KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF ARCHITECTURE AND PLANNING

DEPARTMENT OF BUILDING TECHNOLOGY

Topic

DETERMINATION OF VARIANCE BETWEEN PROJECT COST CONTIGENCIES AND OVERRUNS IN GHANA.

By

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DETERMINATION OF VARIANCE BETWEEN PROJECT COST CONTIGENCIES AND OVERRUNS IN GHANA.

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MAY 2013

DECLARATION

I hereby declare that this submission is my own work towards the MSc Construction Management and that, to the best of my knowledge, it contains no material previously published by another 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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ABSTRACT

All construction projects are prone to various types of risk at various stages of the project. These risks which are either predictable or unpredictable are the reasons why contingencies are allowed on projects. The contingency percentage allocated on a project is to cater for these risks that may occur during the course of the project. Studies have shown that these contingencies allocated on projects above the estimated cost of the project to cushion any overruns that may occur are not adequate. Various factors have been identified to contribute to this some of which are: nature of the project, percentage of contingency allocated, variations and economic conditions

The aim of this study is to advance knowledge in contingency calculation methods in Ghana and identify how these methods used greatly affect the cost overruns of projects. The study also seeks to establish if there is a relationship between cost overruns and contingencies allocated to on projects. The tools for the collection of data included questionnaires, interviews and extensive literature review of works already done in this area of study. The target population for the data collection was forty (40) professionals including building consultants and quantity surveyors. Twenty (20) out of the questionnaires were fully answered and used for the study. Statistical Package for Social Scientists (SPSS V 16) was employed to analyze data obtained and the variance for the study. Research findings reveal a variance between project contingencies allowed on delivered projects and cost over runs. Among the factors that were identified to have an effect on contingencies, project variations were found to be the most prevalent of all.

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DEDICATION

I dedicate this work to my husband, Mr. Joshua Owusu-Ansah

and

To my father: Mr. James Oppong

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My first gratitude goes to the Almighty God for granting me the opportunity to pursue this programme and also for his guidance, wisdom and protection throughout this programme.

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CHAPTER ONE

INTRODUCTION TO THE RESEARCH

1.1 General

Risk as defined by the Project Management Institute is a possible future event that may affect your project either positively or negatively. Positive risk is normally known as opportunity, PmBOK. This adds to the project value. However negative risk has an adverse effect on project that may either reduce or increase the scope, time and cost of the project. Risks can be experienced at any level of the project. Due to the fact that risks can be encountered at different level of the project, a sum of money or a reserve is placed aside of the total cost of works of the project to take care of these unpredictable risks that may occur. These moneys that are allocated and added to the cost of works of the project are called contingencies. This amount is added to a cost estimate to compensate for unexpected expenses resulting from incomplete design, unforeseen and unpredictable conditions, or uncertainties in the project. Contingencies are not part of the estimated cost of the project but they are just added to the estimated construction cost to cushion the effect of any eventualities that may occur.

Project contingency reflects the degree of uncertainty caused by lack of project definition, and process contingency reflects the degree of uncertainty caused by use of new technology. They are put in the contract document in case of any unforeseen circumstances that might arise during the construction process. Post contract award changes of the project total cost of works are referred to as cost overruns. Cost overruns represent additional expenses increasing the project cost from its previously estimated value.

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The typical method of determining the required amount of contingency funding to be allocated to a project is the use of a percentage of the basic construction cost. Assigning a contingency percentage to the budget to take care of overruns can be done by an overly simplistic approach based solely on experience and intuition. Different cost estimation methods such as method of moments, Monte Carlo Simulation among others are also advance and more accurate methods of estimating contingencies aside the simple way of just adding a percentage of the basic construction cost which is a highly questionable procedure to most professional. This is due to the fact that it is not based on any mathematical works but on one's intuition and experience over a long period of practicing. (Mak et al 1998)

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1.1 Problem Statement

Over a period of time, studies have observed that most projects in host Ghana and worldwide usually rise above their estimated project cost. This is of great concern to clients and building professional as such. There are numerous reasons which have been identified as the cause of this problem of which are; errors in budgeting or estimating projects plans, specifications-error, omissions, vague drawings, unique bid request by clients and lack of knowledge by the contractor in new location. This research seeks to find if project overruns are adequately taken care of by the percentage of contingencies added to the estimated cost of the projects.

1.2 Aim

The aim of this research is:

- To determine the degree of variance between contingency levels allocated to projects and cost over runs.

1.3 Objectives

The objectives of the research are:

- To determine the average level of contingency allowed on projects
- To investigate how contingencies are determined by Ghanaian consultants
- To determine the variation between project cost contingency and cost overrun of projects.
- To suggest ways to reduce the variance if any.

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1.4 Scope of Study

The scope of the study will be limited to quantity surveyors in the Greater Accra region of the country.

1.5 Methodology

The methodology adopted involved extensive literature review of books, journal conference proceedings and reports of works in this research area. The theoretical procedure for the collection of data for this research is a quantitative method using paper and electronic questionnaire and face-to-face interview of respondents, who were Quantity Surveyors. The data gathered was on all types of projects ranging from private to public projects.

1.6 Expected outcome and Benefits

At the end of this research, the expected outcome is to establish if there is a variance between project cost contingencies allowed on projects and project cost overruns incurred on these projects in the Ghanaian construction industry.

The benefits of this outcome will lead to an improved understanding of how project cost contingencies and project cost overruns are related in various types of project under various conditions of the project execution; this will principally be felt in improved knowledge and methods of cost estimations for consultants and less cases of project cost overruns.

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CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

All too often construction projects worldwide make the national headlines for being financial disasters – rather than significant engineering achievements that contribute to the improvement of our built environment. In the mid-1990s the United States government investigation revealed that more than one quarter of construction schemes finished over their capital cost limit (HM Treasury, 1995). Further to this, a survey of construction industry clients found that nearly one third clients complained that their projects generally overran their estimated budgets (Barrick, 1995). This problem continued through the latter part of the decade with the Construction Clients Forum (1997) reporting that sixty per cent of clients said that their cost targets of projects were not being met. At the start of this new decade only forty-five per cent of projects are being completed within budget (DETR, 2000a).

The construction industry in Ghana is no exception, it has equally acquired a poor reputation for delivering facilities over budget especially government funded project. About 13 out of 26 World Bank-funded projects in Ghana that were supposed to have been completed within three to five years have run far beyond their completion dates and estimated budgets. The World Bank approved an additional financing of $50 million to the Ghana government, as a supplement to the ongoing Urban Water Project being financed by the Bank with a $103 million grant. (Ghana Business News). The project has suffered an unanticipated cost overruns and financing gap of about $42 million; and this has implemented an additional lot of works that would scale up the project's impact to deprived areas at a cost of $8 million. The ongoing 400 MW Bui

Hydroelectric project which if completed this year has overrun its budget by $168 million. The Government of Ghana is now seeking an additional funding from the EXIM Bank of China to complete Ghana's third hydroelectric power dam that will increase the country's power generation capacity. Complex construction project, such as the Bui Hydroelectric project, which incorporates substantial levels of geological unknowns and other physical risks, needs to recognize the associated uncertainties before the onset of the project. (The Chronicle, 5th June 2013). There are certain inevitable factors such as errors in budgeting, specifications-error and others that also lead to these projects being overrun. It is evident that the Ghanaian construction industry also faces the problem of projects being overrun even with contingencies allocated to take care of these problems. This research investigates if there is relationship between construction project cost overruns and the contingencies allocated to them.

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2.2 What is Project Contingencies?

No standard definition has been found to define contingency as Patrascu (1988:115) observes, however all contingency definitions addresses the fact that there is a risk which cannot be identified from the start of the project. And hence it has to be taken into consideration by allocating an amount for it before the start of the project. These are unforeseen and unpredictable. Contingency is probably the most misunderstood misinterpreted and misapplied word in project execution because it means different things to different people in different fields of study. The amount of money or time needed above the estimated to reduce the risk of overruns of project is considered as contingency. It could be either money or time but in the understanding of many they consider money as the only form of contingency which may not be totally right (PMI

2000: 199). Incomplete design, unforeseen events and unpredictable conditions or uncertainties in the project are the main reasons why contingencies are allocated on projects. However, it should be clear that contingencies are not part of the estimated cost of the project but they are just added to the estimated construction cost to cushion the effect of any eventualities which may occur.

The following are key attributes of the concept of project cost contingency:

- Reserve – Cost contingency is a reserve of money. A reserve is a provision in the project plan to mitigate cost risk (PMI 2000).
- Risk and Uncertainty – The need and amount for contingency reflects the existence of risk and uncertainty in projects (Thompson and Perry 1992). Contingency caters for events within the defined project scope that are unforeseen (Moselhi 1997, Yeo 1990), unknown (PMI 2000), unexpected (Mak et al 1998), unidentified (Levine 1995), or undefined (Clark and Lorenzoni 1985, Thompson and Perry 1992).
- Risk Management – Contingency is an antidote to risk. There is a range of risk treatment strategies for managing risks in projects such as risk transfer, risk reduction, and financial treatments for retained risks e.g. contingencies. Contingency is used in conjunction with other risk treatment strategies in risk management.
- Total Commitment - Cost estimates are prepared and contingencies added in order to indicate the likely total cost of the project. The inclusion of contingencies within a budget estimate means that the estimate represents the total financial commitment for a project. This might not necessarily be true since other measures might be taken as the need arises and drastic measures need to be taken. For example, a loan might be taken by the clients to address risk that need prompt

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action. Contingencies are added generally to avoid the need to appropriate additional funds and reduce the impact of overrunning the cost objective.

- 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, this will cause the project to be uneconomic and aborted, and lock up funds not available for other organizational activities; if too low it may be too rigid and set an unrealistic financial environment, and result in unsatisfactory performance outcomes (Dey et al 1994).

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2.3 Scope of contingencies

Contingency caters for two categories of risk - known unknowns and unknown unknowns (PMI 2000, Hillson 1999). Known unknowns are risks that have been identified, analyzed and it may be possible to plan for them (PMI 2000). An example of the known unknowns is that of clients that have a unique way of information dissemination in the organization in terms of project execution but it may not be known what this module is or requires. They are identifiable sources of uncertainty (Chapman 2000). Unknown unknowns cannot be managed although they may be addressed by applying a general contingency based on past experience with similar projects (PMI 2000). A contingency should be set up to allow for residual unidentified risks not revealed during the risk identification process (Hillson 1999).A new technology may lead to some technical unknown unknowns since there is no technical knowledge in that area. Similarly, the new geography seems to lead to non-technical unknown unknowns. If two projects of a similar scope are planned in Western Canada and in Western Africa the latter may have more non-technical unknown unknowns than the former including country risks, etc.

.Unknown unknowns cannot be anticipated and therefore are not manageable and the realization of some of them is usually inevitable but they exclude risks like '*the world may end tomorrow'* (Chapman 2000).

Cost estimating is one of the most important steps in project management. It establishes the cost baseline of the project at different stages of the development of the project. One of the most difficult and subjective tasks in project cost management is the process of estimating and budgeting. During the process of cost estimation by the quantity surveyor or any other professional numerous assumptions are made based on individual decisions, ideas and concepts. Just as every business has risk associated with them the construction industry is no exception. The construction industry cannot be fully eliminated of the risk of the project being overrun but they can be controlled and managed to an acceptable level.

Due to the sensitivity to which project success is hinged to the contingency, the risk tool to be employed during a quantitative risk analysis for the determination of contingency is very critical. Tools such as expert judgments, sensitivity analysis, decision tree analysis, expected monitory value analysis and Monte Carlo analysis come to mind; each of them has a positive and a negative effect. In recent times, the Monte Carlo simulation technique has been generally used to support contingency decision by modeling major cost components as a random variable (Curran, 1989; Ahmed, 1992; Tuoran & Wiser, 1992). Earlier research by Kangari (1995) has suggested that several factors have posed as risk factors. Defective design, differing site conditions, poor scope definition and delay in payment are the factors considered to cause high risks of cost overruns in projects.

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2.4 Types of contingencies

According to studies by PMI in cost management there is not just one contingency taking care of all unforeseen conditions as is generally known by Ghanaian consultants but there are four types namely:

- Design contingencies
- Management contingencies
- Construction contingencies
- Cash allowance / escalation contingency

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2.4.1 Design contingencies

Baccarani quoted Clark & Lorenzoni (2001) postulating that design contingency is for changes during the design process such as incomplete scope definition and inaccuracy of estimating method. Design contingencies are used to minimize the error due to estimations arising from insufficiencies in scope, lack of design completeness and uncertainties in construction technology; design changes, development and growth result from uncertain conditions such as incomplete detail drawings, incomplete take-off, and increased wastage.

2.4.2 Construction Contingency

Scope definition is hardly 100% complete at the project take-off in the construction industry. This makes the allocation of cash allowance inevitable for certain scope of works. Construction process contingency estimates risk associated with the uncertainties in the process of construction. Patrascu (1988) holds that this is a fund included in the estimates for items that are known to be required but which cannot be

defined, including variations resulting from design changes in technical specifications.

2.4.3 Management Contingency

This is also known as management reserve. It is an amount of fund above the actual estimate, included in an estimate by management, to reduce the risk of overruns of the project objective to a level acceptable to the organization. Management contingency is to cater for "unknown unknowns". Management reserve is an extra allowance after the normal contingency reserve this reserve is just known to management and is not part of the contingency allowed on the works.

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2.5 Contingency – Estimation

A range of estimating techniques is available for calculating project cost contingency

Table 1 Contingency - Estimating methods

Contingency Estimating methods	References (Examples)
1. Traditional percentage	Ahmad 1992, Moselhi 1997
2. Method of Moments	Diekmann 1983; Yeo 1990;Moselhi, 1997,
3. Monte Carlo Simulation	Lorance & Wendling 2001
4. Factor Rating	Hackney 1985, Oberlander &Trost 2001
5. Individual risks – expected value	Mak, Wong & Picken 1998
6. Range Estimating	Curran 1989
7. Regression	Merrow & Schroeder 1991; Aibinu &Jagboro 2002
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

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2.5.1 Traditional Percentage

It is worth briefly describing the long-established percentage approach to estimating contingency because it provides an understanding for the search for alternative estimating methods. Traditionally cost estimates are deterministic [i.e. point estimates for each cost element] based on their most likely value (Mak et al 1998). Contingencies are often calculated as an across-the-board percentage addition on the base estimate, typically derived from intuition, past experience and historical data. The percentage addition method is based on a subjective approach and may consider project characteristics such as type of work, phase of the project, and level of scope definition (Lorance and Wendling 2001). This calculation method is satisfactory for simple projects under stable conditions but is unsuitable for large and complex

projects (Newton 1992).

A different contingency percentage can be calculated for each major cost element, which reflects that some parts of the project may have greater uncertainty than others (Ahmad 1992, Moselhi 1997). Each major segment of the estimate is classified in terms of its degree of uncertainty or accuracy and then attracts its own appropriate contingency (Bent and Humphreys 1996). This method is considered more rational and reliable than the simple application of an overall percentage to the total cost (Traditional method) because it encourages close examination of each cost area (Moselhi 1997).

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Advantages of the Traditional Method

- An advantage of this technique (predetermined percentage) is its ease of use and consistency. Subjectivity is removed from the process by the use of a consistent percentage.
- Because of the easy of this method it is normally applied on smaller projects.

Challenges of the Traditional Percentage

- The traditional method even though it is widely used has its own challenges Thompson and Perry (1992:1) observe "all too often risk is either ignored or dealt with in an arbitrary way: simply adding a 10% 'contingency' to the estimated cost of the project is typical and the percentage may not be appropriate for the project in question (Heinze 1996).
- It is also difficult for the estimator to justify the reason of the percentage used. (Hartman 2000). There is a tendency of padding (to incorporate hidden Contingency within the individual cost elements) as well as an additional percentage to the total cost, which the project manager may not be aware. (Mak et al 1998).

- The traditional method of contingency estimation also does not encourage creativity in estimating practice; it promotes routine and mundane administrative approach requiring little investigation and decision making, which may propagate oversights (Yeo 1990, Mak et al 1998).
- Also it is claimed by (Mok et al 1997) that contingency is often set too high for low-risk projects or too low for high-risk project. There is a tendency to overestimate contingency because an underestimated contingency may attract negative comment whilst there is no penalty for overestimation. (Mak et al 1998).
- This method of contingency estimation removes specificity and subjectivity from the process; it is inflexible to potentially important risk drivers.
- By failing to take project risk drivers into consideration, the traditional percentage method produces large variations in the probability of overrun or under run from one project to another.

These challenges mentioned has led to more studies for more reliable techniques of which some are discussed.

2.5.2Individual Risks - Expected Value

The amount of contingency reserve can be based on the "expected value" for individual risk events. Expected value is the mean of a probability distribution of a risk on a project. For example, the Hong Kong Government's Works Branch introduced Estimating using Risk Analysis (ERA) for construction projects for determining contingencies using expected value (Mak et al, 1998; Mak &Picken, 2000). Firstly, a risk-free estimate of known scope is produced then risk events are

identified and estimated in terms of an average. A maximum risk allowance is calculated. The risks involved on a project can be classified into two. These are:

• Fixed Risk – These are events that will either happen in total or not at all e.g. whether an additional access road will be required or not. If these fixed risks should happen then, the maximum cost will be incurred; on the other hand if not, then no risk will be incurred. So therefore the maximum risk allowance (MRA) will be the cost if the risk eventuates, whilst the average cost (AC) = maximum cost (MC)* probability of its occurrence (PO)

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• Variable Risk – These are events that will occur but the extent is uncertain. The project team based on past experience or records estimates the maximum risk allowance, which is assumed to have a 10% chance of being exceeded. The average risk allowance is estimated as the value that has a 50% chance of being exceeded, and may have a mathematical relationship to the maximum or estimated separately. This 50% level is chosen on the rationale that the worst values for all risks will not occur but rather there will be swings and roundabouts effects of the totality of the risk events identified. The accuracy of contingencies was tested for completed ERA and non-ERA projects (i.e. using traditional percentage addition). It was found that the ERA-derived contingency was significantly more accurate.

Advantages of the ERA (Estimated Risk Analysis)

- Expected value analysis consists of modeling uncertainty as contingencies with specific probabilities these probabilities can be based on historically observed frequencies, subjective assessments, or experts. This enables a varied source of information to be analyzed for better results

Challenges of the ERA (Estimated Risk Analysis)

- Identifying the fixed and variable factors of the project is relative to the type and nature of the project. This makes one factor identified as a fixed factor in one project variable in other project.
- The traditional method of estimation that has been identified as having many challenges is still being used in disguise. This makes the ERA method less reliable since it does not totally eliminate the percentage-based method.
- The maximum risk allowance for one project in one country might be an average risk allowance for another project in another country based on conditions prevailing in both countries.

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2.5.3 Method of Moments

Each cost item in an estimate is expressed by a probability distribution; this probability distribution reflects the risk within the cost item. Each cost item distribution in the project has its expected value and variance. The expected values and variances for all the cost items of the project at hand are added together to arrive at the expected value and standard deviation for the total project cost. A normal distribution based on the central limit theorem can be assumed for the total project cost. The normal distribution based on the central limit theorem is only possible if the cost items of the project are independent of each other. Then, using probability tables (z scores) for a normal distribution, a contingency can be derived from the probability distribution based on a desired confidence level i.e. level of probability of total project cost should not being exceeded. For example, if a company sponsoring a project wants a baseline budget set at the EV of ¢116.67 and then add contingency that will

have a 90% probability of not being exceeded, then the contingency will need be ¢67.61

* EV = (a+b+c)/3; ** V = (a2 + b2 + c2 - ab – ac – bc)/18; *** SD = √ V

Advantages of the Method of Moments analysis

- All items to be used to arrive at the expected values and variances are considered to be independent of each other. This makes it easier to estimate and come out with desired contingency level.

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Challenges of the Method of Moments Analysis

- In the construction industry, the cost items of one section of works in not independent of other cost item. All items in construction are interrelated and for this reason makes this method in appropriate to be applied in estimating construction works.
- Finding the estimate of all cost items of a project is a cumbersome and difficult task aside it being time consuming.
- The relativeness of a confidence level used to arrive at the contingency is ambiguous since a desired confidence level varies from person to person.

2.5.4 Monte Carlo Simulation (MCS)

MCS allows us to examine what would happen if we undertook many trials of a project. MCS is a quantitative technique for analyzing risk and provides a structured way of setting the contingency value in a project cost estimate (Clark, 2001). The output of MCS is a probability distribution for total cost of the project. An example of its application is provided by Honeywell Performance Polymers and Chemical, which used MCS in 47 projects ranging from US$1.4m to US$505m (Clark, 2001). Contingency is be set at 50% probability level (median), based on the rationale that

many projects make up the total annual budget, so cost variations on one may be offset by another project. This approach often yields are commended contingency value of less than 5%, or zero for a well-defined project (Clark, 2001). However, for very large or strategic projects, an 80% or 90% probability level is chosen for contingency; and at a preliminary stage of a project, 95% is usually required.

Many authors (e.g. Lorance &Wendling 1999) advocate assigning contingency so that the Base Estimate + Contingency = 50/50 point (median) because this establishes a target for the project team where they have an equal chance of under running or overrunning the estimate.

The US Federal Aviation Administration (FAA) uses the median (50/50) point as its budget baseline, and contingency is the different between the 50% and 80% confidence level (Fenton et al, 1999).

Though this method is one advanced than the traditional method discussed above it has its own flaws. Users of the Monte Carlos method of estimating like the simplicity of the line-by-line range estimating method whiles management likes the graphical outputs of the estimates, Unfortunately the method as generally practiced is highly flawed. Most outcomes arrived at are unreliable because few practitioners define the "dependencies" or correlation between the model inputs. Finally, this modeling requires the analyst to quantify the degree to which each line item is related to the others and this is often not done this make this method not very reliable.

Advantages of the Monte Carlos estimating method

- The Monte Carlos analysis of estimation helps play the chance game to elicit a distribution of outcomes.
- It also identifies statistical estimators whose properties cannot be adequately determined through mathematical techniques alone.

- The model captures the outcome of the risk identification and impact evaluation and it requires a certain breakdown of the estimate
- The estimation using the Monte Carlo simulations is intended to capture the outcome of the risk identification and impact evaluation breakdown of the estimate.
- Monte Carlo analysis can be applied to any estimate or cost analysis that can be totaled or modeled in a spreadsheet this is because they are very flexible and confidence levels to be used are explicitly considered

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Challenges of the Monte Carlos estimating method

- First, this method may not take account of all of the available information about the assumed values of parameters.
- This technique does not directly provide information about the variance of the statistical distribution of the realized net benefits. As many feel more confident about an expected value with a smaller variance because it has a higher probability of producing net benefits near the expected value of the project.
- Monte Carlo estimating technique is often harder than the traditional method and the method of moments method information may also not be available for analysis.
- When using Monte Carlo simulation in estimating, it is very important to choose an appropriate confidence level, as high values may lead to poor results and very low values may result in unnecessary computational effort.

2.5.5 Estimate Quality

Oberlander &Trost (2001) developed a quantitative model to predict the amount of cost contingency required based the quality of the project cost estimate and historical cost data. Estimate quality refers to the fulfillment of quality requirements for the estimate.

The accuracy of an estimate depends on four determinants: those involved in the estimate (16% influence); how the estimate is prepared (23%); what is known about the project (39%); and other factors considered whilst preparing the estimate (22%). These four determinants were decomposed into 45 elements used to measure the quality of an estimate. A model was developed based on detailed analysis of 67 completed capital projects in the process industry for the estimate, each element is rated, from 1 (best) to 5 (worst). Examples of these elements are: relevant experience of estimating team; time allowed for preparing estimate; what is known about technology. The score for each element is entered into the model and an overall score for estimate quality is automatically derived. An ordinary least-square (OLS) fit through the data. The 67 projects provided the basis for predicting of the accuracy of an estimate. The prediction model is given as $y = mx + b$, where y represents the percentage contingency and x represents the estimate score, m is the slope and b is the intercept. This score then predicts the accuracy of the estimate. From the estimates scores arrived at, the higher the score, the greater the inaccuracy and therefore the need for more contingency for a chosen confidence level. For example, a score of 41.8 has a 90% chance of under running, if 34.9% contingency is added to the base estimate.

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Advantages of the Estimate Quality Method

- The information derived from this method can be used to check the amount of contingency determined by other methods of estimating contingencies.
- Aside it being able to check the contingency amount produced by other methods it is a method of predicting its own contingency.
- Other expectations for the estimate quality method may not be specific requirements of the project, but may reflect on the perceived quality of the estimate.

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Challenges of the Estimate Quality Method

- The rating of the determinants from 1(best) to 5 (worst) is relative to the individual performing the test.
- The four determinants of the accuracy of the estimate are woefully inadequate. What is known about the project contributing a larger portion to the accuracy might be a problem if there is little or no information on the project.

2.5.6 Regression Analysis

Regression analysis is a statistical technique for estimating the best fits sets of observations of a response of variable and multiple explanatory variables are necessary in order to make the best estimate of the true underlying relationships between these variables. Regression models have been used since the 1970s for estimating cost (Kim et al, 2004). The purpose of linear regression is to use the linear relationship between a dependent variable (e.g. estimated final cost) and independent variables (e.g. location, size) to predict or explain the behavior of the dependent variable. Gathering detailed histories of projects, which have been undertaken, and identifying key factors that drive differences between the project estimates and actual

cost outcomes of all the gathered projects derive this technique. It is important to note that regression analysis is empirical and objective by nature, and regression models produce consistent results no matter who applies them

Advantages of the Regression models

- Because regression models are based on historical data of projects, they bring expert knowledge to contingency setting without the need for a skilled expert on every project.
- Regression analysis directly addresses the factors that drive project risk, and these are the factors that drive the contingency consumption of projects. In order to use this technique, detailed project data, cost and project drivers, must be collected.
- The development of this process takes time but after it has been developed it is very simple and easy to use and produces accurate and consistent results since it allows regression models allow explicit relationships between dependent and independent variables to be analyzed.
- This technique, if developed and implemented correctly can be a viable alternative or an adequate supplement to the traditionally used methods for contingency setting.

Challenges of the regression models

- The development of this model through the gathering of all historical data is time consuming and in cases of data not being available does not produce accurate model hence poor result being achieve.

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- This model yields a similar CPI regardless of the level of project definition. This is due to the fact that regression analysis uses the level of project definition as an explicit factor.

2.5.7Artificial Neural Networks (ANNs)

ANNs are an information processing technique that simulates the biological brain and its interconnected neurons (Chen & Hartman, 2000). The structure of ANNs mimics the nervous system by allowing signals to travel through a network of simple processing elements (akin to neurons) by means of interconnections among these elements. These processing elements are organized in a sequence of layers consisting of an input layer, followed by one or more hidden layers and culminating in an output layer. The input processors accept the data into the ANN (e.g. variables that have a relationship to the amount of cost overrun in projects), the hidden processors represent relationships in the data and the output layer produces the required result (e.g. predicted amount of cost overrun). ANNs employ a mechanism to learn and acquire problem-solving capabilities from 'training' examples by detecting hidden relationships among data and generalizing solutions to new problems. ANNs are suitable form non-linear modeling of data, which contrasts with the linear approaches using regression

Over the past decade the use of ANNs for cost estimating has grown. ANN can be used to predict project cost overruns and thereby assist management in developing an appropriate contingency (Chen & Hartman, 2000). Examples of the application of ANNs to predict the level of cost overrun/under run include:

Chen & Hartman (2000) used ANN to predict the final cost of completed oil and gas projects for an organization using 19 risk factors as the input data. It was found that

75% of the predicted final cost of the projects aligned with the actual variance in cases where the ANN model predicted an overrun/under run, an overrun/under run actually occurred with those specific projects.

Chau et al (1997) used 8 key project management factors to predict the final cost of various construction projects. It was found that more than 90% of the examples did not differ by more than one degree of deviation from the expected cost of the construction projects

Gunaydin &Dogan (2004) used 8 design parameters to estimate the square metre cost of reinforced concrete structure systems in low-rise residential buildings and found that the ANN provided an average cost estimation accuracy of 93%. The research on the application of ANN to predict cost performance often compares the accuracy of ANN with multiple linear regression and in most cases ANN produce more accurate predictions (e.g. Chen & Hartman, 2000; Sonmez, 2004; Kim at al, 2004)

Advantages of the ANN

- The prediction accuracy of the Artificial Neural Network method of contingency estimation outperforms that of the multiple linear regression method of estimating contingency

Challenges of the ANN

- It is only suitable for non-linear modeling of data which contradicts the linear approach of regression and other methods like the Monte Carlo.
- This method of estimation is often compared with only the multiple linear regression method and not the other methods of estimating, this makes the accuracy got limited to just the regression analysis and not all the other method.

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2.5.8 Fuzzy sets

Fuzzy set ranking methods are generally based on the fuzzy sets theory developed by Lotfi Zadeh. The idea of using fuzzy sets in decision sciences is new since decision analysis is a field where human-originated information is pervasive and can be altered by many factors. A seminal paper in this area written by Bellman and Zadeh in 1970, high-lighting the role of fuzzy set connectives in criteria aggregation. That pioneering paper makes three main points:

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1. Membership functions can be viewed as a variant of utility functions or rescaled objective functions, and optimized as such.

2. Combining membership functions, especially using the minimum, can be one approach to criteria aggregation.

3. Multiple-stage decision-making problems based on the minimum aggregation connective can then been stated and solved by means of dynamic programming. The fuzzy sets view of decision analysis was taken over by Zimmermann who developed popular multi criteria linear optimization techniques in the seventies. The idea is that constraints are soft and can be viewed as criteria. Then any linear programming problem becomes a max-min fuzzy linear programming problem. The fuzzy sets method of estimating contingency like all the other methods has its advantage and disadvantages.

Advantages of the Fuzzy Sets

- The fuzzy sets method of contingency analysis allows analysis with small samples. This method is particularly useful in revealing relationships between the outcome and explanatory variables where traditional statistical methods lack power due to small sample sizes.

- It can be compared with the regression method of estimating contingencies since the both are linear techniques.

Disadvantages of the Fuzzy Sets method

- It is hard to develop a model from a fuzzy system and concept of study.
- For this method to be used for effective contingency estimation it requires more fine tuning and simulation before it becomes operational.

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2.5.9 Controlled Interval Memory

Numerical integration processes, such as Chapman's Controlled Interval and Memory approach, may be used in place of simulation for combining distributions of variables. (Chapman, 1979; Chapman and Cooper, 1983; Cooper and Chapman, 1987).This method requires special-purpose software, which limits their practicability. They have particular strengths where there are rare events that occur or the tails of the distributions are important, circumstances in which simulation is less efficient. The method of moments is an analytical process for combining distributions based on their mathematical form. It requires many simplifying assumptions, and so it is less commonly used. However, it is a process that may be applicable to simple estimations.

Advantages of the Controlled Interval Memory

- To ensure that the output of the controlled interval memory model will be accepted and its conclusions will command the confidence of decision-makers of the project, the model is reconciled with other views of the project it represents.

Challenges of the Controlled Interval Memory

- The use of mathematical forms makes it difficult to use since the it the management and professionals find it difficult to comprehend
- The assumptions that are considered in this method makes the acquired results far from the reality on the ground.

2.5.10 Influence Diagrams

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Another name for influence diagram is also Causal Network Modeling. It is a method that is highly acknowledged for combining related probabilistic events into a single mathematical model (park et al., 1998). This model is based on a probabilistic theory. For situations of reasoning and decision making the influence diagram is the most ideal and appropriate choice. The network contains nodes, which represent the events and their probability of occurrence. Certain event may be independent by nature or conditionally dependent on other events.

The network contains 'chance' nodes that represent the events that occur and their probability of occurrence. There are mainly two types of node

Chance nodes: these are random variables drawn as circles or ovals. They represent uncertain events relevant to the decision problem.

Value nodes: on the other hand diagrams drawn as diamonds and represent the utility, i.e., a measurement of outcomes of the decision process. They are quantified by each of the possible combinations of outcomes of the parent nodes.

Advantages of Influence Diagrams

- The influence diagram provides an environment in which experts and decision makers can discuss the management of the problem and interdependencies of

decisions and events, without invoking any formal mathematical, probabilistic or statistical notation or implications

- ID links the real-world decision making with that of a scientifically trained analyst by simple terms like diagrams which is easily understood by both parties. The decision-maker focuses on the problem at hand and ensures that the ID accurately reflects the situation of the real world.
- It helps reducing large volumes of data that is essential to the decision-making process.
- It provides a sensitivity analysis to show how much effects the particular decisions or uncertain events have on the final outcomes.

Challenges of influence diagram method

- A Lack of staff commitment to this method of estimation will leave the organization resulting in a shortage of experienced staff in the industry.
- If a client is not supportive of this method of estimating important project decisions, then automatically employees and management involved in the project will have reduced interest and commitment to the project.

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2.5.11 Theory of Constraints

Organizations managing stand-alone or multiple projects, either small or large, whether customers are internal or external, or whether the nature of the work performed is product development, construction, design, IT, or service; all projects are difficult to manage for two main reason: a) All projects involve uncertainty, and b) They involve three different and opposing factors: Due date, budget, and content.

In organizations where management of all these multiple projects is concurrent with common, shared resources, the job is even more challenging. Project manager due to

continual resource shortages and great difficulty in determining which tasks are truly the most important often experiences “Project overload”. The TOC in estimation provides a comprehensive solution to address the root causes of estimation and project management problems. To solve these problems the following point are considered

1) a robust planning process, 2) a more effective scheduling process, 3) a methodology for introducing work that actually leads to increased capacity, 4) execution processes that provide excellent project control, visibility and decision support, and 5) work behaviors that are more conducive to good project performance. Once the resources and required skills are defined, the building team estimates the potential variability of each task and the potential variability associated with specific sequences of tasks. Each task is classified in terms of a “highly probable” time to complete and an “aggressive, but possible” time to complete.

Advantages of Theory of Constraints

- The theory of constraints process results in up-front agreement of all major stakeholders on important project objectives and deliverables. Identification of the key interdependencies that will dominate the project is done early; clear task completion criteria are established for all stakeholders to be aware; realistic resource needs are identified; and a much more complete understanding of the project is achieved.
- The project scheduling process using the theory of constraints yields a feasible, immunized schedule centered on the Critical path of the work that dominates the project through to its execution
- Managers use it as a tool for assessing the impact of any major changes on the entire project.

Challenges of the Theory of Constraints

- Stakeholders who have greater power in the decision of the project turns to control and influence the decision of the other stakeholders leading to bias in decisions taken.
- The concentration of processes and tasks on the critical path makes the other works and processes not on the critical less important.

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2.5.12 Analytical Hierarchy Process

The Analytic Hierarchy Process (AHP) is a multi-criteria decision-making approach it was introduced by Saaty (1977and 1994). The AHP has attracted the interest of many researchers mainly due to its mathematical properties and the fact that the required input data relatively easier to obtain. The AHP is a decision support tool, which can be used to solve complex decision problems in estimation and decision-making. It uses a multi-level hierarchical structure of objectives, criteria, sub criteria, and alternatives. Using a set of pairwise comparisons derives the pertinent data. These comparisons are used to obtain the weights of importance of the decision criteria, and the relative performance measures of the alternatives in terms of each individual decision criterion. If the comparisons are not perfectly consistent, then it provides a mechanism for improving consistency.

Advantages of the Analytical Hierarchy Process

- The AHP provides a convenient and easy approach for solving complex estimating and decision-making problems in engineering. a software package, called Expert Choice developed in (1990), has significantly contributed to the wide acceptance of the AHP methodology.

Challenges of the Analytical Hierarchy Process

- From the observations made of the analytical hierarchy process suggest that this method should be used as a decision support tool and not as the means for deriving the final answer. To find a true solution to a problem using this method may never be humanly possible.

2.6 Contingencies Estimation Worldwide

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CANADA

In Canada, the preparation of project estimates has typically been based on historical information of already completed projects, such information may be outdated, or perhaps not even exist for certain individual types of projects. Therefore, the associated degree of accuracy of the estimate of projects can be expected to vary accordingly from one project to another. Construction projects in Canada and other parts of the world often suffer from high level of uncertainty in many fronts: time, cost, quality, safety, etc. much research has been conducted focusing on how best estimating cost contingency can be done to minimize inaccuracies which may eventually lead to cost overruns.

Even though construction cost estimation and contingency estimation of project has received extensive attention of researchers in Canada and other parts of the world, the Canadian construction industry has found an area of contingency much more problematic than cost contingency and this is time contingency. Time contingency is now of great importance of study. In order for construction industries to meet the deadline of a project, an accurate scheduling is to be sought. The study of time contingency rather than cost contingency in the Canadian industry is to help plan

schedules, which are flexible enough to accommodate changes without negatively affecting the overall duration of the project.

Data collected from sixteen construction companies in Montréal, Québec, Canada found that the methods of cost contingencies estimation were affecting their performance in projects in terms of time, quality and safety. Analytic Hierarchy Processes (AHP) used by some construction firms to develop a cost contingency model show that the predicted cost contingency matches with 87% the estimated contingency for real projects.

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It was however observed that increasing variances between project estimate and final project works are the result of the construction industry's "pricing strategies", or of an inaccurate or insufficient estimating process, it was however concluded to be the latter, since with few exceptions, (Canadian construction Institute, 2000)

AUSTRALIA

In November 2007, Federal Infrastructure engaged Evans & Peck to develop a Standard for "Best Practice Cost Estimation for Road and Rail Construction" for proposed construction projects on the National Land Transport Network that would be in receipt of Australian Government Road and Rail funding. Federal Infrastructure's objective was to use the Standard to foster an improvement in (1) the project cost estimating practices of all agencies that have projects on the National Land Transport Network and (2) its own capacity to monitor and vet project cost estimates so as to improve the management of government road and rail funding throughout Australia.

'Best Practice' in cost estimation from project identification phase through to project delivery and implementation leads to efficient use of scarce public resources and mitigates the risk of cost overruns. Better-cost estimation also provides higher levels

of certainty for public sector organizations, governments and the public to whom government agencies are accountable. As part of developing a Best Practice Standard, major agencies were interviewed to understand the common issues that are faced by the agencies in preparing reliable estimates for projects. The general findings from the interviews with the agencies were:

All agencies acknowledge that cost estimating standards need to be improved and that the problem was exacerbated by a shortfall in resources skilled in estimating.

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- Defining the scope of a project and controlling within that definition requires effective project management procedures;
- The documented estimating procedures varied in content from agency to agency and broadly reflected the size of the organization and the volume of work delivered;
- Scope for improvement and the need for more helpful material was identified in all estimating procedures;
- Structure and use of estimating methods varied between agencies;
- Understanding of risk assessment and the methods of application of contingency allowances varied significantly between agencies;
- Development and application of realistic allowances for escalation varied significantly between agencies
- Ability to support thorough project scoping and estimate reliability at an early stage was hampered by resource constraints; and
- Federal Infrastructure phases were not always aligned with an agency's project planning, development and delivery process phases.

From an analysis of these findings it became clear that the Best Practice Cost Estimation Standard needed to be a document that could be a benchmark for agencies to measure themselves against. It had to be structured in such a way that the focus was on a 'top down' set of attributes rather than a prescriptive manual or a particular cost estimation method since the method used in estimation varied for firm to firm due to their organizational policies and work load.

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USA

The U.S. construction industry has few standards for measurement of estimate components, and these apply only to major building measurements such as gross area and net area of the project in question. This lack of standardization has led to disagreements among those preparing different portions of an estimate. Therefore, it is important to define methods of measurement to be used in a particular estimate and to ensure they are applied consistently. When a detailed estimate is required during design development, complete design documentation and specifications often are not available. Although not all aspects of the design have been detailed enough for full quantity survey, it may still be possible to produce detailed estimates for analysis purposes. One-way used to accomplish this is to use systems and assemblies as a means of defining quantities. This approach provides a bridge between conceptual estimating and a full detailed quantity survey. Systems or assemblies are used to "model" components not completely designed. This exercise is useful because it can establish a quantitative base for future comparison.

When limited design information is available, the estimator works with the designers to develop a set of assumptions on which to base an estimate. It is possible to use historical information from similar facilities or similar building components and

elements as a basis for these estimates. It also may be necessary to develop what are referred to as "assemblies," which essentially are mini-estimates for individual components. Published sources are also used to prepare estimates and to crosscheck estimates prepared using other methods. The R. S. Means Company in the US published a guide that contains a variety of predefined assemblies for architectural, structural, mechanical, electrical, and site work elements for preparing estimates.

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Today's owners expect their design and construction team to manage project costs in an accurate and responsive manner. They expect that an accurately defined budget will be prepared early in a project and that the project will be completed to required scope, meeting expectations of quality and performance, all within the budget. Clients in the US are demanding that designers manage project costs and meet budgets without compromising excellence in design. For many clients a detailed estimate is a required deliverable of the procurement process, and therefore it is made a deliverable of the design team. If the results of this estimate do not indicate that the project is within budget, the procurement process will often come to a halt or the design team may be required to redesign at no cost to meet the budget.

Construction projects inherently possess uncertainties, which represent risks and opportunities to contracting business entities. The business success of most contracting firms in the US is largely defined by how these uncertainties are managed from the planning and estimating to execution phases. For this reason more accurate methods for estimating contingencies are being used by project team members and estimator to give accurate estimation figures, these methods include Monte Carlos, Artificial Neural Network (ANN) and Analytic Hierarchy Processes (AHP). Sophisticated software and applications have also been developed to calculate and

give estimates of projects since construction industries cannot afford to lose client and cost of redesign due to in accurate estimates.

UNITED KINGDOM.

In the United Kingdom, the quantity surveying profession, led by the Royal Institute of Chartered Surveyors, has promoted methods of measurement that meticulously define building components and subcomponents. These methods include the method of moments, regression analysis, the fuzzy sets and expert knowledge. Even with the promotion of other methods of estimating contingencies, which are better than the traditional method and expect knowledge the British economy's building and civil departments are not free from project cost overruns. Recently British transport secretary Patrick McLoughlin told Members of Parliament that the new projected cost of the rail line linking London to the Midlands in central England had risen to 42.6 billion pounds from the original estimate of 33 billion pounds and included a contingency fund.

Britain's Department for Transport (DfT) said the first phase of the project would now cost 21.4 billion pounds with the second phase coming in at 21.2 billion pounds. This includes a 12.7 billion pounds "contingency fund" across the project. The new budget was to include a tunnel under the M6 motorway near Birmingham, (DfT).

2.7 Contingency estimation in Africa

NIGERIA

In most construction contracts in Nigeria, risk is either ignored or dealt with in an arbitrary way by adding a percentage allowance in form of contingency sum for changes that experience shows will likely be required without considering the project

variables. These contingency sums are used to cater for events that are unforeseen which threaten the achievement of objective within the defined project scope. A study in the construction industry in Nigeria identifies a correlation between contingency and project characteristics and variables. Information of past projects is used from organizations and included project variables to determine estimate of contingencies on projects. Correlation analysis is also used to establish the strength and direction of linear relationship between the project variables with special attention on variation to determining future contingency. Analysis of variance (ANOVA) is also used for the analyses of data in exploring relationships among variables and compare groups respectively. The research in exploring the relationships among variables shows there is a strong, positive correlation between variation and five of the variables: consultant estimate, contingency sum, planned duration, gross floor area, and lowest bid and also there was a strong positive correlation between contingency and five of the variables including consultant estimate, planned duration, total variation, the lowest bid and gross floor area with high value of the variables associated with high value of contingency.

Changes and risks are inevitable in construction contract thus, many cost and time overruns in the construction industry are attributable to either unforeseen events for which uncertainties was not appropriately estimated. The effectiveness of contingency management can strongly influence project success. Contingency allocated to projects in Nigeria are proportional to the risk present in the project, and this risk diminishes as the design advances, construction contracts are awarded, and construction is completed. Total project contingency decreases over the life cycle of a project. (Institute of Surveyors, Nigeria)

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SOUTH AFRICA

To enable the management of project-related risk on a portfolio level, contingency estimation must be performed consistently and objectively. The current project contingency estimation method used in the capital program management department of Eskom Distribution Western Cape Operating Unit in South Africa is not standardized, and is based solely on expert opinion. Development of a contingency estimation tool to decrease the influence of subjectivity on contingency estimation methods throughout the project lifecycle to enable consistent project risk reflection on a portfolio level has becoming increasingly essential. From a review of contingency estimation approaches in literature, a hybrid method combining neural network analysis and expected value analysis been developed to be used on various projects in addition to expert opinion by the Eskom Distribution Western Cape Operating Unit and other institutions in South Africa.

GHANA

The process of cost contingency estimation has been one process, which lacks a well-defined framework. Practitioners to date rely on their past experience, historical data and organizational culture to estimate cost contingency. The above-mentioned process has detrimental effect on the execution phase of the project since it lacks any scientific basis and a structured risk management approach. Discussions made in the cost contingency estimating process propose a framework to improve upon the practice. Findings show that at least 95% of the Engineering Design Actors (EDA) primarily used traditional methods. The reasons why Ghanaian construction practitioners predominantly use the deterministic method is the ease of application, unavailability of any tested and approved framework and finally because most of

these actors lacked the requisite knowledge for applying complex risk analysis process. The improvement of the above process relies on the need to develop a framework to suit the Ghanaian environment, re- training professionals to acquire knowledge in risk analysis and the need to re-orient the educational curricula to feature emerging needs of the industry is necessary.

2.8 Why Contingency is Estimated Based on Percentages

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Ghanaian consultant still use past experience in contingency to develop a useful model for future use it is important to establish the reasons why the traditional method of estimating contingencies is still being used. A summary of the key views expressed by respondents in the construction industry are indicated below:

- The industry lacks a cogent and reliable data for use in the estimation of cost contingency.
- Percentages are the simplest and the best method since every figure can be expressed that way for comparative purposes and easy application.
- The contractor is the best person to estimate the project cost hence the contingency figure must be factor on his estimate.
- The knowledge about risk modeling in the industry is low hence limited in application
- Research on cost contingency is not far-fetched in Ghana with any reliable models to rely on
- Lessons learned and experience from previous projects is the best way to improve on subsequent projects hence the use of previous projects data as a basis of determination of subsequent project contingency

- External researches undertaken are based on information from other countries and hence cannot be applied in Ghana.
- Some of the risk methods of determining cost contingency are cumbersome and too mathematical and difficult to comprehend and apply.
- The industry players are adamant to change and not ready to embrace new research which has not been tested and proven to accurate
- The industry players do not have enough time for such research and would rely on the academics for new ideas.
- The practice over the years has been based on percentages (it is an industry practice), and it has worked.

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It can clearly be seen from the reason discussed above that practitioners' use traditional deterministic methods because of its simplicity, without toil and devoid of cumbersome mathematical functions with the challenge of no serious model developed that suits the industry. Most practitioners through their academic carriers have not been acquainted with the knowledge and application of risk modeling hence not conversant with the application

2.9 What Is Project Cost Overrun

In the Ghanaian construction industry project cost overruns can be explained as the total cost of the project exceeding the estimated cost of works of the project. A survey of construction industry clients in Ghana found that nearly one third complained that their projects generally overran budget this is common worldwide and in Ghana. The construction industry worldwide and in Ghana has a lot in common aside the poor

reputation for delivering facilities over budget. Different consultants use different method of calculating contingencies due to various factors they are face with in their environment.

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2.10 Causes of cost overruns

Cost overruns have a broad range across the company spectrum, and several factors cause it of which some maybe significant while others may not. The following can be classified as a few of the causes of cost overruns

1. Errors in budgeting/estimating a project
    - Mathematical errors-transcribing, pressing wrong keys, omissions and miscalculations, plans and specifications-errors, omissions, vague drawings and scope in the plans and specifications, estimators inexperienced in the field of expertise, estimating programs and unique bid requests by the client, lack of knowledge by the contractor in new locations
2. Costs required beyond the scope of work
    - Conditions unknown to the contractor, requests by client clearly not within the scope of work, client failure to fulfill commitments according to specifications.
3. Tools and equipment costs exceed project allocation
    - Inefficient equipment scheduling, poor record keeping, personnel not held accountable for returning tools.
4 Easily missed costly errors
    - Invoices not checked, accounting errors, deliveries not checked.

    The list may be endless but these are a few for our consideration and study.

This project seeks to find out if there is a relationship between project cost overruns of projects and project contingencies allocated to them.

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CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Research Methodology

Kothari, (2003) defines research as the pursuit of truth with help of study, observation, comparison and experiment that is a systematic method of finding solutions to a research problem identified. (Kothari, 2003) further argues that the process of research is a systematic method that includes the following in logical sequence:

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- Enunciating or defining the research problem
- Formulating the hypothesis/ research questions from the research problem
- Designing the appropriate research process.
- Collecting the facts or data to help answer the research questions
- Analyzing the data
- Reaching certain conclusions from the analyzed data hence answering the research questions.

Chapter Two reviewed literature on contingencies and cost overruns in general. The chapter concluded with different contingency methods and estimating practices that are used worldwide and in Ghana and how professional in this part of the world understands contingencies and overruns. This chapter discusses the approach and process followed in this research. The availability and selection of appropriate research design and method that would address the key questions raised to develop this research. This includes the selection and justification for the choice of interviews, methods and techniques used in data collection, analyses, and interpretations are also presented.

3.2 Project Objective

- To determine the average level of contingency allowed on projects by consultants.
- To determine how contingencies are calculated.
- To explore the variance that exists between the project contingencies allocated to projects.
- To make recommendations for realistic contingency estimating.

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3.3 The Study Population

The study population constitutes quantity surveyors practicing in the building industry in Ghana. In order to attain the objective of the study, the researcher mainly considered quantity surveying firms registered under the Ghana Institute of Surveyors. Apart from this, other quantity surveyors who have been practicing individually and on private projects were also considered in the study population.

3.4 Sampling Procedure

In terms of sampling techniques, non-probability sampling technique was adopted. Non-Probability sampling technique used in this study is a combination of purposive sampling and a convenience sampling technique. This selection is premised on the basis that each consultant was capable of providing the information needed for solving the problem in the research and the sampling approach used differed from respondent to respondent.

3.4.1 Purposive Sampling

A non- random sampling method that will be adopted for the study is purposive sampling method. The purposive sampling technique presupposes that the target population has basic and concrete idea about the issues under consideration. In purposive sampling we sample with a purpose in mind and this is occasionally referred to as judgment samples. Researchers select unit subjectively in an attempt to obtain the sample that appears to be representative of the population.

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3.4.2 Convenience/ Accident Sampling

In all forms of research it is idea to test the entire population, but in most cases, the population is just too large that is impossible to include every individual. The number of consultant registered with the Ghana Institute of Surveyors is too large and very difficult to come by them. This is the reason why most researchers rely on sampling techniques like convenience sampling, the most common of all the sampling techniques. This technique is the most preferred among many consultants because it is fast, inexpensive, easy and the subject are reliable. Convenience sampling is a non-probability sampling technique where subjects are selected because of their convenient accessibility and proximity to the researcher. Consultants (Quantity surveyors) were sampled using this approach.

3.5 Determination of Sample Size

Sample size estimates the number of units (out of the population size) to be surveyed for the study. A major concern of the survey was to develop a questionnaire that covers all the relevant areas so that the objectives of the study could be achieved.

The distribution of the questionnaire is to target a reasonably large number of quantity surveyors in the selected firms who can give the true reflection of the state of contingency allocations and project cost overruns in the construction industry. Statistics obtained from the Ghana Business Directory via internet indicates that the total number of quantity surveying firms in Accra is 20. In order to determine the sample size for the study two questionnaires were intended to be issued out to each of the twenty quantity surveying firms to give a better picture of variance of contingencies and cost overrun on the ground. This resulted in forty questionnaires (sample size) distributed in all twenty quantity surveying firms. This information can be mathematically analyzed as follows:

P= Q*N as used by Felix Baffoe-Bonnie 2012 (Performance Measurement of Ghanaian Contractors: The Contribution of Human Resource Management to Contractor Performance)

Where:

P: represents the total number of sample size or questionnaires

Q: represents the number of intended questionnaires to be distributed in each construction firm - 2

N: represents the number of consulting firms in Accra – 20

With the proposed formula given, if Q= 2 and N = 20

Then P= 2 * 20 = 40

Therefore the total sample size as well as the number of questionnaires administered among the quantity-surveying firms is 40.

3.6 Data Collection

Collection of data was in two parts; primary and secondary data. For the collection of primary data, which was done directly from the field (consulting firms), the study

adopted quantitative and qualitative ways of data collection for the achievement of the objectives of the study while the secondary data collection consisted of existing literature and information relating to the study. This approach was adopted due to the nature of the research, type of data (quantitative and qualitative), information required and time available. However in analyzing of the data responds a quantitative approach was used.

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3.6.1 Primary Data

Qualitative framework was used with the aid of semi – structured interviews for collecting data from quantity surveyors. This interview strategy was used to seek more information from consultants on their opinions if there is a relationship between project cost contingency and project cost overruns. The interview sections usually lasted about 10 minutes.

Quantitative data, which is merely to reinforce the qualitative data in the study area, was obtained by well-structured questionnaires. Close and open-ended well-structured questionnaires were administered to quantity surveyors in 20 different consulting firms to collect the requisite data for the study. The questionnaires contained questions mainly on contingency estimations methods and how these contingencies meet the cost overruns of project on which they were allocated.

3.6.2 Secondary Data

The study again relied on the use of secondary source data. Secondary data consist of existing literature and materials relating to the subject matter. Secondary source of data was obtained from existing reports including those from study organizations, journals, unpublished thesis, articles, the Internet as well as appropriate legal statutes.

3.7 Research Approach

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3.7.1 Quantitative Research

Quantitative research follows a deductive approach in relation to theory and is concerned with the design measurement and sampling. The strategy employs the use of mathematical and statistical techniques to identify facts and causal relationships. It follows the practices and norms of natural scientific model and particularly, positivism; and viewing social reality as an external, objective reality. Quantitative research is, therefore, objective in nature and based on testing a hypothesis or theory composed of variables (Fitzgerald and Howcroft 1998; Naoum 2002). Frechtling and Sharp (1997) characterized the common data collection techniques used in quantitative research as questionnaires, tests and existing databases. Hard and reliable data are often collected in quantitative research and, therefore, emphasizes on quantification. The samples collected are often large and representative. This means that quantitative research results can be generalized to a larger population within acceptable error limits. Quantitative or "hard" measures are also required for evaluation and can be replicated using sophisticated statistical techniques (Bryman 2004; Fitzgerald and Howcroft 1998). The validity of results depends on the careful choice of measuring instrument and how accurately it measures targets (Patton 2002). Bryman (2004) outlined the main steps in quantitative research but emphasized that

they represents an ideal account of how research should progress. He, however, argued that, though research is rarely linear, it provides a good indication of the interconnections between the main steps in quantitative research. Naoum (2002) concluded that quantitative research strategy is selected for:

- Finding facts about a concept, a question or an attribute; and
- Collecting factual evidence and study the relationships between the facts in order to test a particular theory or hypothesis. Research was conducted on professionals in the construction industry specifically consultants and quantity surveyors who are still actively practicing.

Out of a sample size of forty questionnaires distributed. Of the only twenty were retrieved fully answered for this study hence the sample size is twenty. The sampling approach is that of convenience sampling. This method was used because it was more efficient and less time consuming since one consultant could lead you to another consulting firm with less bureaucracy. For this study it should be noted that the sample size is not adequate, another researcher can take up this project with a larger sample space to ascertain the outcome of this study.

3.7.2 Qualitative Research

Qualitative research follows an inductive approach in relation to theory. It emphasizes words rather than quantification in the collection and analysis of data. Qualitative research is subjective in nature and is exploratory and attitudinal (Frechtling and Sharp 1997). Qualitative researchers often rely on interpretive or critical social science and follow a non-linear research path. The language of the strategy is, therefore, cases and contexts (Neuman 2003). Small number of, usually, non-representative cases are used and respondents are selected to fill a given requirement

(Sherif 2002). Qualitative researchers tend to collect three kinds of data; in-depth and open-ended interviews; direct observations and written documents. These yield quotations, descriptions and excerpts which are either unstructured or semi-structured (Patton 2002). The data are soft, rich and deep and determine what things exist rather than how many.

3.8 Approach Adopted

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A quantitative strategy was adopted in this research for reasons outlined below.

The research was aimed at providing a holistic approach to improve the Ghanaian consultant's method of estimating contingencies.

3.9 Questionnaire Design

Collis and Hussey (2003) stipulate that questionnaire is performed as a list of questions, which were well structured and tested before. Therefore the issue of questions' design was addressed in the following way. First of all, recommendations developed in the existing literature regarding the main areas of questionnaire design like length, types of questions or scale used were strictly followed (Bryman and Bell, 2003 Saunders, *et al*., 2007;). Selection of questionnaire based on literature background as research methodology seems appropriative.

The questionnaire is the same for all stakeholders. However, the questionnaires were designed to cover some key areas of the study. These areas included

- Personal data on the stakeholder.
- General knowledge of the stakeholder on contingency estimation
- Factors affecting contingency estimation
- How often contingencies allocated on projects meet their overruns

3.10 Limitations to the Study

During the study, a number of difficulties were encountered. These difficulties resulted in the hindrance to the smooth running of the survey, partially filled out questionnaires, rejected and even missing questionnaires. Below are some of the difficulties encountered during the study:

3.10.1 Inadequate Response to Questionnaire

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Some consultants failed to answer certain portions of the questionnaire; they tend to have some reservations about filling some sections of the questionnaires. In other words, some felt some questions were too personal to be given a response to. Other also lacked the time to fill out the questionnaires; they had to leave for meetings.

3.10.2 Time Constraints

Due to time constraints, it was difficult getting to interview some of the managers of the consulting firms. Most of the managers hardly stayed in their offices so it was difficult getting in touch with them. Other managers who agreed for an interview to be held lacked the time and the patience to sit through the interview; in cases where they had to make reference to records of past works, they were reluctant to do so. At worst, quite a number of consultants who took the questionnaire to answer never responded to them hence reducing the number of questionnaires intended to be answered.

3.10.3 Financial Constraints

This thus hindered the fast tracking of some activities, which could have immensely propelled the progress of work of this research study. Location of firms was difficult to identify while others were also father away. Due to these difficulties, the whole process of data collection took a great toll on funds available (especially in the case of transportation purposes as well as other miscellaneous expenses).

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3.11 Data Analysis

The analysis of the data collected was done manually since the volume of data was manageable. Data from the questionnaires were summarized to highlight the key information needed for the research and analyzed using the Statistical Package for Social Scientists (SPSS). The analysis is discussed in detail in the following chapter.

3.12 Research Ethics

Saunders et al., (2007) state that any researcher, who collects data, analyze and report findings might face ethical issues. Therefore this section aims to declare authors awareness in this area and highlight some particular issues regarding this study.

Respondents were assured that:

- The survey's purpose is entirely academic
- Participation in the survey is voluntary
- Any information cannot be traced back to the respondents or company
- All answers will be kept confidential.

CHAPTER FOUR

DATA ANALYSIS AND FINDINGS.

4.1 Introduction

The purpose of this chapter is to present the findings of the studies. The results presented in this chapter are derived from interviews with the building consultant and quantity surveyors in the construction industry. It focuses on how the respondents experience contingencies and overruns in relation to projects they daily undertake.

In- depth interviews were designed and administered to investigate into the relationship between project contingencies allocated to project and project cost overruns of those projects. A total of forty (40) questionnaires were administered in twenty (20) different quantity-surveying firms. However, out of the forty questionnaires (40) administered only twenty questionnaires were retrieved and answered due to some difficulties and limitations encountered during the survey.

4.2 Profile of respondents

The profile of the respondents' gives the minimum years the professional has been practicing in the construction field.

Table 4.1 Number of years of operation/ experience

0-5 years	2
11-15 years	4
16-20 years	5
Above 20 years	9

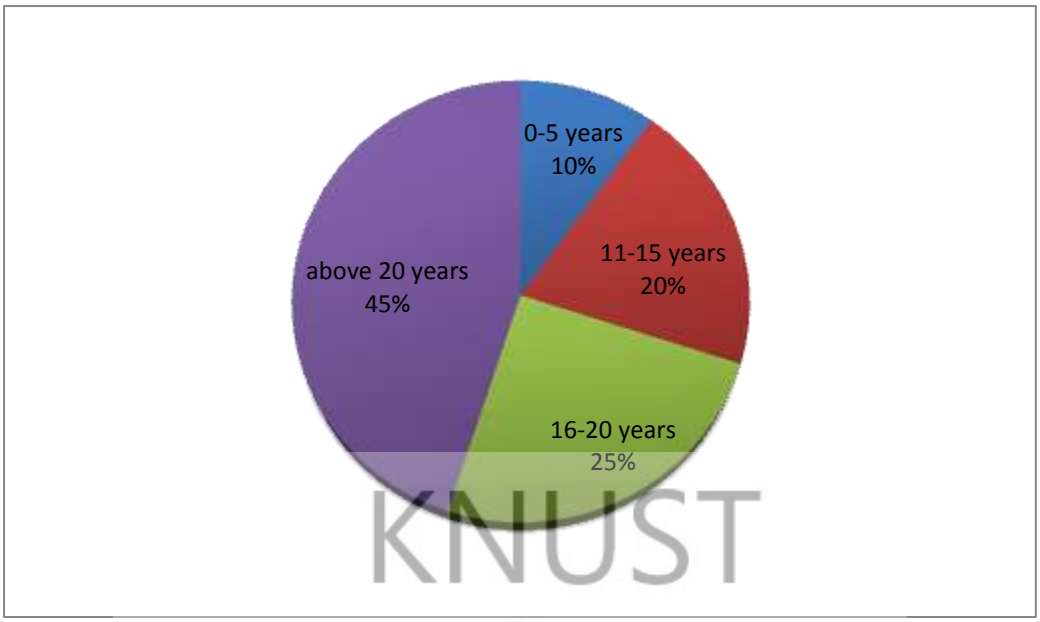

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Figure 4.1 Respondents years of Operation/Experience

Main discussion

From the data collected and arranged in Table 4.1 it is obvious that forty five percent (45%) of the respondents have been practicing for more than twenty years (20), twenty five percent (25%) have been practicing between sixteen (16) and twenty (20) years. Twenty percent (20%) have been in the industry between eleven (11) and fifteen years (15) whiles ten percent (10%) are below five years of practicing (5%)as seen in the pie chat above. Therefore all the respondents interviewed are experienced in their area of profession.

4.3 Contingency calculation methods

This question sought to address which method or methods of contingency estimation is used among professionals in the Ghanaian construction industry in the calculation of contingencies on construction projects they work on.

Table 4.2 Methods used

Guess work based on experience	18
Mathematical method and experience	2

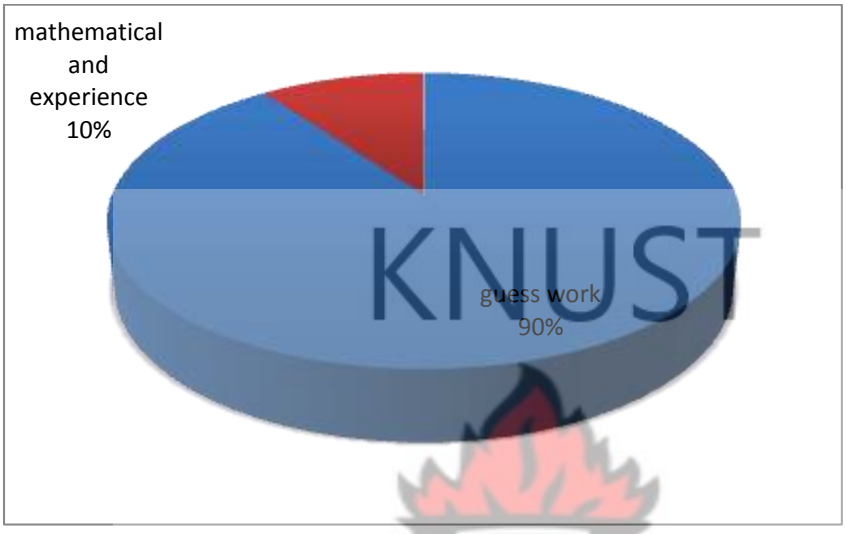

Figure 4.2 Respondents method used

Main discussion

From the literature review in chapter two, it is noticed that each country has its own particular method used in the estimation of contigency. In Canada, the Analytic Hierarchy Processes is mainly used whiles Monte Carlos, Artificial Neural Network and Analytic Hierarchy Processes are used in the USA. Regression and the fuzzy method is also far advanced in the United Kingdom, however in Africa, countries such as Nigeria still use an arbitary percentage method and Ghana is no exception. The chart above shows that ninety percent (90%) of all the professionals interviwed base their contigency percentage allocation on pure guess work and expert knowledge and ten percent (10%) on mathematical methods and experience.

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4.4 Factors affecting contigency estimation

Various factors have been identified to influence the percentage of contigency allocated on project. These factors vary from country to country due to economic and climatic contitions prevailing in the different countries. In Ghana, the factors that have the most influence was identified by the respondents and ranked according to thier level of proirity.

Table 2.3 Factors affecting contingency

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Factors	Frequency
Anticipated variations	10
Nature of the project	4
Location	3
Client	3
Total	20

Figure 4.3 Factors affecting contigency

Main discussion

Of the many factors that influence the consultant's percentage of contigency allocated to a project the risk of anticipated variations was the most pressing of all the factors considered in this study, fifty percent (50%) of respondents confirmed that. Client need for quality and completion of work within shedule and budget is a pressing factor rather than anticipated varations in the USA. The nature of the project been undertaken was twenty percent (20%) ranked next to anticipated varations as a factor affecting contigency estimation of projects. Location of the project and type of client both ranked next to the nature of the project with fifteen percent (15%) respectively

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4.5 Availability of data

There was a need to ascertain if there was data for professionals to rely on in the construction industry in Ghana.

Table 4.4 Availability of data

Item	Frequency
No data	19
Available data	1

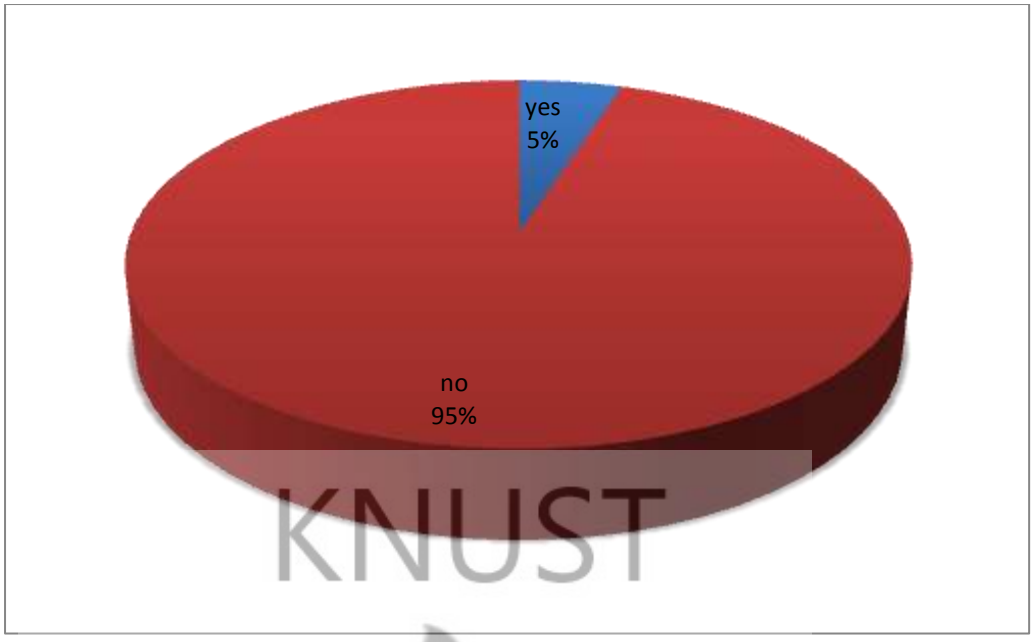

Figure 4.4: Availability of Data

Main discussions

This question sought to seek if there was available data in the form of documented estimating procedures, since procedures vary in content from agency to agency. Estimating procedures also broadly reflected the size of the organization and the volume of work delivered. For example in Australia there is available data to ascertain if there was development and application of realistic allowances on projects. From the response got ninety five percent (95%) of respondents explained that there is no or limited data in setting these contingency percentage on projects. on the contrary, five percent (5%) of the respondent were confident that there was available data in the in the construction industry for setting contingencies.

4.6 Do contingencies meet their overruns

Do contigencies allocated on projects meet their expected overrun? If they do what percent of the cost overruns are met?

Table 4.5 Percentage of contingency which meets overrun

71%-80%	9
81%-90%	7
91%-100%	4

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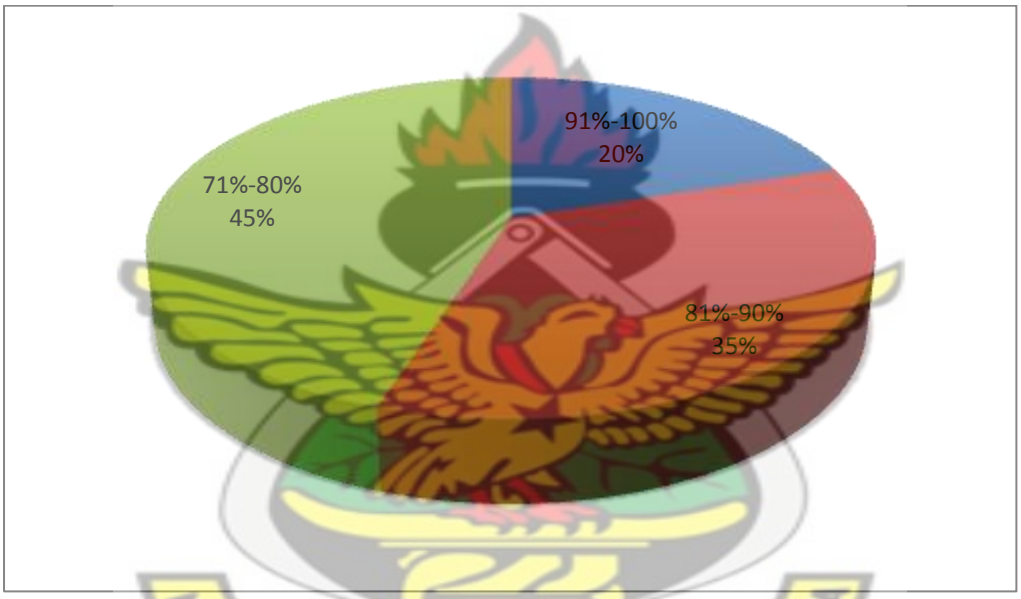

Figure 4.5 Percentage contingency meet overruns

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Main discussions

Contigencies allocated to projects are to meet the cost overruns that may occur, but due to several reasons including the arbitary way of setting contigency, contigencies do not meet the overruns of the projects on which they are allocated fully. Data collected shows that contigencies allocated that meet seventy one to eighty percent (71%-80%) of overruns is forty-five percent (45%). Contigencies which meet eight-

one percent to ninety percent (81%-90%) of their overruns is thirty-five percent (35%) and project which have their overruns perfectly met by their contigencies are just twenty percent (20%). Twenty percent (20%) is however on a very low side as compared with South Africa with a hybrid method combining neural network analysis and expected value analysis hence achieving a sixty percent (60%) of contigency meeting overruns.

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Table 4.6 Estimated and Actual Cost of Projects

Project	Estimated cost (X) Including contingency	Contingency (A)	Cost of Actual works / Contingency (X-A)	Final cost (Y)	Cost Overruns Z=(Y-X)	% Estimated Contingency (C_E)	% Actual Contingency (C_A)	C_A-C_E	% Increase in contingency
1	223,252.85	11750.15	211502.70	235,003.00	23,500.30	5.56%	11.11%	5.5%	100%
2	4,952,871.00	550,319.00	4402552.00	5,503,190.00	1,100,638.00	12.5%	25%	12.5%	100%
3	18,275,212.50	3,225,037.50	15050175.00	20,500,250.00	5,450,075.00	21.43%	36.21%	14.7%	68.97%
4	7,695.00	405	7290.00	8,100.00	810.00	5.56%	11.11%	5.5%	98.92%
5	27,451.80	3,050.20	24401.60	25,502	1,100.40	12.50%	4.51%	-7.9%	-63.2%
6	633,150.00	70,350.00	562800.00	703,500	140,700.00	12.50%	25%	12.5%	100%
7	765,425.00	135,075.00	630350.00	900,500	270,150.00	21.43%	42.85%	21.42%	99.95%
8	7,276,019.55	1,284,003.45	5992016.10	7,060,023	1,068,006.90	21.43%	17.82%	-3.61%	-16.85%
9	418,319.26	10,726.14	407593.13	479,045.39	71,452.27	2.63%	17.53%	14.9%	566.54%
10	608,294.11	18,813.22	589480.89	699,107.33	109,626.44	3.19%	18.59%	15.4%	482.76%
11	621,874.09	15,945.49	605928.60	637,819.58	31,890.98	2.63%	5.26%	2.63%	100%
12	18,704.25	3,300.75	15403.50	22,005.00	6,601.50	21.43%	42.85%	21.42%	99.95%
13	187,421,883	28,117.50	187393765.50	187,450,000.00	56,234.50	0.02%	0.03%	0.01%	50%
14	302,376.39	5400	296976.39	302,376.39	5,400.00	1.81%	1.81%	0%	0%
15	218,552.79	16,450.21	202102.58	205,003	2,900.42	8.14%	1.44%	-6.7%	-82.3%
16	8,805.28	875.72	7929.56	10,006.00	2,076.44	11.04%	26.18%	15.14%	137%
17	2,205,801.00	245,089	1960712.00	2,450,890.00	490,178.00	12.50%	25%	12.5%	100%
18	1,521,766.50	188,083.50	1333683.00	1,489,850.00	156,167.00	14.10%	11.71%	-2.39%	-16.95%
19	3,682,732.40	320,237.60	3362494.80	4,002,970	640,475.20	9.52%	19.05%	9.53%	100%
20	60,101,960.40	10,932,137.60	49169822.80	60,734,098.00	11,564,275.20	22.23%	23.52%	1.29%	5.80%

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4.7 Computing mean and standard deviation

Table 4.7 Descriptive Statistics

Group Statistics					
	variable	N	Mean	Std. Deviation	Std. Error Mean
Contingency	Ce	20	11.1075%	7.45272%	1.66648%
	Ca	20	18.3290%	12.87314%	2.87852%

Independent Samples Test			
		Levene's Test for Equality of Variances	
		F	Sig.
Contingency	Equal variances assumed	4.273	.046
	Equal variances not assumed		

Independent Samples Test					
		t-test for Equality of Means			
		t	Df	Sig. (2-tailed)	Mean Difference
Contingency	Equal variances assumed	-2.171	38	.036	-7.22150%
	Equal variances not assumed	-2.171	30.450	.038	-7.22150%

Independent Samples Test				
		t-test for Equality of Means		
		Std. Error Difference	95% Confidence Interval of the Difference	
			Lower	Upper
Contingency	Equal variances assumed	3.32611%	-13.95487%	-.48813%
	Equal variances not assumed	3.32611%	-14.01012%	-.43288%

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From an independent sample t-test results show that there is a significant increase in project total cost as compared to the estimated project cost. (t (38) = -2.171, p = .036, ^{2} = 3.326). The mean of 11.1075% of the estimated contingency and 18.3290% of the actual contingency of works done shows there is a difference in the two set of data. The actual contingencies of finished projects are higher than the contingencies estimated for the execution of projects. This is mainly attributed to the traditional method of estimating contingencies that is still being used by most professional in the Ghanaian construction industry. The difference from the mean of contingency values both of the estimated and actual cost of works can be given by 7.4527% and 12.8731% respectively.

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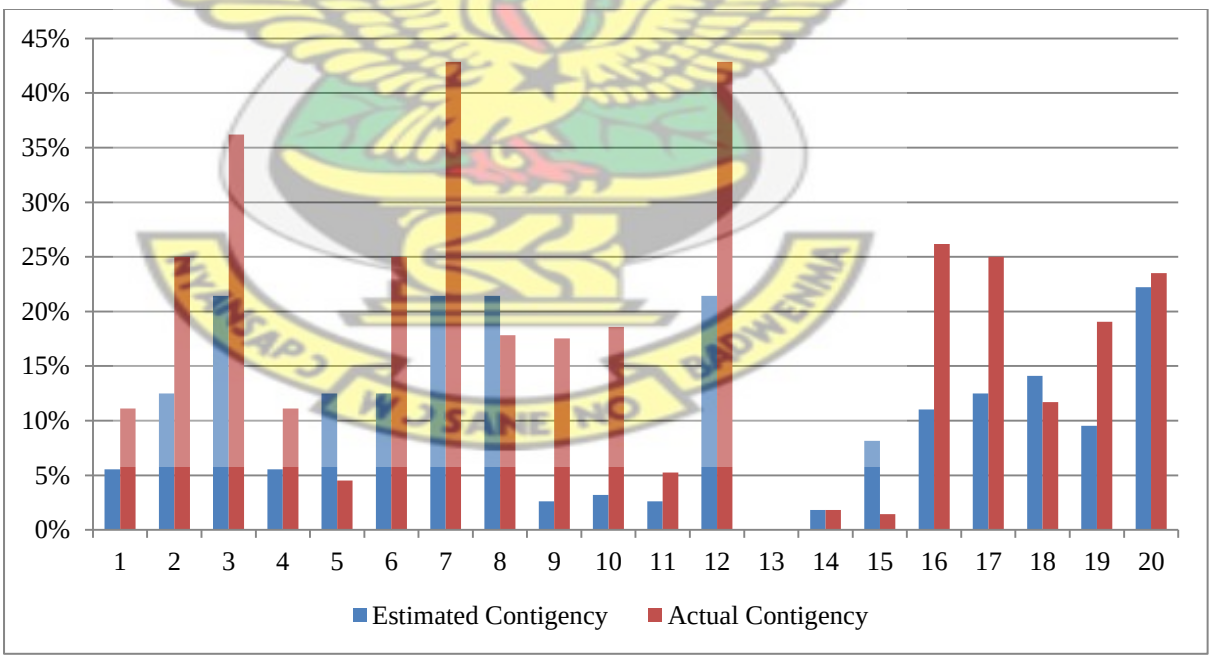

Figure 4.6 A histogram between projects cost contingency and overruns

Main discussion

From the line graph in Fig 6 and the histogram in Fig 7, 95% of all the completed projects contingencies exceed the estimated contingencies allocated to the projects from the conception of the projects. Of the twenty projects under study it is observed that the average level of contingency that should beset by professional to take care of overruns of projects in their estimations was 12%. A range of 10%-12% is what ideally for use in the Ghanaian construction industry in setting contingencies for simple unsophisticated projects. However, for special and sophisticated projects a much more robust method of setting contingency such as the Monte Carlos or the Regression analysis can be used for greater accuracy.

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CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The purpose of this study was to investigate the variance between project contingencies and their overruns and suggest ways of improving it through a better ways of contingency estimation. The chapter presents a discussion of the research findings focusing on key factors that influence contingencies estimation and overruns. Discussions and recommendations will be conducted under the themes identified thus: Industries recommendations and consultant recommendations. However the key factors identified in the data analysis as affecting the contingency and overruns on projects are also considered.

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5.2 Summary of Findings

From the in-depth interviews conducted it was realized that 90% of all practicing quantity surveyors or building consultants arrive at their contingency estimate by guesswork based on experience. This arbitrary method is still used in the Ghanaian construction industry for various reasons of which some are as follows

- Most consultants find other methods like the Monte Carlo and Artificial Neural Network too mathematically inclined, technical and cumbersome to use.
- The educational system in Ghana does not teach other advanced techniques of estimating hence graduates are not aware of the methods that give more accurate contingency estimates.

Poor definition and management of subcontracting works was identified as a factor affecting contingency estimating. However this factor was not as influential as anticipated variations that may occur during the project cycle. Some consultants gave economic conditions as one cause of variations and others gave change of work scope as reason for variation. With change of scope consultants are to advise to educate clients on the effect of project scope change on the total project cost. Little can be done with variations that occur by means of economic factors for this reason close monitoring is essential.

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From the results derived from the data analysis it has been clearly established that there is a relationship between contingencies allocated on projects in Ghana and the cost overruns that occur on these projects. The contingencies allocated are woefully inadequate to take care of the overruns that occur on projects.

The Ghana Institute of Surveyors can aid the construction industry to curb the problem of inadequate databy gather information from all firms and industries that register with them on the various projects that the industry undertakes and all government projects executed could be made available to the public if a policy is instituted where all completed government projects are made possible at an institution. The gathering of this information from the industries will go a long way to make data for estimation available for all in the industry which will reduce the rate of projects overruns in the country as in the case of Australia Federal Infrastructure.

From the data analysis it is obvious that contingencies allocated on projects mostly meet just 71%-80% of overruns that occur on projects, this is not the best for the reputation of the construction industry in Ghana. Methods like the Monte Carlos can be taught in schools and adopted by professional in estimating the contingencies of their projects since it has been found to have the best result when compared to the

other models. This will bring contingencies to a point of meeting contingencies to 100%

Since it has been established that there are variances between contingencies and overruns it is important to note that the establishing of contingencies by guesswork is a very dangerous, risky and unprofessional way of practice in today's fast growing global world.

The average level of contingency allowed on a project from the twenty responds was found to be 12% a little above the 10% syndrome commonly adopted. Many factors are to be considered in the choice of an appropriate estimating model for a particular project, the factors are explained below

- In selecting a contingency method to be used in contingency estimation, it is important to note that the selection of a type of method to be used depends on the level of risk of the project.
- The choice of the method also depends on how sophisticated the method is in relation to its use and the level of accuracy required.
- All factors affecting the estimation process should be considered; including all the variable and fixed factors. Factors such as project size, organizational policies and bias of estimations should not be let out.
- Once a method of contingency estimation has been arrived at and a contingency has been estimated and added to the contract sum the accuracy of the contingency should be checked. This can be done by comparing the predicted final cost against the actual final cost of the project.

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5.3 Recommendations to consultant

Since it has been established that variances do exist between project cost contingencies and project cost overruns, consultants should endeavor to learn and use much more accurate techniques such as Monte Carlos, regression and method of moments in estimating contingencies allocated on project.

It is however important to know if contingency derived covers more than 90% - 100% of their cost overrun. Final cost of projects must be checked with estimated cost of the project to establish this.

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Every project is unique in nature however information from one project can be applied on that of another project to produce good results. It is therefore important that consultants share ideas and information on projects they handle this will adequately inform other professional in the industry. Informed contingency levels will be set not just on guess work but experience by other professionals in the industry.

5.4 Summary of Recommendation

In a nut shell it is recommended that

- A centralized office for the collection of project information can be set up where there can be a centralized place for assessing data by building professionals.
- Since little can be done on variations from economic factors it is important to consider them as a major component in calculating contingencies.
- Sharing information with other consultant in the industry is also a good way of helping information to flow on contingency levels allocated and cost overruns.

The study, establishes a variance between the project contingencies allocated to project and project cost overruns. A quantitative research based was used to analyze the research questions. The findings derived from the data suggested that there is a wide variation between project contingencies and cost overruns. Based on the findings the research believes that the implementation of a well-structured data collection point for all projects will inform and consultant on how contingencies are calculated by other professional to help reduce the project overruns of projects.

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5.5 Limitations of the Study

Due to time and financial constraints the researcher wanted to send out more than forty questionnaires and collect more than the twenty responds got. Project respondents were a little hesitant to give information on project cost overruns on various projects as they saw it as embarrassing and tarnished the image of their consultancy.

The gathering of the data was no easy task as consultancies visited were reluctant to give out company information on both present and past projects since some find it embarrassing to give out their high cost overruns of projects. Others were not willing to give out information on projects due to the sensitivity of the project since most were government projects, for fear of information being disseminated to the general public. Most questionnaire distributed were misplaced by correspondents and others procrastinating responds. Aside a few financial issues faced during the period of questionnaire distribution there were not much challenges faced. No ethical issues were faced during the course of this study.

5.6 Future Research

This project was just to find if there are variances between cost contingencies allocated to project and project cost overruns. There is much room for further study in the line of this study

- A comprehensive study can be done on the various sections of the project and their levels of overruns.
- Client direct or indirect effect on project cost contingencies and project cost overruns can also be studied further.

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APPENDIX

QUESTIONNAIRE

1. How long have you been practicing as a quantity surveyor?

   a. 0-5 b. 6-10 c. 11-15 d. 16-20 e. above 20

2. What method do you use to determine contingencies?

   a. Rule of thumb b. guess work based on experience c. mathematical methods d. mathematical methods and experience e. others

3. The following factors are believed to influence project contingencies you allow on a project? Please rank the following in order of importance (1,2,3,4,5….) where 1 is the higher

   a. Location
   b. Nature of project
   c. Type of client
   d. Weather conditions
   e. Anticipated variations
   f. Others

4. What other factors do you suggest please rank as in question 3 above
5. Does the industry have data to help in the calculation of contingencies?

   a. Yes b. No

6. If Yes is the data reliable?

   a. Yes b. No

7. How often does your contingency allowed meet your cost overruns?

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0%-20% b. 21%-30% c. 31%-40% d. 41%-50% e. 51%-60% f. 61%- 70%

g. 71%-80% h. 81%-90% i. 91% - 100%

8. What are your suggestions on how to improve contingencies estimation?

9.

Name of Project	Type of Project	Percentage of contingency allowed	Amount of contingency allowed	Contract sum (project cost-contingency)	Final project cost

10.

Project type	Main work section	Main contract sum	Final cost	Difference (% Difference)
	Substructure			
	Superstructure			

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