KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,

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DETERMINATION OF COST CONTINGENCY IN THE PROCUREMENT OF FEEDER ROADS IN GHANA

BY

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DECLARATION

I hereby declare that, this study submission is my own work towards the Master of Science in Procurement Management, and that, to the best of my knowledge, contains no material previously published by any person nor material which has been accepted for the award of any other degree of the university, except where due acknowledgement has been made in the text.

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DEDICATION

This research study is dedicated to the Almighty God and my lovely children; Eugenia, Ellen, Euclid and Elkin.

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My gratitude goes to the Almighty God, who is a living God, on whose mercies we live.

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ABSTRACT

Among the numerous effects of cost overruns in the construction industry, particularly on public sector projects is the scrutiny of governments and in consequence the limitation of their investment abilities in new projects. Also, drawing on evidence from developed and transition countries, road infrastructure projects have low-cost performance. That is to say, cost overruns are frequently common on road infrastructure projects. Price fluctuation is argued to be a major contributor to cost overruns. The aim of this study was therefore to examine the determination of price contingency in the road construction industry in Ghana, with emphasis on feeder roads contracts. The study utilised a questionnaire survey and review of a dataset of executed projects. Out of the 55 questionnaires administered, 40 were completed and returned. The analysis was consequently based on this response rate. The main findings of the study are: the percentage allocation for DFR projects for price contingency is 10%; and there was association between awareness and usage in terms of the traditional method and other simplistic approaches. However, with the probability methods the proficiency and awareness were unsurprisingly low. There was agreement between the respondents (among the groups) on the significance of almost all the variables. It is recommended that The DFR needs to provide a CPD to improve upon the estimating methods towards more probabilistic approach. This has been found to improve the accuracy of price contingency. The dataset used for the modeling was small and it is expected that an increase in the data may alter the results and improve the accuracy of the model developed in this thesis. Based on the limitation of the study, future study is encouraged to look into especially the modelling aspect of this study involving a large dataset and including more preliminary variables.

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CHAPTER ONE GENERAL INTRODUCTION

1.1 Background

The construction industry, unlike the manufacturing industry, is complex, unique and uncertain in nature (Oladapo, 2007). Even within the construction industry projects are not the same. In the traditional setting, it is the common practice of separating the functions of design and construction. According to Kwakye (1997) cited in Oladapo, (2007) the separation of these function creates a disconnection between design and constructability that have cost implications on the project. However, cost performance has been a long standing key success criterion for project sponsors (Baccarini, 2004). Surprisingly, cost overruns are a common occurrence in the construction industry, both developed and developing countries (Enshassi et al., 2009; Baccarini, 2004; Touran, 2003). Cost overruns are evidently frequent on projects with high percentage of resources of high variability and thus susceptible to a variety of influences. For example, in the study by Jackson (1999), cost overrun was likely to occur on projects with heavy reliance on labour or with high percentage of labour component. Because according to him, labour component is more variable. Owing to the discomfort that cost overruns subject project sponsors to several studies have thus be conducted in this area. Perhaps, the most fundamental (financial) is the reduction in the return-oninvestment for the client (Park and Papadopoulou, 2012).

There is increasing recognition that staying within budget requires sound strategies, good practices and careful judgment (Enshassi et al., 2009). Project sponsors require accurate project cost estimate that does not vary significantly from the actual cost of the project. This will enable the project sponsors determine their financial commitment. The common practice is the addition of cost contingency within the budget estimate so that the budget represents the total financial commitment of project sponsors (Baccarini, 2004). The term "contingency" as applied in the construction

industry is evasive. This is evident in the understanding of it by the different parties in the construction process. The management, engineers and constructors views on contingency are different (Jackson, 1999). Despite the elusive nature of the term, in literature, a recourse is often made to three basic types of contingencies in projects: tolerance in specification, float in the schedule, and money in the budget (cf. Baccarini, 2004). Project Management Institute (PMI) (2000: p199) defines contingency as "the amount of money or time needed above the estimate to reduce the risk of overruns of project objectives to a level acceptable to the organization". Therefore, the objective of cost contingency allocation is to avoid the impact of exceeding the cost objective of the project.

Generally, contingency is allocated to cater for two categories of risks – known unknowns and unknown unknowns (Baccarini, 2004; PMI, 2000). Owing to its significance in the construction industry, attempts to estimate accurately the contingency of a project abound. A range of estimating techniques was compiled by Baccarini (2004a) and tabulated as follows:

Table 1.1: Estimating techniques for contingency

S/N	Estimating methods	References
1	Traditional percentage	Ahmad, 1992, Moselhi 1997
2	Method of Moments	Diekmann, 1983; Moselhi, 1997, Yeo 1990;
3	Monte Carlo Simulation	Lorance & Wendling 2001
4	Factor Rating	Hackney, 1985, Oberlender & Trost 2001
5	Individual risks – expected	Mak, Wong & Picken 1998
6	Range Estimating	Curran, 1989
7	Regression	Merrow & Schroeder 1991; Aibinu & Jagboro
8	Artificial Neural Networks	Chen & Hartman 2000; Williams 2003
9	Fuzzy Sets	Paek, Lee, & Ock, 1993

10	Controlled Interval Memory	Cooper and Chapman 1985;
11	Influence Diagrams	Diekmann & Featherman 1998
12	Theory of Constraints	Leach, 2003
13	Analytical Hierarchy Process	Dey, Tabucanon & Ogunlana 1994

Albeit these available methods, cost overruns in construction projects are on the ascendency. The probable explanation is the heavy reliance on the traditional percentage in the Ghanaian Construction Industry. This approach relies heavily on personal judgment and past experience without regard to scientific basis (Buertey et al., 2013; Dada and Jagboro, 2007). Although, the calculation is contended to be satisfactory for simple projects under stable conditions its application and accuracy for unstable and complex projects cannot be guaranteed (Newton, 1992).

1.2 Problem Statement

Among the numerous effects of cost overruns in the construction industry, particularly on public sector projects is the scrutiny of governments and in consequence the limitation of their investment abilities in new projects (Park and Papadopoulou, 2012). The repercussions are apparent as it leads to slow down of economic activities in other industrial sectors (Ashworth, 2008). Despite the numerous studies on cost overruns in construction, available empirical evidence of cost performance of projects in Ghana is scanty and even non-existent. However, anecdotal evidence suggests that the cost objective of most projects in Ghana is not met. Enshassi et al. (2009) noted that there is phenomenon is evidently common in traditional type of contracts where projects are awarded to the lowest evaluated bidder. In Ghana, such is the common practice since the enactment of the Public Procurement Act in 2003. It is therefore not surprising that cost overruns are common in almost all infrastructure projects.

Drawing on evidence from developed and transition countries, road infrastructure projects have low-cost performance (Flyvbjerg et al. 2003a). That is to say, cost overruns are frequently common on road infrastructure projects. Albeit this result, research on road infrastructure projects in Ghana is limited. The principle of the application of contingency in construction is expected to reduce the risk of overruns for projects executed under uncertain conditions (Jackson, 1999). However, the elements to be included in contingency is a subject of contention rather than agreed practice. This results in different contingency estimate even when the traditional percentage is used. For instance, Buertey et al. (2012) revealed varied application of the traditional percentage of contingency allocation on construction projects surveyed. It was revealed that 90% of most projects used 10%, whereas some 8% used 5%, and the last 2% used a margin slightly above 15%. This finding confirms the historical elusiveness of construction cost contingency.

With these gaps identified, this research will attempt to fill the gaps by examining the appropriate contingency figure for inclusion in road construction projects.

1.3 Aims and Objectives

1.3.1 Aim

To examine the determination of cost contingency in the road construction industry in Ghana, with emphasis on feeder roads contracts.

1.3.2 Objectives

To satisfy the above research aim the following objectives are set:

- To identify the cost contingency component in Feeder Roads construction contracts

- To assess the awareness of professionals‟ awareness on the various cost contingency methods
- To determine the significance of the variables in the determination of cost contingency; and
- To develop a model for the prediction of cost contingency on Feeder Roads construction projects.

1.4 Scope of the Study

Contextually, the study would be confined to road work contracts in the Department of Feeder Roads. Considering the constraint of time, the study will focus on bitumen surfacing contract undertaken by the department. These contracts constitute a significant part of the budget of DFR. Completed bitumen surfacing contracts for the period between 2010 and 2014 will be studied to elucidate the issues under study. Additionally, the study will also focus mainly on „price contingency‟ provision in contracts, rather than „physical contingency‟. The study will cover selected contracts notwithstanding source of funding for these contracts.

Geographically, the extent of the study would cover all the regions of Ghana since the study seeks to draw on information from all the DFR across the country. The researcher will rely on colleagues at all the offices throughout the country. Data from all the regions will help generate results that will be credible.

1.5 Methodology

The research will source from credible sources information pertaining to cost contingency. These sources would include journals, conference proceedings, unpublished data, etc. This will help disentangle the misconception of the term cost contingency. Following the literature review, completed contracts between the periods of 2010 and 2014 within the Department of Feeder Roads will be reviewed. Subsequently, structured questionnaire survey would be employed and response categories scaled. This will allow efficient coding of data and in consequence statistical analysis. Additionally, the survey was adopted because of the relative homogenous of the population (Brace, 2008) – professionals at DFR. This suggests that the study shall adopt a quantitative research design.

1.6 Significance of the Study

The unprecedented phenomenon of cost overruns in construction has been a subject of discussion especially from the last decade. This recognition has ignited the need to study cost overruns and the use of cost contingency in overcoming such cost overruns. There is enough evidence to pursue this research, in particular when record of such nature is lacking in the road construction industry. Having known from empirical studies from other parts of the world that seek to suggest that road projects have lowcost performance (Park and Papadopoulou, 2012), and confirmed by anecdotal evidence; there is the need to conduct research into cost contingency and how it relates to cost overruns.

It is expected that the project will provide insight into the concept of cost contingency. The study will be of utility to stakeholders in the construction industry.

1.7 Dissertation Structure

The structure of the dissertation would be organized into five related but distinct chapters. The first chapter shall present a general overview of the dissertation. It will contain sub-headings like the background of the study, problem statement, aim and objectives, research methodology, etc. The chapter all together summarizes and places the research in perspective. The Chapter two shall be titled “Literature Review”. In this chapter related or similar literature shall be reviewed and attempts made to tie them together whilst espousing the gaps. Issues that would be covered under this chapter include cost contingency and its attributes, the variables that affect the determination of cost contingency, the significance of the variables, cost overruns in the road construction industry among other things.

Chapter three, the methodology, shall cover the research design and the data collection tools. The population and the analytical tools to be used in the analysis shall all be presented. Chapter Four would seek to analyse the data collected and shall be discussed against literature. Consistencies and disagreement shall be deduced. Chapter Five shall conclude the research and recommendations shall be made: both practical implications and further research.

CHAPTER TWO LITERATURE REVIEW

2.1 Introduction

The ever growing interest in construction and in consequence the volume of construction works in the world place a demand on the need for effective engineering cost management (Li , 2009). It is also no secret that cost performance of project is one of the pillars of the Iron Triangle (Baccarini, 2004). Despite attempts to keep construction cost within budget, cost overruns are commonplace in construction projects. It has been the convention of the industry to allocate a percentage – sometimes based on experience or intuition – to cover anticipated increment in cost.

This is the intent of this chapter - to review related literature on cost contingency.

The chapter looks at issues that include: the construction industry and its significance, the theory of cost contingency, the variables that determine cost contingency and the significance of the variables. In this study, attempt is made to tie the views of many researchers together whilst attempting to identify gaps to be filled by this current study.

2.2 The Construction Industry

Globally, the Construction Industry is one of the significant contributors to the development of economy. In times of recession, the Construction Industry is used to resurrect the industry (Ball and Wood, 1994 cited in Wibowo, 2009). In consequence, Wibowo (2009) and Ofori (2012) opined that the Construction Industry acts as an instrument used by the government to manage the economy. This is reflected in the works executed by the Construction Industry. OECD (2008) reports that the Industry is responsible for the building of new houses, roads, factories, etc. Additionally, the industry maintains and repairs structures in bad shape. In summary, the industry"s significance is epitomized in its contribution to GDP. On the average, the industry contributes 6.47 percent of GDP in OECD countries (OECD, 2008).

The significance of the industry is widely acknowledged, in literature and practice. In 1984, the World Bank"s report about construction seemed to have sharpened the focus of the industry"s significance. The study reported on the great potentials of the Construction Industry (CI). Through its backward and forward linkages the industry affects all sectors of the economy (Nhabinde et al., 2012). The backward linkage refers to the interaction of the industry with the industries where the inputs are obtained. Conversely, the forward linkage is generally the relationship that exists among the Construction Industry and the industries that utilize the output of the Construction Industry. Ofori (2012) noted that the buildings used for the production of goods and services are the products of the Construction Industry. The output also forms a sizeable portion of the GDPs of both developed and developing countries (Wibowo, 2009).

Several attempts towards the development of the Construction Industry have failed to succeed. Ofori (2012) argued that the reason for the historical failure is because the industry faces many problems. Ofori reduces the problems to three main reasons:

- Economic weaknesses
- Lack of commitment from governments
- Inherent underdevelopment of the industry

These problems translate into the performance of projects and productivity of the industry as a whole. In consequence, cost and time overruns are commonplace in developing countries (Ofori, 2012). Additionally, the industry also falls short of a criterion that is increasingly generating attention and continuously being termed as the fourth project objective (i.e. Environment). In attempt to protect the environment, governments are sometimes over-protective thereby instituting high standards that constitute formidable entry barriers to the industry (OECD, 2008). Both the industry in developing and developed countries are plagued with challenges. But these challenges vary from country to country. In the UK for instance, Proverbs et al. (2000) argued that investment in research and development is lacking. With time, the industry in the developed economies is responding to research and development and in consequence there have been significant strides in the area. Conversely, the Industry in developing countries are still in the preliminary stages in investment in research and development (Datta, 2000).

Aside the general challenges plaguing the CI, the CI in developing countries have their unique problems ranging from the influx of foreign contractors and importation of construction materials. Countries that suffer these challenges include but not limited to Ghana (Ayarkwa, 2010), Mozambique (Nhabinde et al., 2012), Nigeria, Liberia, etc. The choice of foreign countries and in consequence the influx of foreign contractors is perhaps due to the high level of dissatisfaction of clients and other stakeholders by the local contractors. Aside the gross dissatisfaction of their services, Construction Industry in developing countries also lack capacity and therefore cannot meet the upsurge in construction demand (Kululanga, 2012). Additionally, the competitive advantages of these firms stem from the ability to produce or deliver quality service with timely completion (Ofori et al., 2002). It is opined that if local contractors are able to regulate cost overruns through efficient and effective mechanisms there is the possibility of competing favorably with foreign contractors.

In the ensuing section cost overrun is highlighted and the causes of it.

2.3 Cost Overruns in the Construction Industry

Traditionally, projects have always been measured using cost performance and other criteria together referred to as “Iron Triangle” (see Ahiaga-Dagbui and Smith, 2014; Chan and Chan, 2004). This implies that cost estimate remains essential part of the construction process (Ahiaga-Dagbui and Smith, 2014; Baccarini, 2004). But it would be relevant if only the estimates are accurate. Accurate estimates are essentially imperative to stakeholders of the Construction Industry, particularly sponsoring organisations (Baccarini, n.d.). For sponsors, a good estimate is required to help plan at the early stages of the project. Projects funded through credit facilities the essence of cost estimate is indispensable (Ahiaga-Dagbui and Smith, 2014).

Albeit this relevance of accurate estimates, cost overrun is still commonplace in construction. Ahiaga-Dagbui and Smith (2014) argued that several factors account for this phenomenon. Attributed factors include: technical errors in design and estimation, managerial incompetency, risk and uncertainty, suspicions of foul-play, deception and delusion, and corruption. It suffices to mention that cost overrun is not only peculiar to developing economies. The discussions on Construction Network of Building Researchers on the issue suggest it is a global phenomenon (Ahiaga-Dagbui and Smith, 2014). However, construction projects in developing countries are rife with cost overruns (Le-Hoai et al., 2008). Because of its occurrence many authors have studied the causes from various perspectives. For example, Kaming et al. (1997) cited from Le-Hoai, (2008) making use of questionnaire survey studied the causes on Indonesian high-rise buildings; and in consequence identified seven causal factors. Additionally, Koushki et al. (2005) explored the causes of cost overruns of selected private residential projects using personal interview among project owners and developers in Kuwait. The two studies in question made use of different research strategy and thus instruments, and also in different countries on different projects confirming the earlier assertion.

Frimpong et al. (2003) also identified causes of cost overruns on groundwater construction projects in Ghana. They also utilised a questionnaire survey identifying twenty-six (26) factors altogether. Frimpong et al. (2003) tested the level of agreement using Kendall‟s coefficient of concordance among three stakeholders – owners, contractors and consultants. The stakeholders agreed on the identified causes since the degree of disagreement was insignificant. Chang (2002) explored the causes on projects in the United States of America using project cases. He utilised a 4 case project documents and classified the causes under the following headings: ownerrelated, contractor-related and consultant-related factors.

The studies, as observed, have not concentrated on one point; they are scattered across different geographical and contextual boundaries. From Africa (Aibinu and Odeyinka, 2006; Frimpong et al., 2003) through Asia (Le-Hoai et al., 2008; Koushki et al., 2005) to America (Chang, 2002).

2.4 Cost Contingency Models

This section looks at the various cost contingency models that have been developed over the years. Attempts are made to review thoroughly as possible much of these models. This section relates with the previous sections on the contemporary works on cost contingency and attempts to integrate it with the variables that affect cost contingency. Under this section, the works of Idrus, Fadhil Nuruddin, and Rohman (2011); Sonmez, Ergin, and Talat Birgonul (2007); Touran (2003a); and Touran (2003b) are looked at. The emphasis is on the tools (models) and variables for predicting cost contingency.

Sonmez et al. (2007) employed correlation and regression analysis in modelling cost contingency on international projects. Fundamentally, project data (risk factors) were collected on twenty-six international project that spanned twenty-one host countries (i.e. Africa, Europe, Middle East and Asia). Risk factors considered included contract sum, project type, mode of delivery among other things. Essentially, the correlation was used to „reduce" the size of the risk factors and to know the critical factors to be included in the model. As a result, ten factors were eliminated and fourteen were included in the regression model. However, the results of the study indicated four factors had major contributions in explaining cost contingency of the projects (Sonmez et al., 2007).

Touran (2003a) assumes cost contingency is a function of change orders on projects.

That is to say cost changes essentially erupt as a result of changes to initial plans. Consequently, Touran (2003a) probabilistically modelled cost contingency using change orders. Unlike Sonmez et al. (2007), Touran (2003a) adopted a rather „unpopular‟ approach of modelling i.e. Probability mass function. He presented two cases: 1. Assumed change orders as independent, and 2. Change orders as identical.

van Niekerk and Bekker (2014) used what they termed as hybrid contingency that combines both Artificial Neural Network (ANN) and an expected value analysis tool. The ANN essentially quantifies risk by identifying the risks that drive the project and correlated them against the risk on the project. Neural network is favoured above regression analysis for its ability to model real life project experience by analysis the inherent subtle relationships among variables ignored by regression (van Niekerk and Bekker, 2014).

2.5 The Theory of Cost Contingency

Risk is inherent is every project. To overcome this risk, management usually makes a decision and adds a percentage addition to the base estimate. Tower and Baccarini (2012) termed this as contingency sum. The term, although, common in construction is evasive and the least understood term. As early as 1985, Clark and Lorenzo asserted that the term is very controversial albeit its common occurrence in project estimates. As time races and with improvement in project estimating one would assume that the term would be clear. However, after three years of Clark and Lorenzoni (1985) assertions; Patrascu (1988) argued that the term is probably the most misunderstood, misinterpreted and obviously misapplied in project execution. And after several years of knowledge management, the term is still elusive and Baccarini (2004a) concurred the earlier positions of the aforementioned authors (Clark and Lorenzo, 1985 and

Patrascu, 1988) that the term is mostly misunderstood.

Amidst its elusiveness, and perhaps the different interpretations the significance of cost contingency cannot be overemphasized. For example, Adafin et al. (2013) found a relationship between contingency sum and the success of a project. They explained that contingency represent the level of risk inherent in a project, and in consequence the efficacy of its application leads to project success. Also, added to the budget estimate the total financial commitment of the project sponsors is known (Baccarini, 2004). Having realized the importance of accurate project estimates to projects, it is essential that cost contingency be also accurate. Therefore, Baccarini (2004a) argued that the estimation of cost contingency and ultimately its adequacy are of prime essence in projects. Surprisingly, the estimation of cost contingency is flawed with subjectivity, and it is inconsistently interpreted and consequently inadequately estimated (Baccarini, 1998). The variability in estimation is perhaps as a result of the various definitions that exist and the differing interpretations from company to company.

Even with the same organization contingency can and actually mean different thing across the various departments. Jackson (1999) conferring to the above noted that, according to management, contingency is money that should not be expended and returned without the profit erosion. This is different from engineers‟ perspective about contingency that suggests contingency as an account that can be drawn on to cover additional costs of underestimated or omitted project costs (Jackson, 1999). Additionally, to the Quantity Surveyor the sum (i.e. contingency) is included to cover cost increment in the project as a result of unclear scope or definition during the estimating stage. Surprisingly, Baccarini (2006) noted no definitive relationship between cost growth and contingency allowance although the general perception is that contingency arose from the need to cater for cost growth.

Despite the above argument that there is no conclusive relationship between cost growth and contingency, there are other attributes of significant interest to the construction industry and thus construction projects. This leads me into my subsection, the characteristics of cost contingency.

2.5.1 Characteristics of Cost Contingency

Baccarini (2004a) identified key attributes of cost contingency as:

Reserve: Contingency is a reserve of money. Project plans are flexed i.e. provisions are made to accommodate risks (Project Management Institute, 2000).

Risk and Uncertainty: Contingency is the cushion for risk and uncertainty. The need for contingency sums implies the existence of risks and uncertainties in construction. Contingency covers events within the defined project scope that are unforeseen (Moselhi, 1997; Yeo, 1990), unknown (Project Management Institute, 2000), unexpected (Mak et al., 1998), unidentified (Levine, 1995), or undefined (Thompson and Perry, 1992).

Risk Management: Throughout literature contingency has been adopted as a risk management approach since it provides cushioning for risks. There are other forms of risk strategies including transfer, avoidance, retention, etc. Contingency is a form of risk retention strategy.

Total Commitment: Total Cost of a project is mathematically represented as Total Cost = Estimated Cost + Contingency Allowance (Bello and Odusami, 2013). This suggests that contingency determines the total commitment of the project, and such it should nullify the appropriation of additional funds (Baccarini, 2004a).

Project outcomes: Contingency can have a major impact on project outcomes for a project sponsor. If contingency is too high it might encourage sloppy cost management, cause the project to be uneconomic and aborted, and lock up funds not available for other organisational activities; if too low it may be too rigid and set an unrealistic financial environment, and result unsatisfactory performance outcomes
(Dey et al., 1994).

A cursory look at the attributes provides an indication that they arose out of the different definitions.

2.6 Contemporary Works on Cost Contingency

Contingency is not always positive i.e. revives an otherwise sickening project. According to Ahmad (1992) reasonability is essential in the application of contingency. If done otherwise, it has tendency to cause an otherwise good project. This suggests that a critical understanding of the term contingency is required to adequately apply the term on construction projects.

Throughout literature on construction project management and even in practice, there have been several attempts to improve on the cost contingency component of projects, and as it were overcome cost overruns that are insidious to construction projects. Under this section, the various cost contingency concepts explored by different authors are looked at; and attempt to tie them together.

The basis of all cost contingency estimating methods is the traditional method. Baccarini (2004a) argues that this method is the building blocks for alternative methods. Baccarini further opined that traditional estimate of cost contingency takes a percentage of the base estimate of the project. This method is based on intuition, past experience and historical data. Lorance and Wendling (2001) added that the approach takes into consideration inter alia the project characteristics and complexities, phase of the project. Albeit the general acceptance of the method or approach, Newton (1992) had earlier established that the method is fundamentally satisfactory for simple projects with stable project conditions. However, current practices apply it on relatively complex projects as opposed to what Newton (1992) opined. Gunhan and Arditi (2007) noted an overall 10% addition as a contingency sum, although there is no formal standardized method or prescriptive model (Otali and Odesola, 2014; Keith, 2011; Touran, 2003; Ford, 2002).

A variant of the traditional percentage evolved owing the degree of uncertainties of the different segments or elements; and as such some parts of the project are likely to be more uncertain than other (Baccarini, 2004; Moselhi, 1996; Ahmad, 1992). With this, Baccarini (2004a) opined that a different contingency percentage can be calculated for each major cost element. This approach is termed as trade-by-trade according to Tower and Bacarini (2012). With this calculation method the contingency addition varies within the same project as different elements attract different contingency addition depending on the degree of uncertainty (Bent and Humphreys, 1996). Moselhi (1997) found the trade-by-trade approach to be more reliable and rational than the simple application of the across-the-board addition percentage. The explanation is perhaps found in the opinions of Yeo (1990) and Newton (1992) that the across-the-board percentage is difficult to justify or defend, and in most cases inadequate (Aibinu et al., 2011).

Going beyond the intuition addition percentage, probabilistic estimates erupted. Under this method, each cost item in an estimate is expressed by probability distribution (Baccarini, 2005). This method predicts the variance and the expected value of each cost item. Moselhi (1997) and Yeo (1990) are among the key researchers in this area. This method is termed as the method of moments. Baccarini (2005) observed that in order to attain expected value and the standard deviation, the expected value and variance for all the cost items are summed.

Lorance and Wendling (2000) also introduced a new probabilistic way of determining overall contingency sum. Monte Carlo Simulation (MCS) is used for this determination. Baccarini (2005) argued that MCS generates the results of many trials of a project. Unlike the traditional approach that allocates 10% of the base estimate, this method usually yields estimated value of around 5%, less or even zero depending on the detail of project scope (Clark, 2001 cited from Baccarini, 2005). Confidence interval level is imperative in the usage of this method. Baccarini (2005) noted that confidence interval level of 80% or 90% is usually set for the contingency.

Regression models proposed to be more rigorous and thus have the tendency to reflect the real world situation was criticized. Regression models date back to the late 1970s (Kim et al., 2004 cited from Baccarini, 2005) for estimating. Regression models assume a linear relationship between cost and cost-influencing variables (Baccarini, 2005). It is this overly simplified assumption has been the point of critic by many researchers including Aibinu et al. (2011). According to Aibinu et al. (2011), this linear relationship does not depict a real world interplay of cost and cost-influencing variables. Additionally, the relationship between the variables and the cost component is non-linear and even worse unknown (Aibinu et al., 2011).

The implication of the results of the regression models is that, although, is easier to understand they fail to depict a real world construction situation (Smith and Mason, 1996). In order to overcome this limitation, a more robust approach was proposed – Artificial Neural Networks (ANN). ANN is a technique that simulates biological brain and the interconnecting neurons (Chen and Hartman, 2000 cited from Baccarini, 2005). Unlike regression models that assume a linear relationship between variables, ANN depicts the subtlety of the real world situation (Aibinu et al., 2011). Also, the challenge of finding a mathematical relationship that models cost as a function of the cost-influencing variables is overcome (Kim et al. 2004).

2.7 Variables that Affect Cost Contingency of Contracts

Many factors affect the determination of contingency sum in construction projects. These factors perhaps stemmed from the question – Why should contingency be added to an estimate? – posed by Ahmad (1992) and subsequently, the response opined. According to Ahmad (1992) the answer to his very question would differ depending on the level of involvement of the person in the project. This suggests that a lot of factors influence the inclusion of cost contingency in a project, and even the value of the contingency. Under this section the variables that affect contingency are discussed relying on literature.

2.7.1 Total Contract Sum

The practice of estimating contingency sum as a percentage of the total contract sum (Abednego et al., 2014; Baccarini, 2005; Baccarini, 2004a; Touran, 2003; Thompson and Perry, 1992) suggests invariably the influence of contract sum on contingency determination. Albeit the criticisms of this traditional approach, the method is widely known and heavily applied in the industry. It was therefore not surprising that Otali and Odesola (2014) established the significance of contract sum in the determination of cost contingency. In their study, the stakeholders identify the variable as among the top four determinants of cost contingency. Since the study was conducted in a developing country that relies heavily on percentage addition, it was not surprising.

2.7.2 Experience of Estimator

The thrust of the accuracy of contingency sum invariably lies in the experience of the estimator. For example, Abednego et al. (2014) opined that contingency methodologies depend on the project‟s personnel subjective assessment which includes the estimator that is instrumental in cost contingency determination. More so, with the heavy reliance on the across-the-board percentage that in-turn depends on intuition and experience (Aibinu et al., 2011; Baccarini, 2004a, 2004b); the experience of the estimator cannot be overemphasized. Furthermore, Tower and Baccarini (2012) noted that the professionals involved in the estimating and allocating of contingency sums have wealth of experience. Hitherto, Hegazy and Moselhi (1995) argued that experience is necessary and surpasses any procedure or tool. Aside the traditional addition percentage that depends on the experience of the estimator, other more advanced methodologies (e.g. fuzzy approach) also rely on the qualitative information of the project generated from the expert.

2.7.3 Location of Project

The utmost essence of contingency is to eventuate risk. Mohamed et al. (2009) observed that the location of the project somewhat influences the amount of risk and in consequence the contingency allowance. Although most researchers (e.g. Jimoh and Adama, 2014; Otali and Odesola, 2014; Tower and Baccarini, 2012; Baccarini, 2004b) over the years have established that location impacts on contingency sum. However, contrary to this, Bello and Odusami (2009) established an insignificant correlation between the variable and contingency sum. Additionally, Baccarini (2004b) to his surprise found no correlation between the location of project and contingency sum. To him, projects situated at remote places are more likely to be susceptible to risks and in consequence higher contingency sums. The finding contrasts with the opinion he held. However, Aibinu et al. (2011) included location as part of the variables to train the learning model of ANN. The explanation is that project location is a high-level project characteristic. Otali and Odesola (2014) found project location to be the third influencing factor of contingency sum.

2.7.4 Complexity of Project

Many a time, researchers and practitioners confuse complexity with size of a project. This confusion has generated a lot of attention among both professionals (Doyle and Hughes, 2000; Cilliers, 1998; Melles et al., 1990) with the former doing more to disentangle the difference if there is. Doyle and Hughes (2000) set the tone by observing that there is a strong relationship between complexity and size of a project, and yet relationship is less clear. Similarly, several research have produce conflicting results. However, complexity of a project refers to the technical entanglements of the processes involved in construction. This definition suggests difficulty in grasping some aspects of the construction process. This casts no doubts on the uncertainties of the projects since complexity is the interaction of the elements (Doyle and Hughes, 2000). This implies that the more complex are more uncertain. It was established that contingency sum is fundamentally a cushion for uncertainties, and in consequence complexity influences contingency sum. Addo (2015) and Otali and Odesola (2014) confirmed that complexity of project as a significant influence on contingency sum.

2.7.5 Type of Client

In construction, clients broadly fall under two main categories – public and private. Available literature opines that the type of client influences the percentage of contingency sum to be included in a project. For instance, Jimoh and Adama (2014) noted that in the determination of contingency addition, respondents opined that the type of client is the most influential factor. Also, Bello and Odusami (2009) concurred that type of client among other factors determine the contingency addition. However, the regression model generated a result that contrasted the position of the respondent. The model showed an insignificant relationship between the variable and contingency sum addition (see Jimoh and Adama, 2014).

2.7.6 Project Duration/Contract Period

Contingency is imperative to the achievement of project objectives. Key amongst these project objectives is time which is assessed using project duration. Throughout literature many authors have found contract period to influence contingency sum addition (cf. Addo, 2015; Bello and Odusami, 2009; Ling and Boo, 2001; Gunner and Skitmore, 1999a). Bello and Odusami (2009) found a strong correlation between project duration and contingency sum. Additionally, Jimoh and Adama (2014) argued that project duration is the next significant variable after type of client.

2.7.7 Inflation Rate

Economic and fiscal indicators influence uncertainties of construction projects. Inflation refers to rate at which prices of goods and services increase within an economy. Economies of developing countries are noted for attaining high inflation rates which impact on the prices of construction inputs thereby increasing their variability. Jackson (1999) argued that variability in inputs influence cost overruns; and this partially explains the common occurrence of cost overruns in developing countries. However, estimators in Nigeria do not pay attention to inflation rate in estimating or forecasting cost (Otali and Odesola, 2014). This phenomenon is peculiar to most developing countries.

2.7.8 Available Technology

Technology in the form of equipment availability, issue of renting, damages, etc. may increase contingency sum (Mohamed et al., 2009). Similarly, Otali and Odesola (2014) established that available technology influences contingency sum.

2.7.9 Company Policy

Adjudication is the process that converts an estimate into tender which in turn represents the cost of a project. This decision-making is solely the reserve of the top management and as such the policy of the company. This follows that the method of contingency determination, ***inter alia*** are sometimes the policy of the company. Consequently, the percentage of contingency sum is influenced by the policy of the company. Otali and Odesola (2014) found a strong positive correlation between company policy and contingency sum.

CHAPTER THREE RESEARCH METHODOLOGY

3.1 Introduction

The previous chapters set the tone for the study and reviewed related literature. This chapter presents the research design adopted for the study. The justification for the adoption of the study is accordingly presented.

3.2 Research Philosophy

The understanding of the research philosophy is central to the study undertaking. According to Ahadzie (2007), it helps in curbing "controversies" in the form of criticisms and doubts about the research. There is therefore the need to explain the constructs underpinning the epistemological, methodological and methods as adopted for this study. The ensuing paragraphs elucidate the various terms aforementioned.

Epistemology, at the basic level, is the „dictator‟ of the research process in that it explains the knowledge that underlies the research process being investigated and developed (cf. Smyth and Morris, 2007). The methodology, on the other hand, is encapsulated within the „research process‟ philosophy. Accordingly, the assumptions and values that translate into the rationale of the research are included in the methodology (Ahadzie, 2007). Alternatively, research methods refer to the instruments and tools for undertaking the research (Smyth and Morris, 2007).

3.2.1 Methodological Paradigms

In research methodology literature, when explaining paradigms, recourse is often made to Pollack (2007). According to Pollack, a paradigm is *"a commonly shared set of assumptions, values and concepts within a community, which constitutes a way of viewing reality"*. Creswell (2009) opined that paradigms influence or guide action. Although paradigms may be inherent in research, it is observed to shape the thinking underlying a researcher‟s choice of a particular methodology adopted and in consequence the techniques to be used (Manu, 2012; Ahadzie, 2007; Smyth and Morris, 2007).

Within literature, two main research paradigms are prominent; and these are: positivism and interpretivism (Fellows and Liu, 2008 cited from Manu, 2012). Positivism trajects on the assumption that social phenomenon obeys the natural law and thus can be subjected to quantitative logic. Whereas the interpretivism assumes that phenomenon does not obey the natural laws and its explanation or interpretation is based on people‟s conviction or set of beliefs about the issue in contention (Walliman, 2003 cited from Ahadzie 2007). The two paradigms are inextricably related to the ontological, epistemological and axiological assumptions underlying the research. So, Ahadzie (2007) explained that the difference between the two paradigms is influenced by the aforementioned research philosophies (i.e. ontology, epistemology and axiology). However, Manu (2012) argued that the adoption of any of the paradigms is influenced by the conception of reality, and as such the paradigm is linked mainly to the ontological assumption.

The positivist paradigm is linked to the ontological position of single reality (i.e. objectivism), whiles the interpretivist paradigm is linked to multiple realities (constructivism) (Sutrisna, 2009). As already noted the choice of the paradigm has significant implications for the conduct of a study. For instance, in interpretivism the researcher or the observer is often a part of the whole research process; whereas in the positivism the observer is not part of the thing investigated (Manu, 2012). Table 3.1 further presents contrasting implications of positivism and interpretivism.

Table 3.1 Contrasting implications of positivism and interpretivism.

Interpretivism	Positivism
The observer is part of the research process i.e. what is being studied.	The observer must be independent
The observer is the main driver of science	The observer should be irrelevant
Aim is to increase general understanding of the situation	Must demonstrate causality

The research progress through the collection of rich data from which ideas are inducted	The research progress through hypothesis

Source: (Manu, 2012; Ahadzie, 2007)

3.2.2 Research Paradigm Adopted

Several factors influence the choice of a particular research paradigm. Notably, the research phenomenon under consideration and the key research questions influence the research paradigm that has to be adopted (Pollack, 2007 cited from Ahadzie, 2007). Moreover, the review of literature or conceptual model also is a strategic way of deciding which paradigm to follow (Miles and Huberman, 1994 cited from Manu, 2012). From the objectives stipulated in Chapter One of this dissertation, it is apparent that they are laden with measurement and therefore in order for objective measurements to be obtained it is logical to adopt positivism as an overarching world view for the phenomenon being investigated. By adopting the positivism approach the thinking is that the degree of the variables that influence price contingency can be viewed as single reality which can be assessed and analyzed objectively.

3.3 Research Method

Aside the research philosophy, there are many research methods (instruments) for collecting and analysing data. Notwithstanding there are many research methods, there is no „one-sure" preferable research method (Wilkinson and Birmingham, 2003). Notwithstanding, some methods are better suited in addressing specific issues (Ahadzie, 2007). The fundamental point in research is that the choice should be appropriate, reasonable and explicit (Denscombe, 2003). The neglect of these fundamentals flaws the research and in consequence the findings of the study.

By adopting the positivism as the paradigm, the research methods ideally available are: case studies, surveys, and experiments. Experiments are usually tied with laboratory in the physical sciences, and in the social sciences are usually field experiments. Thus, in view of the nature of this enquiry, experiment was discounted as the ideal option. In order to choose the research method, the research objectives were revisited.

3.3.1 Surveys

This strategy provides a quantitative or numeric description of trends, attitudes, or opinion of a population by studying a sample of that population (Creswell, 2009). It includes cross-sectional and longitudinal studies using questionnaires for data collection with the intent of generalising from a sample to a population (Babbie, 1990). With a cross-sectional survey, all the data on relevant variables are collected simultaneously or within a relatively short time frame. It therefore provides a snapshot of the variables included in the investigation at one particular point in time. On the other hand, in longitudinal surveys, data is collected over long periods of time.

Measurements are taken on each variable over two or more distinct time periods (Manu, 2012). This permits the measurement of change in variables over time. In this study the longitudinal survey was adopted in order to study the change the variables over a long period.

3.4 Data Collection

This section covers issues relating to the collection of data.

3.4.1 Unit of Analysis

The aim of this study as already established is to examine price contingency as applied on Department of Feeder Roads‟ projects. From this it is apparent that the most appropriate unit of analysis is past projects executed by the Department of Feeder

Roads, relying on the project data (see Appendix A) and drawing on the experience of the professionals at the department using survey enquiring about the variables that affect price contingency. To ensure that the survey captured the various aspects of price contingency in DFR projects, the questionnaire developed focused on DFR projects as well as the data reviewed.

3.4.2 Questionnaire Development

Being the main data collection tool, the questionnaire was designed to be respondentfriendly in order to facilitate the involvement of a lot and in consequence maximise the response rate. The questionnaire was designed using plain language devoid of

„technical" words except where used the term was explained to the respondents. Aside the plain language, the questionnaire was deliberately designed to include open- and close-ended questions. This provided flexibility in questionnaire design and avoided monotony which in turned made the questionnaire interesting for the respondents (Babbie, 1990). However, in the main, close-ended questions with ordinal scale were used to make the questionnaire as easy as possible for the participants (cf. Ankrah, 2007). Also, the layout and format of the questionnaire were carefully considered as they impact on the response rate. Instructions were given at the beginning of every major part for filling the questionnaire.

As aforementioned, the unit of analysis was completed DFR projects. Hence, in order to obtain information to satisfy the research objectives and the overarching aim, information on the completed projects were required. The questionnaire solicited information from professionals that participated in these recently completed projects. The thinking or the rationale for targeting these recently completed projects and participants involved on these projects is that information would readily be available and the participants would be readily be informed as to the dynamics of such projects respectively. That is to say such projects would relatively be fresh in their minds and in consequence lead to the minimization or total avoidance of potential distortions.

The questionnaire was in two main sections, Parts A and B. The Part A focused primarily on the demographics of the respondents and as such requested the background information of the respondents. Studies have demonstrated the significance of demographic variables or background information, particularly in quantitative studies.

The Part B was anchored on the research objectives and as such was based on the literature review in regards to the awareness of the various price contingency computation techniques and significance of the variables for determining the price contingency. The various parts and questions in the questionnaire available at Appendix B, were therefore relevant for the statistical analyses (see Ankrah, 2007). Having decided on the variables, the Likert scale Ratings was employed to help elicit appropriate ratings. Here, the conventional five-point rating scale was used as literature suggest more complex rating scale yields no significant advantages (Oppenheim, 1992 cited from Ahadzie, 2007).

3.4.3 The Sampling Frame

In a survey research, sampling is essential. Babbie (1990) argued that it is necessary because of time and cost constraints. In this study, as already indicated in the Chapter One, the target population is the professionals at the Department of Feeder Roads (DFR). Thus, the sampling frame was extracted from the Registry of the DFR. Altogether, the total population across the various regions was 124. These professionals were Engineers and Quantity Surveyors.

In order to establish a suitable sample size the following formula from Creative Research Systems (2003) and Ankrah (2007) was used:

$$SS = \frac{z2\ x\ p\ (1 - p)}{c2}$$

Where; SS = sample size z = standardized variable p = percentage picking a choice, expressed as a decimal c = confidence interval expressed as a percentage

Here the confidence interval was set at 95% based on the reasons put forward by Maisell and Persell (1996) as seen in Manu (2012). The argument was that 95% confidence interval is used to find a balance between the level of precision, resources available and usefulness of the finding. The percentage picking a choice was also assumed to be 50% which according to Manu (2012) represents the worst case scenario. Based on these assumptions the sample size is calculated as:

$$SS = \frac{1.96\ ^{2}x\ 0.5\ (1-0.5)}{0.1^{2}}$$

=96.04

Having known this, the required sample is then calculated. Although the required sample size for the questionnaire survey is 96, it is important to correct the figure for a more finite population. In doing so, the study draws on the formula used by Czaja and Blair (1996) cited in Ankrah (2007). The formula is given as:

$$New\ ss = \frac{SS}{\;}$$

Where:

Pop = Population

Ss = sample size

New ss =

New ss = 54.37

3.4.4 Response Rate

In accordance with the new sample size, 55 participants were considered in the survey. Thus, a total of 55 questionnaires were sent out to the participants for completion in the survey. The researcher selected a representative in each of the offices to aid easy administration and retrieval of the answered questionnaires. The non-probability sampling technique of convenience was used for the selection of sample units due to the relatively homogenous nature of the population. To encourage a good response a number of steps were followed in accordance with literature. First, as prescribed by Ankrah (2007), advanced mail was sent to the various participants to notify them of the forthcoming survey and the need for their participation.

Second, the questionnaires were administered to the participants through the various representatives. This followed about one-week after the notification mails had been sent. This is in-line with Creswell (2003) cited from Ankrah (2007). Of the 55 questionnaires administered, 40 were completed and returned representing an overall response rate of 72.73%.

3.5 Data Analysis

As aforementioned the study adopted wholly a quantitative approach of enquiry. Consequently, to realise the research objectives statistical data analyses need to be performed on the collected data. The statistical analyses are presented below:

3.5.1 Descriptive Statistics

Descriptive statistics helped to understand the nature of the data collected. The descriptive statistics employed included: measures of central tendency (i.e. means) and measure of dispersion (i.e. standard deviation). These were undertaken using SPSS v21. According to Manu (2012), the descriptive statistics show how credible the study is as it is important in demonstrating that the respondents belong to the category of the participants of the study.

3.5.2 Multiple Regression

In order to explore the relationship between a single dependent (response) variable and several independent (predictor) variables; the multiple regression was employed. The tool studies the effects and the intensity of the effects of many independent variables on the dependent variable (Kerlinger and Lee, 2000 cited from Manu, 2012).

Because the independent variables were many, the multiple regression analysis was used instead of the simple regression analysis. Field (2005) propounded a generic equation as showed below:

$Y = \beta + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots\ldots\ldots\ldots\ldots\ldots \beta_n X_n$ Where:

Y = Outcome or Dependent Variable β =

Intercept/Constant β_1 = Coefficient of the

first predictor X_1 β_2 = Coefficient of the

Second predictor X_2 β_n = Coefficient of the

nth predictor X_n

CHAPTER FOUR ANALYSIS AND DISCUSSION OF RESULTS

4.1 Introduction

The Chapter highlights the analysis of the data collected from the survey and past projects. As indicated in the previous chapter, the questionnaires queried the awareness and use of the various price contingency methods and the variables for the determination of price contingency. Also, the study wanted to establish from data on previous projects executed the relationship of certain variables and consequently predict from those variables. The ensuing discussions will thus be anchored on these objectives and attempts to elucidate the discussion.

The Chapter is organised with the analysis of demographic characteristics first followed by the analysis of the questions bordering on the main objectives. Subsequently, the analysis of the data of the past projects is also presented and discussed. As can be seen from the questionnaires (Appendix B), there was a mixture of ordinal, nominal and scale data. As a result, a number of statistical techniques procedures were therefore employed ranging from frequency and distribution, through descriptive statistics to multiple regression.

4.2 Demographic Characteristics

In quantitative analysis, the demographic characteristics of the participants and consequently the respondents are imperative to the findings of the study. This gives credence to the responses to elicited from the respondents. In the questionnaire, certain demographic information were requested from the respondents. This section analyses the demographic data and discusses the results thereof. The ensuing subsections show the results of the analysis.

4.2.1 Role of Respondents

The extent of this question was limited to the management of road construction projects. The respondents were required to indicate by ticking their respective roles. The instruction was not to answer more than one. The results revealed that, out of the forty (40) surveyed respondents; fifteen (15) indicated they served as Quantity Surveyors in the management of roads contracts, whereas the remaining twenty-five (25) served as Civil Engineers. This was not surprising as the respondents were engineers and quantity surveyors. These are respondents whose roles involve forecasting price contingency and actively involved in the management of road
projects.

Table 4.1 Role of Respondents

Role	Frequency	Percentage (%)
Quantity Surveyors	15	37.5
Civil Engineers	25	62.5

4.2.2 Years with the Department of Feeder Roads

Here, the intent of the question was to find the years of experience of working with the department of feeder roads. The thinking was that the longer the years of experience, the more the knowledge into Department of Feeder Roads‟ projects. The results indicated that majority of the respondents had been with DFR for more than 10 years. A banded breakdown of the respondents (i.e. <5 years, 5-10 years, 10-15 years and >15 years) given by Table 4.2, indicates that 28.6% have less than 5 years of experience at the Department. 20.0% have from 5 to 10 years of experience and

42.8% have practiced as Artisans between 10 and 15 years. Also, 8.6% have 15 years and above experience at the Department. This shows that majority of the respondents (42.8%+8.6%=51.4%) have more experience at DFR.

Table 4.2 Years of Experience

Years	Valid Percent
Less than 5 years	28.6
5-10 years	20.0
Between 10 and 15 years	42.8
15 years and above	8.6
Total	100.0

4.2.3 Years of Experience in Practice

A summary of the respondents years of experience in the profession (shown by Table 4.3) indicates that averagely, the respondents have 8.54 years of experience (with Standard Deviation = 0.795) in professional practice. The minimum and maximum experience as artisans is 5 years and 15 years respectively. This indicates that the respondents have enough experience to provide responses required for the study.

Table 4.3 Years of Experience in Practice

Statistic	Years of experience in practice
Mean	8.5436
Std. Error of Mean	.16582
Std. Deviation	.79524
Minimum	5.00
Maximum	15.00

4.2.4 Average Provision for Price and Physical Contingencies

The intent of this question was to elicit from the respondents, based on their experience the average provision in terms of percentage usually allocated to price and physical contingencies. The results are presented in Table 4.4. The Standard Error Mean gives a reflection of the population and the small value suggests that the respondents reflected the scope of the study. From the results, it is showed that the average percentage allocated by the various categories of contingency are 10.00% and 10.00% for price and physical respectively.

Table 4.4 Average percentage for contingencies

Statistic	**Average Percentage**
Price Contingency	
Mean	10.00
Std. Error of Mean	.1286
Std. Deviation	.79524
Physical Contingency	
Mean	10.00
Std. Error of Mean	.1286
Std. Deviation	.79524

From the respondents‟ demographic information, it is evident that the experience and expertise of the respondents is respectable and they are well placed to adequately respond to the subject being addressed by the survey. Their responses can thus be regarded as important and reliable. A reasonable conclusion is that the findings drawn from their responses will be a sound and credible representation of the price contingency as a tool for preventing price-overruns in the procurement of roads projects.

4.3 Awareness of the Various Price Contingency Methods

The adoption of price contingency methods is inextricably related to the understanding and consequently the usage of the methods. It is important to establish that various methods have been proposed by several academics and practitioners. Knowing these methods i.e. awareness is one thing, and the proficiency in it is another. Under this section, the intent was to find both the awareness of these methods and the proficiency (i.e. usage) in the methods. The methods identified from literature were presented to the respondents. The methods range from traditional techniques that heavily rely on intuition to more sophisticated methods that rely on statistical tools.

The respondents were asked to indicate the level of awareness and usage on a Likert Scale item of 1 to 5 (*1 = Never 2 = Rarely 3 = Neutral 4 = Frequently 5 = Always*). In the analysis of the extent of the agreement in order to establish the satisfaction level of usage and awareness, the Relative importance index was utilised. The score of each factor is calculated by summing up the scores given to it by the respondents (e.g. Badu et al., 2013). For a five-point response item, RII produces a value ranging from 0.2 – 1.0 (cf Badu et al., 2013). In the calculation of the Relative Importance Index (RII), the following formula was used (Badu et al., 2013):

$$RII = \frac{\Sigma W}{A * N}$$

Where, W: weighting given to each statement by the respondents and ranges from 1 to 5;

A – Higher response integer (5), and N – total number of respondents.

Table 4.5 Level of awareness and usage of Methods/Techniques

Item	Methods/Techniques	Awareness Rankings					RII	Rank	Usage Rankings					RII	Rank
		1	2	3	4	5			1	2	3	4	5		
I.	Traditional percentage	0	0	0	0	40	1.00	1	0	0	0	0	40	1.00	1
II.	Method of Moments	0	0	11	20	9	0.79	4	28	12	0	0	0	0.26	9
III.	Monte Carlo Simulation	17	8	9	4	2	0.43	9	30	8	2	0	0	0.26	9
IV.	Factor Rating	0	0	7	23	10	0.84	3	0	0	7	23	10	0.82	3
V.	Individual risks – expected value	0	0	0	5	35	0.98	2	0	0	0	5	35	0.98	2
VI.	Range Estimating	0	0	12	18	10	0.79	4	0	0	12	18	10	0.79	4
VII.	Regression	0	0	15	25	0	0.73	6	15	5	15	5	0	0.45	5
VIII.	Artificial Neural Networks	15	10	10	3	2	0.44	8	15	10	10	3	2	0.44	6
IX.	Fuzzy Sets	18	15	5	2	0	0.36	11	18	15	5	2	0	0.36	7
X.	Controlled Interval Memory	35	5	0	0	0	0.23	13	35	5	0	0	0	0.23	12
XI.	Influence Diagrams	27	3	10	0	0	0.32	12	27	10	3	0	0	0.28	8
XII.	Theory of Constraints	19	1	10	5	5	0.48	7	29	10	1	0	0	0.26	9
XIII.	Analytic Hierarchy Process	17	8	10	3	2	0.43	9	27	3	10	0	0	023	12

From Table 4.5 there is an association (although subtle) between level of awareness and usage. This is seen in the RII values of level of awareness and usage. It can be inferred that where RII value was high for the level of awareness, there was a corresponding RII values for usage. However, it can be seen from the Table that Traditional percentage obtained a RII value of 1.00 for both level of awareness and usage. This finding is consistent with literature that it is the basis of all cost contingency and as such it is expected that every practitioner is aware and able to use it (Baccarini, 2004a). The popularity of this method may also be ascribed to the small projects undertaken by the Feeder Roads. Newton (1992) established that this method is mostly used for simple projects.

This was closely followed by „Individual risks – expected value" with a RII value of 0.98 for both the level of awareness and usage. This method lends itself more with the traditional approach, except that the level of individual risks is considered. Owing to that some authors (e.g. Baccarini, 2004, Moselhi, 1996) argued that it is a variant of traditional method or techniques. It was therefore not surprising the method was heavily used given its simplistic nature.

The results revealed a startling finding with regard to methods of moments. Although the respondents indicated that they are aware of the method i.e. Method of Moments, obtaining a RII of 0.79 and ranking 4th; its usage was rather startling. The usage obtained a RII value of 0.26 ranking 9th. This suggests that beyond the intuition and simplistic methods and techniques of predicting price contingency, the usage of probabilistic techniques is rare. This is the same for the other probabilistic techniques and methods. The worrying trend is that whilst the inclination towards probabilistic methods is high in developed countries, the same cannot be said in the context of developing countries. This partially explains why cost-overruns is commonplace in developing countries.

4.4 Variables for the Determination of Price Contingency

The currency given to price contingency provides a reason to study the factors or variables that influence it. The understanding, perhaps, is that if price contingency is accurately predicted the chances of staying within budget are high. Adding to this, the question posed by Ahmad (1992) referred to in the Chapter 2 further underscores the need to examine the variables that affect price contingency. According to him, a lot of variables come to play in determining the price contingency of a project. The variables were identified from literature and subsequently presented to the respondents to determine the significance of the variables. Here the independent TTest was used largely because the study was also interested in finding this significance from the two categories of respondents i.e. Quantity surveyors and Civil Engineers. This study takes a clue from the findings of Addo (2015). In his study, the two professions had differing views regarding the significance of the variables. Addo (2015) rather used RII, and this study wants to consider a different analytical tool in the form of Independent T-test.

From these two domain sets, the independent group sample t-test of the dependent variables was conducted to determine whether there exist any level of agreement between them in respect of the significance of the variables that affect price contingency.

An independent group‟s t-test is most appropriate when different participant from the same population have implemented in each of the different conditions (Coakes et al., 2001). In this regard, this inquiry wishes to conclude whether the difference between the perceived significance of the variables of the two domains (i.e.

Quantity Surveyors and Civil Engineers) is significant.

Assumptions:

The variables are assigned to one of two sets indiscriminately. The dissemination of the means linked are normal with equal variances as inferred from the work of Field (2005a).

Test: The hypotheses for the comparison of two independent groups are:

H_o: $u_1 = u_2$ (means of the two groups are equal)

The null hypothesis for the independent t-test is that the population means from the two unrelated groups are equal and,

H_a: $u_1 \neq u_2$ (means of the two group are not equal)

The alternative hypothesis for the independent t-test is that the population means from the two unrelated groups are unequal. When the p-value is less than 0.05 ($p<0.05$) then the difference between the two means is statistically significant and that there is evidence to reject the null hypothesis in favour of the alternative (Field, 2005a).

Likewise, when the p-value is greater than 0.05 ($p>0.05$) then the difference between the two means is not statistically significant then the null hypothesis is accepted.

Cursory look at the Table reveals that respondents that are civil engineers were twenty-five (25) and fifteen (15) were the respondents are quantity surveyors. Also, in most cases standard deviations were more than one (1) indicating inconsistency in the level of agreement of respondents. However, table 4.6 suggests smaller standard errors attributed to the adequate sample size and therefore reflect a degree of consistency between means of different samples and more likely to have a high level of accuracy (see for instance Field, 2005).

Table 4.6 Group Statistics

Barriers	Profession	N	Mean	Std. Deviation	Std. Error Mean
Total Contract Sum	Civil Eng	25	3.6552	1.00980	.18752
	QS	15	3.6154	.86972	.24122
Method of construction	Civil Eng	25	3.8276	1.07135	.19894
	QS	15	4.0714	1.07161	.28640
Location of Project	Civil Eng	25	3.3448	.85673	.15909
	QS	15	3.5000	.65044	.17384
Project Duration/Contract Period	Civil Eng	25	3.3103	1.03866	.19287
	QS	15	3.3571	1.00821	.26945
Complexity of Project	Civil Eng	25	3.5517	.86957	.16148
	QS	15	3.1429	.94926	.25370
Urgency of Completion	Civil Eng	25	3.6897	.80638	.14974
	QS	15	3.3571	.74495	.19910
Change Orders	Civil Eng	25	3.1379	1.12517	.20894
	QS	15	3.5714	1.22250	.32673
Inflation Rate	Civil Eng	25	3.6897	1.13715	.21116
	QS	15	3.4286	1.15787	.30945
Experience of Estimator	Civil Eng	25	4.1379	1.15648	.21475
	QS	15	4.3571	.84190	.22501
Weather Conditions	Civil Eng	25	3.5517	1.18280	.21964
	QS	15	3.8571	1.09945	.29384

Type of Client	Civil Eng	25	3.418	.18280	.21964
	QS	15	3.8571	1.09945	.1842

Table 4.7 Levene's Test for Equality of Variances

	Levene's Test for Equality of Variances	t-test for Equality of Means	
			95% Confidence Interval of the

		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Difference	
									Lower	Upper
Total Contract Sum	Equal variances assumed	.776	.384	.123	39	.903	.03979	.32373	-.61450	.69407
	Equal variances not assumed			.130	26.706	.897	.03979	.30553	-.58743	.66700
Method of construction	Equal variances assumed	.044	.835	-.699	39	.488	-.24384	.34869	-.94803	.46034
	Equal variances not assumed			-.699	25.785	.491	-.24384	.34872	-.96093	.47325
Location of Project	Equal variances assumed	1.473	.232	-.598	39	.553	-.15517	.25942	-.67907	.36873
	Equal variances not assumed			-.658	33.111	.515	-.15517	.23565	-.63454	.32420
Project Duration/Contract Period	Equal variances assumed	.003	.957	-.140	39	.890	-.04680	.33491	-.72317	.62957
	Equal variances not assumed			-.141	26.504	.889	-.04680	.33137	-.72731	.63371
Complexity of Project	Equal variances assumed	.141	.709	1.403	39	.168	.40887	.29147	-.17976	.99750
	Equal variances not assumed			1.360	23.849	.187	.40887	.30073	-.21202	1.02975
Urgency of Completion	Equal variances assumed	.176	.677	1.298	39	.202	.33251	.25626	-.18501	.85004
	Equal variances not assumed			1.335	27.745	.193	.33251	.24912	-.17800	.84302
Change Orders	Equal variances assumed	.822	.370	-1.151	39	.256	-.43350	.37651	-1.19387	.32688
	Equal variances not assumed			-1.118	23.947	.275	-.43350	.38782	-1.23402	.36702
					39		.26108	.37222		
	Equal variances not assumed			.697	25.371	.492	.26108	.37463	-.50992	1.03209
Experience of Estimator	Equal variances assumed	2.516	.120	-.631	39	.531	-.21921	.34719	-.92037	.48195
	Equal variances not assumed			-.705	34.269	.486	-.21921	.31104	-.85114	.41272
Weather Conditions	Equal variances assumed	.187	.667	-.811	39	.422	-.30542	.37654	-1.06586	.45502
	Equal variances not assumed			-.833	27.587	.412	-.30542	.36686	-1.05740	.44656
Type of Client	Equal variances assumed	2.534	.537	-.811	39	.422	-.0453	.37654	-1.06586	.45502
	Equal variances not assumed			-.833	27.587	.412	-.0453	.36686	-1.05740	.44656
Inflation Rate	Equal variances assumed	.008	.928	.701		.487			-.49064	1.01281

Table 4.6 provides results for the independent sample tests for the variables that affect the determination of price contingency. The first section of the Table 4.7 gives the results for the Levene's Test for Equality of Variances. This tests whether the variation in the scores of the two groups is the same. The significance level of the test is larger than 0.05 indicating that the variances for the two groups (QS or Civil Eng) are the same. Further analysis of the table suggests that:

Total Contract Sum

From the Table 4.7, the Levene‟s test for equality of variance, the sig. value for total contract sum is larger than 0.05 and that is 0.384. As already noted, this implies that the scores for the two groups are the same. Hence the variability in the significance of the variables is the same. It is apparent from Table 4.6 that the difference in mean values between the two groups is not significant. Civil Engineers had a mean value of 3.655 whereas the „Quantity Surveyors‟ had a mean value of 3.615. Interestingly, the standard deviation of Quantity Surveyors‟ was less than one (1) indicating there is agreement in the response. Whilst the standard deviation of the „Civil Engineers‟ was more than one depicting the reverse (refer Table 4.6). The examination of the table further suggests that the significance as the respondents considered does not depend on the profession of the respondents. In Ghana, total contract sum is considered significant by both categories of respondents. The findings concur study by
Abednego et al., (2014); Baccarini, (2005); Baccarini (2004a); Touran (2003) Thompson and Perry (1992) that established the influence of this variable on price contingency.

Method of Construction

From table 4.8 the sig. value of Method of Construction is larger than 0.05. This indicates that the variability in the two types of respondents is about the same; that is the mean score in

„Civil Engineer‟ do not vary too much more than Quantity Surveyors. Hence, variability in the two categories of respondents is not significantly different. A cursory look at the table reveals that, although, both categories consider the variables as significant Quantity Surveyors perceived the variables more significant than the other category of respondents – having a mean value of 4.071 whereas Civil Engineers had a value of 3.828 (see Table 4.5). Both groups had a standard deviation more than one (1) suggesting variability in the agreement of response. The plausible explanation could be that the respondents understood the variable in their own ways.

Location of Project

Location has an influence on the price contingency allocated for a project (Mohamed et al., 2009). This is confirmed by other academics in the field (for example Jimoh and Adama, 2014; Otali and Odesola, 2014; Tower and Baccarini, 2012; Baccarini, 2004b). However, Bellow and Odusami (2009) found an insignificant relationship between location of a project and price contingency. The two groups – Civil Eng and QS – had mean values 3.345 and 3.500 respectively (Table 4.6). This lend to the plausible explanation that the QS regard the variable as significant between the markets forces in locations differ. This may be ascribed to their training. However, from table 4.8 the sig. value of Location of projects is larger than 0.05. This indicates that the variability in the two types of respondents is about the same.

4.5 Modelling the Relationship between Price Contingency (Predictor) and Selected Explanatory Variables

Field (2000) cited from Ankrah (2007) argued that correlations are useful for exploring relationships between variables. However, they provide little information about the predictive power of the explanatory variables. Conversely, Regression has been found to detail the information about the predictive power of the individual variables whilst exploring the relationships (Ankrah, 2007). In view of this, regression was applied to a dataset collected over a period of years on projects executed by the DFR (Appendix A). Specifically, the multiple

regression analysis was used. Also, Research has shown that for accuracy of predictive model, homogeneity is very important (Hassan et al, 2015; Mensah 2010; Aibinu and Jagboro 2005). As a result, cost data collected and used for the analysis are shown in
Appendix A were adjusted to June, 2015 using price adjustment formula from the ministry of Roads and Highways (see Appendix A) as illustrated by equations 5.1 and 5.2 for homogeneity reasons so as to have a fair basis for comparisons. This was necessary because it has been suggested that for accuracy of predictive models, homogeneity is very important (Aibinu and Jagboro 2002, Ogunsemi 2002). The price adjustment formula (clause 47 of the conditions of contract and contract data) used for the adjustment of the cost (see Appendix C)
is:

$$Pc = Ac + a.\frac{LL}{LLo} + b.\frac{PL}{PL0} \times \frac{FE}{FE0} + c.\frac{FU}{FU0} + d.\frac{BI}{BI0} + e.\frac{CE}{CE0} + f.\frac{RS}{RS0} + g.\frac{TI}{TI0} + h.\frac{CH}{CH0} + i.\frac{PC}{PC0} + j.\frac{CO}{CO0} \quad \ldots 5.1$$

where "a", "b", "c", "d", "e", "f ", "g", "h" "i" and "j" are coefficients representing the estimated proportion of each cost element (labour, equipment, materials, etc.,) in the works or sections thereof, net of provisional sums.

"LL", "PL", "FE", "FU", "BI", "CE", "RS", "TI", "CH", "PC" and "CO" which are the current cost indices (in this case June, 2015) corresponding to reference prices applicable respectively to the elements of local labour, provision and maintenance of construction plant, foreign exchange rate, fuel, bitumen, cement, reinforcing steel, timber, chippings, precast concrete pipes, and consumer index. Pc is the price adjustment factor and "LL0", "PL0",
"FE0", etc., are the base cost indices (in this case month/year of completion of the selected projects) or reference prices corresponding to "LL", "PL", "FE" etc. See Appendix C for samples of computations of the price adjustment factors (PAF).

Adjusted cost = Cost data collected x Pc ……………………………………………5.2

The results are presented below.

R in the model measures the degree of association between the price contingency (predictor) and all the independent variables jointly. R value of 0.575 indicates that there is strong positive association between price contingency and all the explanatory variables.

R-square measures the proportion of variation in the dependent variable, price contingency that is explained by the explanatory variables; contract period and initial estimated cost jointly. From the results, it is observed that R-square is 0.331 which means that the fitted regression line explained the variation in price contingency is almost 33.1%. This means that about 33% of the variation in price contingency is explained by the variation in the two independent variables (i.e. contract period and initial estimated cost), while a little over 66% is unexplained. The regression result make sense (the model fitness is moderate).

Also, the ANOVA section showing the overall significance of the explanatory variables on the explained variable, price contingency. It was observed that the explanatory variables have significant effect on price contingency. The probability value is less than 5 percent, showing that there is significant effect of the explanatory variables on the explained variable. Also, the VIF of 1.149 obtained indicates that there is no collinearity within the data (Field, 2000 cited from Ankrah, 2000).

Below is the estimated regression model deduced from the partial regression coefficients in Table 4.10.

47675.410

The regression coefficient of contract period, 47675.410 shows that holding initial estimated cost zero, a unit increase in contract period on average increases price contingency by 47675.410 unit. In other words, increment in contract period leads to a corresponding increase in price contingency.

The coefficient; 0.146 is the partial regression of estimated cost of works, which tells us that holding all the other explanatory variables constant, a unit increase in estimated cost leads to an increase in price contingency by 0.146 unit. However, it suffices to mention here that the variable had a p-value greater than 0.05 (see Table 4.10) suggesting that the variable is not significant. This in contrast to the conventional thinking, especially at the DFR since price contingency is heavily dependent on the initial estimated cost. Several factors may have accounted for this including the relative small size of the dataset.

The intercept value of -415816.119 indicates that if the all explanatory variables were fixed at zero, the average price contingency would be negatively high. Technically, the intercept is the point at which the regression line and the y-axis intercept. This means that when all the variables are 0, the price contingency is negatively high. This gives a false indication and one is tempted to interpret this as the price contingency even when there are no estimates. However, in this case, the intercept is probably meaningless. Because our sample did not include projects with zero contract values, no basis is then established for interpreting this intercept value. However, this may partially explain the economic environment or atmosphere of construction activities

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Table 4.8 Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.575[a]	.331	.302	311077.5580	.331	11.608	2	47	.000	1.085

a. Predictors: (Constant), Contract Period, Initial Estimated Cost of Project

b. Dependent Variable: Price Contingency

Table 4.9 ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2246516747285.168	2	1123258373642.584	11.608	.000[b]
	Residual	4548154612489.557	47	96769247074.246		
	Total	6794671359774.725	49			

a. Dependent Variable: Price Contingency

b. Predictors: (Constant), Contract Period, Initial Estimated Cost of Project

Table 4.10 Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
(Constant)	-415816.119	177186.394		-2.347	.023					
Initial Estimated Cost of Project	.146	.096	.195	1.524	.134	.366	.217	.182	.871	1.149
Contract Period	47675.410	12829.016	.475	3.716	.001	.545	.477	.443	.871	1.149

a. Dependent Variable: Price Contingency

CHAPTER FIVE SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Cost-overruns are commonplace in the Ghanaian Construction Industry, and it is observed that the major source is from contract fluctuation as a result of inaccurate estimates of price contingency. The study was therefore stimulated to using price contingency as a tool for controlling cost overruns. Here, the aim was to examine the determination of cost contingency in the road construction industry in Ghana, with emphasis on feeder roads contracts. The previous chapters have introduced the study, reviewed pertinent literature on the study and data collected analysed. This chapter is dedicated to summarizing the findings of the study and drawing conclusions in that regard. How the various objectives were achieved is revisited, limitations of the study are pointed and recommendations put forward. The ensuing sections show these:

5.2 Summary of Findings

In the first chapter of this project report, the background and problem statement to this research was presented. The main issue revealed was that, price contingency has association with cost overruns and consequently pervasive effects on curbing cost overruns. However, to estimate correctly price contingency requires the knowledge and proficiency in the various methods and the factors that influence it. This informed the posing of four research objectives:

- To identify the cost contingency component in Feeder Roads construction contracts
- To assess the awareness of professionals‟ awareness on the various cost contingency methods

- To determine the significance of the variables in the determination of cost contingency
- To develop a model for the prediction of cost contingency on Feeder Roads construction projects.

The succeeding subsection highlights the review of research objectives and how these objectives were achieved.

This objective was realised in two folds. First by asking the respondents to indicate the average percentage of cost or price contingency allocated on projects undertaken by DFR. Second, price contingency was modeled using explanatory variables such as contract period and initial estimated cost of works from data on previously executed projects. The first instance was analysed using descriptive statistics, and the results showed that the average percentage is 10.00%. Secondly, a hypothesis was posed that sought to say there was a relationship between price contingency and other variables (i.e. Contract Period and Initial Estimated Cost of Work). In fulfilling this, the multiple regression was used. The model showed positive relationship with contract period and initial estimated cost of works. Generally, the predictive power of the model is moderate explaining about 33% of the variation.

As aforementioned, the accuracy of forecasting price contingency somewhat depends on the knowledge on and proficiency in the methods for determining price contingency. The objective therefore sought to assess the awareness of the professionals on the various cost contingency methods and by extension the usage of such methods. Because the thinking was that the mere fact that you are aware of the existence does not mean its usage. RII was used to assess the awareness and usage.

There was association between awareness and usage in terms of the traditional method and other simplistic approaches. However, with the probability methods the proficiency and awareness were unsurprisingly low.

Throughout literature, it has been noticed that price contingency is affected by various variables. The significance and insignificance of these variables are still issues of contention among academics and practitioners. The objective sought to establish the significance of these variables identified from literature, and particularly from the perspectives of the two main professionals – Quantity Surveyors and Civil Engineers. In view of this, the independent t-test was used to compare the views between the two groups. There was agreement between the respondents on the significance of almost all the variables.

5.3 Conclusion

The main conclusions drawn from the study are:

- The method of price contingency determination at the DFR is still traditional and its variants. This is seen in the fact that the respondents proficiency in and knowledge on probabilistic approaches are very low.
- Contract Period and initial estimated cost of projects are major determinants of price contingency. Both Initial Estimated Cost and Contract Period positively relate with price contingency suggesting an increase in the former results in a corresponding increment in the latter.
- There was no significant difference between the two groups on the significance of the variables except one or two variables.

5.4 Practical Implication

The insight provided by this study has implications for improving the estimating method of price contingency at the DFR and is discussed below:

- The DFR needs to provide a CPD to improve upon the estimating methods towards more probabilistic approach. This has been found to improve the accuracy of price contingency.

5.5 Limitations of the Study

It is worth pointing out that the study was limited in various regards. A more important one is the dataset used for the modelling accounting for the „moderate‟ strength of the model. The data was small and it is expected that an increase in the data may alter the results and improve the accuracy of the model.

5.6 Recommendation for Future Study

Based on the limitation of the study, future study is encouraged to look into especially the modelling aspect of this study involving a large dataset and including more preliminary variables.

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APPENDIX A: REVIEW OF COMPLETED CONTRACTS

S/N	CONTRACT NAME	REGION	CONTRACT SUM (GH¢)	PRICE CONTINGENCY PROVISION IN CONTRACT (GH¢)	PHYSICAL CONTINGENCY PROVISION IN CONTRACT (GH¢)	INITIAL ESTIMATED COST OF WORKS	AVERAGE PAF FOR JUNE, 2015	INITIAL ESTIMATED COST OF WORKS ADJUSTED TO JUNE, 2015	CONTRACT COMPLETION PERIOD (MONTHS)	ACTUAL COMPLETION PERIOD (MONTHS)	ACTUAL COST OF WORK (GH¢)	ACTUAL COST OF WORK ADJUSTED TO JUNE, 2015 (GH¢)	COST OVERRUN (GH¢)	COST OVERRUN ADJUSTED TO JUNE, 2015	ACTUAL PRICE FLUCTUATION PAID (GH¢)	ACTUAL PRICE FLUCTUATION PAID ADJUSTED TO JUNE, 2015 (GH¢)	COST OVERRUN DUE TO PRICE FLUCTUATION (GH¢)	COST OVERRUN DUE TO PRICE FLUCTUATION ADJUSTED TO JUNE, 2015 (GH¢)	YEAR OF COMPLETION	% INCREASE IN PRICE CONTINGENCY (%)	% OF ACTUAL FLUCTUATION OF INITIAL ESTIMATED COST OF WORKS
(a)	(b)	(c)	(d)	(e)	(f)	(g) = (d-e-f)	(h)	(i) = (g*h)	(j)	(k)	(l)	(m) = (l*h)	(n) = (l-d)	(o) = (n*h)	(p)	(q) = (p*h)	(r) = (p-e)	(s) = (r*h)	(t)	(u) = (p-e)/e*100	(v) = p/g*100
1	SURFACING OF KWAMANG JN. - JEDUAKO FEEDER ROAD PH. 2	ASHANTI	1,298,160.00	58,689.09	58,689.09	1,180,781.82	1.069	1,262,364.81	18	45	1,681,548.36	1,797,730.49	383,388.36	409,877.56	157,808.18	168,711.52	99,119.09	105,967.46	NOVEMBER, 2014	168.89	13.36
2	SURFACING OF CAMP - BREKETE FEEDER ROAD PH. 2 (KM 7.25 - 10.75)	ASHANTI	1,175,917.52	95,576.46	95,576.46	984,764.60	1.167	1,149,348.17	12	33	1,256,661.33	1,466,686.96	80,743.81	94,238.51	150,353.98	175,482.62	54,777.52	63,932.48	JUNE, 2014	57.31	15.27
3	SURFACING OF NYAMEANI - BEPOSO FEEDER ROAD PH. 2 (KM 4.0 - 10.0)	ASHANTI	2,167,161.80	173,180.15	173,180.15	1,820,801.50	1.106	2,014,558.02	14	17	2,523,230.46	2,791,734.39	356,068.66	393,958.91	390,313.99	431,848.38	217,133.84	240,239.65	AUGUST, 2014	125.38	21.44
4	SURFACING OF AMOAFO - KOTWE FEEDER ROAD (4.5KM)	ASHANTI	1,401,620.84	109,385.07	109,385.07	1,182,850.70	1.658	1,961,569.51	14	11	1,694,688.43	2,810,370.88	293,067.59	486,005.93	129,869.39	215,367.70	20,484.32	33,969.98	SEPTEMBER, 2012	18.73	10.98
5	SURFACING OF KONONGO TOWN ROADS (2.3KM)	ASHANTI	701,887.76	57,615.65	57,615.65	586,656.47	2.824	1,656,982.11	12	16	735,140.12	2,076,366.82	33,252.36	93,919.64	71,703.00	202,521.57	14,087.36	39,789.04	AUGUST, 2008	24.45	12.22
6	SURFACING OF APUTUOGYA - KOKOFU FEEDER ROAD	ASHANTI	926,105.35	41,959.34	41,959.34	842,186.68	1.782	1,500,934.68	12	60	1,217,334.43	2,169,518.35	291,229.08	519,024.86	52,695.95	93,914.07	10,736.62	19,134.66	FEBRUARY, 2012	25.59	6.26
7	SURFACING OF JUAHO - TWABIDI FEEDER ROAD PH. 3 (KM 13.3 - 17.8)	ASHANTI	1,169,783.41	96,440.29	96,440.29	976,902.84	1.303	1,272,561.45	12	60	1,010,546.12	1,316,386.83	-159,237.29	-207,430.29	192,838.28	251,200.58	96,398.00	125,572.75	FEBRUARY, 2014	99.96	19.74
8	SURFACING OF WAMFIE TOWN ROADS [2.40KM]	BRONG AHAFO	407,441.38	17,292.79	17,292.79	372,855.81	2.005	747,754.14	12	15	721,207.67	1,446,366.18	313,766.29	629,251.42	46,054.61	92,361.50	28,761.82	57,681.20	MAY, 2011	166.32	12.35
9	SURFACING OF YEJI TOWN ROADS [2.0KM]	BRONG AHAFO	775,685.84	63,473.82	63,473.82	648,738.20	1.919	1,245,065.10	12	15	1,065,388.10	2,044,703.93	289,702.26	555,999.59	109,740.38	210,614.87	46,266.56	88,795.26	DECEMBER, 2011	72.89	16.92
10	SURFACING OF SAMPA TOWN ROADS (2.0KM)	BRONG AHAFO	656,421.68	53,535.14	53,535.14	549,351.40	1.939	1,065,077.48	12	15	812,603.28	1,575,467.82	156,181.60	302,803.46	67,427.22	130,727.28	13,892.08	26,933.84	NOVEMBER, 2011	25.95	12.27
11	SURFACING OF SANKORE - ABUOM - NANKETE FEEDER ROAD [KM 14+500 - 19+000]	BRONG AHAFO	1,043,576.16	85,714.68	85,714.68	872,146.80	1.834	1,599,922.82	12	37	777,490.70	1,426,279.50	-266,085.46	-488,124.48	77,978.14	143,048.16	-7,736.54	-14,192.42	JANUARY, 2012	-9.03	8.94
12	SURFACING OF BEREKUM - SENASE FEEDER ROAD [2.70KM]	BRONG AHAFO	517,369.32	42,322.45	42,322.45	432,724.43	1.519	657,507.72	12	48	585,741.01	890,010.38	68,371.69	103,888.08	125,266.15	190,336.97	82,943.70	126,029.69	AUGUST, 2013	195.98	28.95
13	SURFACING OF ODUMASI – NKWABENG – ABUENTEM FEEDER ROAD (KM 0.00 – 2.80) & OTHERS (2.0KM)	BRONG AHAFO	1,187,687.44	94,715.62	94,715.62	998,256.20	1.651	1,647,804.33	12	12	1,647,193.26	2,718,993.56	459,505.82	758,498.34	236,027.66	389,606.79	141,312.04	233,261.35	AUGUST, 2012	149.20	23.64
14	BITUMEN SURFACING OF ODUMASI – NKWABENG – ABUENTEM FEEDER ROAD PH. II (KM 5.80 – 11.6)	BRONG AHAFO	1,779,091.70	145,840.98	145,840.98	1,487,409.75	1.438	2,138,666.08	18	25	1,915,931.11	2,754,813.78	136,839.41	196,753.99	327,692.73	471,171.66	181,851.75	261,474.81	JANUARY, 2014	124.69	22.03
15	SURFACING OF MEHAME JNC. – DADIESOABA FEEDER ROAD (KM 0.00 – 6.00)	BRONG AHAFO	1,419,234.80	113,177.90	113,177.90	1,192,879.00	1.745	2,081,314.60	12	9	2,107,111.92	3,676,452.35	687,877.12	1,200,196.07	275,708.92	481,052.14	162,531.02	283,581.30	APRIL, 2012	143.61	23.11
16	SURFACING OF KUKUOM TOWN ROADS (1.40KM)	BRONG AHAFO	498,422.54	32,858.53	32,858.53	432,705.49	1.834	793,783.09	12	15	761,192.11	1,396,380.32	262,769.57	482,041.59	84,831.04	155,619.58	51,972.52	95,341.76	JANUARY, 2012	158.17	19.60
17	SURFACING OF BEDIAKO - KASAPIN - ADIEMBRA FEEDER ROAD (KM 21+000 - 27+000)	BRONG AHAFO	762,209.77	62,767.48	62,767.48	636,674.81	2.257	1,436,767.74	12	14	1,457,898.48	3,290,002.18	695,688.71	1,569,942.90	241,880.29	545,845.06	179,112.81	404,199.29	MAY, 2010	285.36	37.99
18	SURFACING OF ASEMPANEYE - KUSHEA FEEDER ROAD PH. I (KM 0+000 - 5+000)	CENTRAL	758,413.24	62,117.77	62,117.77	634,177.70	1.040	659,782.20	12	68	790,986.42	822,921.97	32,573.18	33,888.30	236,301.87	245,842.40	174,184.10	181,216.67	MAY, 2015	280.41	37.26
19	SURFACING OF PRASO - BIMPONAGYA - BIMPONSO FEEDER ROAD PH. 2 (KM 4+500 - 7+500)	CENTRAL	922,627.64	76,118.97	76,118.97	770,389.70	1.438	1,107,701.71	12	29	1,224,436.98	1,760,551.75	301,809.34	433,955.34	297,243.50	427,390.36	221,124.53	317,943.01	JANUARY, 2014	290.50	38.58
20	BITUMEN SURFACING OF SOMANYA TOWN ROADS (3.31KM)	EASTERN	3,211,961.94	145,611.91	145,611.91	2,920,738.13	1.069	3,122,538.80	10	4	3,352,679.58	3,584,324.10	140,717.64	150,440.15	494,111.35	528,250.66	348,499.44	372,578.09	NOVEMBER, 2014	239.33	16.92
21	BITUMEN SURFACING OF AKIM TAFO TOWN ROADS (1.975KM)	EASTERN	1,926,993.24	89,474.70	89,474.70	1,748,043.85	1.198	2,094,127.69	12	8	1,429,451.25	1,712,459.01	-497,541.99	-596,047.09	193,928.78	232,323.48	104,454.09	125,134.27	DECEMBER, 2014	116.74	11.09
22	SURFACING OF ADOAGYIRI - COALTAR - OWURAM FEEDER ROAD (5.30KM)	EASTERN	1,285,901.44	104,800.12	104,800.12	1,076,301.20	1.657	1,783,308.70	12	10	1,156,376.11	1,915,983.71	-129,525.33	-214,608.75	187,038.41	309,901.37	82,238.29	136,259.49	JUNE, 2012	78.47	17.38
23	SURFACING OF OYARIFA - TEIMAN - ABOKOBI FEEDER ROAD PH.1 (2.00KM)	GREATER ACCRA	1,328,372.82	109,822.74	109,822.74	1,108,727.35	1.526	1,692,004.68	12	19	1,692,785.72	2,583,323.45	364,412.90	556,122.60	269,410.48	411,141.47	159,587.74	243,543.38	JULY, 2013	145.31	24.30
24	SURFACING OF DODOWA TOWN ROADS	GREATER ACCRA	498,883.87	39,581.98	39,581.98	419,719.91	2.233	937,270.63	12	9	498,119.04	1,112,342.63	-764.83	-1,707.93	80,824.15	180,487.27	41,242.17	92,097.31	AUGUST, 2010	104.19	19.26

25	BITUMEN SURFACING OF ADENTA TOWN ROADS (1.70KM)	GREATER ACCRA	618,225.21	49,477.10	49,477.10	519,271.01	1.519	789,011.84	12	20	867,167.56	1,317,626.94	248,942.35	378,258.09	147,101.58	223,515.05	97,624.48	148,336.55	AUGUST, 2013	197.31	28.33
26	SURFACING OF ASHALEBOTWE TOWN ROADS (2.10KM)	GREATER ACCRA	312,291.63	14,149.62	14,149.62	283,992.39	2.265	643,380.73	12	43	521,540.95	1,181,543.63	209,249.32	474,051.37	27,268.16	61,775.63	13,118.54	29,719.87	NOVEMBER, 2010	92.71	9.60
27	SURFACING DOMEABRA - KPASARA - DEBRE FEEDER ROAD PH. 1 (KM 0.00 - 5.00)	NORTHERN	1,388,133.84	112,302.82	112,302.82	1,163,528.20	1.071	1,246,641.39	24	67 34	1,540,112.92	1,650,126.33	151,979.08	162,835.26	335,368.29	359,324.33	223,065.47	238,999.49	OCTOBER, 2014	198.63	28.82
28	SURFACING DOMEABRA JN. - KPASARA - DEBRE FEEDER ROAD PH. 3 (10.5 - 15.50KM)	NORTHERN	2,398,346.60	187,445.55	187,445.55	2,023,455.50	1.499	3,032,899.24	24	25	2,412,733.19	3,616,376.37	14,386.59	21,563.65	207,354.60	310,797.84	19,909.05	29,841.10	OCTOBER, 2013	10.62	10.25
29	SURFACING WALEWALE - WUNGU FEEDER ROAD PH. 1 (KM 0.00 - 4.50)	NORTHERN	1,603,395.04	132,382.62	132,382.62	1,338,629.80	1.040	1,392,676.09	12	27	1,929,910.12	2,007,828.96	326,515.08	339,697.91	270,973.67	281,914.05	138,591.05	144,186.57	MAY, 2015	104.69	20.24

SURFACING OF BONGO TOWN ROADS

REVIEW OF COMPLETED CONTRACTS

S/N	CONTRACT NAME	REGION	CONTRACT SUM (GH¢)	PRICE CONTINGENCY PROVISION IN CONTRACT (GH¢)	PHYSICAL CONTINGENCY PROVISION IN CONTRACT (GH¢)	INITIAL ESTIMATED COST OF WORKS	AVERAGE PAF FOR JUNE, 2015	INITIAL ESTIMATED COST OF WORKS ADJUSTED TO JUNE, 2015	CONTRACT COMPLETION PERIOD (MONTHS)	ACTUAL COMPLETION PERIOD (MONTHS)	ACTUAL COST OF WORK (GH¢)	ACTUAL COST OF WORK ADJUSTED TO JUNE, 2015 (GH¢)	COST OVERRUN (GH¢)	COST OVERRUN ADJUSTED TO JUNE, 2015	ACTUAL PRICE FLUCTUATION PAID (GH¢)	ACTUAL PRICE FLUCTUATION PAID ADJUSTED TO JUNE, 2015 (GH¢)	COST OVERRUN DUE TO PRICE FLUCTUATION (GH¢)	COST OVERRUN DUE TO PRICE FLUCTUATION ADJUSTED TO JUNE, 2015 (GH¢)	YEAR OF COMPLETION	% INCREASE IN PRICE CONTINGENCY (%)	% OF ACTUAL FLUCTUATION OF INITIAL ESTIMATED COST OF WORKS
(a)	(b)	(c)	(d)	(e)	(f)	(g) = (d-e-f)	(h)	(i) = (g*h)	(j)	(k)	(l)	(m) = (l*h)	(n) = (l-d)	(o) = (n*h)	(p)	(q) = (p*h)	(r) = (p-e)	(s) = (r*h)	(t)	(u) = (p-e)/e*100	(v) = p/g*100
31	SURFACING OF KANDIGA JNC. - SIRIGU FEEDER ROAD (KM 0.00 - 5.00)	UPPER EAST	1,481,270.35	118,239.20	118,239.20	1,244,791.96	1.526	1,899,649.93	18	24	2,541,280.39	3,878,192.71	1,060,010.04	1,617,658.26	430,604.12	657,135.58	312,364.93	476,693.32	JULY, 2013	264.18	34.59
32	SURFACING OF KANDIGA JN. - KANDIGA PH 1 FEEDER ROAD	UPPER EAST	1,481,270.35	118,239.20	118,239.20	1,244,791.96	1.519	1,891,412.33	18	24	2,543,649.79	3,864,975.62	1,062,379.44	1,614,243.70	432,973.52	657,886.20	314,734.33	478,226.40	AUGUST, 2013	266.18	34.78
33	SURFACING OF NAVRONGO - PUNGU FEEDER ROAD	UPPER EAST	633,159.29	28,552.70	28,552.70	576,053.90	1.939	1,116,848.04	18	22	1,011,158.85	1,960,425.54	377,999.56	732,862.09	132,576.47	257,038.05	104,023.78	201,680.34	NOVEMBER, 2011	364.32	23.01
34	SURFACING OF SANDEMA TOWN ROADS FEEDER ROAD	UPPER EAST	520,335.10	42,943.92	42,943.92	434,447.27	2.405	1,044,840.66	12	7	499,160.13	1,200,474.35	-21,174.97	-50,925.56	48,274.38	116,099.33	5,330.47	12,819.71	SEPTEMBER, 2009	12.41	11.11
35	SURFACING OF ZEBILLA - ZABRE PH I FEEDER ROAD	UPPER EAST	1,049,934.48	82,294.50	82,294.50	885,345.48	1.546	1,368,978.36	20	25	1,487,018.95	2,299,324.73	437,084.47	675,848.23	286,285.88	442,673.71	203,991.38	315,424.64	MAY. 2013	247.88	32.34
36	SURFACING OF SOMBO -DAFFIAMA PH.I (0.00 - 10.00KM) FEEDER ROAD	UPPER WEST	1,256,511.00	59,578.05	59,578.05	1,137,354.90	2.560	2,911,202.88	21	21	2,844,996.93	7,282,127.38	1,588,485.93	4,065,929.48	779,971.47	1,996,435.05	720,393.42	1,843,937.54	APRIL, 2009	1209.16	68.58
37	SURFACING OF SOMBO -DAFFIAMA PH.II (10.00 - 18.00KM) FEEDER ROAD	UPPER WEST	1,479,179.75	66,328.63	66,328.63	1,346,522.50	2.463	3,316,354.06	18	13	2,203,833.68	5,427,828.18	724,653.93	1,784,752.21	648,712.60	1,597,716.09	582,383.98	1,434,355.13	JUNE, 2009	878.03	48.18
38	BITUMEN SURFACING OF VAKPO - TSRUKPE - BOTOKU FEEDER ROAD PHI (KM 2+900 - 7+800)	VOLTA	1,964,633.16	160,819.43	160,819.43	1,642,994.30	1.071	1,760,356.73	18	27	2,672,036.90	2,862,905.94	707,403.74	757,935.03	849,872.57	910,580.70	689,053.14	738,273.61	OCTOBER, 2014	428.46	51.73
39	SURFACING OF ABOTOASE - ATONKOR & OTHER FEEDER ROAD (14.10KM)	VOLTA	1,569,648.53	70,074.94	70,074.94	1,429,498.66	2.255	3,224,161.90	24	40	3,094,614.64	6,979,746.73	1,524,966.11	3,439,483.89	609,948.41	1,375,707.79	539,873.48	1,217,657.32	OCTOBER, 2010	770.42	42.67
40	SURFACING OF HOHOE - BAIKA - NEW AYOMA FEEDER ROAD PH. III (KM 17+000 - 22+000)	VOLTA	690,679.23	57,389.94	57,389.94	575,899.35	2.441	1,405,848.67	12	17	893,786.74	2,181,855.04	203,107.51	495,813.06	174,653.90	426,353.93	117,263.96	286,257.28	JULY, 2009	204.33	30.33
41	SURFACING OF KADJEBI - ASATO FEEDER ROAD (KM 0+000 - 5+000)	VOLTA	712,395.13	60,657.47	60,657.47	591,080.19	2.085	1,232,274.79	12	36	1,084,073.71	2,260,060.02	371,678.58	774,869.73	207,940.39	433,510.90	147,282.92	307,053.14	FEBRUARY, 2011	242.81	35.18
42	SURFACING OF POASE CEMENT - OBUASE FEEDER ROAD PH. 2 (4.00KM)	VOLTA	1,150,470.10	94,179.09	94,179.09	962,111.92	2.085	2,005,795.97	12	24	1,566,583.01	3,265,987.91	416,112.91	867,505.73	197,646.21	412,049.75	103,467.12	215,706.65	FEBRUARY, 2011	109.86	20.54
43	SURFACING OF POASE CEMENT - OBUASE FEEDER ROAD PH. 1 (4.00KM)	VOLTA	931,852.26	74,004.36	74,004.36	783,843.55	2.085	1,634,144.85	12	24	834,510.55	1,739,774.61	-97,341.71	-202,936.49	91,570.10	190,903.91	17,565.74	36,620.79	FEBRUARY, 2011	23.74	11.68
44	SURFACING OF KPETOE TOWN ROADS (2.0KM)	VOLTA	479,225.98	36,993.83	36,993.83	405,238.32	2.303	933,459.80	12	15	660,523.15	1,521,504.21	181,297.17	417,615.05	144,685.68	333,281.08	107,691.85	248,066.40	FEBRUARY, 2010	291.11	35.70
45	SURFACING OF KPEVE TOWN ROADS (1.60KM)	VOLTA	678,276.68	53,581.39	53,581.39	571,113.90	2.241	1,279,614.40	12	11	754,206.88	1,689,845.02	75,930.20	170,126.10	26,357.96	59,056.55	-27,223.43	-60,995.71	SEPTEMBER, 2010	-50.81	4.62
46	UPGRADING OF ANKAAKO - ATOBIASE FEEDER ROAD (KM 4.5 - 9.0)	WESTERN	1,060,320.93	86,818.41	86,818.41	886,684.11	2.546	2,257,832.17	12	10	889,124.07	2,264,045.22	-171,196.86	-435,931.79	126,484.96	322,078.42	39,666.55	101,006.00	MAY, 2009	45.69	14.26
47	SURFACING OF ANKAAKO -ATOBIASE F/RD PH 1 (0.00 -4.50)	WESTERN	901,048.13	73,545.68	73,545.68	753,956.77	2.397	1,806,958.78	12	14	902,140.07	2,162,099.99	1,091.94	2,616.98	176,135.36	422,132.07	102,589.68	245,869.96	OCTOBER , 2009	139.49	23.36
48	UPGRADING OF BOGOSO -INSU SIDING OPPONG VALLEY FEEDER ROADS PH.I(KM 0.0 - 3.00)	WESTERN	770,899.64	63,074.97	63,074.97	644,749.70	1.983	1,278,716.52	12	26	1,035,157.90	2,053,003.69	264,258.26	524,097.03	167,482.14	332,163.29	104,407.17	207,068.22	AUGUST, 2011	165.53	25.98
49	UPGRADING OF LINESO JN. - MFRAMAKROM FEEDER ROAD PH.II(KM 5.0 - 10.0)	WESTERN	1,060,320.93	86,818.41	86,818.41	886,684.11	2.012	1,783,793.41	18	34	1,233,257.55	2,481,015.14	172,936.62	347,906.55	347,943.17	699,977.29	261,124.76	525,319.70	APRIL, 2011	300.77	39.24
50	SURFACE DRESSING OF TELEKUBOKAZOANYINASE F/RD (0.00-7km)	WESTERN	1,075,017.18	48,023.51	48,023.51	978,970.16	2.405	2,354,411.92	18	14	1,061,627.69	2,553,202.33	-13,389.49	-32,201.56	111,361.75	267,823.72	63,338.24	152,327.74	SEPTEMBER, 2009	131.89	11.38

APPENDIX B: QUESTIONNAIRE

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI COLLEGE OF ART AND BUILT ENVIRONMENT DEPARTMENT OF BUILDING TECHNOLOGY

Dear Sir/Madam,

QUESTIONNAIRE

This survey is part of a postgraduate level research entitled determination of cost contingency in the procurement of feeder roads in Ghana.

The questionnaire is in two sections. Section A requests for the background information of the respondents. Section B focuses largely on price or cost contingency in feeder roads contracts. Here the emphasis is on the awareness of other cost contingency computation tools or methods aside the widely used traditional percentage, the variables that influence cost contingency and their significance.

Relying on your broad experience, please answer all questions to the best of your ability. There are no “correct” or “incorrect” answers. Only your valued expert response is requested. The questionnaire will take approximately **10 minutes** to complete.

Thank you.

Yours Faithfully,

Daniel Y. Babaa

MSc Procurement Management

Department of Building Technology

Kwame Nkrumah University of Science and Technology,

Kumasi

Tel: 0208405704

E-mail: danielbabaa@yahoo.com

SECTION A: DEMOGRAPHIC CHARACTERISTICS

Region of operation …………………………………………………………………

1. Kindly indicate (by ticking √) your role in the management of road construction projects
   A. Quantity Surveyor [ ]
   B. Estimator [ ]
   C. Project Manager [ ]
   D. Civil Engineer [ ]
2. How long have you been working with the Department of Feeder Roads? Kindly indicate by ticking (√)
   A. Less than 5 years [ ] B. 5 to 10 years [ ]
   C. Between 10 and 15 years [ ]
   D. 15 to 20 years [ ]
   E. Above 20 years [ ]
3. Kindly indicate your general years of experience in professional practice
   …………….years……………..months
4. What is the average provision (in terms of percentage) do you make for?
   i. Price Contingency ……………………………
   ii. Physical Contingency…………………………

SECTION B: PRICE CONTINGENCY IN DEPARTMENT OF FEEDER ROADS' (DFR) CONTRACTS Awareness of the various Price Contingency Methods

5. Review of literature reveals the following as other price contingency methods available to project professionals in the determination of price contingency. Please kindly rate on the scale provided your level of awareness in general; and the usage on DFR projects.

1 = Never 2 = Rarely 3 = Neutral 4 = Frequently 5 = Always

		Awareness					**Usage**				
Item	**Methods/Techniques**	**Rankings**					**Rankings**				
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
XIV.	Traditional percentage										
XV.	Method of Moments										
XVI.	Monte Carlo Simulation										
XVII.	Factor Rating										
VIII.	Individual risks – expected value										
XIX.	Range Estimating										
XX.	Regression										
XXI.	Artificial Neural Networks										
XXII.	Fuzzy Sets										
XIII.	Controlled Interval Memory										
XIV.	Influence Diagrams										
XXV.	Theory of Constraints										
XVI.	Analytic Hierarchy Process										

Variables for Determination of Price Contingency

6. How significant does your price contingency sum or percentage depend on the following variables of price contingency? Use the key 1= Not significant 2= Less significant 3= Neutral 4= Significant 5= Very significant

Item	Variables	Rankings				
		1	2	3	4	5
I.	Total Contract Sum					
II.	Experience of Estimator					
III.	Location of Project					
IV.	Complexity of Project					
V.	Type of Client					
VI.	Project Duration/Contract Period					
VII.	Inflation Rate					
VIII.	Available technology					
IX.	Company Policy					
X.	Level of dilapidation					
XI.	Method of Construction					
XII.	Weather Conditions					
XIII.	Urgency of Completion					
XIV.	Change Orders or Variation					

THANK YOU

APPENDIX C: SAMPLES COMPUTATION OF PRICE ADJUSTMENT FACTORS (PAF)

COMPUTATION OF PRICE ADJUSTMENT FACTORS (PAF)

BASE MONTH… **AUGUST, 2008** **AUGUST, 2015**

PRICE ADJUSTMENT FACTORS FOR THE MONTH(S) OF JUNE, 2015

WORK SECTION	X	a. LL / LLo	b. PL / PLo	x FE / FEo	c. FU / FUo	d. BI / BIo	e. CE / CEo	f. RS / RSo	g. CH / CHo	h. TI / TIo	I. PC / PCo	j. CO / COo	Total PAF
COMPUTED AVERAGE IND'S.		28885.28	894.42	41883.00	324000.00	760760.00	282470.00	71910.00	27438.27	8572.52		593.53	
BASE MONTH IND'S.		9206.82	782.09	11020.00	120000.00	389970.97	77235.48	44045.00	14208.40	2260.80		263.38	
INDEX FACTOR.		3.137		4.347	2.700	1.951	3.657	1.633	1.931	3.792		2.254	
SITE CLEARANCE	0.10	0.03 0.094	0.65 2.825		0.11 0.297							0.11 0.248	3.564
EARTHWORKS	0.10	0.02 0.063	0.63 2.738		0.13 0.351							0.12 0.270	3.522
CONCRETEWORKS	0.10	0.04 0.125	0.05 0.217		0.01 0.027		0.35 1.280		0.34 0.657			0.11 0.248	2.654
FORMWORK	0.10	0.15 0.471								0.50 1.896		0.25 0.563	3.030
REINFORCEMENT STEEL	0.10	0.04 0.125	0.06 0.261		0.02 0.054			0.65 1.061				0.13 0.293	1.894
PRECAST CONC PIPES	0.10	0.02 0.063	0.17 0.739		0.05 0.135		0.01 0.037				0.52 0.000	0.13 0.293	
SURFACING - PRIMER SEAL AND SEAL	0.10	0.04 0.1255	0.02 0.087		0.01 0.027	0.72 1.405			0.000			0.11 0.248	1.992
SURFACING - PRECOATED CHIPPINGS	0.10	0.16 0.5020	0.19 0.826		0.06 0.162	0.15 0.293			0.20 0.386			0.14 0.315	2.584
HAULAGE OF AGG	0.10	0.02 0.0627	0.58 2.521		0.18 0.486							0.12 0.270	3.440

WORK SECTION	X	a. LL / LLo	b. PL / PLo	x FE / FEo	c. FU / FUo	d. BI / BIo	e. CE / CEo	f. RS / RSo	g. CH / CHo	h. TI / TIo	I. PC / PCo	j. CO / COo	Total PAF
GENERAL ITEMS	0.10	0.08 0.251	0.22 0.956		0.04 0.108		0.05 0.183	0.02 0.033	0.08 0.154	0.02 0.076		0.39 0.879	2.740
AVERAGE PAF													**2.824**

COMPUTATION OF PRICE ADJUSTMENT FACTORS (PAF)

BASE MONTH… APRIL, 2009 **AUGUST, 2015**

PRICE ADJUSTMENT FACTORS FOR THE MONTH(S) OF JUNE, 2015

WORK SECTION	X	a. LL LLo	b. PL PLo	x FE FEo	c. FU FUo	d. BI BIo	e. CE CEo	f. RS RSo	g. CH CHo	h. TI TIo	I. PC PCo	j. CO COo	Total PAF
COMPUTED AVERAGE IND'S. BASE MONTH IND'S. INDEX FACTOR.		28885.28 10913.17 2.647	894.42 801.42	41883.00 14035.00 3.330	324000.00 86200.00 3.759	760760.00 295600.00 2.574	282470.00 92000.00 3.070	71910.00 34327.00 2.095	27438.27 14065.40 1.951	8572.52 3016.98 2.841		593.53 298.22 1.990	
SITE CLEARANCE	0.10	0.03 0.079	0.65 2.165		0.11 0.413							0.11 0.219	2.977
EARTHWORKS	0.10	0.02 0.053	0.63 2.098		0.13 0.489							0.12 0.239	2.979
CONCRETEWORKS	0.10	0.04 0.106	0.05 0.167		0.01 0.038		0.35 1.075		0.34 0.663			0.11 0.219	2.367
FORMWORK	0.10	0.15 0.397								0.50 1.421		0.25 0.498	2.415
REINFORCEMENT STEEL	0.10	0.04 0.106	0.06 0.200		0.02 0.075			0.65 1.362				0.13 0.259	2.101
PRECAST CONC PIPES	0.10	0.02 0.053	0.17 0.566		0.05 0.188		0.01 0.031				0.52 0.000	0.13 0.259	

SURFACING - PRIMER SEAL AND SEAL	0.10	0.04 0.1059	0.02 0.067		0.01 0.038	0.72 1.853			0.000			0.11 0.219	2.382
SURFACING - PRECOATED CHIPPINGS	0.10	0.16 0.4235	0.19 0.633		0.06 0.226	0.15 0.386			0.20 0.390			0.14 0.279	2.437
HAULAGE OF AGG	0.10	0.02 0.0529	0.58 1.932		0.18 0.677							0.12 0.239	3.000
GENERAL ITEMS	0.10	0.08 0.212	0.22 0.733		0.04 0.150		0.05 0.154	0.02 0.042	0.08 0.156	0.02 0.057		0.39 0.776	2.379
AVERAGE PAF													**2.560**

COMPUTATION OF PRICE ADJUSTMENT FACTORS (PAF)

BASE MONTH… MAY, 2009 AUGUST, 2015

PRICE ADJUSTMENT FACTORS FOR THE MONTH(S) OF JUNE, 2015

WORK SECTION	X	a. LL LLo	b. PL PLo	x FE FEo	c. FU FUo	d. BI BIo	e. CE CEo	f. RS RSo	g. CH CHo	h. TI TIo	I. PC PCo	j. CO COo	Total PAF
COMPUTED AVERAGE IND'S. BASE MONTH IND'S. INDEX FACTOR.		28885.28 10913.17 2.647	894.42 801.76	41883.00 14312.00 3.265	324000.00 86200.00 3.759	760760.00 295600.00 2.574	282470.00 97401.29 2.900	71910.00 31545.06 2.280	27438.27 14065.40 1.951	8572.52 2893.52 2.963		593.53 306.48 1.937	
SITE CLEARANCE	0.10	0.03 0.079	0.65 2.122		0.11 0.413							0.11 0.213	2.928
EARTHWORKS	0.10	0.02 0.053	0.63 2.057		0.13 0.489							0.12 0.232	2.931
CONCRETEWORKS	0.10	0.04 0.106	0.05 0.163		0.01 0.038		0.35 1.015		0.34 0.663			0.11 0.213	2.298

FORMWORK	0.10	0.15 0.397							0.50 1.481		0.25 0.484	2.463
REINFORCEMENT STEEL	0.10	0.04 0.106	0.06 0.196	0.02 0.075			0.65 1.482				0.13 0.252	2.210
PRECAST CONC PIPES	0.10	0.02 0.053	0.17 0.555	0.05 0.188		0.01 0.029				0.52 0.000	0.13 0.252	
SURFACING - PRIMER SEAL AND SEAL	0.10	0.04 0.1059	0.02 0.065	0.01 0.038	0.72 1.853			0.000			0.11 0.213	2.375
SURFACING - PRECOATED CHIPPINGS	0.10	0.16 0.4235	0.19 0.620	0.06 0.226	0.15 0.386			0.20 0.390			0.14 0.271	2.417
HAULAGE OF AGG	0.10	0.02 0.0529	0.58 1.893	0.18 0.677							0.12 0.232	2.955
GENERAL ITEMS	0.10	0.08 0.212	0.22 0.718	0.04 0.150		0.05 0.145	0.02 0.046	0.08 0.156	0.02 0.059		0.39 0.755	2.341
AVERAGE PAF												**2.546**

COMPUTATION OF PRICE ADJUSTMENT FACTORS (PAF)

BASE MONTH… **JUNE, 2009** **AUGUST, 2015**

PRICE ADJUSTMENT FACTORS FOR THE MONTH(S) OF JUNE, 2015

WORK SECTION	X	a. LL LLo	b. PL PLo	x FE FEo	c. FU FUo	d. BI BIo	e. CE CEo	f. RS RSo	g. CH CHo	h. TI TIo	I. PC PCo	j. CO COo	Total PAF
COMPUTED AVERAGE IND'S. BASE MONTH IND'S.		28885.28 10913.17	894.42 801.87	41883.00 14700.00	324000.00 107750.00	760760.00 295600.00	282470.00 98440.00	71910.00 30015.00	27438.27 14785.80	8572.52 3001.54		593.53 314.57	
INDEX FACTOR.		2.647		3.178	3.007	2.574	2.869	2.396	1.856	2.856		1.887	

SITE CLEARANCE	0.10	0.03 0.079	0.65 2.066	0.11 0.331							0.11 0.208	2.783
EARTHWORKS	0.10	0.02 0.053	0.63 2.002	0.13 0.391							0.12 0.226	2.772
CONCRETEWORKS	0.10	0.04 0.106	0.05 0.159	0.01 0.030		0.35 1.004		0.34 0.631			0.11 0.208	2.238
FORMWORK	0.10	0.15 0.397							0.50 1.428		0.25 0.472	2.397
REINFORCEMENT STEEL	0.10	0.04 0.106	0.06 0.191	0.02 0.060			0.65 1.557				0.13 0.245	2.259
PRECAST CONC PIPES	0.10	0.02 0.053	0.17 0.540	0.05 0.150		0.01 0.029				0.52 0.000	0.13 0.245	
SURFACING - PRIMER SEAL AND SEAL	0.10	0.04 0.1059	0.02 0.064	0.01 0.030	0.72 1.853			0.000			0.11 0.208	2.360
SURFACING - PRECOATED CHIPPINGS	0.10	0.16 0.4235	0.19 0.604	0.06 0.180	0.15 0.386			0.20 0.371			0.14 0.264	2.329
HAULAGE OF AGG	0.10	0.02 0.0529	0.58 1.843	0.18 0.541							0.12 0.226	2.764
GENERAL ITEMS	0.10	0.08 0.212	0.22 0.699	0.04 0.120		0.05 0.143	0.02 0.048	0.08 0.148	0.02 0.057		0.39 0.736	2.264
AVERAGE PAF												**2.463**

COMPUTATION OF PRICE ADJUSTMENT FACTORS (PAF)												
BASE MONTH…	**JULY, 2009**		**PRICE ADJUSTMENT FACTORS FOR THE MONTH(S) OF JUNE, 2015**						**AUGUST, 2015**			
WORK SECTION	X	a. LL LLo	b. PL x FE PLo FEo	c. FU FUo	d. BI BIo	e. CE CEo	f. RS RSo	g. CH CHo	h. TI TIo	I. PC PCo	j. CO COo	Total PAF

COMPUTED AVERAGE IND'S. BASE MONTH IND'S. INDEX FACTOR.		28885.28 10913.17 2.647	894.42 801.65	41883.00 14805.00 3.156	324000.00 112060.00 2.891	760760.00 295600.00 2.574	282470.00 100725.16 2.804	71910.00 30015.00 2.396	27438.27 14831.80 1.850	8572.52 3055.56 2.806		593.53 317.33 1.870	
SITE CLEARANCE	0.10	0.03 0.079	0.65 2.052		0.11 0.318							0.11 0.206	2.755
EARTHWORKS	0.10	0.02 0.053	0.63 1.989		0.13 0.376							0.12 0.224	2.742
CONCRETEWORKS	0.10	0.04 0.106	0.05 0.158		0.01 0.029		0.35 0.982		0.34 0.629			0.11 0.206	2.209
FORMWORK	0.10	0.15 0.397								0.50 1.403		0.25 0.468	2.367
REINFORCEMENT STEEL	0.10	0.04 0.106	0.06 0.189		0.02 0.058			0.65 1.557				0.13 0.243	2.254
PRECAST CONC PIPES	0.10	0.02 0.053	0.17 0.537		0.05 0.145		0.01 0.028				0.52 0.000	0.13 0.243	
SURFACING - PRIMER SEAL AND SEAL	0.10	0.04 0.1059	0.02 0.063		0.01 0.029	0.72 1.853			0.000			0.11 0.206	2.357
SURFACING - PRECOATED CHIPPINGS	0.10	0.16 0.4235	0.19 0.600		0.06 0.173	0.15 0.386			0.20 0.370			0.14 0.262	2.315
HAULAGE OF AGG	0.10	0.02 0.0529	0.58 1.831		0.18 0.520							0.12 0.224	2.729
GENERAL ITEMS	0.10	0.08 0.212	0.22 0.694		0.04 0.116		0.05 0.140	0.02 0.048	0.08 0.148	0.02 0.056		0.39 0.729	2.243
AVERAGE PAF													**2.441**