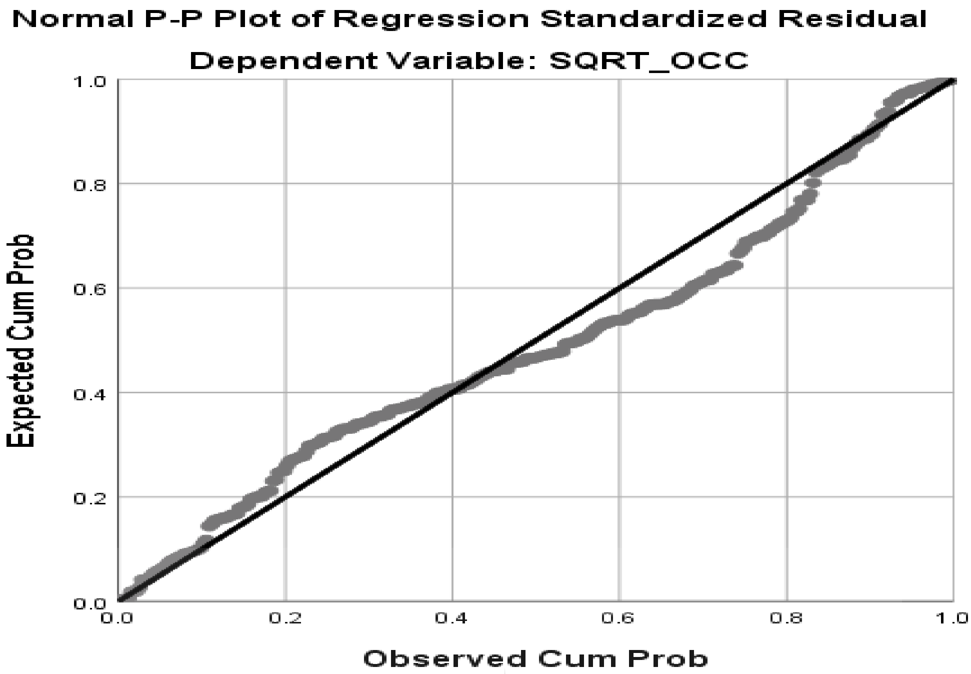

Figure 9.21: Normality probability plot

Table 9.68: Summary of output on cost control model

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.479[a]	.230	.225	.19997

a. Predictors: (Constant), DM Decision Making, PCM Project Cost Monitoring
b. Dependent Variable: SQRT_OCC

The results in Table 9.68 show that Decision-making and Project cost monitoring had explanatory power on the Output of cost control of its variability (R Square = 0.230) hence the model is a good fit for the data. Considering Decision-making, Project cost monitoring as a variable on its own implies a moderately positive relationship with SQRT Output cost control.

9.5.4 ANOVA results on SQRT OCC

Table 9.69: ANOVA Results on SQRT OCC (Output Cost Control)

Model	**Sum of Square**	**Df**	**Mean Square**	**F**	**Sig**
Regression	3.545	2	1.773	44.329	0.000
Residual	11.877	297	0.040		
Total	15.422	299			

a. Dependent Variable: SQRT_OCC
b. Predictors: (Constant), DM Decision Making, PCM Project Cost Monitoring

Table 9.69 presents the analysis of variance of the study on Decision-making and Project cost monitoring on SQRT output cost control. The results reveal a significant relationship exists between Decision-making, Project cost monitoring and Output cost control with a p-value of 0.000.

Since the P-value is less than 0.05, it indicates that the predictor variable explains the variation in the dependent variables, Decision-making and Project cost control) on SQRT_ Output of cost control (F = 44.329, p = 0.000). If the significance value of *P* had been larger than 0.05, then the independent variables would not explain the variation in the dependent variable (Lakew & Rao, 2009).

9.5.5 Regression coefficients of output cost control

The results of the regression coefficients of the Output cost control model are presented in Table 9.70:

Table 9.70: Regression coefficients of Output cost control

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.264	0.096		23.649	0.000
	PCM Project Cost Monitoring (x_1)	-0.120	0.022	-0.306	-5.398	0.000
	DM Decision Making ((x_2))	-0.099	0.022	-0.257	-4.536	0.000

a. Dependent Variable: SQRT_OCC

Table 10.70 displays that the regression coefficients results of Project cost monitoring (supported by β=-0.306, p-value = 0.000), and Decision-making (supported by β= -0.257, p-value = 0.000) are statistically significant in explaining Output cost control practice by contractors in the Ghanaian construction industry.

This implies that the regression model can be summarised by the equation.

$Y = 2.264 – 0.120x_1 – 0.099x_2$ ……………………………………..……….. Equation 10.1, where:

Y = OCC (Output Cost Control), X_1 = PCM (Project Cost Monitoring), X_2 = DM (Decision Making).

9.6 CONCLUSION

This chapter presents the fieldwork survey results by firstly showing the descriptive statistics. The factor analysis results followed the descriptive statistics. The chapter finally ends with the regression analysis. Reliability and validity tests were also conducted for the survey data.

The test for the hypothesis of the cost control practice and its direct relationships with the primary constructs were determined for the outcomes of cost control practice in the Ghanaian construction industry.

The factor analysis confirmed all the eight constructs, while the multi-linear regression analysis accepted only two constructs. The model attained goodness-of-fit criteria and the equation presented in this chapter. There is, therefore, the need for model examination and improvement in future. This chapter concludes that two factors were predicted and statistically significant for Cost control practice by contractors in the Ghanaian construction industry.

CHAPTER TEN

DISCUSSION OF RESULTS FROM THE FIELDWORK SURVEY

10.0 INTRODUCTION

The chapter discusses the results of the descriptive and inferential statistics of the fieldwork data in the previous chapter. The extent of hypothesised relationship fitting and identified factors are discussed. The fieldwork data and its relationship with the Delphi survey results are discussed. Further, the factors that predict the multi-linear regression model are also discussed in this chapter.

10.1 DISCUSSION OF FIELDWORK SURVEY RESULTS

The discussion of the fieldwork survey results is presented under descriptive statistics and inferential statistics. The inferential statistics' section is presented in the discussion of the EFA and the new model developed for Cost control practice for contractors in the Ghanaian construction industry.

10.1.1 Descriptive Statistics

Descriptive statistics determined that 64% were D2K2 class of contractors and 38% were D1K1 contractors. The top class of contractors surveyed have well-structured organisations with good cost management functions, including cost control practice (Adjei *et al.*, 2018). The construction firms showed 36%, the majority. had been in operation for 6-10 years. The results show that the views of more experienced construction firms were sought. This influences the outcome of the study. Most of the respondents (40%) were quantity surveyors who are the key persons who undertake project cost control systems in the organisations (Adjei *et al.*, 2015; Nkado & Meyer, 2001; Uher & Davenport, 2002). Forty-eight per cent, representing 144 respondents, often prepare the cost control systems quarterly. The others do it weekly, daily or annually. Efforts are being made by contractors to undertake cost control practice periodically, to prevent cost overruns in the delivery of construction projects. Hence, this indicates the absence of a cost control model to be followed by the Ghanaian construction industry.

The findings of the current investigation's hypothesised model testing indicate that cost control practice and the outcomes of the cost control practice are predicted by project cost monitoring and decision-making. In all, the 300 valid responses were considered to be sufficient for the prediction of the model through the use of the regression analysis (Scott, 2000; Knofczynski & Mundfrom, 2008).

10.1.2 Inferential Statistics

10.1.2.1 Exploratory Factor Analysis (EFA)

EFA was used to explore the factors that influence cost control practice. The EFA was used to establish the interrelationships between the main factors and the related factors. This corresponds with Pallant, (2007). Pallant (2007) used determinants of a factor for the correlation matrix, Bartlett's test, Kaiser-Meyer-Olkin (KMO), and Cronbach's alpha values. The correlation matrix used demonstrates a relationship of $r = 0.3$ or more; Bartlett's test of sphericity ought to be factually critical at $p < 0.5$ and the KMO proportion of examining ought to be 0.6 or more. However, the results were more than 0.6. The results were run for the principal component analysis (PCA) using the varimax rotation. Its purpose was to check the quantity of variables to separate utilising the Kaiser's rule, the aggregate number of segments that have an eigenvalue of at least 1 or above stand resolved and embraced. The eigenvalue is depicted as a scientific property of a framework, conveyed both as a foundation for setting up the quantity of variables to remove and as a proportion of change represented by a given measurement (Dainty *et al.*, 2003; Ahadzie *et al.*, 2008). Additionally, the graphic scree test is utilised to reject variables, with the scree plot demonstrating the limit point where the eigenvalues levelled off (Dainty *et al.*, 2003).

The principal determinants of cost control factors are project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis, decision-making, change management and project cost communication. These findings are supported by other similar cost control studies undertaken by Olawale and Sun (2015, Charoenngam and Sriprasert (2001) and Abubakar (1992). Their works determined cost control factors as project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis, and decision-making. The change management factor is supported by Hafez *et al.*, (2015) who claimed that change management should be included in cost control practice. Zou & Lee, (2008) also support the fact that construction projects with change management principles accomplish better in terms of cost performance. The project cost communication factor is in line with Te'eni *et al.* (2001) and Kwofie (2015), who found that effective communication among the members of the organisation increases the level of understanding and the relationships among the team members and leads to effective cost delivery.

10.1.2.2 Discussion of the model results using regression analysis

The multi-linear regression analysis is presented in Table 9.72. The variability of the model is shown by the R square. The R square value is 0.230, hence the model is a good fit for the data. Two predictors of cost control practice had a strong influence and explanatory power on the outcomes of cost control practice with the other weak constructs. The two factors that predicted the cost control practice are Project cost monitoring and Decision -making as in equation one. The testing assumed that cost control factors have significant influence on the outcomes of cost control practice.

10.1.2.2.1 Relationship of Project cost monitoring and Cost control practice

It has been clearly shown that project cost monitoring impacts on cost control practice, as conjectured in the investigation. The findings show that increasing the cost control practice (outcomes of cost control) by 2.264 will negatively affect project cost monitoring by 0.120. in other words, an increase in cost control practice by 2.264 will reduce project cost monitoring by 0.120. The findings of the investigation coincided with other discoveries: Olawale and Sun (2015), Charoenngam and Sriprasert (2001) and Abubakar (1992). The studies by the authors mentioned established that project cost monitoring influences the cost control practice. Project cost monitoring was defined by 12 indicator variables: Training site personnel in monitoring process, Provision of manuals for site monitoring team to refer to, Planning milestone monitoring process, Monitoring updated cost records, Selection of appropriate technique for cost monitoring, Monitoring cost performance, Selecting appropriate tools for tracking project cost, Identifying cost changing factors, Detecting early warning signs, Monitoring cost data (material, labour, plant, overheads, subcontractor cost, etc.), Cost data verification, and Monitoring reported cost information.

Planning the monitoring process, Provision of cost monitoring manuals and training of the team in the site monitoring have also been recognised as significant by Olawale & Sun (2015) and Tom & Sachin (2013). The key monitoring variable of monitoring is the monitoring of cost data, thus, the monitoring of all the resources used in the project. To monitor cost data means: monitor labour cost for both owned and labour only works, monitor material cost from purchasing, control inventory of materials, monitor the right quantity of materials used, monitor the right unit rate cost of materials, monitor equipment in terms of those hired, monitor the right hours used by plants/equipment, monitor of overhead cost of hired or owned plant cost and , in addition, to monitor earned value in terms of quantities measured from the cost performance.

(Olawale & Sun, 2015; Anyanwu, 2013; Charoenngam & Sriprasert, 2001; Abubakar, 1992). The selection of an appropriate technique for cost monitoring indicates that there are several cost monitoring techniques available for use for cost monitoring: the PERT, earned value analysis, cost variances, cost performance index for monitoring project cost (Raut & Pimplikar, 2014; Aliverdi *et al.*, 2013; Pajares & López-Paredes, 2011).

Project cost monitoring is not only the collection of information for further tasks but also verifying that the cost payment invoices or vouchers correspond with the budgeted cost by the various divisions within the organisation (Charoenngam & Sriprasert, 2001: Cunningham, 2017). The purpose of cost verification is to ensure that cost documentation, cost calculations and actual cost reflect work progress are accurate (Cunningham, 2017; Charoenngam & Sriprasert, 2001). The cost manager or quantity surveyor on the construction stage is also expected to follow each work activity to check specifications used and to advise where necessary about the cost implications. Monitoring cost performance is about cost progress and technical performance (Aliverdi *et al.*, 2013; Khamidi *et al.*, 2011; European Commission, 2005).

The cost information and updated cost records must be monitored to ensure that the cost data used for cost control is always up to date (Ogunlana & Butt, 2000; Tom & Sachin, 2013; Ahuja & Thiruvengadam, 2004).

The goal of project cost monitoring is to detect early warning signs and to identify cost changing factors for corrective measures to be taken to prevent their reoccurrence in the future. This is supported by numerous authors, including Aliverdi *et al.*, (2013), Khamidi *et al.* (2011), Charoenngam & Sriprasert (2001), Byung-Cheol & Reinschmidt (2011), Khamidi *et al.* (2011) and Al-Jibouri, (2003).

Construction project cost cannot be controlled without firstly monitoring the cost at the construction site to compare it with the budgeted cost for decision s to be made.

10.1.2.2.2 Relationship of Decision-making and cost control practice

It has been very well articulated that decision-making impacts on cost control practice as conjectured in this investigation. The findings show that increasing cost control practice (outcomes of cost control) by 2.264 will negatively affect decision-making by 0.099. In other words, an increase in cost control practice by the 2.264 will reduce decision-making by 0.099. The decision-making concept appears in existing cost control theories. The findings of the investigation corresponded with the discoveries of Olawale and Sun (2015), Charoenngam and Sriprasert (2001) and Abubakar (1992). Many researchers, such as Okunbor (2013), Adjei *et al.* (2017), Haji-Kazemi *et al.* (2012) and Veronika *et al*. (2006), have supported the notion of the influence of decision-making on cost control practice. The seven variables of decision-making found in the current study are: selection of the relevant corrective measures, identifying the root/main cause of the cost variances, evaluation of the corrective measure used, developing alternative measures for cost variances, implementation of the selected measure, categorising the causes of the problem and analysing the problem.

The decision-making process is supported by Lepadatu (2011), Beecroft *et al.*, (2003), Patel and Patel (2013), and Adjei *et al*. (2017). The project cost manager must know how to act promptly under conditions of uncertainty. For this, the cost manager needs to use a decision-making model (Lepadatu, 2011). Corrective measures in project cost control entail a decision-making process where measures are taken to solve or overcome any problem in the cost variances. In a simplified approach, all the work activities of the various work sections are controlled with corrective measures (Adjei *et al.*, 2017; Haji-Kazemi *et al.*, 2012; Veronika *et al*., 2006).

10.1.2.2.3 Extent to which the Hypothesised Integrated Model fits the Identified Factors

The most outstanding contribution of the current study is the development of a model for project cost control practice for contractors in the Ghanaian construction industry. The findings of the regression model suggest that two out of the eight identified exogenous variables, project cost monitoring and decision-making, had a negative influence on the endogenous variable, namely, the outcomes of project cost control practice. The assumption that effective cost control practice is directly influenced by the identified exogenous variables was upheld, confirming the multidimensionality of the determinants of effective cost control practice (Olawale & Sun, 2015; Charoenngam & Sriprasert, 2001; Abubakar, 1992).

The relationship between the established exogenous and endogenous variables shows that two of the variables were statistically significant, as pointed out in equation 10.1. Moreover, the findings reveal that all the latent variables of these constructs satisfactorily measured the overall effectiveness of the project cost control practice. It was shown by the results that: project cost monitoring and decision-making are the most significant predictors of project cost control practice. The outcome of the results shows that project cost monitoring and making good decisions to solve cost deviations results in a successful delivery of project cost in the Ghanaian construction industry.

10.2 FIELDWORK DATA AND DELPHI SURVEY DATA RELATIONSHIP

The Delphi survey data reveals the primary factors and the sub-variables that determine cost control practice, although there is an absence of a formal cost control model for the construction industry in Ghana.

The Delphi survey results were validated and the latent constructs responses were: project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis, decision-making, change management and project cost communication. These constructs had positive relationships and were statistically significant for predicting cost control practice. The results of the factor analysis and IQD produced similar relationships of the exogenous and endogenous variables. The advantage of using both factor analysis and Delphi survey was to validate the Delphi findings as clearly as possible and to predict the exogenous factors that had significant influence on cost control factors.

Additionally, the regression analysis approach also helped to validate the Delphi survey. Regression analysis had two factors which had a strong and direct relationship with the outcomes of cost control practice.

10.3 CONCLUSION

The Delphi survey results (qualitative data) support the fieldwork survey results (quantitative data) as the Delphi survey uses inferential statistics. The factors that predict the cost control practice are project cost monitoring and decision- making. They both influence, cost control practice and the outcome variables. Construction cost control can not be conducted without these two main variables. They are key in the determination of the outcomes of cost control practice.

CHAPTER ELEVEN

CONCLUSIONS AND RECOMMENDATIONS

11.0 INTRODUCTION

This study has investigated the factors enhancing cost control practice and predicted those factors for contractors in the Ghanaian construction industry. The key goal was to develop a model for predicting the factors for contractors. This section, condenses the principle discoveries of the objectives of the examination and their influence on the development of the model. The conclusions have been formed from the former chapters, and fitting recommendations are suggested to address the findings, where important. This last section links the contribution to knowledge, the restrictions of the investigation and proposals for future investigation. In addition, it specifies the investigation goal by revisiting the objectives set for the study.

11.1 RESEARCH OBJECTIVES

The main goal of the study is to develop a model for predicting the factors enhancing cost control practice in the Ghanaian construction industry for contractors. This prompted the detailing of six noteworthy objectives, important to address the general point. In order to address the primary point of the examination, the accompanying objectives emerged.

RO1: To establish the current theories and literature on cost control practice in construction with the view to identifying gaps for further studies;

RO2: To determine the main and sub attributes that influence cost control practice and **to** examine whether the attributes that determine cost control practice in other cultural contexts are the same in Ghana;

RO3: To develop a holistic cost control conceptual framework for contractors in Ghana;

RO4: To determine the organisational elements that influence cost control practice in Ghana;

RO5: To determine the cost control challenges for contractors in Ghana;

RO6: To predict the factors that determine cost control practice for contractors in Ghana.

11.1.1 Research objective 1

The first research objective was to establish the current theories and literature on cost control practice in construction, with the view to identifying gaps for further studies. Current literature was perused with the view of extracting information on current theories on cost control and gaps that have not been attended to and their related constructs. The findings revealed that cost control research works have not concentrated on comprehensive constructs in the advancement of the past models and theories. The recognised gaps identified from the broad literature survey were change management, project cost communication and the setting of a new approach to project cost monitoring. Change management, project cost communication and the setting of a new approach to project cost monitoring are necessary to bring life into the cost control practice and also to accomplish better cost performance in construction project delivery. The key factors of cost control practice are project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis and decision-making. Cost control theory from literature has six-factor constructs. This research shows the classification of the constructs that have used in the prediction of cost control practice. The current investigation argues that cost control practice has eight-factor constructs, based on the findings from the reviewed literature.

11.1.2 Research objective 2

The second research objective was to determine the main and sub attributes influencing cost control practice and to determine whether the attributes determining cost control practice in other cultural contexts is the same in Ghana. Current literature was reviewed with the view to extracting information from global perspectives of the main attributes of cost control practice. The findings show that there is more than one construct in the main attributes of cost control practice. The main attributes of cost control practice are project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis and decision-making. The findings show that cost control practice is a continuous process and that no step can be omitted. The project cost estimation is prepared to establish the cost of the project. Literature informs that accuracy is required by estimators to achieve correct or approximate costs of project. The setting of the project cost budget needs to be realistic. During the execution of the project, predetermined periods are important for project cost monitoring processes, where project cost reports and project cost analysis are prepared for decisions to be made by top management to solve cost deviations from the budgeted cost. The practice of cost control has been embraced by developed nations for close to two decades.

The Delphi survey technique, consensus on the influence and impact levels of the various attributes of cost control practice were used together with the literature review. The findings show a number of main and sub attributes that were realised to be essential in the implementation of cost control practice from the Delphi survey. The principal determinants of cost control practice were project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis and decision-making. The findings indicate that attributes that determine cost control practice in other cultural context are similar in the Ghanaian construction industry. The attributes led to the development of a cost control model.

11.1.3 Research objective 3

The third objective was to develop a holistic cost control conceptual framework for contractors in Ghana. Current literature was consulted following which the Delphi survey technique was selected to achieve this objective. The new conceptual cost control model was developed with eight-factor constructs. The factors are project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis, decision-making, change management and project cost communication. The hypothesis was validated through multi-linear regression modelling of the fieldwork survey data.

11.1.4 Research objective 4

The fourth research objective was to determine the organisational elements that influence cost control practice in Ghana. The Delphi survey technique, consensus on the influence and impact levels of the various attributes on cost control practice was used to achieve this objective. The findings show that the organisational elements influencing cost control practice are organisational structure, organisational culture and ICT tool and knowledge. The findings show the three main constructs and their sub attributes to influence cost control practice. It also indicates how systems work within the organisation relating to cost control practice. The knowledge of the cost control process is not only important but it is also argued that, the way systems are activated within organizations affects the practice of cost control.

11.1.5 Research objective 5

The fifth objective was to determine the cost control challenges for contractors in Ghana. A blend of the literature review, reinforced by the results of the questionnaires assisted in the accomplishment of this objective. The findings reveal that present challenges exist in the practice of cost control. The 11 challenges are: using outmoded methods and concepts, over-emphasising results without following the project cost control process, lack of cost control processes/systems suitable for the firm, lack of knowledge of the use of available tools and technology, decision-making failure, poor attitude towards ICT usage, difficulty in monitoring different sources of day-to-day cost data, no clear distinction between monitoring and reporting, lack of financial commitment in projects, lack of knowledge of the use of available tools and technology and abandonment of complicated strategies

11.1.6 Research objective 6

The sixth objective was to predict the factors that determine cost control practice for contractors in Ghana. In achieving this objective, multiple regression analysis was employed to build up the model. Multiple regression analysis was selected because of its descriptive nature of the determinants of cost control factors. It uses the R square values, where the coefficients of the determinants are known. Factor analysis was conducted on the main and related factors to scale down the variables. The outcomes of cost control practice, the dependent variables, which also had six variables were scaled as a single variable. Two constructs were predicted to have a statistically significant influence on cost control practice for contractors in Ghana. These are: project cost monitoring and decision-making.

11.2 SIGNIFICANCE AND VALUE OF STUDIES

The discoveries of this thesis are presented under four main areas of contributions and value, PCC model, theoretical, practical and methodology. In addition, it is important that the most noteworthy commitment of the examination is the methodology for the development of the cost control model.

11.2.1 Project Cost Control Model

The most outstanding contribution of the current study is the development and validation of the Project Cost Control (PCC) model for construction project cost delivery in Ghana. It is further revealed as a significant influence on project cost monitoring and decision-making in the implementation of the cost control practice. The current and validated PCC model encapsulates the two factor constructs and fits the hypothesised PCC model. The combined theories underscore the variables: project cost monitoring and decision-making hypothesised in the PCC model for successful delivery of project cost in Ghana.

11.2.2 Theoretical Significance and Value

The study found that cost control theories have not been upgraded over the past two decades. Although the previous works were relevant to the construction industry, it has subsequently been established from the developed countries. The existing cost control theories have six-factor constructs which influence cost control practice. These are: project cost estimation, project cost budgeting, project cost monitoring, project cost reporting, project cost analysis and decision-making. The results of both the Delphi survey and the factor analysis confirm that cost control theory should have eight-factor constructs. The two constructs which the previous works have not addressed are change management and project cost communication. This study's results confirm and redefine the project cost monitoring approach which influences cost control practice. This aspect is considered essential because of previous similar recommendations. Apparently, there is no evidence of studies conducted on the factors that predict cost control practice relating to the research area selected for the study. The extensive interrogation of literature shows that the use of the mixed method approach, using the Delphi survey and modelling for cost control practice served well in the Ghanaian construction industry, and in Africa as a whole. Consequently, this study will serve as a guide to champion other related works through the use of the new variables.

The model developed through the use of the multiple linear regression model will serve as a source of knowledge for contractors for advancing cost control practice in the Ghanaian construction industry and other developing nations.

11.2.3 Methodological Significance and Value

The research methodology approach used for this study, the mixed method, has not been used for cost control practice. However, the Delphi survey technique is not new in cost control studies. The focus of previous cost control studies by Gharaibeh (2013) and Olawale and Sun (2015) is on deficiencies and problems of cost control practice. These studies did not focus on cost control determinants. Moreover, the studies on cost control theories by Abubakar (1992) and Charoenngam and Sriprasert (2001) do not employ the more robust methodology approaches of the Delphi survey, factor analysis and regression modelling. However, the work by Abubakar (1992) uses regression analysis for the trends in cost data and its influence on construction project cost.

High reliability figures were attained through the use of designed structure questionnaire survey data and will serve as a source of knowledge for other related works to validate this study for future purposes. The methodology approach conducted for the study is the mixed method which contributes to the body of knowledge in cost control methodologies.

11.2.4 Practical Significance and Value

Developed nations have emphasised is the practical significance of cost control practice over the past two decades but there has been less emphasis in developing nations. Each construction project is unique with its own cost management and control issues which influence the outcomes of the overall project cost. Therefore, a lot of practical significance has emerged from this work to assist the practice of cost control by contractors in the Ghanaian construction industry.

Project quantity surveyors, cost engineers, cost managers and project owners can adopt the eight-factor constructs of cost control factors to enhance project cost delivery in construction projects. The cost control practice in the construction industry has not integrated the importance of change management and project cost communication to enhance cost control practice. The results of this research study indicate the significant contribution these play in cost control practice.

This study offers practical steps for the cost control process which can be used to train various levels of the contractors' management team to work together to achieve effective cost delivery. Additionally, professional bodies, such as the Ghana Institute of Surveyors (GhIS), Ghana Institution of Engineers (GIE) and Ghana Institute of Construction (GIOC) can use the cost control factors to provide continuous professional development (CPD) for members who handle construction project cost to achieve effective cost delivery.

11.3 RECOMMENDATION

The key issues on cost control practice and result of this investigation lead to direct further research into the developed PCC model and the theoretical, methodological and practical parts of the examination's value.

11.3.1 Project Cost Control Model

The most outstanding contribution of the current study is the development of a model for PCC. This study employs a two-factor construct, namely project cost monitoring and decision-making to conceptualise the effective project cost control practice in the Ghanaian construction industry. Notwithstanding this fact, there are several other factors and approaches to PCC identified from literature to have significant influence on PCC practice. While prescribing an approval of the current PCC model on the more extensive populace, the investigation further suggests the joining of other constructs as seen as being critical, although excluded in the present model. The other dropped constructs were observed as having impact or influence on PCC.

11.3.2 Theoretical Recommendation

The results of both the Delphi survey and the factor analysis confirm that cost control theory has eight-factor constructs However, the multiple-linear regression model considered only two constructs as models fit for contractors in the Ghanaian construction industry. It is, therefore, recommended expanding the model to include more variables in future studies to improve cost control practice. The weak constructs have been identified as having a strong influence on cost control practice.

11.3.3 Methodological Recommendations

It is suggested that a related investigation ought to be directed using an alternate approach to choosing the population sample, for example, using professional quantity surveyors in the country. This study used the Delphi experts and top-class contractors D1K1 and D2K2 to reach the eight-factor construct of cost control. Quantity surveyors are professionals who handle project cost from inception to completion. Therefore, using quantity surveyors is anticipated to bring out a more robust model to enhance cost control practice in the construction industry.

Moreover, research should be carried out on all the variables to determine the relationship and fitness of the model, using a two-stage approach including the structural equation modelling (SEM). More variables are likely to be defined by the use of the SEM. No research exists in this area, so there would be an improvement of the existing cost control model. The SEM technique would further aid the approval of the investigation and improve its speculation. In addition, many investigations in the construction industry are being undertaken to set up cause-impact connections between various main constructs. Be that as it may, the vast majority of these investigations adopt deficient expository strategies and non-comprehensive procedures which do not yield helpful testing of theories at the dimension of deliberation. It is suggested that for comparative examinations, such as the present investigation on cost control practice, SEM be prescribed to be used as the explanatory strategy for improved outcomes.

11.3.4 Practical Recommendations

The following practical recommendations are made:

Contractors should develop comprehensive and robust cost control systems using ICT tools. This should include all the cost control factors to enhance effective delivery of construction project cost. The top management team should have all-inclusive cost control structures, while these should be narrowed down for the lower level management team. This means that the lower level will only have the cost control information required at each stage, while top management will have more detailed information on cost control. Additionally, cost control templates could be developed for use for cost control practice.

As far as possible, contractors should provide training to site management team members to adopt and appreciate the need for cost control practice and cost data to aid the cost control process. The training should include most important factors, like project cost monitoring, project cost reporting, change management and project cost communication.

Project managers or quantity surveyors should always keep the project cost on track by making good decisions to solve any deviations and apply the change management concepts to manage the changes in the cost, to achieve the targeted project cost.

Project owners, both public and private persons or institutions, should ensure project cost control by selecting competent contractors or professionals who will apply the cost control factors in the delivery of the construction project to achieve value for money invested.

11.4 LIMITATIONS

The limitations of the study are provided below:

The study was conducted in the Ghanaian construction industry. This is because infrastructure development in every nation is performed by the construction industry and funds are invested in which value for money is the project cost objective. The study was limited to experts, as defined in the former chapter, and top-class contractors who were registered with the Ministry of Water Resources, Works and Housing. The respondents were all employed in the Ghanaian construction industry.

The study used the mixed method methodology approach - the Delphi survey, factor analysis and regression analysis. The factor analysis indicated the relationships between the cost control factors. The regression analysis was used to predict the model with the raw data.

Reliability tests were conducted on the cost control factors to show the internal consistency. Some constructs, such as Change Management (CM), and Project Cost Estimation (PCE) indicated very much higher correlation values than the rest. This could have been the result of using one type of structure questions to gather information from respondents.

An audit of the survey questionnaire strategy used to accumulate the data would have profited the discoveries of the examination.

11.5 CONCLUSION

This chapter is the last section of the thesis and deals with the conclusions and recommendations for the study. This part concludes the development of a model for predicting a cost control practice using existing cost control models. The summary of the study is formulated with the study objectives set, which are revisited by showing how each objective was accomplished.

The study suggests that cost control factors are influenced by eight-factor constructs in accomplishing cost control outcomes for enhanced project cost delivery. The regression analysis predicts two constructs statistically significant in predicting the outcomes of cost control practice, while the others are weak constructs. Project cost monitoring and decision-making are the predictors of cost control practice for contractors.

The mixed methodology approach was used for the study. The Delphi survey used experts in the construction industry after an extensive literature review on cost control. This was followed with a fieldwork survey using questionnaires to predict the factors enhancing cost control. The reliability and validity tests were conducted on the data received from respondents.

The findings contributing to the body of knowledge are categorised under four sections which: project cost control model, theoretical, methodological and practical. The results of both the Delphi survey and factor analysis confirm that cost control theory has eight-factor constructs. The model used to predict the factors enhancing cost control practice can be used to improve the delivery of project cost. The mixed method approach was used as an innovative methodology in cost control practice. The data collected was validated. The relationships of the variables and the outcomes of cost control practice are presented. Some practical values are: the model assists the practice of cost control by contractors, training of both levels of the contractors’ management team and professionals who handle project cost to adopt the eight-factor constructs of cost control factors to achieve effective cost delivery.

It was recommended that contractors should develop a comprehensive and robust cost control system through the use of cost control templates for cost control practice. As far as possible, contractors should train site management team members to adopt and appreciate the need for cost control practice and cost data to aid the cost control process.

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APPENDIX A - DELPHI SURVEY

UNIVERSITY OF JOHANNESBURG, SOUTH AFRICA
Postgraduate School of Engineering Management

DELPHI SURVEY – ROUND ONE (INITIAL QUESTIONNAIRE)

ON

A MODEL TO PREDICT COST CONTROL PRACTICE IN THE GHANAIAN CONSTRUCTION INDUSTRY

I am very grateful to you for accepting to be part of the panel in this Delphi survey for the research on the factors enhancing construction project cost control practice in Ghana. Your opinion and time are highly appreciated. The time to be spent in answering the questions in the first-round survey is approximately 20 minutes. The survey is envisaged to be in three rounds and the subsequent rounds will require less time for completion.

An opportunity will be given to you to change your response later after all Delphi panels have completed the First-Round survey and results have been analysed. The results will be communicated to you thereafter. The results will be presented to you in simple statistics e.g. median, average, range and percentage.

INSTRUCTIONS

1. Please answer all questions to the best of your knowledge.

2. Please indicate your response by placing an **'X'** in the appropriate box. The survey requests that you rate the prospect of the elements influencing *factors for cost control practices* by contractors in the Ghanaian construction industry. This will assist in establishing the factors for predicting cost control practices to be used by contractors in Ghana. The last three elements are *organisational factors* that enable organisations to practice project cost control.

3. The influence (probability) scale is presented, and only a number should be used for a probability range. For instance, if you consider the influence (probability) range to be between 71% & 80% of the factors, mark **'X'** under the box '8'.
If the impact is considered to be high, then **'X'** should be marked under the '**7**' or **'8'** box depending on whether your opinion is inclined more towards high or very high impact (See the attached questions).

Please use your experience, expertise and judgement to rate what you perceive to be the average negative or positive influence of the various factors enhancing cost control practice in the Ghanaian construction industry. Kindly mark with a cross ('x') as you consider the factors as lacking or present.

PROBABILITY SCALE (likelihood in percentage)

1-10%	11-20%	21-30%	31-40	41-50	51-60	61-70	71-80	81-90	91-100
1	2	3	4	5	6	7	8	9	10

IMPACT SCALE

No impact		Low impact		Medium impact		High impact		Very high impact	
1	2	3	4	5	6	7	8	9	10

Q1. MAIN FACTORS ENHANCING COST CONTROL PRACTICE
To identify the main factors enhancing cost control practice by contractors in the Ghanaian construction industry.

FACTORS ENHANCING COST CONTROL PRACTICE	What is the level of **influence** of the following listed factors in enhancing cost control practice for contractors in the Ghanaian construction industry? (1=low probability, 10=high probability)										
	1	2	3	4	5	6	7	8	9	10	rank
Project cost estimation								**X**			
Project budgeting					**X**						
Project cost monitoring							**X**				
Project cost analysis							**X**				
Project cost reporting							**X**				
Decision making							**X**				
Change management					**X**						
Project cost communication									**X**		
Contractor’s organisational structure									**X**		
Contractor’s organisational culture									**X**		
ICT tools and knowledge of the organisation									**X**		

Q2. SUB-ATTRIBUTES ENHANCING COST CONTROL PRACTICE
To identify the sub-attributes that enhance cost control practice by contractors in the Ghanaian construction industry

2.1 PROJECT COST ESTIMATION

PROJECT COST ESTIMATION	What is the **impact** of the following estimation processes on construction cost control practice of contractors? (1=low impact, 10=high impact)										
	1	2	3	4	5	6	7	8	9	10	rank
Estimation process											
Appropriate method of estimation							**X**				
Availability of cost indexes average							**X**				
Experience of the estimator							**X**				
Standard procedure for updating cost information										**X**	
Appropriate method for contingency sum determination										**X**	
Availability of productivity standards										**X**	
Conducting market survey for current prices of resources										**X**	

Calculating the unit rates for the project								X			
Preparation of tender documents								X			
Converting the estimates to tender							X				
Construction project characteristics											
Method of construction								X			
Complexity of the project								X			
Site constraints (site conditions)									X		
Client's financial position									X		
Location of the project									X		
Type of contract								X			
Duration of project								X			
Content of project specification									X		
Quality of firm's planning principles									X		
Quality of firm's management strategy									X		
Attitude towards change								X			
Nationality of labour								X			
Social impact								X			
Cultural impact					X						
Environmental issues					X						
Bidding situations											
Identification of number of competitors							X				
Level of competition								X			
Time availability before bid opening								X			
Accuracy of bidding documents								X			
Financial issues											
Accuracy of estimated cost									X		
Current exchange fluctuation average								X			
Availability of financial management plans								X			
Punctuality of periodic payment							X				
Inflation pressure							X				
Economic instability							X				
Uncertainty of taxes				X							
Knowing the state of the market			X								

2.2 PROJECT BUDGETING

PROJECT BUDGETING	What is the **impact** of budgeting concepts on construction cost control practice of contractors? (1=low impact, 10=high impact)										
	1	2	3	4	5	6	7	8	9	10	Rank
Allocation of activity budget								X			
Negotiation of the main budget								X			
Approval of master and functional budgets								X			

Establishing a realistic working budget								X			
Periodic revision of the budget						X					
Ensuring that project team members understand the budget											

2.3 PROJECT COST MONITORING

PROJECT COST MONITORING	What is the **impact** of project monitoring systems on construction cost control practice of contractors? (1=low impact, 10=high impact)										
	1	2	3	4	5	6	7	8	9	10	Rank
Planning milestone monitoring process									X		
Selection of appropriate technique for cost monitoring							X				
Selecting appropriate tools for tracking project cost							X				
Monitoring cost data (material, labour, plant, overheads, subcontractor cost, etc.)									X		
Cost data verification									X		
Monitoring cost performance									X		
Monitoring updated cost records									X		
Monitoring reported cost information (actual, planned, forecast)									X		
Detecting early warning signs										X	
Identifying cost changing factors										X	
Provision of manuals for site monitoring								X			
Training site personnel in monitoring process										X	

2.4 PROJECT COST ANALYSIS

PROJECT COST ANALYSIS	What is the **impact** of project cost analysis on the cost control practice of contractors? (1=low impact, 10=high impact)										
	1	2	3	4	5	6	7	8	9	10	Rank
Collection of relevant and detailed cost data										X	
Calculating actual project cost							X				
Comparing budgeted cost with actual cost									X		
Comparing actual cost with forecast cost									X		
Analysing the cost variance									X		
Identifying causes of cost overrun									X		
Updating cost status of the project							X				

2.5 PROJECT COST REPORTING

PROJECT COST REPORTING	What is the **impact** of project cost reporting system on cost control practice of contractors? (1=low impact, 10=high impact)										
	1	2	3	4	5	6	7	8	9	10	Rank
Planning for cost report									X		
Developing various types of cost control reports							X				
Reporting on cost variances from analysis									X		
Distribution of the cost control report to appropriate sections									X		
Reporting on feedback or actions taken										X	

2. 6 DECISION MAKING

DECISION MAKING	What is the **impact** of the following decision-making processes on cost control practice of contractors? (1=low impact, 10=high impact)										
	1	2	3	4	5	6	7	8	9	10	Rank
Identify the root/main causes of the cost variances										X	
Analysing the problem										X	
Categorising the causes of the problem								X			
Developing alternative measures for cost variances									X		
Selection of the relevant corrective measures									X		
Implementation of the selected measure									X		
Evaluation of the corrective measure used									X		

2.7 CHANGE MANAGEMENT

CHANGE MANAGEMENT	What is the **impact** of change management process that assist contractors in the practice of cost control? (1=low impact, 10=high impact)										
	1	2	3	4	5	6	7	8	9	10	Rank
Establishing the sense of urgency for change									X		
Developing a vision for cost change									X		
Developing strategies for cost change									X		
Designing short term success plans									X		
Promoting a balanced change									X		
Implementing the change									X		
Evaluating the change									X		
Continuous improvement from lessons									X		

learnt											
Empowering others to act on the vision							X				
Selecting appropriate leadership style									X		
Motivating for change								X			

2.8 PROJECT COST COMMUNICATION

PROJECT COST COMMUNICATION	What is the **impact** of communication elements on cost control practice of contractors? (1=low impact, 10=high impact)										
	1	2	3	4	5	6	7	8	9	10	Rank
The context of communication (adopted) in the organisation										X	
Form of communication (adopted) within the organisation								X			
Identification of the sender and receiver					X						
Formulating a clear message										X	
Appropriate methods of communication (email, text message, etc.)									X		
Clear communication activity									X		
Appropriate feedback channel									X		
Standardisation of communication documents										X	
Access to information					X						
Reducing barriers to effective communication										X	

2.9 CONTRACTOR'S ORGANISATIONAL STRUCTURE

CONTRACTOR'S ORGANISATIONAL STRUCTURE	What is the **impact** of the organisational structure elements on cost control practice of contractors? (1=low impact, 10=high impact)										
	1	2	3	4	5	6	7	8	9	10	Rank
Roles and positions of the departments								X			
Formal relationship								X			
Nature of formation/number of layers										X	
Specialisation/professionalism									X		
Centralisation of authority	X										
Decentralisation of authority										X	
Level of horizontal integration						X					
Patterns of communication								X			
Easy coordination among members										X	

Personnel ratio (e.g. core employees to supporting staff)			**X**								
Mechanism for problem solving									**X**		
Accountability channels in the organisation									**X**		
Set of policies/procedures and standards							**X**				
Organisational knowledge										**X**	
Organisational prestige								**X**			
Corporate governance										**X**	

2.10 CONTRACTOR'S ORGANISATIONAL CULTURE

CONTRACTOR'S ORGANISATIONAL CULTURE	What is the **impact** of the values, attitudes, beliefs, and norms that affect cost control practice of contractors? (1=low impact, 10=high impact)										
	1	2	3	4	5	6	7	8	9	10	Rank
Setting clear goals								**X**			
Setting actions to match organisational goals									**X**		
Developing clear approach to succeed						**X**					
Emphasis on team contribution										**X**	
Amicable opinions and ideas exchange						**X**					
Members commitment to team										**X**	
Resolve internal problems effectively								**X**			
Resolve conflict that arises								**X**			
Encourage inter-department collaboration										**X**	
Encourage information sharing										**X**	
Guidance for performance improvement										**X**	
Emphasis on good performance							**X**				
Explicit set of performance standards							**X**				
Accept adventurous ideas for sustaining competitiveness										**X**	
Welcome alternative solutions										**X**	
Encourage creative and innovative ideas										**X**	
Allocate resources for implementing innovative ideas							**X**				
Value employees' ideas							**X**				
Employees' input on major decisions							**X**				
Employees' participation in decision-making process							**X**				
Loyalty of employees						**X**					
Emphasis on team accountability									**X**		
Emphasis on reward instead of punishment									**X**		
Creation of trust atmosphere									**X**		
Performance-based rewards									**X**		
Accept criticism and negative feedback									**X**		
Sharing the responsibility of the things that go wrong									**X**		

	1	2	3	4	5	6	7	8	9	10	Rank
Recognise and reward members' performance									**X**		
Equitable reward									**X**		

2.11 ICT TOOLS AND KNOWLEDGE

ICT TOOLS AND KNOWLEDGE	What is the **impact** of ICT tools and knowledge on cost control practice of contractors? (1=low impact, 10=high impact)										
	1	2	3	4	5	6	7	8	9	10	Rank
Acceptance of ICT usage						**X**					
Perceived usefulness of ICT (Data exchange, Data storage, Data retrieving, Data analysis)						**X**					
Using ICT for communication (Internet chat, Emailing information exchange, Live video calls)									**X**		
Availability of specific software for cost control									**X**		
Provision of technical support									**X**		
Supportive workplace environment									**X**		
ICT training and continuous development of staff										**X**	
Setting investment for ICT									**X**		

2.12. OUTCOMES OF COST CONTROL

Do you agree with the **impact** of outcomes from adopting cost control practice ofr contractors?
1 = Strongly Disagree, 10 = Strongly Agree

Outcomes from adopting cost control practice		**Strongly Disagree – Strongly Agree**										
		1	2	3	4	5	6	7	8	9	10	Median
OCC 1	Achieving accurate cost information for decision-making											
OCC 2	Establishing project cost outcome (profit/loss)											
OCC 3	Obtaining historic cost data for future projects											
OCC 4	Enhancement of the targeted profitability											
OCC 5	Prevention of wasted resources											
OCC 6	Increased efficiency of work											
Comments												

BACKGROUND INFORMATION OF EXPERT PANEL MEMBERS

Title (Mr, Mrs, Ms, Rev, Dr, Prof)	
Highest qualification	
Field of specialisation	
Professional body affiliation (MRICS, FRICS, MGhIS, FGhIS, etc.)	
Years of work experience (construction cost management)	
Member of a project committee (Yes/No)	
Chairman of a project committee (Yes/No)	
Current employer	
Position	
Email:	
Region	

Thank you. The second round of the Delphi process will be a follow-up email at the end of November 2017.

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APPENDIX 1: Conceptual Descriptions of the Factors Indicators in Q1

No	Performance Indicators	Description of each indicator
1	Construction Cost Estimation	The process of establishing the cost of a construction project.
2	Project budgeting	Budgeting involves allocation the overall cost estimates to individual work items in order to establish a cost baseline for measuring project cost and for cost control
3	Project cost monitoring	A recurring process involving comparison of actual to scheduled performance, estimates to completion and corrective actions based on such forecasts.
4	Project cost analysis	Calculation of construction project cost and comparing actual with budgeted cost for decision-making
5	Project cost reporting	Project cost report is the documentation of a summary view of the status of the project cost of resources used in a project as of each cost report date which will be compared to the project budgeted cost
6	Decision-making	The action an organisation agrees to to adopt alternative(s) to eliminate or reduce the effect of project cost variances on construction cost by acting as a remedy.
7	Change management	A structured and strategic approach to initiate and manage the change process in the organisation structure and culture, as well as the individuals/teams' behaviour and attitudes to maintain or improve their effectiveness.
8	Cost Communication	The transmission of resources (e.g. information of project cost and other meanings, including ideas, knowledge, specific skills and technology) from one party to another through the use of shared symbols and media.
9	Organisational structure	The management framework adopted to oversee the various activities of a construction project or other activities of an organisation.
10	Organisational culture	Organisational culture is the set of shared values and norms that controls organisational members to achieve organisational goals.
11	ICT tools and knowledge	ICT covers any product that will store, retrieve, manipulate, transmit or receive information electronically in a digital form.

Conceptual definition of construction cost control:

Cleland & Ireland (2002) define cost control as the process of monitoring; evaluating and comparing planned results with actual results to determine the status of the project cost, schedule and technical performance objectives.

Objectives of the Delphi Survey

DS01: To establish the attributes (main and sub) that assist in the practice of cost control and to examine whether these factors influencing cost control practice which are applicable in other cultural locations are the same in Ghana.

DS02: To confirm or otherwise whether the factors revealed as gaps from the literature survey influence the practice of cost control.

DS03: To determine the elements of organisational philosophies (structures, culture, ICT tools and knowledge) that affect cost control practice.

DS04: To evaluate the project cost control output as a result of the practice of cost control.

APPENDIX B - DELPHI ROUND TWO

UNIVERSITY OF JOHANNESBURG, SOUTH AFRICA

Postgraduate School of Engineering Management

DELPHI SURVEY – ROUND TWO (QUESTIONNAIRE)

Thank you for completing Round 1 of the Delphi survey. I recognise that the survey required a considerable time investment to complete thoughtfully. I appreciate your time and effort. The Round 2 survey continues the Delphi process for the study. The purpose of Round 2 is to provide you with the opportunity to change or agree with your responses, given the MEDIAN group response for each question and element, if you so desire.

The second-round survey is intended to take approximately 20 minutes of your time as you are only being asked to review your previous responses, given the collective group MEDIAN. When you have finished answering all questions, please email your responses to: kofiwusugh@yahoo.com or 201494604@student.uj.ac.za before December 2017.

INSTRUCTIONS

1. For each element, you will see 2 values: your response from Round 1 (Indicated in the yellow highlighted box), and the group MEDIAN from Round 1 survey, indicated in the column to the far-right hand of each table. Please tick one of the following three actions for each category:

- **Accept the group MEDIAN by leaving the field completely unchanged**
- **Maintain your ORIGINAL response by placing an X in the HIGHLIGHTED field**
- **Indicate a NEW response by placing an X in the appropriate box**

2. If your response is more than 10% (One Unit) above or below the group MEDIAN, please provide a reason for your outlying response in the field provided.

Q1

Factors ehancing cost control

1. Do you agree to that the following listed factors enhance cost control practice of contractors in the Ghanaian construction industry?

   1 = Strongly Disagree, 10 = Strongly Agree

Factors		**Strongly Disagree – Strongly Agree**										
		1	2	3	4	5	6	7	8	9	10	Median
PCE	Project cost estimation											9
PB	Project budgeting											9
PCM	Project cost monitoring											10
PCA	Project cost analysis											9
PCR	Project cost reporting											10
DM	Decision making											10
CM	Change management											9
PCC	Project cost communication											9
COS	Contractor's organisational											7

		1	2	3	4	5	6	7	8	9	10	
	structure											
COC	Contractor's organisational culture											8
ICT	ICT tools and knowledge of the organisation											8

To identify the sub-attributes that enhance cost control practice by contractors in the Ghanaian construction industry

Q2. PROJECT COST ESTIMATION:

Do you agree the **impact** of the following estimation process on construction cost control practice of contractors?

1 = Strongly Disagree, 10 = Strongly Agree

PROJECT COST ESTIMATION		Strongly Disagree – Strongly Agree										
		1	2	3	4	5	6	7	8	9	10	Median
PCE 1	Appropriate method of estimation											9
PCE 2	Availability of cost indexes average											9
PCE 3	Experience of the estimator											9
PCE 4	Standard procedure for updating cost information											8
PCE 5	Appropriate method for contingency sum determination											8
PCE 6	Availability of productivity standards											9
PCE 7	Conducting market survey for current prices of resources											9
PCE 8	Calculating the unit rates for the project											9
PCE 9	Preparation of tender documents											7
PCE 10	Converting the estimates to tender											8
PCE 11	Method of construction											8
PCE 12	Complexity of the project											8
PCE 13	Site constraints (site conditions)											8
PCE 14	Client's financial position											9
PCE 15	Location of the project											9
PCE 16	Size of the project											8
PCE 17	Type of contract											8
PCE 18	Duration of project											8
PCE 19	Content of project specification											9
PCE 20	Quality of firm's planning principles											8
PCE 21	Quality of firm's management strategy											8
PCE 22	Attitude towards changes											7
PCE 23	Nationality of labour											7
PCE 24	Weather conditions											8
PCE 25	Social impact											8
PCE 26	Cultural impact											6
PCE 27	Environmental issues											9
PCE 28	Identification of number of competitors											9
PCE 29	Level of competition											9
PCE 30	Time availability before bid opening											9

		1	2	3	4	5	6	7	8	9	10	Median
PCE 31	Accuracy of bidding documents											9
PCE 32	Accuracy of estimated cost											9
PCE 33	Current exchange fluctuation average											9
PCE 34	Availability of financial management plans											8
PCE 35	Punctuality of periodic payment											9
PCE 36	Inflation pressure											8
PCE 37	Economic instability											8
PCE 38	Uncertainty of taxes											8
PCE 39	Knowing the state of the market											8
Comments												

Q3. PROJECT BUDGETING:
Do you agree to the **impact** of budgeting concepts on construction cost control practice ofcontractors?

1 = Strongly Disagree, 10 = Strongly Agree

PROJECT COST BUDGETING		**Strongly Disagree – Strongly Agree**										
		1	2	3	4	5	6	7	8	9	10	Median
PCB 1	Allocation of activity budget											9
PCB 2	Negotiation of the main budget											8
PCB 3	Approval of master and functional budgets											8
PCB 4	Establishing a realistic working budget											8
PCB 5	Periodic revision of the budget											8
PCB 6	Ensuring that project team members understand the budget											9
Comments												

Q4. PROJECT COST MONITORING

Do you agree to the **impact** of project cost monitoring systems on construction cost control practice of contractors?

1 = Strongly Disagree, 10 = Strongly Agree

PROJECT COST MONITORING		**Strongly Disagree – Strongly Agree**										
		1	2	3	4	5	6	7	8	9	10	Median
PCM 1	Planning milestone monitoring processes											9
PCM 2	Selection of appropriate technique for cost monitoring											9
PCM 3	Selecting appropriate tools for tracking project cost											9
PCM 4	Monitoring cost data (material, labour, plant, overheads, subcontractor cost, etc.)											9
PCM 5	Cost data verification											9
PCM 6	Monitoring cost performance											9
PCM 7	Monitoring updated cost records											9
PCM 8	Monitoring reported cost information (actual, planned, forecast)											9

		1	2	3	4	5	6	7	8	9	10	Median
PCM 9	Detecting early warning signs											10
PCM 10	Identifying cost changing factors											10
PCM 11	Provision of manuals for site monitoring											10
PCM 12	Training site personnel in monitoring process											10
Comments												

Q5. PROJECT COST ANALYSIS

Do you agree the **<u>impact</u>** of project cost analysis on the cost control practice ofr contractors?

1 = Strongly Disagree, 10 = Strongly Agree

PROJECT COST ANALYSIS		Strongly Disagree – Strongly Agree										
		1	2	3	4	5	6	7	8	9	10	Median
PCAN 1	Collection of relevant and detailed cost data											10
PCAN 2	Calculating actual project cost											8
PCAN 3	Comparing budgeted cost with actual cost											9
PCAN 4	Comparing actual cost with forecast cost											9
PCAN 5	Analysing the cost variance											9
PCAN 6	Identifying causes of cost overrun											9
PCAN 7	Updating cost status of the project											9
Comments												

Q6. PROJECT COST REPORTING

Do you agree the **<u>impact</u>** of project cost reporting system on cost control practice of contractors?

1 = Strongly Disagree, 10 = Strongly Agree

PROJECT COST REPORTING		Strongly Disagree – Strongly Agree										
		1	2	3	4	5	6	7	8	9	10	Median
PCR 1	Planning for cost report											9
PCR 2	Developing various types of cost control report											8
PCR 3	Reporting on cost variances from analysis											8
PCR 4	Distribution of the cost control report to appropriate sections											9
PCR 5	Reporting on feedback or actions taken											10
Comments												

Q7. DECISION MAKING

Do you agree the **impact** of the following decision-making processes on cost control practice of contractors?

1 = Strongly Disagree, 10 = Strongly Agree

DECISION MAKING		Strongly Disagree – Strongly Agree										
		1	2	3	4	5	6	7	8	9	10	Median
DM 1	Identify the root/main causes of the cost variances											9
DM 2	Analysing the problem											8
DM 3	Categorising the causes of the problem											8
DM 4	Developing alternative measures for cost variances											8
DM 5	Selection of the relevant corrective measures											9
DM 6	Implementation of the selected measure											9
DM 7	Evaluation of the corrective measure used											9
Comments												

Q8. CHANGE MANAGEMENT

Do you agree the **impact** of change management process that assist contractors in the practice of cost control?

1 = Strongly Disagree, 10 = Strongly Agree

CHANGE MANAGEMENT		Strongly Disagree – Strongly Agree										
		1	2	3	4	5	6	7	8	9	10	Median
CM 1	Establishing the sense of urgency for change											7
CM 2	Developing a vision for cost change											8
CM 3	Developing strategies for cost change											9
CM 4	Designing short term success plans											9
CM 5	Promoting a balanced change											9
CM 6	Implementing the change											9
CM 7	Evaluating the change											9
CM 8	Continuous improvement from lessons learnt											9
CM 9	Empowering others to act on the vision											7
CM 10	Selecting appropriate leadership style											9
CM 11	Motivating for change											8
Comments												

Q9. PROJECT COST COMMUNICATION

Do you agree the **impact** of communication elements on cost control practice of contractors?

1 = Strongly Disagree, 10 = Strongly Agree

PROJECT COST COMMUNICATION		Strongly Disagree – Strongly Agree										
		1	2	3	4	5	6	7	8	9	10	Median
PCCM 1	The context of communication (adopted) in the organisation											9
PCCM 2	Form of communication (adopted) within the organisation											7
PCCM 3	Identification of the sender and receiver											7
PCCM 4	Formulating a clear message											8
PCCM 5	Appropriate methods of communication (email, text message, etc.)											9
PCCM 6	Clear communication activity											8
PCCM 7	Appropriate feedback channel											8
PCCM 8	Standardisation of communication											8
PCCM 9	Access to information											9
PCCM 10	Reducing barriers to effective communication											9
PCCM 11	The context of communication (adopted) in the organisation											9
Comments												

Q10. CONTRACTOR'S ORGANISATIONAL STRUCTURE

Do you agree the **impact** of the organisational structure elements on cost control practice of contractors?

CONTRACTOR'S ORGANISATIONAL STRUCTURE		Strongly Disagree – Strongly Agree										
		1	2	3	4	5	6	7	8	9	10	Median
COS 1	Roles and positions of the departments											8
COS 2	Formal relationship											8
COS 3	Nature of formation/number of layers											7
COS 4	Specialisation/professionalism											8
COS 5	Centralisation of authority											6
COS 6	Decentralisation of authority											9
COS 7	Level of horizontal integration											7
COS 8	Patterns of communication											7
COS 9	Easy coordination among members											9
COS 10	Personnel ratio (e.g. core employees to supporting staff)											6
COS 11	Mechanism for problem solving											8
COS 12	Accountability channels in the organisation											9
COS 13	Set of policies/procedures and standards											8
COS 14	Organisational knowledge											10
COS 15	Organisational prestige											7

COS 16	Corporate governance											10
Comments												

Q11. CONTRACTOR'S ORGANISATIONAL CULTURE

Do you agree the **impact** of the values, attitudes, beliefs, and norms that affect cost control practice of contractors?

1 = Strongly Disagree, 10 = Strongly Agree

CONTRACTOR'S ORGANISATIONAL CULTURE		**Strongly Disagree – Strongly Agree**										
		1	2	3	4	5	6	7	8	9	10	Median
COC 1	Setting clear goals											9
COC 2	Setting actions to match organisational goals											9
COC 3	Developing clear approach to succeed											8
COC 4	Emphasis on team contribution											9
COC 5	Amicable opinions and ideas exchange											9
COC 6	Members commitment to team											10
COC 7	Resolve internal problems effectively											9
COC 8	Resolve conflict that arises											8
COC 9	Encourage inter-department collaboration											9
COC 10	Encourage information sharing											9
COC 11	Guidance for performance improvement											9
COC 12	Emphasis on good performance											9
COC 13	Explicit set of performance standards											8
COC 14	Accept adventurous ideas for sustaining competitiveness											9
COC 15	Welcome alternative solutions											9
COC 16	Encourage creative and innovative ideas											9
COC 17	Allocate resources for implementing innovative ideas											8
COC 18	Value employees' ideas											7
COC 19	Employees' input on major decisions											7
COC 20	Employees' participation in decision-making process											8
COC 21	Loyalty of employees											9
COC 22	Emphasis on team accountability											9
COC 23	Emphasis on reward instead of punishment											9
COC 24	Creation of trust atmosphere											9
COC 25	Performance-based rewards											9
COC 26	Accept criticism and negative feedback											9
COC 27	Sharing the responsibility of the things that goes wrong											9
COC 28	Recognise and reward members' performance											9
COC 29	Equitable reward											9
Comments												

Q12. ICT TOOLS AND KNOWLEDGE

Do you agree the **impact** of ICT tools and knowledge on cost control practice of contractors?

1 = Strongly Disagree, 10 = Strongly Agree

ICT TOOLS AND KNOWLEDGE		**Strongly Disagree – Strongly Agree**										
		1	2	3	4	5	6	7	8	9	10	Median
ICT 1	Acceptance of ICT usage											9
ICT 2	Perceived usefulness of ICT (Data exchange, Data storage, Data retrieving, Data analysis)											8
ICT 3	Using ICT for communication (Internet chat, Emailing information exchange, Live video calls)											9
ICT 4	Availability of specific software for cost control											10
ICT 5	Provision of technical support											9
ICT 6	Supportive workplace environment											9
ICT 7	ICT training and continuous development of staff											10
ICT 8	Setting investment for ICT											9
Comments												

Q13. OUTCOMES OF COST CONTROL

Do you agree the **impact** of Outcomes from adopting cost control practice of contractors?

1 = Strongly Disagree, 10 = Strongly Agree

Outcomes from adopting cost control practice		**Strongly Disagree – Strongly Agree**										
		1	2	3	4	5	6	7	8	9	10	Median
OCC 1	Achieving accurate cost information for decision making											9
OCC 2	Establishing project cost outcome (profit/loss)											8
OCC 3	Obtaining historic cost data for future projects											9
OCC 4	Enhancement of the targeted profitability											10
OCC 5	Prevention of wasted resources											9
OCC 6	Increased efficiency of work											9
Comments												

BACKGROUND INFORMATION OF EXPERT PANEL MEMBERS

Title (Mr, Mrs, Ms, Rev, Dr, Prof)	
Highest qualification	
Field of specialisation	
Professional body affiliation (MRICS, FRICS, MGhIS, FGhIS, etc.)	
Years of work experience (construction cost management)	
Member of a project committee (Yes/No)	
Member of a project committee (Yes/No)	
Current employer	
Position	
Email:	
Region	

Thank you. The final round of the Delphi process will be a follow-up email at the end of December 2017.

Contact details:
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APPENDIX C - FIELD SURVEY QUESTIONNAIRE

Construction Management & Quantity Surveying Department
University of Johannesburg
P. O. Box 17011
Doornfontein 2028
South Africa

May 2018

Dear Respondent,

LETTER OF INVITATION TO PARTICIPATE IN THE FIELD SURVEY

The Postgraduate School of Engineering Management at the University of Johannesburg is undertaking a research project aimed at developing an integrated model for enhanced project cost control practice in the Ghanaian construction industry and similar developing country construction industries. Kindly spend about 15 minutes of your time to complete the questionnaire.

Your confidentiality will be respected in this study. The results will be available at the institution by July 2018.

Should you have any question, please do not hesitate to contact me on the following email: *kofiwusugh@yahoo.com*/*201494604@student.uj.ac.za*. Contact numbers: +(27)733193416/+(233)243373477

Thank you for your participation.

KOFI OWUSU ADJEI

PhD candidate

KINDLY ANSWER THE FOLLOWING QUESTIONS BY TICKING (√) THE RELEVANT BLOCK OR BY WRITING DOWN YOUR RESPONSE IN THE SPACE PROVIDED

SECTION A: RESPONDENT BACKGROUND

1. What is the **class of your company**?

D1K1	1	D2K2	2

2. In which **region** in the country (Ghana) do you operate? Please kindly tick only one

Greater Accra Region	1	Ashanti Region	6
Eastern Region	2	Central Region	7
Brong-Ahafo Region	3	Western Region	8
Volta Region	4	Upper East Region	9
Northern Region	5	Upper West Region	10

3. How long has your **company been in operation**? .... years.

4. What is your **highest qualification**?

Diploma	1	Master's degree	4
Higher National Diploma	2	Doctoral degree	5
Bachelor's degree	3		

5. Which **one** of the following categories best describes the **nature of your business**?

Building works	1	Electrical works	3
Civil works	2	Plumbing works	4

6. In your company, who is the **key person who undertakes project cost control**?

Managing Director	1	Project Manager	3
Quantity Surveyor	2	Construction Manager	4

7. How many **years** have you been **working in the company**? ……………..years.

8. What **category of project** does your company usually (most often) undertake? (choose one only)

Residential Buildings	1	Industrial buildings	4
Educational Buildings	2	Highway construction	5
Recreational Buildings	3		

9. For the project category chosen in Question 8, on average, how long do such projects take to complete?

…………..months

10. During the construction stage of the project **how often do you normally prepare** or carry out cost control systems?

Daily	1	Twice a year	4
Weekly	2	Annually (once a year)	5
Quarterly	3		

SECTION B: FACTORS INFLUENCING PROJECT COST CONTROL PRACTICE

11. PROJECT COST ESTIMATION:

Project cost estimation is the process of establishing the cost of a construction project.

The following are **factors which could influence project cost estimation for construction cost control practice** of contractors. What influence does each factor have on the project cost estimation of cost control practice?

Code	Related factors	Extent of influence (Low → High)				
PCE 1	Appropriate method of estimation	1	2	3	4	5
PCE 2	Standard procedure for estimation	1	2	3	4	5
PCE 3	Experience of the estimator	1	2	3	4	5
PCE 4	Available project information	1	2	3	4	5
PCE 5	Available cost indices	1	2	3	4	5
PCE 6	Conducting market survey	1	2	3	4	5
PCE 7	Provision of standard tender documentation	1	2	3	4	5
PCE 8	Availability of client financial management plans	1	2	3	4	5
PCE 9	Firm's bidding strategy	1	2	3	4	5
PCE 10	Use of local work force	1	2	3	4	5
PCE 11	Unpredicted weather conditions	1	2	3	4	5
PCE 12	Flooding of the site	1	2	3	4	5
PCE 13	Air pollution	1	2	3	4	5
PCE 14	Water pollution	1	2	3	4	5
PCE 15	Erosion from road construction	1	2	3	4	5
PCE 16	Disposal of hazardous waste	1	2	3	4	5

12. PROJECT COST BUDGETING:

Project cost budgeting is assigning cost estimates to individual work items/resources, combining them to develop an overall cost and baseline.

Below is a list of **factors which could influence budgeting for construction cost control practice** by contractors. What influence does each factor have on the project cost budgeting of cost control practice?

Code	Related factors	Extent of influence (Low → High)				
PCB 1	Allocation of activity budget	1	2	3	4	5
PCB 2	Negotiation of the main budget	1	2	3	4	5
PCB 3	Approval of master and functional budgets	1	2	3	4	5
PCB 4	Establishing a realistic working budget	1	2	3	4	5
PCB 5	Periodic revision of the budget	1	2	3	4	5
PCB 6	Ensuring that project team members understand the budget	1	2	3	4	5

13. PROJECT COST REPORTING

Project cost reporting is the documentation process of the summary view of the status of the project cost of resources used as of each cost report date

Below is a list of **project cost reporting concepts which could influence construction cost control practice** by contractors. Based on your experience and knowledge, what influence does each factor have on the project cost reporting of cost control practice?

Code	**Related factors**	Extent of influence (Low → High)				
PCR 1	Planning for the cost report	1	2	3	4	5
PCR 2	Developing various types of cost control report	1	2	3	4	5
PCR 3	Reporting cost variances from analysis	1	2	3	4	5
PCR 4	Distribution of the cost control reports to appropriate sections	1	2	3	4	5
PCR 5	Reporting on feedback or actions taken	1	2	3	4	5

14. PROJECT COST ANALYSIS

Project cost analysis is the calculation of construction project cost and comparing actual with budgeted cost for decision making

Below is a list of **project cost analysis processes which could influence construction cost control practice** by contractors. Based on your experience and knowledge, what influence does each factor have on project cost analysis of cost control practice?

Code	**Related factors**	Extent of influence (Low → High)				
PCA 1	Collection of relevant and detailed cost data	1	2	3	4	5
PCA 2	Calculating actual project cost	1	2	3	4	5
PCA 3	Comparing budgeted cost with actual cost	1	2	3	4	5
PCA 4	Comparing actual cost with forecast cost	1	2	3	4	5
PCA 5	Analysing cost variance	1	2	3	4	5
PCA 6	Identifying causes of cost overrun	1	2	3	4	5
PCA 7	Updating cost status of the project	1	2	3	4	5

15. PROJECT COST MONITORING

Project cost monitoring is a recurring process, involving comparison of actual cost performance, estimates with completion, and corrective actions based on such forecasts.

Below is a list of **project cost monitoring concepts which could influence construction cost control practice** by contractors. Based on your experience and knowledge, what influence does each factor have on project cost monitoring of cost control practice?

Code	**Related factors**	Extent of influence (Low → High)				
PCM 1	Planning milestone monitoring process	1	2	3	4	5
PCM 2	Selection of appropriate techniques for cost monitoring	1	2	3	4	5
PCM 3	Selecting appropriate tools for tracking project cost	1	2	3	4	5
PCM 4	Monitoring cost data (material, labour, plant, overheads, subcontractor cost, etc.)	1	2	3	4	5
PCM 5	Cost data verification	1	2	3	4	5
PCM 6	Monitoring cost performance	1	2	3	4	5
PCM 7	Monitoring updated cost records	1	2	3	4	5
PCM 8	Monitoring reported cost information					
PCM 9	Detecting early warning signs	1	2	3	4	5

PCM 10	Identifying cost changing factors	1	2	3	4	5
PCM 11	Provision of manuals for site monitoring team to refer to	1	2	3	4	5
PCM 12	Training site personnel in monitoring process	1	2	3	4	5

16. DECISION-MAKING

Decision-making is the action taken when an organisation agrees to adopt alternatives to eliminate or reduce the effect of project cost variances on construction cost. It acts as a remedy.

Below is a list of **project cost decision-making processes which could influence construction cost control practice** by contractors. Based on your experience and knowledge, what influence does each factor have on project cost decision-making of cost control practice?

Code	Related factors	Extent of influence (Low ⟶ High)				
DM 1	Identifying the root/main cause of the cost variances	1	2	3	4	5
DM 2	Analysing the problem	1	2	3	4	5
DM 3	Categorising the causes of the problem	1	2	3	4	5
DM 4	Developing alternative measures for cost variances	1	2	3	4	5
DM 5	Selection of the relevant corrective measures	1	2	3	4	5
DM 6	Implementation of the selected measure	1	2	3	4	5
DM 7	Evaluation of the corrective measure used	1	2	3	4	5

17. CHANGE MANAGEMENT

Change management is a structured and strategic approach to initiate and manage the change process in the organisation structure and culture as well as the individuals/teams' behaviour and attitudes to maintain or improve their effectiveness.

Below is a list of **change management concepts which could influence construction cost control practice** by contractors. Based on your experience and knowledge, what influence does each factor have on change management of cost control practice?

Code	Related factors	Extent of influence (Low ⟶ High)				
CM 1	Establishing the sense of urgency for change	1	2	3	4	5
CM 2	Developing a vision for cost change	1	2	3	4	5
CM 3	Developing strategies for cost change	1	2	3	4	5
CM 4	Designing short term success plan	1	2	3	4	5
CM 5	Promoting a balanced change	1	2	3	4	5
CM 6	Implementing the change	1	2	3	4	5
CM 7	Evaluating the change	1	2	3	4	5
CM 8	Continuous improvement from lessons learnt	1	2	3	4	5
CM 9	Empowering others to act on the vision	1	2	3	4	5
CM 10	Selecting appropriate leadership style	1	2	3	4	5
CM 11	Motivating for change	1	2	3	4	5

18. PROJECT COST COMMUNICATION

Cost communication is the transmission of resources (e.g. information of project cost and other meanings, including ideas, knowledge, specific skills and technology) from one person or office to another using shared symbols and media.

Below is a list of **project cost communication concepts which could influence construction cost control practice** by contractors. Based on your experience and knowledge, what influence does each factor have on project cost communication of cost control practice?

Code	Related factors	Extent of influence (Low ⟶ High)				
PCC 1	The context of communication (adopted) in the organisation	1	2	3	4	5
PCC 2	Form of communication (adopted) within the organisation (verbal, written)	1	2	3	4	5
PCC 3	Identification of the sender and receiver	1	2	3	4	5
PCC 4	Formulating a clear message	1	2	3	4	5
PCC 5	Appropriate methods of communication (emails, text messages, etc.)	1	2	3	4	5
PCC 6	Clear communication activity	1	2	3	4	5
PCC 7	Appropriate feedback channel	1	2	3	4	5
PCC 8	Standardisation of communication documents	1	2	3	4	5
PCC 9	Access to information	1	2	3	4	5
PCC 10	Reduction of barriers in communication	1	2	3	4	5

19. OUTCOMES OF PROJECT COST CONTROL

Below is a list of **possible outcomes of successful cost control practice**. Based on your experience and knowledge, what is the likelihood each outcome can be achieved by adopting cost control practice?

Code	Outcomes from adopting cost control practice	Likelihood (Low ⟶ High)				
OCC 1	Achieving accurate cost information for decision making	1	2	3	4	5
OCC 2	Establishing project cost outcome (profit/loss)	1	2	3	4	5
OCC 3	Obtaining historic cost data for future projects	1	2	3	4	5
OCC 4	Enhancement of the targeted profitability	1	2	3	4	5
OCC 5	Prevention of wasted resources	1	2	3	4	5
OCC 6	Increased efficiency of work	1	2	3	4	5

<u>SECTION C: APPLICATION AND CHALLENGES OF PROJECT COST CONTROL PRACTICES</u>

20. How often do you use the following cost control techniques in your operations?

5 - always, 4 – very often, 3 – sometimes, 2 – rarely, 1 – never

Code	Cost control techniques	(Never ⟶ Always)				
CCT 1	Overall Profit or Loss account	1	2	3	4	5
CCT 2	Profit or Loss on each contract stage	1	2	3	4	5
CCT 3	Unit rate costing	1	2	3	4	5
CCT 4	Standard costing	1	2	3	4	5
CCT 5	Activity-based variance	1	2	3	4	5
CCT 6	Earned value analysis	1	2	3	4	5
CCT 7	Programme evaluation and review technique (PERT/COST)	1	2	3	4	5

CCT 8	Leading parameter method	1	2	3	4	5
CCT 9	Labour/plant/material (actual versus forecast reconciliation)	1	2	3	4	5

21. Do you use the following software for project cost control practice? If Yes, please indicate how often you use the software.

Code	**Software for cost control**	**Do you use**		Extent of usage				
		Yes	**No**	(Low → High)				
S 1	Primavera Sure Trak	1	2	1	2	3	4	5
S 2	Microsoft Excel	1	2	1	2	3	4	5
S 3	Bespoke/in-house systems	1	2	1	2	3	4	5
S 4	Microsoft Project	1	2	1	2	3	4	5
S 5	Project Costing System (PCS)	1	2	1	2	3	4	5
S 6	Asta Power Project	1	2	1	2	3	4	5
S 7	Construction Industry Software (COINS)	1	2	1	2	3	4	5
S 8	QSPro	1	2	1	2	3	4	5
S 9	WinQS	1	2	1	2	3	4	5

Cost control is the process of monitoring; evaluating and comparing planned results with actual results to determine the status of the project cost, schedule and technical performance objectives

22. What are the challenges of project cost control practice?

Code	**Challenges of cost control**	Extent of challenge (Low → High)				
CCC 1	Using outmoded methods and concepts	1	2	3	4	5
CCC 2	Over-emphasising results without following the project cost control process	1	2	3	4	5
CCC 3	Lack of cost control processes/systems suitable for the firm	1	2	3	4	5
CCC 4	Lack of consistent cost management practice by managers	1	2	3	4	5
CCC 5	Decision-making failure	1	2	3	4	5
CCC 6	Poor attitude towards ICT usage	1	2	3	4	5
CCC 7	Difficulty in monitoring different sources of day-to-day cost data	1	2	3	4	5
CCC 8	No clear distinction between monitoring and reporting	1	2	3	4	5
CCC 9	Lack of financial commitment in project	1	2	3	4	5
CCC 10	Lack of knowledge of the use of available tools and technology	1	2	3	4	5
CCC 11	Abandonment of complicated strategies	1	2	3	4	5