FACULTY OF ENVIRONMENTAL AND DEVELOPMENT STUDIES

DEPARTMENT OF BUILDING TECHNOLOGY

DETERMINING AND MONITORING OF PROJECT CONTINGENCY SUM FOR BUILDING DEVELOPMENTS IN GHANA.

(A CASE STUDY IN ASHANTI AND GREATER ACCRA REGIONS)

BY

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A PROJECT REPORT PRESENTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR A DEGREE OF MASTER OF SCIENCE IN CONSTRUCTION MANAGEMENT

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CERTIFICATION

I hereby declare that this submission is my own work towards the Master Of Science 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 acknowledgment has been made in the text.

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ABSTRACT

Risk management is a major concern to players in the construction industry.

Poor management of risk has resulted in delay in completion of projects, and in some cases leading to litigation. Several management strategies have been adopted for managing risk. Amongst such strategies is the use of Contingency Sum in construction projects. This study was to identify existing methods and factors influencing determination, monitoring Contingency Sum and propose guidelines for determining and monitoring Contingency Sum. Random sampling technique (stratified) was used for determining sample size for selected building professionals (Quantity Surveyors, Architects and Civil Engineers), using the Kish formula. 250 questionnaires were administered to professionals in the building industry and 133(53.2%) were returned.

Data collected were analysed using the relative important index (4 - most important factor and 1 – least important ranking). Kendall's co-efficient of concordance was used to measure the degree of agreement among the selected professionals. The study identified that Deterministic approach (percentage method) was the most widely used method. Unexpected ground conditions (substructure works), design consideration and inflation were identified as the most influencing factors. Contingency Sums were mainly monitored by Project Managers. The study concludes by proposing a method for determining contingency sum and suggests the use of a more scientific approach such as Estimating Using Risk Analysis or the Monte Carlo Simulation. Further, an over site body should be established to monitor the management of Contingency Sum.

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DEDICATION

Dedicated to my mother Alice Adoma Mensah, my wife Mrs. Joyce Oduro Asamaoh, my sons Kwabena Siaw Asamoah and Kwame Asamoah Agyemang, all my siblings and to the memory of my late father Paul Siaw Asamoah.

ACKNOWLEDGEMENT

Undertaking such a Project would have been impossible but for the grace of God and help of some institutions and personalities that need to be acknowledged.

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CHAPTER ONE

INTRODUCTION

1.0 BACKGROUND

Contingency Sum is an integral part of the total estimated costs of projects. It has been defined as additional funds to cater for unforeseeable elements of cost within the defined project scope (Ford, 2002 and American Association of Cost Engineers (AACE, 2000)). Contingency Sum may be derived either through statistical analysis of past project cost or by applying experience gained on similar projects. This usually does not include changes in scope or scheduled events such as Industrial Action and Force Majeure (Parsons Jr, 1999).

The purpose of Contingency Sum therefore is to generate a reserve fund, sufficient to manage the inherent risk within the project completion time and within the project total budget. Its establishment eliminates the adverse impact of unforeseen event.

Risk is inherent in all human activities including construction work(s) and risk elements are diverse and varied (Odeyinka, 2000). Risk and uncertainties are some of the inherent difficulties which arise during construction process. The degree of risk in a project may result from a combination of factors and these factors differ from one project to another. According to Kwakye (1997), there is no construction project that can be undertaken without an element of risk.

In the construction industry, risk is defined as an exposure to economic loss or gain arising from involvement in the construction process. Some of the major risks in construction at project level include physical risk, environmental risk, logistic risk, legal risk, political risk and financial risk, among others (Odeyinka, 2000).

In recent times, risk in construction has received a lot of attention because of time and cost overruns.

Unforeseen conditions could exist but other considerations that can affect and influence risk factors include construction restraints due to continuity of operation, security, environmental complexity and other unique factors of a project. Regardless of the complexity of factors, the degree of detailed design to produce an accurate estimate is an important factor (AACE, 2000).

Projects which cannot be defined adequately require high contingency sum. As the project progresses, the amount of contingency decreases. The cost performance of building construction projects is a key success criterion for clients. Projects require that budgets are set for the clients' financial commitment to provide the basis for cost control and measurement of cost performance.

A key component of a project budget is Contingency Sum. Project cost contingency has been part of projects and project management for at least fifty years. Despite the ubiquity of project cost contingency in the theory of project cost management, there has been little empirical research into project practitioners' understanding of the concept, its intended scope and methods of estimating or management. The accuracy of an estimated price has a major impact on the cost of a project (Baccarini, 2005).

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In Ghana, it is characteristic to undertake construction works without any risk appraisal. High contingency sums which often do not occur are rather included in the mark –ups, to address future problems (Badu, 2004). The construction industry in Ghana is bedeviled with time overrun. This may be associated with many factors which include the following;

- Lack of access to finance
- Weak cash flow
- Lack of collateral
- High bank interest rates (Owusu Taiwah, 1999).

These factors have their associate risk thereby influencing the determination and management of project cost contingency sum.

1.1 STATEMENT OF THE PROBLEM

Project Contingency Sums have been across – board percentage addition to base estimate. This method is as a result of past experiences, intuition and sometimes historical data without much scientific bases. Though the method is simple, it has resulted into some problems including delay in completion of project, loss of capital and some litigations as well as abandonment of projects have bedeviled the industry in Ghana. Contractors are also faced with high interest rates on loans, high cost of project overhead and loss of profit.

It is against this background that it has become necessary to find out methods of determining Contingency Sums and to promote management for Contingency Sum and contract security in Ghana.

AIMS AND OBJECTIVES

1.2.1 AIM

The aim of the study is to identify existing method(s), alternative methods and factors influencing the determination and monitoring of Contingency Sum, and propose a system for determining contingency sum.

1.2.2 OBJECTIVES:

The specific objectives are:

(i) To identify the existing method (s) of determining Contingency Sum in the building industry in Ghana.

(ii) To identify alternative methods of determining Contingency Sum

(ii) To identify the factors influencing the determination of Contingency Sum.

(vi) Propose a system for determining and monitoring Contingency Sum

1.3 SCOPE OF THE STUDY

The study intends to assess the concept of project contingency sum, with the aim of finding out how Contingency Sum is determined and monitored in the building industry. The study will use a sample of building professionals including Architects, Civil or Structural Engineers and most preferably Quantity Surveyors in Ghana (Ashanti and Greater Accra Regions). Completed projects such as the Social investment Fund (S.I.F) Projects (Teachers' bungalows and Classroom blocks) in the Kumasi Metropolis will be studied.

1.4 HYPOTHESES

The study and setting of objectives are based on the following hypotheses:

- The building industry in Ghana considers contingency sum as a percentage of the gross total estimate.
- The building industry in Ghana does not have management policy on Contingency Sum.

1.5 METHOD OF STUDY

To achieve the set objectives, the research adopted the following methodology:

1.5.1 Documentation of information

- Information for the study was obtained from source documents of related subjects on the study.
- The internet was also used to obtain supplementary information for the study.

1.5.2 Empirical Survey

This was obtained through personal interviews and collection of relevant data from building professionals involved in the projects. Structured questionnaires were administered and informal interviews were used to obtain information from these professionals and contractors.

1.5.3 Analytical Survey

Data collected was analysed statistically in order to establish a scientific basis for the observations and conclusions.

1.6 JUSTIFICATION

The first estimate for construction works given to a client is what he always remembers and it is the estimate that often forms the basis upon which all other estimates are judged. Unfortunately at the stage when this estimate is being prepared, there is limited information about the project. This makes the preparation of an accurate estimate for construction works difficult. More so construction works are mostly subject to risks and uncertainties at the inception stage.

A factor that affects the quality of the first estimate is the Contingency Sum which in most cases is included by estimators using no formal method of assessment.

The assessment of an appropriate contingency sum requires an understanding of how estimators make budget contingency decisions and the impact of these decisions on the level of accuracy of the included Contingency Sum.

The study intends to assess the possible means of determining and monitoring contingency sum and to propose a formal system of determining contingency sum devoid of intuitions, past experience and subjectivity.

This should help project performance and quality as well as encourage creativity in estimating practices. It also serves as a mechanism for accounting for public money

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CHAPTER TWO

DETERMINATION OF PROJECT CONTINGENCY SUMS

2.0 INTRODUCTION

Contingency Sum is an integral part of the total estimated cost of a project. It has been defined by the American Association of Cost Engineers (AACE, 2000) as specific Provision for Unforeseeable element of cost within the defined project scope. It is particularly important where previous experiences relating to actual cost have shown that unforeseeable events such as industrial action, fire outbreak, incremental weather, etc will increase costs.

The Department of Energy of Los Angeles in the United States of America also defines Contingency Sum as provision which covers cost that may result from incomplete design, unforeseen and uncertainties within the defined project scope (Parsons, 1999).

The amount of the Contingency Sum will therefore depend on the status of design, procurement and construction methods.

Contingency Sum should not be used to cover up deficiency in estimated cost of projects. According to Baccarini (2004), the key attributes of the concept of project cost contingency are:

- Reserve
- Risk
- Risk Management
- Project Outcomes
-

2.1.1 Reserve

Contingency Sum is defined as a reserve of money added to the base estimated figure to achieve specific project objectives or to allow for changes that experience shows will likely occur. Also, Contingency Sum is a specific provision of money in an estimate for undefined items which statistical studies of historical data have shown will be required (AACE, 2000).

2.1.2 Risk

Construction projects are subject to risk and uncertainties, particularly at the early stages where the scope of the project is not clearly defined. As a project progresses information becomes available to allow cost to be established to a greater degree of accuracy. In construction, risk can be defined as exposure to economics loss or gain arising from involvement in the construction process (Odeyinka, 2006).

Project Contingency Sum is an amount needed to minimse the existence of risk in projects. The Project Management Institute (PMI, 2000) considers risk in two categories:

- Known unknown
- Unknown unknown

2.1.2.1 Known Unknown Risk

Risks that have been identified, analyzed, and may be possible to plan for them.

2.1.2.2 Unknown Unknown Risk

Risk that cannot be managed, so project managers may address them by applying a general contingency sum.

2.1.3 Risk Management

Risk management strategies can be grouped into three stages. These are:

- Risk Identification
- Risk analysis
- Risk Response

2.1.3.1 Risk Identification

This is the process of defining a risk event. The information to be sought includes the type of risk and effects on the project. The primary basis for identifying risks is historical data, experience and insight.

2.1.3.2 Risk Analysis

It is assumed that one has no control over the occurrence of a given risk. Information available in the form of historical data, experience and insight may assist in assessing the probability of its occurrence. Each construction project is unique and care must therefore be taken on the reliance on experience.

2.1.3.3 Risk Response

The possible alternative response methods available in order to provide for the effect of risk are avoidance, rejection, reduction, prevention, retention, transfer and insurance.

2.1.4 Project Outcome

Contingency Sum has a major impact on project outcome for clients. High contingency figure might encourage poor project cost management, causing project to be uneconomical and sometimes aborted. Funds, needed for other organizational activities may be locked up. Low contingency may however be too rigid and set unrealistic financial conditions which may result in unsatisfactory project outcome (Alaa eltal, 2006).

2.2 Types of Project Contingency Sum in Building Work

Management of contingency for large projects can cover three main types of contingency. These are:

- Special Risk Contingency
- Design Contingency
- Construction Contingency

2.2.1 Special Risk Contingency

This is an amount to cover the risks arising from issues like higher land acquisition costs, changes in external factors such as the availability of funds, statutory requirements and force majeure. It can also cover the risk of changes in project specifications.

2.2.2 Design Contingency

This is an amount set aside to cover risk during the technical design process to provide for changes due to design development or estimating process.

2.2.3 Construction Contingency

This is a provision allowed to manage changes during the construction process to provide for the risk of change due to site conditions, or as a result of change in construction methods or poor performance by contractors or sub-contractors.

2.3 METHODS OF DETERMINING PROJECT COST CONTINGENCY SUM

Determination of an appropriate Contingency Sum requires an understanding of how estimators make budget contingency decisions and the impact on the level of accuracy of the included contingency sum. The Contingency Sum, usually expressed as a percentage markup on the base estimate, is used in an attempt to allow for the unexpected conditions (Picken and Mak, 2001).

Baccarini (2006) identified these 13 methods of determining contingency sum for construction works:

- Deterministic Estimation (percentage addition)
- Range Estimating
- Analytical hierarchy Process
- Monte Carlo Simulation
- Probabilistic Estimating
- Methods of moments
- Factors Rating
- Individual risks – expected value
- Regression
- Artificial Neural Networks
- Fuzzy Sets
- Controlled interval memory
- Influence Diagrams
- Theory of constraints

The Hong Kong government has also come out with the Estimating Using Risk Analysis. The Untied Kingdom was among the first to adopt Estimating Using Risk Analysis (ERA) which was known as Multiple Estimating Using Risk Analysis (MERA) (Picken 2001).

In Ghana the building industry considers contingency as an across- board percentage addition to base estimates. This is based on past experience and intuition.

For the purposes of this study, the research will focus on the following:

- Deterministic Estimation (percentage approach)
- Range Estimating
- Estimation Using Risk Analysis (ERA).
- Monte Carlo Simulation
- Probabilistic Estimating

2.3.1 DETERMINISTIC ESTIMATION (PERCENTAGE ADDITION)

The deterministic estimate for Contingency Sum is a single value estimates based on the most likely values of the cost elements. These point estimates may or may not accurately indicate the possible value of the estimate, and they certainly do not indicate the possible range of values an estimate may assume. When estimating, the most common method of allowing for uncertainty is to add a percentage figure (5 to 10 %) to the most likely estimate of final cost of the known works. The amount added is usually called a contingency sum (Pickens and Mak, 2001).

The objective of Contingency Sum allocation is to ensure that the estimated project cost is realistic and sufficient to contain any cost incurred by risks and uncertainties.

However, there are several weaknesses inherent in using a contingency amount which includes the following:

- The percentage figure is, most likely, arbitrarily arrived at and not appropriate for the specific project.
- There is a tendency to double-count risk because some estimators are inclined to include contingencies in their best estimate.
- A percentage addition still results in a single-figure prediction of estimated cost, implying a degree of certainty that is simply not justified.
- The percentage added indicates the potential for detrimental or downside risk; it does not indicate any potential for cost reduction, and may therefore hide poor management of the execution of the project.
- Because the percentage allows for all risk in terms of a cost contingency, it tends to direct attention away from time, performance and quality risks.
- It does not encourage creativity in estimating practice, allowing it to become routine and mundane, which can propagate oversights.

2.3.2 RANGE ESTIMATING

This is decision making technique in which risk of each line item of an estimate is determined by specifying the lowest and highest values that each element could assume based on an assessment of the related risks . The low end of the range is an estimate of the most optimistic outcome. The high end of the range is an estimate of the most pessimistic outcome. The boundaries of the range are often measured in relation to a deterministic estimate of each line item. Risk analysis is to be performed for each element on Weight Base System (WBS). Results of this analysis will be related to a contingency which will be listed for each WBS element. The aim is to make the method of cost estimation and contingency determination uniform across all elements.

The procedure for estimating contingency sum using range estimation includes;

Comparing the conceptual state of the project and the potential risk within the project to Technical, Cost and Time schedules to determine risk factors and appropriate weighting factors respectively.

The individual risk factor is multiply by the corresponding weighting factors. These are summed to determine the composite contingency percentage.

The amount of contingency for a project is obtained by multiplying the base cost by the calculated contingency percentage.

2.3.3 ESTIMATING USING RISK ANALYSIS (ERA)

The approach of using risk analysis in project planning goes hand in hand with techniques in as value management. Estimating Using Risk Analysis is used to estimate the contingency of a project by identifying and costing risk events associated with a project. The starting point for the ERA process is a base estimate which is an estimate of the known scope and is risk free. The contingencies as determined by the ERA process are added to the base estimate. The method identifies all possible risks, and grouped risks into either fixed or variable. Fixed risk events are those which either happens in total or not at all. If the event happens, the maximum cost will be incurred; if not, then no cost will be incurred. Variable risk events are those events which will occur but the extent to which they will occur is uncertain.

The effect of the risk events identified should be able to cover the most likely cost incurred. Having identified all risk events and calculated their average and maximum risk allowances, the summation of all events, average risk allowance will become the contingency of the project. (Mak and Picken, 2001). ERA imposes a discipline from the outset systematically to identify, cost and consider the likely significance of any risks associated with a project. It serves as financial control in having risk and uncertainty costs identified before action is taken to determine precise requirements. It makes it less uncertain. A distinct advantage of ERA lies in its ability to retain the traditional method (percentage approach) of presenting a project cost estimate in the form of a base estimate plus a contingency.

Table 2.4 shows a typical ERA worksheet indicating the various risk elements and their related risk factors.

Table 2.1: An example of ERA worksheet at pre- tender stage

ERA Calculation

Project: Construction of the Central Library — Date: 2 March 1995

Client: Urban Council — ERA Run: 1

(1) Risk	(2) Type	(3) Probability (Fixed Risks Only)	(4) Average Risk Allowance $	(5) Max. Risk Allowance $	(6) Spread (5) - (4) $ M	(7) Spread squared $ M
Design Development	V		8,400,000	12,600,000	4.2	17.64
Additional Space	F	.7	11,760,000	16,800,000	5.04	25.4016
Site Conditions	V		525,000	1,000,000	.475	0.2256
Market Conditions	V		4,000,000	8,500,000	4.5	20.25
A/C Cooling Source	V		250,000	1,250,000	1	1
Access Road	F	.50	250,000	500,000	.25	0.0625
Additional Client Requirements	V		1,680,000	4,200,000	2.52	6.3504
Contract Variations	V		8,400,000	12,600,000	4.2	17.64
Project Co-ordination	V		500,000	1,500,000	1	1
Contract Period	F	.60	1,000,000	1,750,000	.75	0.5625
			36,765,000			90.1326
					Sq Root	9.494

Maximum Likely Addition = $9,494,000

Base Estimate = $168,000,000

Average Risk Estimate = Base Estimate + *Total* Average Risk Allowance
= $204,765,000 (21.88% on base)

Maximum Likely Estimate = Base Estimate + Average Risk Allowance + Maximum Likely Addition
= $214,259,000 (27.54% on base)

Note: ***The Maximum Likely Addition is the figure (the additional amount) which would flow from a situation where every identified risk identified by the project group occurs in total with maximum financial consequences. This is seen as a catastrophic set of circumstances. The mathematical expression of the combined effect of the maximum risk allowances is that they do not add together by simple addition. This situation is dealt with by the Central Limit Theorem - that is the various maximum risk allowances for each risk add together by the sum of their squares.***

Source: Risk analysis in cost planning and its effect on efficiency in capital cost budgeting (Mak and Picken, 2001).

Table 2.5 shows how average risk allowance (Contingency Sum) evolves at successive ERA exercises. As more information becomes available about risk items identified. In addition, it shows the relative proportion of risk allowance (Contingency Sum) and base estimate at different stages of the project.

Table 2.2: Showing Changes in base estimate, contingency and expenditure with time

ERA Calculation

Project: Construction of the Central Library — Date: 11 September 1995

Client: Urban Council — ERA Run: 2

(1) Risk	(2) Type	(3) Probability (Fixed Risks Only)	(4) Average Risk Allowance $	(5) Max. Risk Allowance $	(6) Spread (5) - (4) $ M	(7) Spread squared $ M
Design Development	V		5,400,000	9,000,000	3.6	12.96
Additional Space	F	No longer a risk			-	-
Site Conditions	V		250,000	750,000	.5	.25
Market Conditions	V		0	4,250,000	4.25	18.0625
A/C Cooling Source	V	No longer a risk			-	-
Access Road	F	No longer a risk			-	-
External Cladding	V		3,150,000	4,500,000	1.35	1.8225
Redesign	F	.75	2,275,000	3,030,000	.755	.5700
Additional Client Requirements	V		1,800,000	3,600,000	1.8	3.24
Contract Variations	V		9,000,000	13,500,000	4.5	17.64
Project Co-ordination	V		0	500,000	.5	.25
Contract Period	F	.90	1,800,000	2,000,000	.2	.04
			23,675,000			54.835
					Sq Root	7.405

Maximum Likely Addition = $7,405,00

Base Estimate = $180,000,000

Average Risk Estimate = Base Estimate + *Total* Average Risk Allowance
= $203,675,000 (13.15% on base)

Maximum Likely Estimate = Base Estimate + Average Risk Allowance + Maximum Likely Addition
= $211,080,000 (17.27% on base)

Source: Risk analysis in cost planning and its effect on efficiency in capital cost budgeting (Mak and Picken, 2001).

2.3.4 MONTE CARLO RISK ANALYSIS

Monte Carlo Simulation is a risk analysis method for providing a means to quantify project risks, managing multiple numerical uncertainties and determining project Contingency Sum using cost and schedule range estimating data inputs. Monte Carlo program is marketed by the software company Primavera Systems International. Monte Carlo Simulation program has the capability of sampling and simulating as many as thousands of likely permutations and combinations of ranged cost elements in such a way that they can plot probabilistic distribution groups of simulations. The usual distribution of the simulation groups of samples of cost combinations can be programmed to fall into "modified" triangular or normal "bell" curve distribution as shown in figure 2:4.

The process is as follows:

i. Define the capital resources by developing the deterministic model of the estimate.

ii. Identify the uncertainty in the estimate by specifying the possible values of the variables in the estimate with probability ranges.

iii. Analyse the estimate with simulation. The model is run repeatedly to determine the range and probabilities of all possible outcomes of the model. During each run, a value for each variable is selected randomly based upon its specified probability distribution. As the Monte Carlo simulation is run, the model calculates and collects the results.

The population of results is then presented as the overall probability distribution.

iv. The final step is to make a decision based upon the results of the analysis.

The results of a simulation using Monte Carlo risk analysis allow the quality of the estimate to be determined. The estimate meets the specified quality requirements if the expected accuracy ranges are achieved. This can be determined by selecting the values at the 10% and 90% points of the distribution, and calculating the percentages from the base estimate including contingency. The 10% and 90% points of the distribution establish an 80% confidence interval, and are generally expressed in percentages of +x% or -y%, as shown in table 2:6

Table 2.3 Statistical output from simulation with contingency calculations added.

Percentile (%)	Total estimate	Contingency		Range as Percentage (%)
		$	%	
0	46,303	-25,825	-35.8	
5	63,570	-8,558	-11.9	
10	**68,038**	**-4,090**	**-5.7**	**-18.8**
15	70,682	-1,446	-2.0	
20	73,096	968	1.3	
25	75,316	3,188	4.4	
30	77,156	5,028	7.0	
35	78,731	6,603	9.2	
40	80,432	8,304	11.5	
45	82,186	10,058	13.9	
50	**83,811**	**11,683**	**16.2**	**100**
55	85,303	13,175	18.3	
60	87,280	15,152	21.0	
65	89,222	17,094	23.7	
70	91,605	19,477	27.0	
75	93,799	21,671	30.0	
80	96,642	24,514	34.0	
85	100,261	28,133	39.0	
90	**104,698**	**32570**	**45.2**	**24.9**
95	110,742	38,614	53.5	
100	143,241	71,113	98.6	

Source: Lorance and Wendling, 1999,

Table 2.6 shows the various outcomes after using Monte Carlo risk analysis to determine contingency figures. Note that at the 50/50 point is a 16.2% contingency. The 80% confidence interval is a +24.9% / -18.8%.

The figure 2.1 below shows a typical graphical presentation of Monte Carlo Simulation with contingency figure of 6% as indicated on the graph.

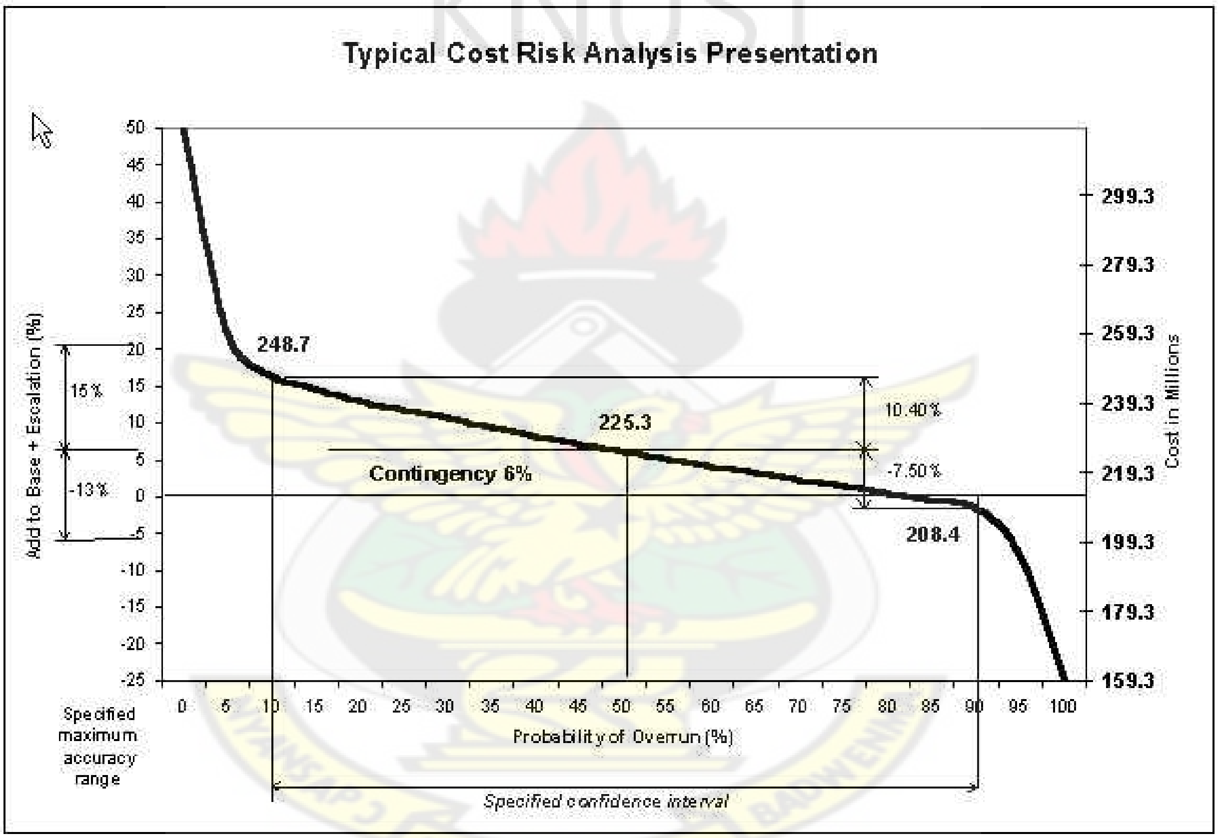


Figure 2.2: Typical Cost Analysis Graphical Presentation of Monte Carlo Simulation

Source:(Lorance and Wendling, 1999,)

2.3.5 PROBABILISTIC ESTIMATING

This is a method of estimating and analyzing the accounts for the uncertainty or the likelihood of occurrence of the costs of a project. It is a computation of cost based on probabilities and ranges of possibilities of the outcome of a project. Probabilistic estimating provides a means for measuring risk by using range estimating and Monte Carlo simulation procedures.

2.4 FACTORS INFLUENCING THE DETERMINATION OF PROJECT COST

In Ghana, there are many factors that influence the cost of project. These wide ranges of factors have been grouped into technical, economic and institutional factors (Owusu Tawiah, 1999). No two infrastructure projects will cost the same amount no matter how similar they are. Apart from basic technical factors, the wide range of economic and institutional conditions. The fundamental project costs are based on the actual cost of the land, materials, equipment and labour in the region where the project is being procured. These basic costs will vary depending upon a number of factors which are discussed below. These factors therefore influence the determination of project contingency sum.

Technical Factors

- Project Specification
- Form of Procurement/Contract
- Site Characteristics
- Project Duration
- Project Management
- Design Considerations
- Unexpected Ground Conditions
- Material and Plant

Economic Factors

- Tax Liabilities
- Inflation
- Exchange Rates

Institutional Factors

- Location
- Land Acquisition
- Force Majeure

2.4.1 TECHNICAL FACTORS

2.4.1.1 PROJECT SPECIFICATION

Specification defines the physical attributes of a project. The required function and expected usage rate will lead to a specification of total floor space, height, internal and external appearance, floor loadings, heating and lighting requirements etc. Generally, the more detailed the specification, the less the risk the project incurs. Thus the smaller the amount of contingency to be included in a project estimates.

2.4.1.2 FORM OF PROCUREMENT/CONTRACT

With emerging trends in the construction industry, contract conditions have been altered to suit the present day requirements to achieve value for money. Types of contracts such as the lump sum, cost reimbursements or the negotiated contracts have Clauses like interest payment to contractors, contingencies, bid security, performance securities, mobilization allowances, ex gratia payments (such as for losses incurred due to suspension of work)to manage risk.

2.4.1.3 SITE CHARACTERISTICS

Site can be affected by the nature of soil, drainage conditions, the nature of the vegetation and accessibility to site. These can influence the initial project estimates.

Where there are uncertainties about site conditions, high Contingency Sums are added to the base estimate to address the risks and uncertainties.

2.4.1.4 RENOVATION OF EXISITNG WORKS.

Generally, the construction of new infrastructure is more expensive than improvement on existing infrastructure, or the refurbishment of buildings. This is primarily because the "non-building" costs such as land purchase, foundations, provision of external services and infrastructure do not have to be included when simply upgrading existing structures. These major developments will require high amount of Contingency Sum to address unforeseen events. Renovation works where the scope of work is not well defined will experience high risk and will require high Contingency Sum.

2.4.1.5 PROJECT DURATION

Project timescales are dependent on the specification of a project. Usually, the larger a project is the longer it will take to implement. Though additional resources may be use to accelerate the completion of the project. In some cases, work on a project may take a lot longer than expected because its phasing is dependent upon other projects or public finance programmes. A project which involves non-continuous phases is usually more expensive than one undertaken without interruption because of the additional costs involved in re-mobilising plant and other resources.

In Ghana, delays in construction projects contribute immensely to high project cost, but with an efficient management system, this can be reduced to the minimum.

2.4.1.6 PROJECT MANAGEMENT

The role of the project manager or project management team is probably the most important element in containing the costs of a project. It is often true that a project with a good project management will be completed satisfactorily. It follows therefore that a Profitable project combined with poor project management, will face difficulties. Making it difficult to allocate and manage contingency sum.

2.4.1.7 DESIGN CONSIDERATION

A change in a project design can arise for a number of reasons. It may be that the client wants additional elements to be included in the project or complete changes in the original scope. Usually, these design changes require additional time, materials and cost as well as inputs from quantity surveyors, architects and engineers. The changes and cost implications will influence the determination and the use of contingency sum.

2.4.1.8 UNEXPECTED GROUND CONDITIONS

In Ghana all substructure works are measured as provisional due to the unexpected ground conditions of projects. To assess ground conditions require experimental works before the start of a project. However, the actual site conditions for the full extent of a project are not usually determined until construction begins. It is possible that, difficult conditions are overlooked by the initial review or that conditions have changed due to adverse weather conditions or changes in sub-soil conditions. Unexpected sub-surface conditions can, at times, require fundamental redesign of projects at great expense. This is associated with high risk and contingency sum.

2.4.1.9 MATERIALS AND PLANT

The scarcity of imported construction materials and plant haunted contractors in Ghana. And this has resulted to speculative buying which in turn reduced contractors' profit margins (Asamoah, 1982). During periods when the level of development activity is unusually high, there may be shortages of some construction materials, plant and servicing plant. If this was not anticipated in the original cost estimate, delays may occur and the prices of materials and plant may increase.

2.4.2 ECONOMIC FACTORS

Economic factors are normally beyond the control of the project but are subject to government policies and global trends. Some of these factors include: Tax liability, inflation and Exchange Rate.

2.4.2.1 TAX LIABILITY

Construction companies in Ghana until 2006 paid withholding tax of 5% of very project executed to the central government. Currently the tax is a 7.5%. This in effect influences contractors' estimates and returns. These tax costs can have a significant impact on gross construction costs. For contractors to make up for the tax element, they may increase the estimates, thereby increasing contingency sum.

2.4.2.2 INFLATION

The Bank of Ghana interest rate has dropped from 30% per annum in 1999 to 12.5% as at June 2007. Also Inflation in Ghana has dropped from 42% to 10.7%. These indicate reductions, but they are still high for contractors to borrow and do business as compared to the developed economies (Mirror, July 21, 2007).

Increase in Inflation may increase the original estimates of construction costs. Inflation may have been taken into account in the original estimates, but if the rate of inflation increases above the predicted level during the construction period, then the original cost estimate will be exceeded

2.4.2.3 EXCHANGE RATES

The exchange rate is particularly relevant if contracting services or other elements of the project are being purchased from other Countries. If exchange rates change beyond the level predicted by the project client, the cost of the project can increase. It can of course operate in the opposite way where the project client takes advantage of strengthening of his own currency.

2.4.2.4 GLOBAL ECONOMIC

The economies of the world are depended on each other. The high economic rescission in the developed economies such as the United State of America, Europe and China has limited the economic assistance to the least developed economies such as Ghana. This has resulted into high cost of imported materials (including construction material) and the cost of construction. The recent increases in price of fuel in the international market have affected many developing economies including Ghana.

2.4.3 INSTITUTIONAL FACTORS

2.4.3.1 LOCATION

In geographical terms, construction and material costs, land costs and design standards differ because of the varying distances from suppliers, weather conditions, and general market conditions. Even within a particular region, variations will exist depending on whether a project is being implemented in a central area, or in an urban or rural context.

Generally, the more remote a project is, the more expensive it will be because of the cost of transporting construction materials, labour and equipment to the site.

2.4.3.2 LAND ACQUISITION

The land on which a project will be built may not always owned by the client. In Ghana, Chiefs and Family leaders are the custodians of land. The local authorities by legal statues acquire land. The statutes usually require that land (and any properties on it) is valued and that compensation is paid to the owner on the basis of the valuations. Local Government Authorities, Chiefs and Family heads can agree on the release of land for development following the payment of compensation to the Chief or the Family involved Although the right to purchase and actually develop the land can be agreed relatively quickly, the amount of compensation that actually has to be paid can sometimes be disputed until the end of the project, especially if the land owner appeals against the original valuation. The owner may have the right to appeal and it is up to a Court to agree a fair price for the land.

2.4.3.3 FORCE MAJEURE

This term covers a range of events which are also commonly referred to as “Act of God”. They include revolution, war, riot, extreme weather, earthquake, landslip, and fire, political and economic instability. Usually, the contractor is required to insure against such events. Where they do occur, normally associated with high risk, leading to significant delays and, consequently, cost increase. This therefore requires high Contingency Sum to manage.

2.5 MANAGEMENT (MONITORING) OF PROJECT CONTINGENCY SUM

Projects can be broken down into different phases and can be managed by work packages. Thus, it is prudent that portions of the overall Contingency Sum be assigned against specific project activities or work packages based on the risks. Contingency sum can be managed by the following:

- By the Project Manager (Contingency Is Under the Control of Project Manager)
- Sensitivity Analysis (Draw down Plot)
- Continuous Issues and Risk Management Communication

2.5.1 MONITORING OF CONTINGENCY SUM BY THE PROJECT MANAGER (PROJECT MANAGEMENT TEAM)

Contingency Sum is held entirely by the Project Manager, not by subsystem managers (Quantity Surveyor, Architect, Civil Engineer and other related professionals).

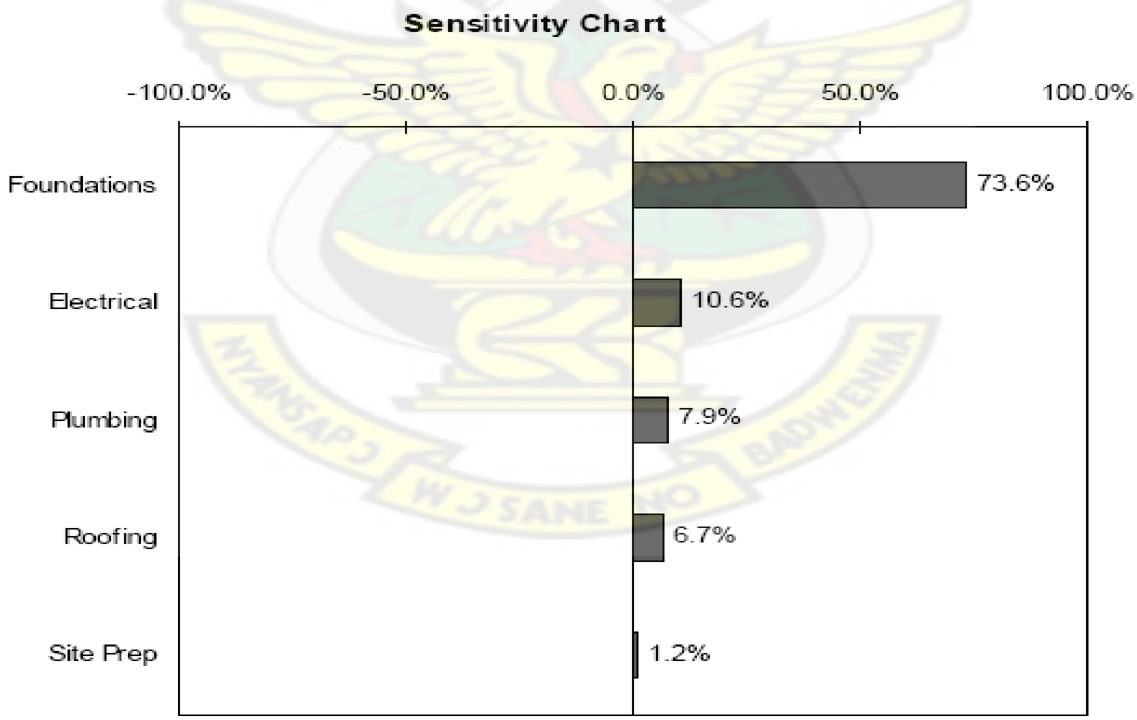
This gives the Project manager the ability to apply midcourse corrections when most needed. Allocation of contingency sum is the decision of the Project Manager (Project Management Team), upon request of the subsystem managers and with the advice and consent of the Management Board and concurrence of the relevant funding agency. All risks and uncertainties that will require future use of contingency must be explicitly approved by the Project Manager.

Allocation of contingency is reflected through a request for funds in excess of the proposed estimate. (Hanlon, 1997).

2.5.2 SENSITIVITY ANALYSIS (DRAW DOWN PLOT)

Sensitivity analysis model utilizes the sensitivity features of the simulation software to determine which inputs were most significant. The software calculates sensitivity based upon either of two analytical techniques: regression or correlation. Both techniques give similar results. Figure 2.3 identifies and ranks the inputs that were most significant. The most significant inputs were identified with longer bars at the top of the graph. Sensitivity analysis allows reviewing of an estimate to concentrate on the specific inputs. Sensitivity analysis identifies where the most promising opportunities exist to perform additional work.

Figure 2.3: showing sensitivity chart for building works



Source: Iqbal and Robert Tichacek, P.E. 2004, The data that can be used to determine how much contingency to assign to each risk factor as shown in figure 2.3. The relative contribution of each risk factor to the overall uncertainty on the project is provided. About 74 % of the total contingency could be applied to foundation. The monitoring of Contingency Sum using the sensitivity chart provides management with quick and more accurate information regarding the adequacy of the current Contingency Sum. Thus, management is at a better position to make decisions regarding redistribution or return of unspent Contingency Sum.

2.5.3: CONTINUOUS ISSUES AND RISK MANAGEMENT COMMUNICATION

Project risk management is not a one-time activity that is completed once a contingency is determined. The sensitivity chart shown in Figure 2.3 provides funding for continuous management of issues and risks. Figure 2.4 shown a continuous issue and risk management.

Figure 2.4: The five-step process shown in the Figure below allows risks to be continuously assessed and prioritized Source: Iqbal and Robert Tichacek, P.E. 2004,

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CHAPTER THREE

RESEARCH METHODOLOGY

3.1 RESEARCH METHODS

The research has taken the form of a literature review and a survey using questionnaire and interviews. This includes integrative review, theoretical review and mathematical review.

Integrative review: this aims at summarizing past research by drawing overall conclusion from separate studies that are believed to address related problems.

Theoretical review: this is an attempt to present theories to explain a particular phenomenon and to draw comparison between them with regards to their breadth, internal consistency and the nature of their predictions.

Mathematical review: this is intended to examine the measured methods and operational definitions that have been applied to a problem area.

To determine the methodology of the research, it was important to define the fundamental questions in order that the conclusion could be drawn. The major questions that the research sought to explore were;

I. What method(s) are used to determine project contingency?

II. What factors are considered in determining project contingency?

III. Whether the use of contingency is monitored

3.2 DATA COLLECTION

The primary source of data for the research was in the form of structured questionnaire and interviews designed to collect information from top level building professional (Quantity Surveyors, Architects and Civil Engineers).

3.2.1 DESIGN OF QUESTIONNAIRE

The questionnaire was designed in line with the objectives of the study which were as follows:

. Identify method (s) of determining Contingency Sum.

. Identify factors influencing the allocation of contingency.

. Identify method(s) of managing Contingency Sum.

. Propose system for determining Contingency Sum for building works.

The questionnaire dealt with general information on the respondent and their regards to project Contingency Sum.

The respondents were asked to rank the factors influencing determination of Contingency Sum using a scale of 1-4.

4- Most Significant

3- Significant

2- Less Significant

1- Not Significant

Rankings with limited number of values usually agree well enough for practical purposes (Snedecor, 1975. The last part dealt with the management and factors influencing project cost).

3.2.2 SAMPLING TECHNIQUE

The random sampling technique (stratified) was used for the data collection.

The target population was the construction professionals; Architects, Civil Engineers and most preferably Quantity Surveyors in Ghana.

3.2.2.1 DETERMINATION OF SAMPLE SIZE

Table 3.1 List of selected building professionals practicing in Ghana.

PROFESSIONALS	**NUMBER**
Quantity Surveyors	209
Architects	350
Civil Engineers	358
Total	**917**

Sources: 2005 Annual Quantity Surveyors Seminar and Workshop.

Daily Graphic, July 20, 2006, No 149797 pp 27

Daily Graphic, June, 14, 2007, No 150074 pp38-39

In order to obtain the sample size for the survey, a statistical method was used in deriving the sample size for all the selected professionals for the study.

The sample size was determined using the Kish (1965) formula as stated below

$$:n = \frac{n'}{(1+n'/N)}$$

n = Sample Size

$$n' = \frac{S^2}{V^2}$$

N = Population Size

S	=	Maximum standard deviation in the population element (total error = 0.1at a confidence level of 95%)
V	=	Standard error of sampling distribution = 0.05
P	=	the population elements.
S^2	=	P (1-P) = 0.5(1-0.5) = 0.25

3.2.2.2 SAMPLE SIZE FOR QUANTITY SURVEYORS

n = $\frac{n'}{(1+n'/N)}$

N = 209

n' = $\frac{0.25}{005^2}$ = 100

n = 100/ (1+ (100/209)) = 67.62 = **68**

3.2.2.3 SAMPLE SIZE FOR ARCHITECTS

n = $\frac{n'}{(1+n'/N)}$

N = 350

n' = $\frac{0.25}{005^2}$ = 100

n = 100/ (1+ (100/350)) = 77.76 = **78**

3.2.2.4 SAMPLE SIZE FOR CIVIL ENGINEERS

n = $\frac{n'}{(1+n'/N)}$

N = 358

$$n' = \frac{0.25}{005^2} = 100$$

$$n = 100/ (1+ (100/350)) = 78.29= \mathbf{78}$$

The overall sample size of 224 was obtained .Assuming a return rater of 45 %,(that is 101). This was increased to 250. The stratified random sampling approach was adopted base on each professional contribution towards the determination of project cost as indicated in table 3.1 below.

Table 3.2: Sample size for each of the selected building professionals.

PROFESSIONALS	No of Registered Professionals	Minimum sample size required	No of Questionnaires Allotted
Quantity Surveyors	209	68	90
Architects	350	78	80
Civil Engineers	358	78	80
Total	**917**	**224**	**250**

3.2.3 ADMINISTRATION OF QUESTIONNAIRE

Most of the questionnaires were personally administered, where advantage was taken to interview some professionals (Architects, Civil Engineers and Quantity Surveyors).

All respondents were given the free will to answer the questions. However, questions that needed clarification were attended to, but in principles to avoid bias.

3.3 ANAYLSIS OF DATA

The data collected on the uses, methods and factors were to be analyzed using an important index computed by the formula:

$$1 = \frac{100\sum (ai\ fi)}{AF}$$

Where i= important index

ai= variable expressing the weight of the i^{th} term ranging from 1-4

A = highest weight, that is 4

fi= frequency of the i^{h} response

i= response category index, where i= 1,2,3,4

F=total number of respondents.

Based on the important indices, the factors for determining contingency were ranked and the agreement between the sampled building professionals determined by the use of the Kendall's concordance analysis. The Kendall's concordance co-efficient, which measures the degree of agreement among sets of ranking, is expressed as

$$W = [\sum^{k} (R_I - \check{R})^2] \,/\, [n (n^2-1)/12]$$

Where,

k = the number of set of ranking (e.g. the number of judgments)

n = the number of aspects of a problem or factors being ranked.

Ř= average of the ranks assigned to the n^{th} aspect of the problem

$n(n^2-1)/12$ = the maximum possible squared deviation i.e., the numerator which will occur if there were perfect agreement among k sets of ranks, and the average ranking were 1,2,3….n.

Ri = the rank assigned by an individual judge to one aspect of the problem posed.

The value of W ranges from 0 – 1 regardless of the number of rankings.

A high value of W indicates a high degree of agreement between the set of rankings.

The significance of W is then tested using the chi-square distribution based on the null hypothesis H_0 = the k set of rankings are unrelated or independent, the alternative hypothesis H_1= the k set of rankings are related. The observed chi-square value is calculated using

$\lambda^2 = k(n-1)W$

Where;

k, n and W are as previously defined. The critical chi-square value is read from the statistical table at (k-1) degrees of freedom. Where the calculated chi-square value exceeds the critical value (that read from tables), the null hypothesis is rejected and the alternative is accepted. A high significant value of W could be interpreted as meaning that k respondents to a question are applying essentially the same standards in rating the n^{th} aspect of a problem under study. For the purposes of interpretation of data, A rating of 1-2 were perceived to be very important, 3 -4 implies important, 5-7 marginally important and 8-10 perceived to be not important.

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CHAPTER FOUR

ANALYSIS AND INTERPRETATION OF DATA

4.1 RESPONSE TO QUESTIONNAIRE

Data was collected from Kumasi and some professionals in Accra. These were the commercial cities in Ghana. Where most of practicing Quantity Surveyors, Architects and Civil Engineers could be located. Also most of the construction activities in the country could be located. Stratified system- the random sampling technique was used for the data collection. The sample sizes for the selected professionals are shown in the table below.

A total of 250 questionnaires were administered to professionals in the building industry. A total of 133 questionnaires representing 53.2% of the total questionnaires administered were returned. The return rate was high for the Quantity Surveying since. Table 4.1 shows details of questionnaires administered and the rate of return.

TABLE 4.1: DETAILS OF QUESTIONNAIRES ADMINISTERED AND RETURNED

BUILDING PROFESSIONALS	NO. OF QUESTIONNAIRES DISTRIBUTED	NO. OF QUESTIONNAIRES RETURNED	% RATE OF RETURNED
Quantity Surveyors	90	52	57.8
Architects	80	41	51.3
Civil/Structural Engineers	80	40	50
TOTAL	**250**	**133**	**53.2**

Source: Field Survey, February – March, 2007

4.2 RESPONSIVENESS OF QUESTIONNAIRE

Questionnaire was said to be responsive where the relevant questions in relation to the topic (Determination and management of contingency sum for building Developments) were fully answered. Table 4.2 shows the responsiveness of the questionnaires returned by the various building professionals.

TABLE 4.2: RESPONSIVENESS OF QUESTIONNAIRES RETURNED

BUILDING PROFESSIONALS	NO. OF QUESTIONNAIRES RETURNED	NO. OF RESPONSIVE QUESTIONNAIRES	%	NO. OF NON RESPONSIVE QUESTIONNAIRES	%
Quantity Surveyors	52	47	90.4	5	9.6
Architects	41	32	78.05	9	22
Civil Engineers	40	27	67.5	13	32.5
TOTAL	**133**	**106**	**79.70**	**27**	**20.3**

Source: Field Survey, February – March, 2007

4.3 THE RELATION BETWEEN YEARS OF PRACTISING AND PREPARATION OF BUILDING ESTIMATE

The responses received from the various professionals based on their years of practicing in the building industry as shown in table 4.3 indicates that 75.2 %(that is from 10 years and above) of the sample sizes have more than ten years working experience.

This information regarding the respondents indicates that responses provided could be relied upon for the study.

TABLE 4.3 THE RELATION BETWEEN YEARS OF PRACTISING AND PREPARATION OF BUILDING ESTIMATE

YEARS OF PRACTISING IN THE BUILDING INDUSTRY	QUANTITY SURVEYORS	ARCHITECTS	CIVIL ENGINEERS	TOTAL	%
0 – 5	14	10	9	33	**24.8**
6 –10	15	10	9	34	**25.6**
11 – 20	11	13	11	35	**26.3**
25 and above	12	8	11	31	**23.3**
TOTAL	**52**	**41**	**40**	**133**	**100**

Source: Field Survey, February – March, 2007.

4.5 EXISTING METHOD(S) OF DETERMINING PROJECT CONTINGENCY SUM IN BUILDING WORKS.

From the literature review, Contingency Sum was determined by the following;

(i) B1 – Deterministic method (traditional or single addition of percentage to base estimate).

(ii) B2 – Probabilistic Estimation (base on experience of past project completed)

(iii) B3 – Estimating using Risk Analysis (ERA)

(iv) B4 – Range Estimating

(v) B5- Monte Carlo Simulation

The study shows that the deterministic approach (Percentage Approach) is the most widely used and Known method for determining Contingency Sum by professionals in Ghana. As indicated in table 4.4, 77% of the professionals have been using the deterministic approach. 23 % have been using the probabilistic Estimation.

The selected professionals were familiar to the Estimating using Risk Analysis, Range Estimating and the Monte Carlo methods of determining Contingency Sum, but have not used any of the methods before.

TABLE 4.4: EXISTING METHOD(S) OF DETERMINING PROJECT CONTINGENCY SUM.

METHODS	QUANTITY SURVEYORS	ARCHITECTS	CIVIL ENGINEERS	TOTAL	%
B1	43	27	21	91	77
B2	8	12	8	23	23
B3	0	0	0	0	0
B4	0	0	0	0	0
B5	0	0	0	0	0
TOTAL	51	39	29	119	100

Source: Field Survey, February – March, 2007.

Professionals were not able to state the actual percentage range for Contingency Sum. Available information as shown in the table 4.5 indicates percentage ranges of 2.5 to 10% for some selected projects financed by the Government of Ghana and her development partners such as the African Development Bank and the World Bank from 1999 to 2007 (See Appendices1).The amount for contingency sum is variable, 10% is recommended for lump sum project. And for other types of contracts (cost plus contracts) it is advisable to set contingency above 10% (Davey, 1992). The building industries in Ghana do not have specific contingency percentage figures for projects.

4.6 ALTERNATIVE METHODS OF DETERMINING CONTINGENCY SUM

The Deterministic method (Percentage) has been established as the most familiar and widely used method for determining Contingency Sum. The literature has shown that the method is associated with difficulties. These include inflating of contingency to cover for over spending. It is important to consider other methods of determining Contingency Sum.

The table below indicates other alternative methods of determining Contingency Sum, advantages and disadvantages. Barccarini (2006) identified 13 methods of determining contingency sum and the Hong Kong government has also established the Estimating using Risk Analysis for determining contingency sum in 1993. For the purposes of this study, the research will focus on the following;

- Deterministic Estimation (percentage approach)
- Range Estimating
- Estimation Using Risk Analysis (ERA).
- Monte Carlo Simulation
- Probabilistic Estimating

4.6.1 COMPARING EXISTING METHOD (DETERMINISTIC) AND SELECTED METHODS OF DETERMINING CONTINGENCY SUM

The table indicates that, Range Estimating, Estimating Using Risk Analysis and Monte Carlo methods have more advantages as compare to the existing method (Percentage Approach) and the probability method. From the literature, Range Estimating, Estimating Using Risk Analysis and Monte Carlo involve scientific analysis to determine Contingency Sum.

TABLE 4.5 COMPARING EXISTING METHOD (DETERMINISTIC) AND SELECTED METHODS OF DETERMINING CONTINGENCY SUM

METHODS	ADVANTAGES	DISADVANTAGES
Deterministic (Percentage)	Avoid the need to request for additional fund Simple to determine and ease to understand	Inflating of cost contingency to cover for over spending The tendency of double – count of risk No proper monitoring of project performance and quality of risk Does not indicate any source of cost reduction Does not encourages creativity in estimating practices
Range Estimating	Avoid the tendency of double – count of risk Proper monitoring of project performance and quality of risk Indicate source of cost reduction Does encourages creativity in estimating practices Every member of building team is involved	The need to request for additional fund It require more time and resources

Estimating Using Risk Analysis	Avoid the tendency of double – count of risk Proper monitoring of project performance and quality of risk Indicate source of cost reduction Does encourages creativity in estimating practices Every member of building team is involved Serve as cost and quality control mechanisms Mechanism for accounting for public money	The need to request for additional fund It require more time and resources
Monte Carlo	Avoid the tendency of double – count of risk Proper monitoring of project performance and quality of risk Indicate source of cost reduction Does encourages creativity in estimating practices Every member of building team is involved Serve as cost and quality control mechanisms	It require more time and technical experts to work with It is not easy to understand by the layman It requires more resources.
Probability Estimating	Avoid the need to request for additional fund Quick and ease to determine and understand	Inflating of cost contingency to cover for over spending The tendency of double – count of risk No proper monitoring of project performance and quality of risk Does not indicate any source of cost reduction

4.7 FACTORS INFLUENCING THE OF DETERMINATION OF PROJECT CONTINGENCY SUM FOR BUILDING WORK

The literature review, the following factors were identified during the determination of contingency sum for building works. The factors as below:

Technical Factors

F1 – Form of procurement / contract

F2- Project Specifications

F3 – Project Duration

F4 – Project management

F5 - Design Considerations

F6 - Unexpected ground conditions

Economic Factors

F7- Inflation

F8 – Global economic pressure (increase in demand for fuel)

Environmental /Institutional Factors

F9 – Increase in demand for extractive materials (Timber, Steel etc)

F10 – Force Majeure

The building professionals were asked to rank the above factors according to their level importance to the determination of contingency using a scale of 1-4 where'

4– Very important

3 – Important

2 – Less Important

1 – Not important.

The response received from the various building professionals as shown in the tables below 4.6 - 4.11.

TABLE 4.6: RESPONSES FROM QUANTITY SURVEYORS' FOR FACTORS INFLUENCING THE DETERMINATION OF PROJECT CONTINGENCY SUM FOR BUILDING WORK.

FACTORS	FREQUENCY DISTRIBUTION OF RESPONSE				TOTAL
	1	**2**	**3**	**4**	
F1	6	12	11	23	52
F2	17	12	12	11	52
F3	11	12	18	11	52
F4	21	19	5	7	52
F5	5	4	11	32	52
F6	0	2	11	39	52
F7	9	5	17	21	52
F8	16	20	13	3	52
F9	5	11	17	19	52
F10	25	20	7	0	52

Source: Field Survey, February – March, 2007

TABLE 4.7: RESPONSES FROM ARCHIECTS'FOR FACTORS INFLUENCING THE DETERMINATION OF PROJECT CONTINGENCY SUM FOR BUILDING WORK.

FACTORS	FREQUENCY DISTRIBUTION OF RESPONSE				TOTAL
	1	**2**	**3**	**4**	
F1	0	8	15	9	32
F2	0	0	15	17	32
F3	3	3	17	9	32
F4	9	14	9	0	32
F5	0	7	0	25	32
F6	0	0	12	20	32
F7	4	0	0	28	32
F8	0	4	0	28	32
F9	0	28	4	28	32
F10	9	14	9	0	32

Source: Field Survey, February – March, 2007

TABLE 4.8: RESPONSES FROM CIVIL ENGINEERS' FOR FACTORS INFLUENCING THE DETERMINATION OF PROJECT CONTINGENCY SUM FOR BUILDING WORK.

FACTORS	FREQUENCY DISTRIBUTION OF RESPONSE				TOTAL
	1	**2**	**3**	**4**	
F1	7	8	8	4	27
F2	6	6	12	3	27
F3	7	9	7	4	27
F4	8	13	3	3	27
F5	0	6	10	11	27
F6	5	0	9	13	27
F7	4	0	9	14	27
F8	9	6	11	1	27
F9	7	7	7	6	27
F10	15	9	3	0	27

Source: Field Survey, February – March, 2007

TABLE 4.9: IMPORTANCE INDICES AND RANKING OF FACTORS INFLUENCING THE DETERMINATION OF PROJECT CONTINGENCY SUM FOR BUILDING WORK BY QUANTITY SURVEYORS.

FACTORS	WEIGHTING OF FACTORS								$\sum(a_i f_i)$	IMPORTANCE INDEX	RANK
	1	af	2	af	3	af	4	af			
F1	6	6	12	24	11	33	23	92	155	74.52	4th
F2	17	17	12	24	12	36	11	44	121	58.17	7th
F3	11	11	12	24	18	54	11	44	133	63.94	6th
F4	21	21	19	38	5	15	7	28	92	44.23	10th
F5	5	5	4	8	11	33	32	128	174	83.65	2nd
F6	0	0	2	4	11	33	39	156	193	92.79	1st
F7	9	9	5	10	17	51	21	84	160	76.92	3rd
F8	5	5	11	22	17	51	19	76	154	74.04	5th
F9	16	16	20	40	13	39	3	12	107	51.44	9th
F10	15	15	20	40	7	21	10	40	116	55.77	8th

Source: Field Survey, February – March, 2007

Where (af) = (Weighting of factors (ranging from 1-4)) X (frequency of the weighting of the particular factor.

TABLE 4.10: IMPORTANCE INDICES AND RANKING OF FACTORS INFLUENCING THE DETERMINATION OF PROJECT CONTINGENCY SUM FOR BUILDING WORK BY ARCHITECTS.

FACTORS	WEIGHTING OF FACTORS								$\sum(a_i f_i)$	IMPORTANCE INDEX	RANK
	1	af	2	af	3	af	4	af			
F1	0	0	8	16	15	45	9	36	97	75.78	5th
F2	0	0	0	0	15	45	17	68	113	88.28	4th
F3	3	3	3	6	17	51	9	36	96	75	6th
F4	9	9	14	28	9	27	0	0	64	50	9th
F5	0	0	7	14	0	0	25	100	114	89.06	3rd
F6	0	0	0	0	12	36	20	80	116	90.63	1st
F7	4	4	0	0	0	0	28	112	116	90.63	1st
F8	4	4	4	8	22	66	2	8	86	67.19	7th
F9	28	28	0	0	4	12	0	0	40	31.25	10th
F10	9	9	12	24	9	27	2	8	68	53.13	8th

Source: Field Survey, February – March, 2007

Where (af) = (Weighting of factors (ranging from 1-4)) X (frequency of the weighting of the particular factor.

TABLE 4.11: IMPORTANCE INDICES AND RANKING OF FACTORS INFLUENCING THE DETERMINATION OF PROJECT CONTINGENCY SUM FOR BUILDING WORK BY CIVIL ENGINEERS.

FACTORS	WEIGHTING OF FACTORS								$\sum(a_i f_i)$	IMPORTANCE INDEX	RANK
	1	af	2	af	3	af	4	af			
F1	7	7	8	16	8	24	4	16	48	44.44	9th
F2	6	6	6	12	12	36	3	12	66	61.11	4th
F3	7	7	9	18	7	21	4	16	62	57.41	6h
F4	8	8	13	26	3	9	3	12	55	50.93	8th
F5	0	0	6	12	10	60	11	44	116	107.41	1st
F6	5	5	0	0	9	36	13	52	93	86.11	2nd
F7	4	4	0	0	9	27	14	56	87	80.56	3rd
F8	9	9	6	12	11	33	1	4	58	53.70	7th
F9	7	7	7	14	7	21	6	24	66	61.11	4th
F10	15	15	9	18	3	9	0	0	42	38.89	10th

Source: Field Survey, February – March, 2007

Where (af) = (Weighting of factors (ranging from 1-4)) X (frequency of the weighting of the particular factor.

4.7.1 AGREEMENT BETWEEN BUILDING PROFESSIONALS ON FACTORS OF DETERMINING CONTINGENCY SUM.

According to Kendall (1970), the best estimate of true ranking of n objects is provided where W (the coefficient of concordance) is significant by the order of various sums of ranks. If one accepts the criteria used by the judges, then the best true ranking is provided by the mean of the ranks. This implies most factors influencing are the highest overall ranking. Based on the above premise, the overall rankings were calculated for the Quantity Surveyors, Architects, Civil Engineers and all building professional (that is Quantity Surveyors, Architects and Civil Engineers). The agreement (indicated by the value of W calculated) between the following:

Quantity Surveyors and Architects

Quantity Surveyors and Civil engineers

The overall ranking for the selected professionals was determined

TABLE 4.12: AGREEMENT BETWEEN QUANTITY SURVEYORS AND ARCHITECTS ON FACTORS INFLUENCING THE DETERMINATION OF CONTINGENCY SUM.

FACTORS	QUANTITY SURVEYORS	ARCHITECTS	SUM OF RANKING (R_I)	MEANS OF RANKING (Ř)	R_I -Ř	(R_I - Ř)^2	OVERALL RANKING
Form of Procurement /Contract	4	5	9	4.5	-1	1	4th
Project Specification	7	4	11	5.5	0	0	5th
Project Duration	6	6	12	6	0.5	0.25	6th
Project Management	10	9	19	9.5	4	16	9th
Design Consideration	2	3	5	2.5	-3	9	3rd
Unexpected ground conditions	1	1	2	1	-4.5	20.25	1st
Inflation	3	1	4	2	-3.5	12.25	2nd
Increase in demand for extractive Materials (Timber, Steel etc)	9	10	19	9.5	4	16	9th
Global economic pressure (increase in demand for fuel)	5	7	12	6	0.5	0.25	6th
Force Majerue	8	8	16	8	2.5	6.25	8th

Source: Field Survey, February – March, 2007

Grand mean $Ř = \sum_{i=1}^{n} R_I = 5.5$ $\qquad \sum (R_I - Ř)^2 = 81.25$

Where R_I is the mean of rankings and 'n 'is the number of factors being ranked.

W (Coefficient of concordance) for Selected building Professionals

$$\check{R} = \frac{R_I}{n}$$

$$W = \left[\sum_{i=1}^{k} (R_I - \check{R})^2\right] / \left[n(n^2-1)/12\right]$$

n = number of factors ranked = 10

$n(n^2 - 1)/12 = 10(10^2 - 1)/12 = 82.5$

$$W = \frac{81.25}{82.5} = 0.98$$

Testing the significance of W at 95% level based on the null hypothesis H_0 that the set of rankings by the Quantity Surveyors and Architects are unrelated. The alternative H_1 = the set of rankings are related.

$\lambda^2 = k(n-1)W$ where k = number of groups being compared which in this case = 2(that is the Quantity Surveyors and Architects being compared)

$\lambda^2 = 2(10 - 1)0.98 = 17.64$

From the chi-square distribution tables, the critical value

$\lambda^2_{0.95 \quad 15}$ = 7.26 Since the observed λ^2 value = 17.64 greater than 7.26, the null hypothesis H_0 is rejected and the alternative hypothesis H_1 that the set of rankings by the above groups are related is accepted. This shows that there is high degree of agreement between Quantity Surveyors and Architects on the factors influencing the determination of contingency sum.

TABLE 4.13: AGREEMENT BETWEEN QUANTITY SURVEYORS AND CIVIL ENGINEERS FACTORS INFLUENCING THE DETERMINATION OF CONTINGENCY SUM.

FACTORS	QUANTITY SURVEYORS	CIVIL ENGINEERS	SUM OF RANKING (R_I)	MEANS OF RANKING (Ř)	R_I -Ř	$(R_I – Ř)^2$	OVERALL RANKING
Form of Procurement /Contract	4	9	13	4.5	-0.9	0.81	4th
Project Specification	7	4	11	5.5	0.1	0.01	5th
Project Duration	6	6	12	6	0.6	0.36	6th
Project Management	10	8	18	9	3.6	12.96	9th
Design Consideration	2	1	5	2.5	2.9	8.41	3rd
Unexpected ground conditions	1	2	3	1.5	-3.9	15.21	1st
Inflation	3	3	6	3	-2.4	5.76	2nd
Increase in demand for extractive materials(Timber, Steel etc)	9	7	16	8	-2.6	6.76	9th
Global economic pressure (increase in demand for fuel)	5	4	9	4.5	0.9	0.81	6th
Force Majerue	8	10	18	9	-2.9	8.41	8th

Source: Field Survey, February – March, 2007

$$\text{Grand mean } Ř = \sum_{i=1}^{n} R_I = 5.4 \qquad \sum (R_I – Ř)^2 = 51.5$$

Where R_I is the mean of rankings and 'n 'is the number of factors being ranked.

W (Coefficient of concordance) for Quantity Surveyors and Civil Engineers.

$$Ř = \frac{R_I}{n}$$

$$W = \left[\sum_{i=1}^{k}(R_I - \check{R})^2\right] / \left[n(n^2-1)/12\right]$$

n = number of factors ranked = 10

$n(n^2 - 1)/12 = 10(10^2 - 1)/12 = 82.5$

$W = \frac{82.5}{51.5} = 1.60$

Testing the significance of W at 95% level based on the null hypothesis H_0 that the set of rankings by the Quantity Surveyors and Civil Engineers are unrelated. The alternative H_1 = the set of rankings are related.

$\lambda^2 = k(n-1)W$ where k = number of groups being compared which in this case = 2(that is the Quantity Surveyors and Civil Engineers being compared)

$\lambda^2 = 2(10 - 1)1.60 = 28.8$

From the chi-square distribution tables, the critical value $\lambda^2_{0.95 \quad 15}$ = 7.26 since the observed λ^2 value = 28.8 is greater than 7.26 the null hypothesis Ho is rejected and the alternative hypothesis H1 that the set of rankings by the above groups are related is accepted. This shows that there is high degree of agreement between Quantity Surveyors and Architects on the factors influencing determination of contingency sum.

TABLE 4.14: AGREEMENT BETWEEN BUILDING PROFESSIONALS

FACTORS INFLUENCING THE DETERMINATION OF CONTINGENCY SUM.

FACTORS	QUANTITY SURVEYORS	ARCHITECTS	CIVIL ENGINEERS	SUM OF RANKING (R_I)	MEANS OF RANKING ($\check{R}$)	$R_I - \check{R}$	$(R_I - \check{R})^2$	OVERALL RANKING
Form of Procurement /Contract	4	5	9	18	6	0.6	0.36	7th
Project Specification	7	4	4	15	5	-0.4	0.16	6th
Project Duration	6	6	6	18	6	0.6	0.36	7th
Project Management	10	9	8	27	9	3.6	12.96	3rd
Design Consideration	2	3	1	6	2	-3.4	11.56	2nd
Unexpected ground conditions	1	1	2	4	1.33	- 4.07	16.56	1st
Inflation	3	1	3	7	2.33	- 3.07	9.42	3rd
Increase in demand for extractive Materials (Timber, Steel etc)	9	10	7	26	8.67	3.27	10.69	9th
Global economic pressure (increase in demand for fuel)	5	7	4	16	5.33	- 0.07	0.005	5th
Force Majerue	8	8	10	26	8.67	3.27	10.69	9th

Source: Field Survey, February – March, 2007

$$\text{Grand mean } \check{R} = \sum_{i=1}^{n} R_I = 5.4 \qquad \sum (R_I - \check{R})^2 = 72.77$$

Where R_I is the mean of rankings and 'n 'is the number of factors being ranked.

W (Coefficient of concordance) building professionals (Quantity Surveyors, Architects and Civil Engineers).

$$\check{R} = \frac{R_I}{n}$$

$$W = \left[\sum_{i=1}^{k} (R_I - \check{R})^2\right] / \left[n (n^2-1)/12\right]$$

n = number of factors ranked = 10

$n(n^2 - 1)/12 = 10(10^2 -1)/12 = 82.5$

$$W = \frac{72.77}{82.5} = 0.88$$

Testing the significance of W at 95% level based on the null hypothesis Ho that the set of rankings by the Quantity Surveyors, Architects and Civil Engineers are unrelated. The alternative H1 = the set of rankings are related.

$\lambda^2 = k(n-1)W$ where k = number of groups being compared which in this case = 3(that is the Quantity Surveyors ,Architects and Civil Engineers being compared)

$\lambda^2 = 3(10 - 1)0.88 = 23.76$ .From the chi-square distribution tables, the critical value $\lambda^2_{0.95 \quad 15} = 7.26$ since the observed λ^2 value = 23.76 is greater than 7.26 the null hypothesis Ho is rejected and the alternative hypothesis H1 that the set of rankings by the above groups are related is accepted. This shows that there is high degree of agreement between Quantity Surveyors, Architects and Civil Engineers on the factors influencing the determination of contingency sum (See Appendix 2).

4.7.2 PROPOSED METHOD FOR DETERMINING CONTINGENCY SUM

The study adopted and modified risk rating factors developed by the American Association of Cost Engineers (AACE, 1997) as shown in table 4.16 to develop a system for determining contingency figure as a percentage to be added to project cost.

The method is a visual basic programme designed to cover identified factors influencing the determination of contingency sum. The factors have been grouped into Economic, Technical and Environmental/ Institutional Factors. From the study Technical and Environmental/ Institutional Factors contribute 20% respectively to the determination of contingency sum, whiles Economic factors contributes 60%. Each of the main factors has related minor factors. Each of these minor factors has risk rated values which vary depending on conditions and the impact of risk as identified by project team as shown in table 4. 15 (See Appendix 3-10 for the flow chart of the Proposed Contingency Calculator and work examples).

ITEM	FACTORS	RISK FACTOR %	MINIMUM	MEDIUM	MAXIMUM
1	**ENVIRONMENTAL / INSTITUTIONAL FACTORS**	20%			
A	Demand for Extractive materials	0-55	0-18	19-36	37-55
B	Force Majeure	0-35	0- 10	11-20	21-35
C	Cultural Implication	0-10	0-3	4-7	8-10
2	**ECONOMIC FACTORS**	60%			
D	Inflation	0-65	0-20	21-40	41-60
E	Global economic pressure	0-35	0-10	11-20	21-35
3	**TECHNICAL FACTORS**	20%			
F	Project Specification	0-15	0-4	5-10	11-15
G	Design Consideration	0-20	0-5	7- 12	13-20
H	Contract Period	0-15	0-4	5-10	11-15
J	Project management	0-10	0-3	4-7	8-10
L	Form of Contract	0-40	14-27	14-27	28-40

4.15: Risk Rating Factors for Determining Contingency Sum for Building Works

The proposed progrramme was tested using 60 selected projects from Kumasi Metropolitan Assembly, Skyere West District, Bosomtwi Atwima Kwawoma and Ejisu Juaben Districts (See Appendix 4). The projects were grouped into two for easy mathematical analysis as in table below.

Project	Estimated Contingency %	Contingency using Proposed Method %	Actual Overrun at the end of project %	Difference	
A	B	C	D	E=D-B	F=D-C
1	10	17.2	21	11	3.8
2	2.5	10.2	4.8	2.3	-5.4
3	2.5	10.8	4.5	2	-6.3
4	5	21.8	41	36	19.2
5	10	9	0	-10	-9
6	9.1	11	9.7	0.6	-1.3
7	9	10.2	8.9	-0.1	-1.3
8	10	10.2	10	0	-0.2
9	5	4.8	5	0	0.2
10	2.5	11.4	0	-2.5	-11.4
11	9	20.8	26.4	17.4	5.6
12	10	20.6	35.5	25.5	14.9
13	10	12.8	10.6	0.6	-2.2
14	5	16.8	21	16	4.2
15	5	16.8	21	16	4.2
16	5	16.8	21	16	4.2
17	5	10.4	7	2	-3.4
18	4.7	20.4	31.8	27.1	11.4
19	9	22.8	25.7	16.7	2.9
20	5	14.8	13.1	8.1	-1.7
21	10	12.8	10	0	-2.8
22	5	13.4	6.7	1.7	-6.7
23	5	13.4	26.3	21.3	12.9
24	5	10.4	5.9	0.9	-4.5
25	5	22.8	30	25	7.2
26	5	26	42.3	37.3	16.3
27	5	0	0	-5	0
28	5	22.8	30	25	7.2
29	5	9.4	8	3	-1.4
30	5	12.4	0	-5	-12.4
TOTAL	188.3	433	477.2		

Table 4.16 Computation of Contingency Sums

Group B

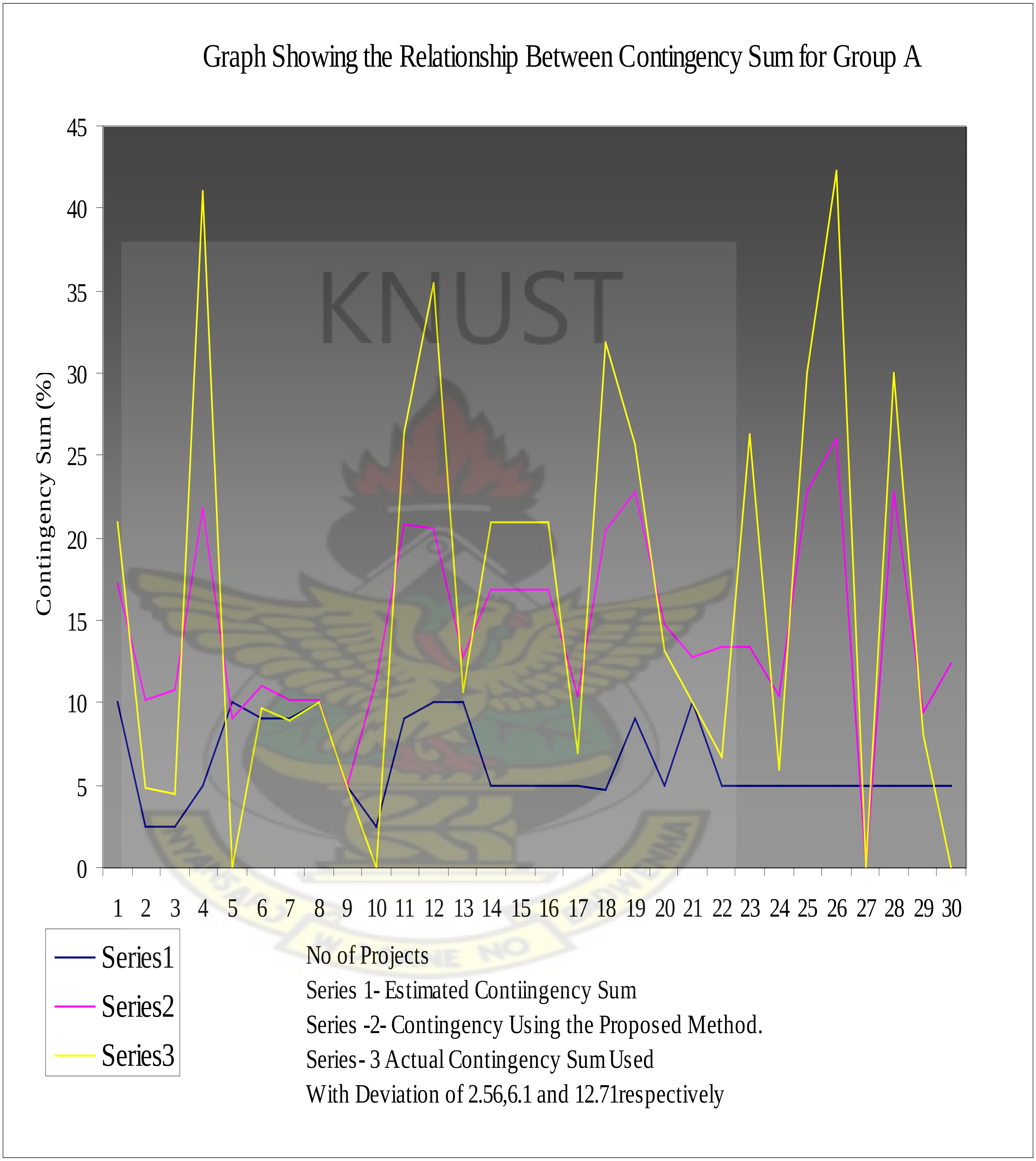
Project	Estimated Contingency %	Contingency using Proposed Method %	Actual Overrun at the end of project %	Difference	
A	B	C	D	E=D-B	F=D-C
1	10	12.8	11	1	-1.8
2	10	12.8	13	3	0.2
3	10	16.4	15	5	-1.4
4	10	8.4	10	0	1.6
5	10	12	15	5	3
6	10	12	12	2	0
7	10	14	12	2	-2
8	10	11.4	10	0	-1.4
9	10	10.4	10	0	-0.4
10	7.5	15	13	5.5	-2
11	10	15	16	6	1
12	10	15	14	4	-1
13	10	15	15	5	0
14	10	13.4	15	5	1.6
15	10	13.4	8.5	-1.5	-4.9
16	10	13.4	10	0	-3.4
17	4.76	12.4	15	10.24	2.6
18	5	13	15	10	2
19	4.76	14.4	17	12.24	2.6
20	7	14.4	10	3	-4.4
21	4.7	14.4	0	-4.7	-14.4
22	10	13.4	10	0	-3.4
23	5	13.4	10	5	-3.4
24	10	11.4	10	0	-1.4
25	5	12.4	12	7	-0.4
26	5	11.4	0	-5	-11.4
27	5	10.4	7	2	-3.4
28	5	12.4	5	0	-7.4
29	5	9.4	5	0	-4.4
30	5	14.4	15	10	0.6
TOTAL	**238.72**	**387.6**	**330.5**		

Table 4.17 Computation of Contingency Sums

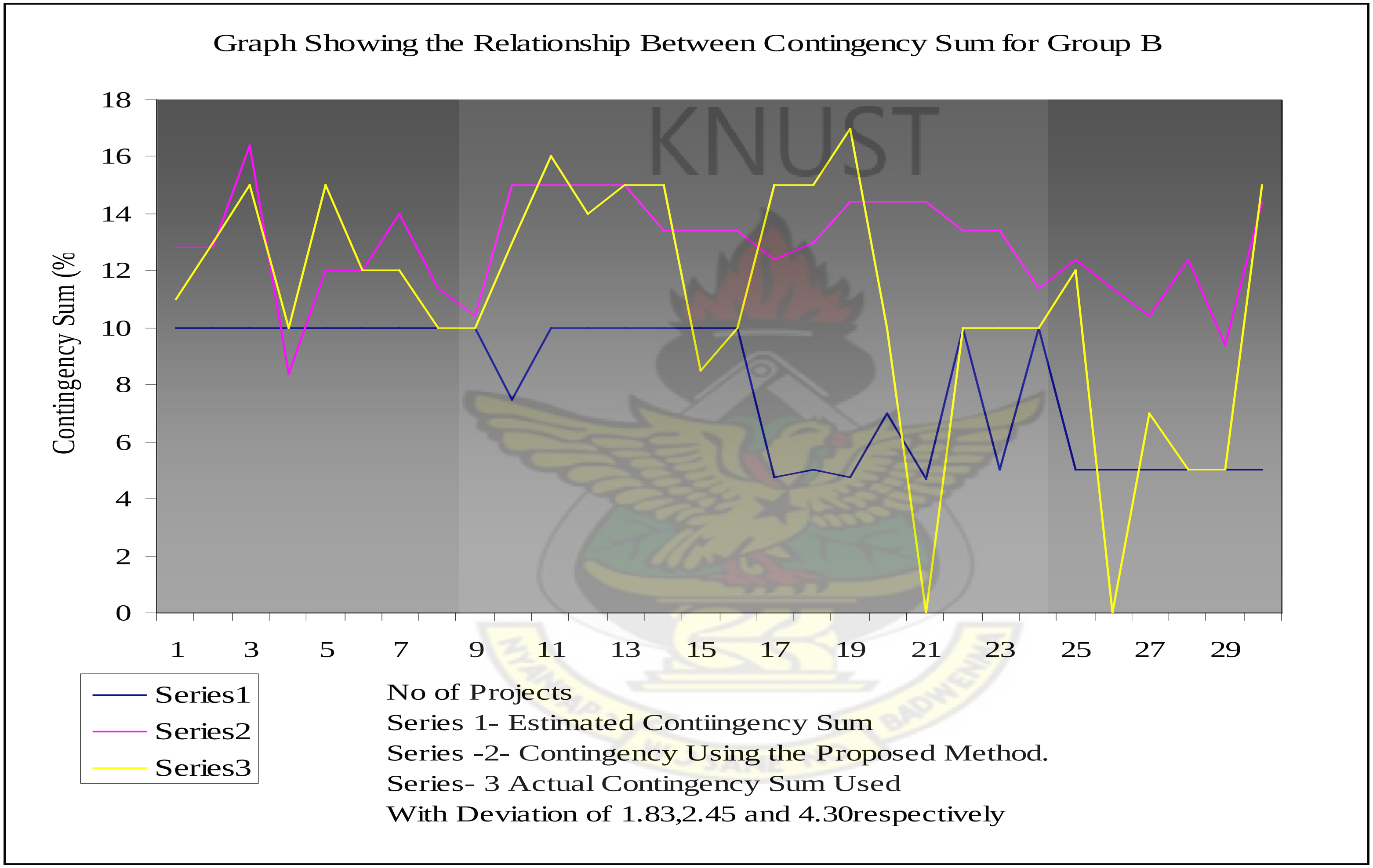
The final computations were used to draw line graphs indicating the deviation between the estimated contingency, Contingency Sum using the proposed method and Actual overrun at the end of a particular project.

The test indicated that from Group A, Estimated contingency sum had a deviation of 2.56%, Actual Contingency -12.71% and Contingency using the proposed method 6.02. This means that from Group A, Estimated Contingency was 21% accurate whiles the proposed method was 48% accurate. Projects in Group B also had the following figures as standard deviation 1.83, 4.30 and 2.43 respectively. With accuracy of 43% for estimated contingency Sum and 57% for the proposed methods.

The graphs below show the relationship between contingency sum, Estimated Contingency and the Contingency Sum using the proposed method.



Graph 4.1: Showing the deviations between Contingency Sums in Group A



Graph 4.2: Showing the deviations between Contingency Sums in Group

4.8 MONITORING THE USE OF PROJECT CONTINGENCY SUM IN BUILDING WORKS.

Respondents were asked to indicate if they monitor the use of project contingency sum. Those who answered in the affirmative were then asked to indicate which of the following was used as a method of monitoring Contingency Sum,

(A) Sensitivity Analysis

(B) Risk Management Communication

(C) By the Project Manager (Contingency Sum under the control of project Manager)

(D) No method

TABLE 4.18: MONITORING THE USE OF PROJECT CONTINGENCY SUM.

POLICY	FREQUENCY DISTRIBUTION OF RESPONSE				
	QUANTITY SURVEYORS	ARCHITECTS	CIVIL ENGINEER	TOTAL	%
A	7	0	6	13	11.71
B	5	0	0	5	4.50
C	40	32	15	87	78.38
D	0	0	6	6	5.41
TOTAL	52	32	27	111	100

Source: Field Survey, February – March, 2007

Table 4.17 shows that almost 78 % of the professionals monitored the use of Contingency Sum by monitoring stage payments of work done (by the Project Manager or the Project Team). 11.71 % used the sensitivity method, 4.50% use the Continuous Risk management. While 5.41% did not monitor the use of contingency.

4.9 TEST OF HYPOTHESES.

4.9.1 HYPOTHESES FORMULATED.

1. The building industry in Ghana considers Contingency Sum as a percentage addition to the gross total estimate.
2 The building industry in Ghana does not monitor the use of Contingency Sum.

4.9.2 STATISTICAL APPROACH

An estimate of the views of the building industry in the regions can be made from the information supplied by the sample population. The validity of the hypotheses were tested based on the observations made from the views of the sample size selected.

4.9.3 TEST OF HYPOTHESIS

A statistical hypothesis was formulated with the sole purpose of accepting or rejecting it. The hypothesis formulated above, were considered as the null hypothesis (H_0). A test of the null hypothesis (H_0) or significant test is a rule based on the results of a sample whereby acceptance or rejection of H_0 is decided.

4.9.4 LEVEL OF SIGNIFICANCE

The maximum probability with which one would be willing to risk a type 1 error (i.e. rejecting H_0 when is should be accepted). Normally, a 5% level of significance is used in statistical analysis and it simply means that there are about five chances in a hundred that one would reject a hypothesis when if should be accepted. That is to say that one is about 95% confident that the right decision would be made.

4.9.5 CRITICAL REGION AND CRITICAL VALUE

The set of values of the test statistic (Z) which tells when to reject H_0 is called the critical region and it depends on the type and level of test chosen. The boundaries of the critical region are called the critical values. Often the critical region is chosen so that the probability that Z falls within it is just 5 %.

4.9.6 POPULATION AND SAMPLE SIZE.

To use the normal approximation to the binomial distribution, the sample size considered must be large. Out of 250 questionnaires, 133 representing 53.2% of the total were returned. 106 representing 79.7% was judged to be responsive and hence represent the sample size.

4.9.7 TEST OF HYPOTHESIS NO.1

"The building industry in Ghana considers project contingency sum as a percentage addition of the gross estimates "be the null hypothesis denoted by H_0

The alternative hypothesis denoted by H_1 will therefore be "The building industry in the region does not considers project contingency sum as a percentage of the gross estimates"

Let 'p' =

$$\frac{\text{No. of professionals that consider contingency sum as percentage of base estimates}}{\text{Sample size}}$$

From table 4.1 No of building professionals that consider contingency as percentage of the base estimates = 79.7 %

Sample size = n = 106

Hence p = 79.7/106 = 0.75

Let q be the proportion of building professionals that do not consider contingency as percentage of the total gross estimate.

q= 1-p = 1 – 0.75= 0.25

X ~ N (np, npq). Thus X follows a normal distribution with mean "np "and variance "npq". X = Sample size of building professionals who consider contingency sum as percentage of total base estimate.

Testing the above hypothesis at 5% level of significance, = P (|Z| > X) = 0.05

From normal distribution tables, x = + or - 1.96

H0 is rejected if |Z| > 1.96

Mean = np = 106 (0.75) = 79.5

Variance = npq, but np = 79.5

npq = 79.5 (0.25) = 19.88

Assuming 95 % of sample taken will reasonably represent the view of the building industry in Ashanti region.

$$X = \frac{95 \times 79.5}{100} = 75.6$$

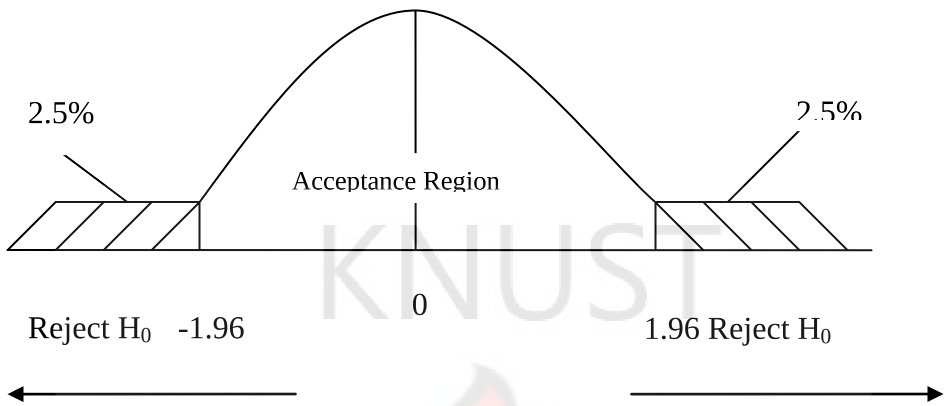
The test statistic $Z = \frac{x - np}{\sqrt{npq}}$

x = 75.6

np = 79.5

npq = 19.88

$$= Z = \frac{75.6 - 79.5}{\sqrt{19.88}} = \frac{-3.9.}{4.5} = -0.87$$



Conclusion

Since the test statistic (Z) lies within the acceptance region, there is significant evidence at 5% level to suggest that about 95% of building professionals in Ashanti region consider contingency sum as percentage addition. Hence H_0 is rejected and H_1 is established.

4.9.9 TEST OF HYPOTHESIS NO.2

“The building industry in Ghana does not manage the use contingency “be the null hypothesis denoted by H_0

The alternative hypothesis denoted by H_1 will therefore be “The building industry in Ghana manages the use contingency sum.

Let ‘p’ =

$$\frac{\text{No. of professionals that do not have management policy for the use contingency sum}}{\text{Sample size}}$$

From table 4.1 No of professionals that do not have management policy for the use contingency sum = 3

Sample size = n = 106

Hence p = 5.41/106 = 0.05

Let q be the proportion of professionals that use contingency sum to address building related problems.

q= 1-p = 1 – 0.05 = 0.95

X ~ N (np, npq). Thus X follows a normal distribution with mean "np "and variance "npq". X = Sample size of building professionals who consider contingency sum as percentage of total base estimate.

Testing the above hypothesis at 5% level of significance, = P (|Z| > X) = 0.05

From normal distribution tables, x = + or - 1.96

H0 is rejected if |Z| > 1.96

Mean = np =106 (0.05) = 5.3

Variance = npq, but np = 5.3

npq = 5.3 (0.95) = 5.0

Assuming 60 % of sample taken will reasonably represent the view of the building industry in Ghana.

$X = \frac{60 \times 106}{100} = 63.6$

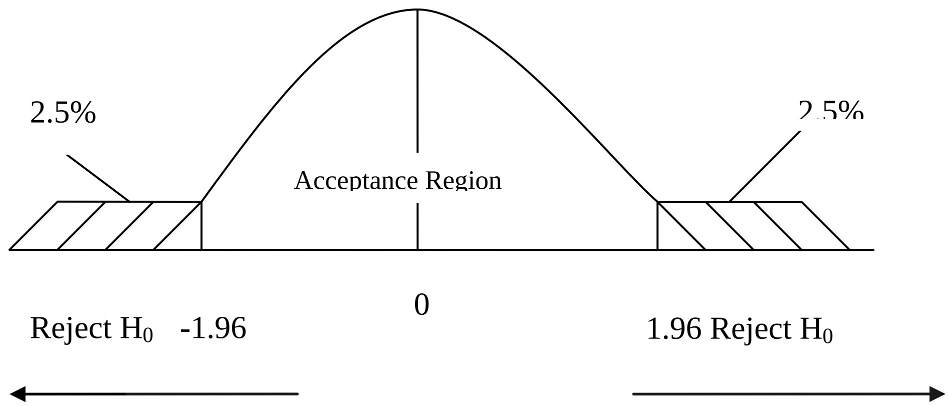
The test statistic $Z = \frac{x - np}{\sqrt{npq}}$

x = 63.6

np = 5.3

npq = 5.0

$= Z = \frac{63.6 - 5.3}{\sqrt{5}} = \frac{58.3}{2.2} = 26.5$



Conclusion

Since the test statistic (Z) lies far outside the acceptance region, there is significant evidence at 5% level to suggest that about 60% of building professionals in Ghana do have management policy for the use of contingency sum. Hence H_0 is rejected and H_1 is established.

Further Testing

Testing for 15 % of the sample size on similar basis

$$X = \frac{20 \times 5.3}{100} = 1.06$$

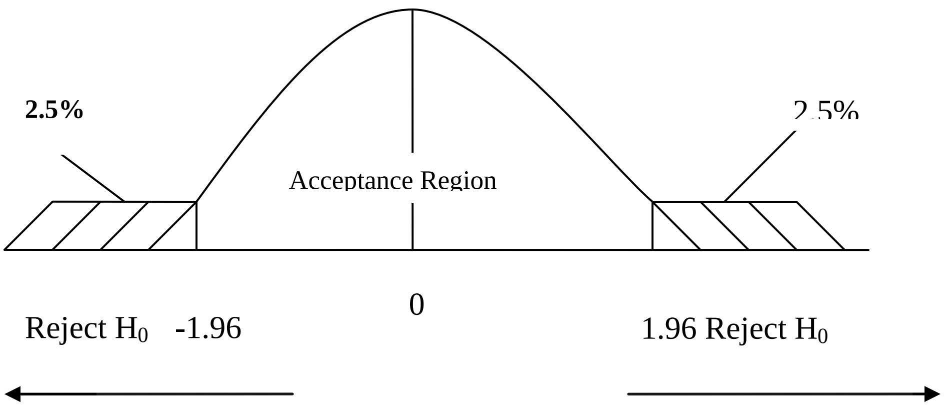
The test statistic $Z = \frac{x - np}{\sqrt{npq}}$

$x = 1.06$

$np = 5.3$

$npq = 5.0$

$$= Z = \frac{1.06 - 5.3}{\sqrt{5.0}} = \frac{-4.24}{2.2} = -1.92$$



Conclusion

Since the test statistic (Z) lies within the critical region, there is significant evidence at 5% level that not even 20% of building professionals in Ghana do not have management policy for the use of contingency sum. Hence H_0 is accepted.

TABLE 4.19: SUMMARY OF TEST OF HYPOTHESES

ITEM	HYPOTHESES	LEVEL OF SIGNIFICANCE	% OF SAMPLE CONSIDERED	RESULTS	
1	NO.1	5%	95	H_0 established	H_1 rejected
2	NO.2	5%	60	H_0 rejected	H_1 established
		5%	20	H_0 established	H_1 rejected

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The study established that some efforts were made to control the impact of risk in construction projects in Ghana. The specifics are outline below.

5.1.1 METHODS OF DETERMINING PROJECT CONTINGENCY SUM IN BUILDING WORKS.

The study has revealed that, the Deterministic (Percentage Approach) is the most frequent known and used method of determining Contingency Sum. 77% of selected building professionals used the percentage approach and 23% used the Probabilistic Estimating. These methods were based on subjective analysis. The study confirmed that the building industry in Ghana do not have specific percentage figures. Available information suggests that professionals use 2.5 to 10% for Contingency Sum.

5.1.2 ALTERNATIVE METHODS OF DETERMINING CONTINGENCY SUM

The study established that, there were other methods of determining Contingency Sum, but most of them were not familiar to professionals in Ghana. The study considered these methods:

- Range Estimating
- Estimation Using Risk Analysis (ERA).
- Monte Carlo Simulation
- Probabilistic Estimating

5.1.3 FACTORS INFLUENCING THE DETERMINATION OF CONTINGENCY SUM

The study established that by rating, the four most important factors that affect the determination of contingency sum were, unexpected ground conditions, design considerations, Project management and inflation (See Page 55).

In spite of the above rating, most professionals in Ghana consider Economic factors (Inflation, Global economic pressures) as the most influential factors and may contribute about 60%, since most of these factors are beyond the control of building professionals. Technical and environmental/ institutional factors may contribute 20 % each. It was identified that with proper management during the pre-tender stage, risk associated with technical factors can be controlled.

5.1.4 MONITORING THE USE OF PROJECT CONTINGENCY SUM.

The study established that, 78.95 % of selected professionals do monitor contingency through the Project Manager. 11.84 % use the sensitivity Analysis, 5.26% use the Continuous Risk Management Communication, and 3.95% do not monitor the use of contingency sum.

5.2 RECOMMENDATIONS

Based on the findings from the research the following recommendations are being made.

5.2.1 EXISTING AND ALTERNATIVE METHODS OF DETERMINING PROJECT CONTINGENCY SUM IN BUILDING WORKS.

The Deterministic (Percentage Approach) or the Traditional Method which is the most frequently used is based on subjective approach and has many limitations. It is therefore recommended that professionals should be encouraged to use more scientific method such as the Estimating Using Risk Analysis (ERA) or the Monte Carlo Simulation. The governing council for the various professional associations should organize workshops and seminars to introduce their members on how to work with some of the scientific methods of determining contingency and their advantages over the percentage method.

5.2.2 FACTORS INFLUENCING THE DETERMINATION OF COST CONTINGENCY SUM

Unexpected ground conditions, design considerations, and inflation have been identified as the most significant factors. The study recommends that professionals should engage in planning at development stages of the project to gather all possible information to minimise the impact of technical factors and other related factors.

Attention should be given to economic factors since most of them are beyond the control of the professionals. Provision should be available for environmental/ institutional factors. There should also be regular meeting among professionals in Ghana to deliberate on contractual and construction risks to determine possible contingency sum for a particular period.

5.2.3 MONITORING THE USE OF PROJECT CONTINGENCY SUM.

The study established that, about 84% of the building professionals monitor the use of project contingency sum. It is therefore recommended that, professionals should be encouraged to use defined method such as the sensitivity analysis.

5.2.4 PROPOSED METHOD FOR DETERMINING CONTINGENCY SUM

The study has developed a method for determining contingency sum which is devoid of subjective analysis. The Sample test of the method for 60 projects (30 projects in each group) gave an accuracy of 48% and 57% as compared to the estimated contingency of 21and 43% respectively. The study recommends that professionals should consider use of the proposed contingency calculator (See appendices 3-10 for the flow chart and work examples of the proposed method of determining contingency sum).

5.3 FURTHER RESEARCH WORK

The study has established that deterministic or the percentage approach is the method for determining contingency sum for building works in Ghana. However, this method is associated with difficulties. It is therefore recommended that, further studies should be conducted into other methods to develop a scientific method of determining contingency sum for the local construction industry.

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APPENDIX 1

PROJECTS AND CONTINGENCY PERCENTAGES

Item	Project	Contract Sum	Contingency In Percentages	Contingency Sum
1	Ghana Poverty Reduction Project/Social Investment Fund- Construction of Classroom blocks, Bungalows and Ancillary Facility	¢147,628.000	10	¢14,762,800
2	Basic Education Support Projects- Construction of Classroom blocks and Ancillary Facility- Ashanti and Brong Aharfo	¢3,829,710,397.68	2.5	¢95,742,759.93
3	HIPC/GETFUND relief Programme Construction of Classroom blocks and Ancillary Facility – Ejisu- Juaben District.	¢524,872,664.81	7.5	¢39,365,449.86
4	Primary Education Rehabilitation Project – Construction of Classroom blocks and Ancillary Facility –Upper East &West Region	$3,264,564.95	10	$326,456.5
5	Primary Education Rehabilitation Project – Construction of Classroom blocks and Ancillary Facility - Northern	$3,602,576.37	10	$360,257.64
6	Upgrading and Rehabilitation of Second cycle School- Effiduase Secondary commercial School – Two- Storey Dormitory Block	¢2,564,540,432	5	¢128,227,021.60
7	Construction of Community Clinic – Bosotwe –Atwima- Kwanwoma District Assembly	264,800,000	10	¢26, 480,000
8	Construction and completion of 2 –Unit daycare – Afrancho- Bosotwe –Atwima- Kwanwoma District Assembly	170,705,587.50	10	¢17,070,558.75
9	Promoting Partnership with Traditional Authorities (PPTAP)	¢992,612,229.28	10	¢99,261,222.93
10	Construction and completion of Headmaster's Bungalow for Sirigu Senior Secondary School – Upper East Region	¢747,995,856.55	10	¢74,799,585.7

Source: Construction Division – Building and Road Research Institute.

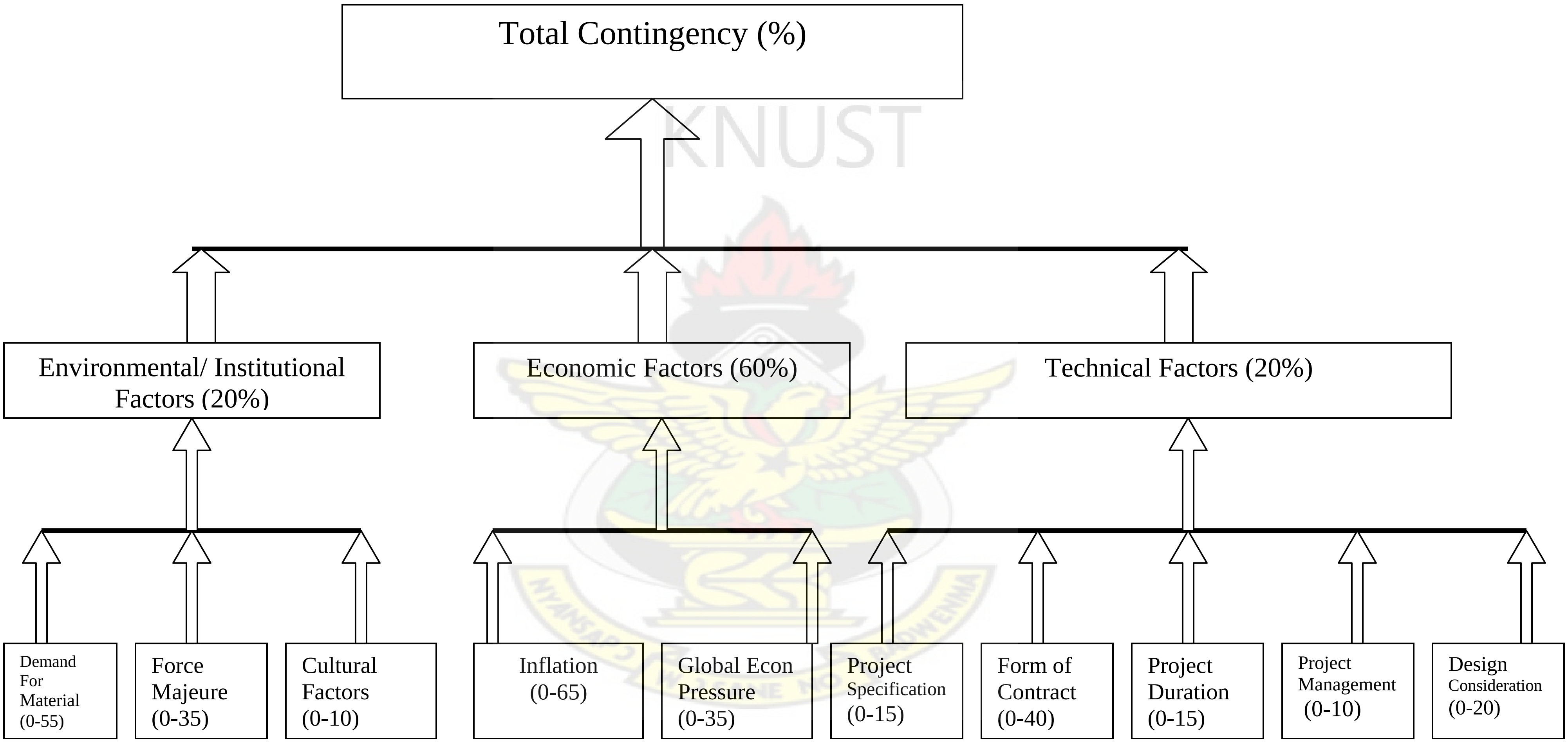
APPENDIX 2

FACTORS	QUANTITY SURVEYORS	ARCHITECTS	CIVIL ENGINEERS	OVERALL RANKING
Form of Procurement /Contract	4	5	9	7^{th}
Project Specification	7	4	4	6^{th}
Project Duration	6	6	6	7^{th}
Project Management	10	9	8	3rd
Design Consideration	2	3	1	2nd
Unexpected ground conditions	1	1	2	1^{st}
Inflation	3	1	3	3^{rd}
Increase in demand for extractive materials(Timber, Steel etc)	9	10	7	9^{th}
Global economic pressure (e.g. increase in demand for fuel)	5	7	4	5th
Force Majerue	8	8	10	9th

Rating of Factors Influencing Determination of Contingency Sum

Source: Field Survey, February – March, 2007

APPENDIX 3



Flow Chart Indicating the Determination of Contingency Sums

APPENDIX 4- GROUP A
LIST OF SELECTED PROJECTS

Item	Projects	Contract Sum	Estimated Contingency Sum from Bills Of Quantities		Actual Overrun After Completion		Using the Proposed Contingency Calculator.		Difference	
(A)	(B)	(C)	% (D)	Amount (E)	% (F)	Amount (G)	% (H)	Amount (J)	K= (F-D)	L= (F-H)
1	HIPC/GETFUND Relief Programme Construction of Day Care, Clinic Post Office for Bosomtwi Atwima Kwawoma District.	¢ 1,356,400,000	10	¢ 135,640,000	21	¢ 285,640,000	17.2	¢ 233,300,800	11	3.8
2	Basic Education Support Projects 5No 6 unit classroom Block and 10 unit 3-seater K.V.I.P-Adansi District – Ashanti Region BESP-1	¢ 4,238,051,100	2.5	¢ 103,367,100	4.8	¢ 203,056,000	10.2	¢ 432,281,212. 20	2.3	-5.4
3	Basic Education Support Projects 6No 6 unit classroom Block and 12 unit 3-seater K.V.I.P-Offinso District – Ashanti Region BESP-2	¢ 3,649,136,789.	2.5	¢ 86,002,336.25	4.5	163,519,926.25	10.8	¢ 394,106,773. 20	2	-6.3
4	Upgrading and Rehabilitation of Second cycle School – Construction of 2- storey boys Dormitory- Effiduase Secondary Commercial School	¢ 2,597,572,193	5	¢ 129,878,609.6 5	41	1,064,731,237.56	21.8	¢ 566,270,738. 10	36	19.2
5	Primary Education Rehabilitation Project – Construction of Classroom blocks and Ancillary Facility	$3,602,576.37	10	$360,257.64	-	-	-	$324,231.87	-	-

6	Construction of 6-unit Teachers’ Quarters- Offinso District.	¢ 283,000,000	9.1	¢ 25,800,000	9.7	¢ 27,500,000	11	¢ 31,130,000	0.6	-1.3
7	nstruction of 4-unit Teachers’ uarters- Offinso District.	¢ 206,800,000	9	¢ 18,800,000	8.9	¢ 18,483,871.50	2	¢ 21,093,600	-0.1	-2.1
8	Construction of 3-unit Teachers’ Quarters- Offinso District.	¢ 153,313,705	10	¢ 15,331,370.5	10	¢ 15,331,370.5	10.2	¢ 15,637,997	0	-0.2
9	Re-roofing of Yaa Asantewaah Basic School- Kumasi	¢ 41,701,152.50	5	¢ 2,085,057.63	5	¢ 2,085,057.63	4.8	¢ 2,001,655.3 0	0	-0.2
10	Basic Education Support Projects 5No 6 unit classroom Block and 10 unit 3-seater K.V.I.P-Sekyere west District	¢ 3,815,083,801.	2.5	¢ 95,377,095.03	N/A	N/A	11.4	¢ 434,919,553	-	-
11	Construction of 6- unit classroom Block- Kumasi	¢ 185,000,000	9	¢ 16,636,400	26.4	¢ 48,762,500	10. 20.8	¢ 38,480,000	17.4	5.6
12	Construction of Day Care center at Old Amokom	¢ 97,107,385.	10	¢ 9,710,738.50	35.5	¢ 34,504,115	20.6	¢ 20,004,121	25.5	14.9
13	Construction of 6- unit classroom Block- Ahamadiya Basic school Kumasi	¢ 151,494,367	10	¢ 15,149,436.7	10.6	¢ 16,132,	183.9 412.8	¢ 19,391,279	0.6	-2.2

Item	Projects	Contract Sum (¢)	Estimated Contingency Sum Details from Bills Of Quantities		Actual Overrun After Completion		Using the Proposed Contingency Calculator.		Difference	
			% (D)	Amount (¢) (E)	% (F)	Amount (¢) (G)	% (H)	Amount (¢) (J)	K= (F-D)	L= (F-H)
(A)	(B)	(C)								
14	Construction of 2- Room Day Care, for Bosomtwi Atwima Kwawoma District.	179,521,728	5	8,976,086.44	21	37,902,961.20	16.8	30,159,650	16	4.2
15	Construction of 2- Room Day Care in bricks, for Bosomtwi Atwima Kwawoma District.	170,705,587	5	8,535,279.38	21	36,041,582.80	16.8	36,041,582.80	16	4.2
16	Construction of 3-unit classroom Block Bosomtwi Atwima Kwawoma District.	184,402,549	5	9,220,127.46	21	43,872,453.50	16.8	43,872,453.50	16.8	4.2
17	Construction of 2-storey Post Office and Stores	822,621,470	5	41,131,073.50	7	57,583,502.8	10.4	57,583,502.8	2	3.4
18	Construction of Community Library – AME ZION Amokom- Kumasi	88,213,650	4.7	4,200,650	31.8	28,686.650	20.4	17,995,58	27.1	11.4
19	Construction of 7- unit classroom Block- Amankwatia Kumasi	189,500,000	9	16,636,400	25.7	48,762,500	22.8	43,206,000	16.7	2.9
20	Construction of Day Care center for Bosomtwi Atwima Kwawoma	169,178,184	5	8,458,909.20	13.10	22,314,602.40	14.8	5,038,371	8.1	-1.7
21	Construction of 3- unit classroom Block- office and staff -Nobowem Ejisu –Juaben District	261,429.000	10	26,142,900	10	26,142,900.	12.8	33,462,912	0	-2.1

Item	Projects	Contract Sum (¢)	Estimated Contingency Sum Details from Bills Of Quantities		Actual Overrun After Completion		Using the Proposed Contingency Calculator.		Difference	
			% (D)	Amount (¢) (E)	% (F)	Amount (¢) (G)	% (H)	Amount (¢) (J)	K= (F-D)	L= (F-H)
(A)	(B)	(C)								
22	Construction of New Girls Dormitory- Effiduase Secondary/ commercial School	2,564,540,432	5	128,227,021	6.7	168,498,161	13.4	343,648,418	-1.7	-6.7
23	Construction of New Computer and Renovation of Home Economics Block- Effiduase Secondary/ commercial School	811,531,796	5	40,576,589	26.3	213,476,874	22.8	185,029,249	21.3	3.5
24	Construction of Kitchen and Dinning hall Complex- Effiduase Secondary/ commercial	1,690,920,375	5	84,546,018	5.9	99,809,633	10.4	169,092,037	-4.9	-4.5
25	Construction of New Library Block- Effiduase Secondary/ commercial School	1,071,101,885	5	53,550,942	30	321,032,558	22.8	244,211,229.	25	-7.2
26	Construction of New Assembly Hall- Effiduase Secondary/ commercial School.	1,387,362,115	5	69,368,105.75	42.3	587,259,068	26	360,714,150	37.3	26.3
27	Construction of 2No 3- bedroom Masters' Bungalow -Effiduase Secondary School	610,172,700	5	30,508,635	N/A	N/A	2.9	91,525,905	-	-
28	Construction of 12-unit classroom block- Effiduase Secondary/ commercial School.	1,126,192,738	5	56,309,636.90	30	338,540,406	22.8	256,771,940	25	7.2
29	Construction of Community Library	145,942,912	5	7,297,145.63	8	11,675,433	9.4	13,718,633.78	3	1.4
30	Construction of Community Clinic and urinal	117,764,013	5	5,888,200.65	N/A	N/A	12.4	14,602,737..61	-	-

APPENDIX 4- GROUP B
LIST OF SELECTED PROJECTS

Item (A)	Projects (B)	Contract Sum (¢) (C)	Estimated Contingency Sum Details from Bills Of Quantities % (D)	Amount (¢) (E)	Actual Overrun After Completion % (F)	Amount (¢) (G)	Using the Proposed Contingency Calculator. % (H)	Amount (¢) (J)	Difference K= (F-D)	L= (F-H)
1	Construction of Day 3- unit Classroom Block for	132,584,689	10	13,258,468	11	14,584,315	12.8	16,970,840	1	1.8
2	Construction of Day 3- unit Classroom and Library Block	158,626,198.	10	15,626,198	13	20,621,405	12.8	20,304,153	3	0.2
3	6- Unit Teachers Quarters'	132,671,463	10	13,267,146	15	163,519,926	16.4	21,758,120	5	-0.6
4	Rehabilitation of 6 Unit Classroom Block	140,777,355	10	14,077,735	10	14,077,735	8.4	11,825,297	0	0.6
5	Construction of 6 unit Classroom blocks and Ancillary Facility	284,853,388	10	28,485,338	15	42,728,008	12	34,182,406	5	-3
6	Construction of 3 unit Classroom blocks and KVIP and Urinal	195,000,000	10	19,500,000	12	23,400,000	12	23,400,000	2	0
7	Construction of 6 unit Classroom blocks and KVIP and Urinal	301,000,000	10	30,100,000	12	38,128,000	14	42,140,000	2	-2
8	Construction of 6 unit Classroom blocks and KVIP and Urinal	292,514,817	10	29,251,481	10	29,251,481	11.4	33,346,689.14	0	-1.4

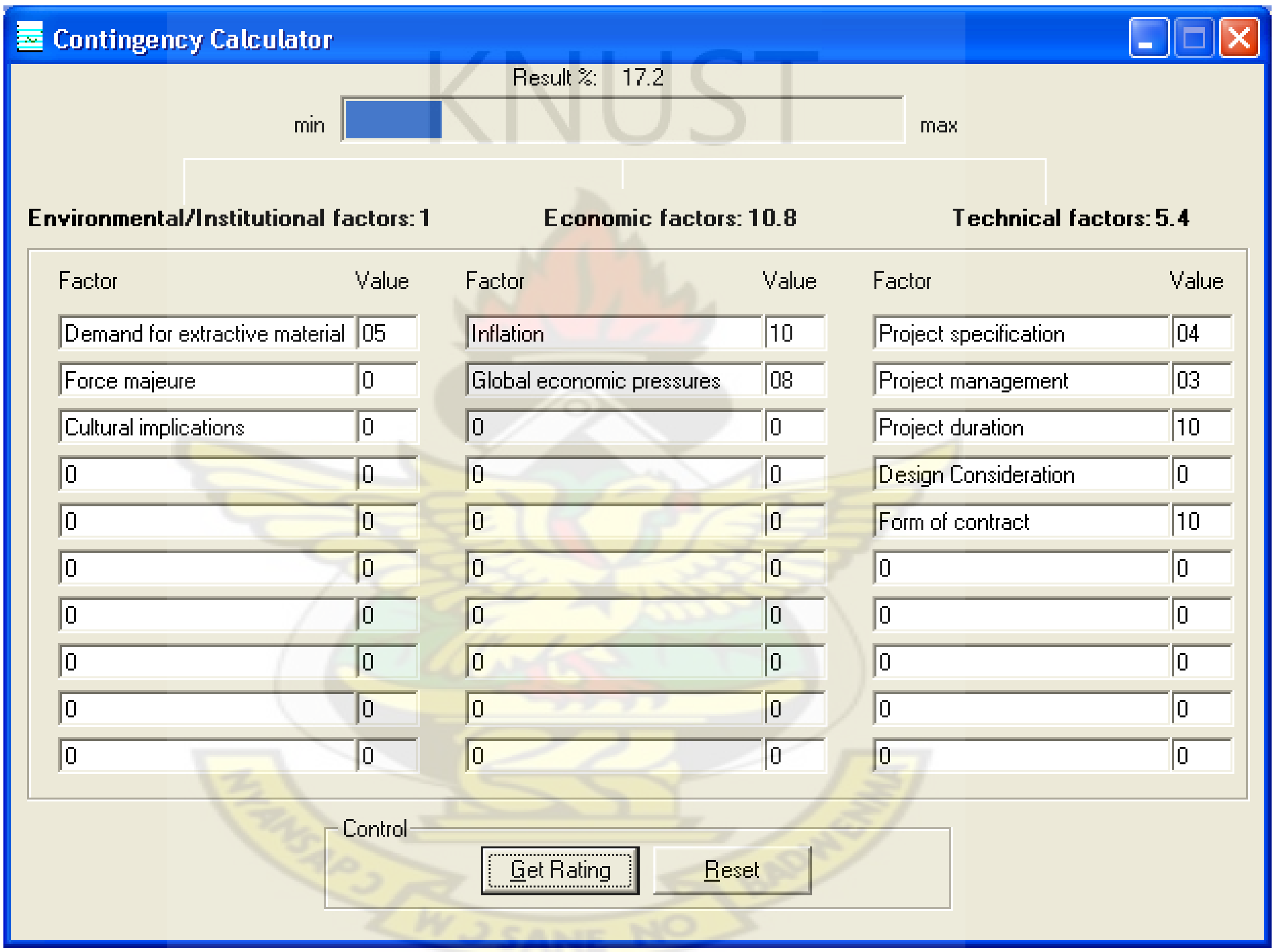
Item (A)	Projects (B)	Contract Sum (¢) (C)	Estimated Contingency Sum Details from Bills Of Quantities		Actual Overrun After Completion		Using the Proposed Contingency Calculator.		Difference	
			% (D)	Amount (¢) (E)	% (F)	Amount (¢) (G)	% (H)	Amount (¢) (J)	K= (F-D)	L= (F-H)
9	Construction of 6-unit Teachers' Quarters	239,309,058	10	23,930,905	10	23,930,905.84	10.4	24,888,142	0	-0.4
10	Community Clinic and 2- unit bedroom	319,555,582	7.5	23,966,668.69	13	41,542,225.73	15	47,933,337	5.5	-2
11	Construction of 2 Bedroom Semi-detached bungalow	245,000,000	10	24,000,000	16	38,400,000	15	36,750,000	5	1
12	Construction of 2 Bedroom Semi-detached bungalow	265,000,000	10	24,000,000	14	37,100,000	15	39,750,000	4	-1
13	Construction of 2 Bedroom Semi-detached bungalow	240,000,000	10	24,000,000	15	36,000,000	15	36,000,000	5	0
14	Construction of 6- unit classroom Block	199,998,783.	10	19,999,878	15	29,999,817.45	13.4	26,799,836	5	1.6
15	Construction of Administration Block	597,243,423.07	10	59,724,342.31	8.5	50,510,690.96	13.4	80,030,61868	0.5	-4.9
16	Construction of 6- unit classroom Block	525,287,574	10	52,528,757.	10.	52,528,757.4	13.4	70.388,534	0	-3.4

Item	Projects	Contract Sum (¢)	Estimated Contingency Sum Details from Bills Of Quantities		Actual Overrun After Completion		Using the Proposed Contingency Calculator.		Difference	
			%	Amount (¢)	%	Amount (¢)	%	Amount (¢)	K=	L=
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(J)	(F-D)	(F-H)
17	Construction of 3- unit classroom Block	147,267,313.20	4.76	6,976,512	15	22,090,096.95	12.4	18,261,146.84	10.24	-2.6
18	Construction of 6-unit Teachers' Quarters	249,021,462	5	12,451,073	15	37,353,219.75	13	32,372,790.06	10	-2
19	Community Clinic.	174,134,730	4.76	8,292,130	17	43,872,453.50	14.4	25,075,401.12	12.24	2.6
20	Construction of 3 unit preschool classroom block	198,042,642	7	13,862,984	10	19,804,264.2	14.4	28,518,140.45	3	-3.4
21	Construction of Community Library	230,777,410	4.7	16,154,418	N/A	N/A	14.4	33,231,947.04	-	-
22	Construction of District medical stores	155,109,680	10	15,510,968	10	15,510,968	13.4	20,784,679.12	0	-3.4
23	Construction of 2 Bedroom Semi-detached Nurses bungalow	175,219,222.50.	5	8,760,961	10	17,219,222.50	13.4	23,479,375.82	5	3.4
24	Construction of 3- unit classroom Block-office and staff	261,429.000	10	26,142,900	10	26,142,900.	11.4	29,802,906	0	-1.4

Item (A)	Projects (B)	Contract Sum (¢) (C)	Estimated Contingency Sum Details from Bills Of Quantities		Actual Overrun After Completion		Using the Proposed Contingency Calculator.		Difference	
			% (D)	Amount (¢) (E)	% (F)	Amount (¢) (G)	% (H)	Amount (¢) (J)	K= (F-D)	L= (F-H)
25	Construction of Community Clinic with staff Quarters'	180,772,042.50	5	9,038,602.13	12	21,692,645.10	12.4	22,415,733.27	7	0.4
26	Construction of 6- unit classroom Block and KVIP	294,227,430	5	14,711,371.50	N/A	N/A	11.4	33,541,927.02	-	-
27	Construction of 3- unit classroom Block and KVIP	184,657,305	5	9,232,865.25	7	12,926,011.35	10.4	19,204,359.72	2	-3.4
28	Construction of Health centre and Nurses Quarters	247,958,865	5	12,397,943.25	5	12,397,943.25	12.4	30,746,992.00	0	-7.4
29	Cladding of Pavilion and construction of 5 Seater KVIP.	116,848,935	5	5,842,446.75	5	5,842,446.75	9.4	10,983,799.89	0	-4.4
30	Construction of Dormitory block, Computer Room and 2- bedroom staff quarters;	321,214,339.69	5	16,060,716.98	15	48,182,150.94	14.4	46,254,864.90	0	1.4

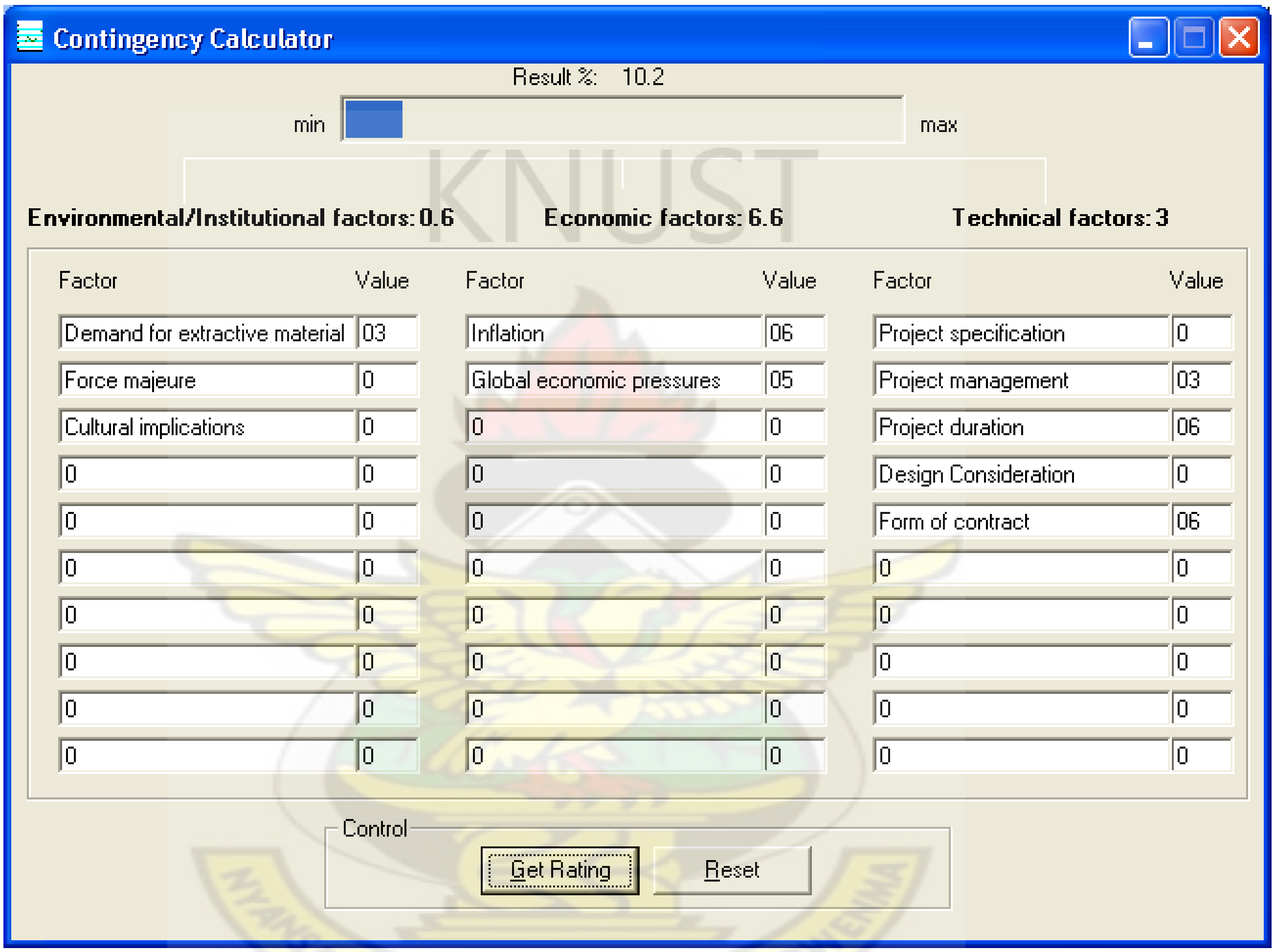
APPENDIX 5

The Proposed Contingency Calculator gives a contingency figure of 17.2% for the GETFUND Project



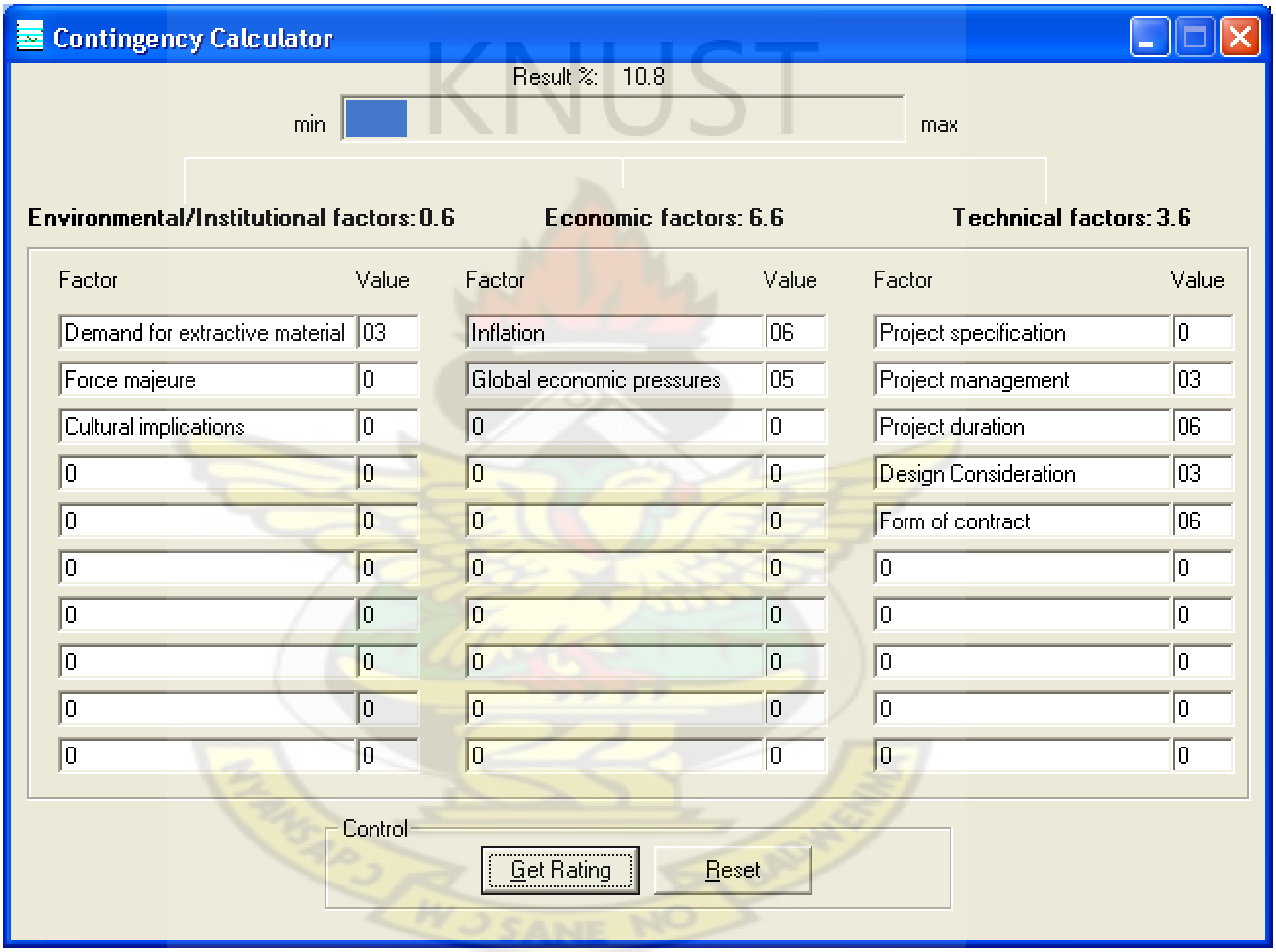
APPENDIX 6

The Proposed Contingency Calculator gives a contingency figure of 10.2% for t Basic Education Support Projects Offinso District – Ashanti Region (BESP 1)



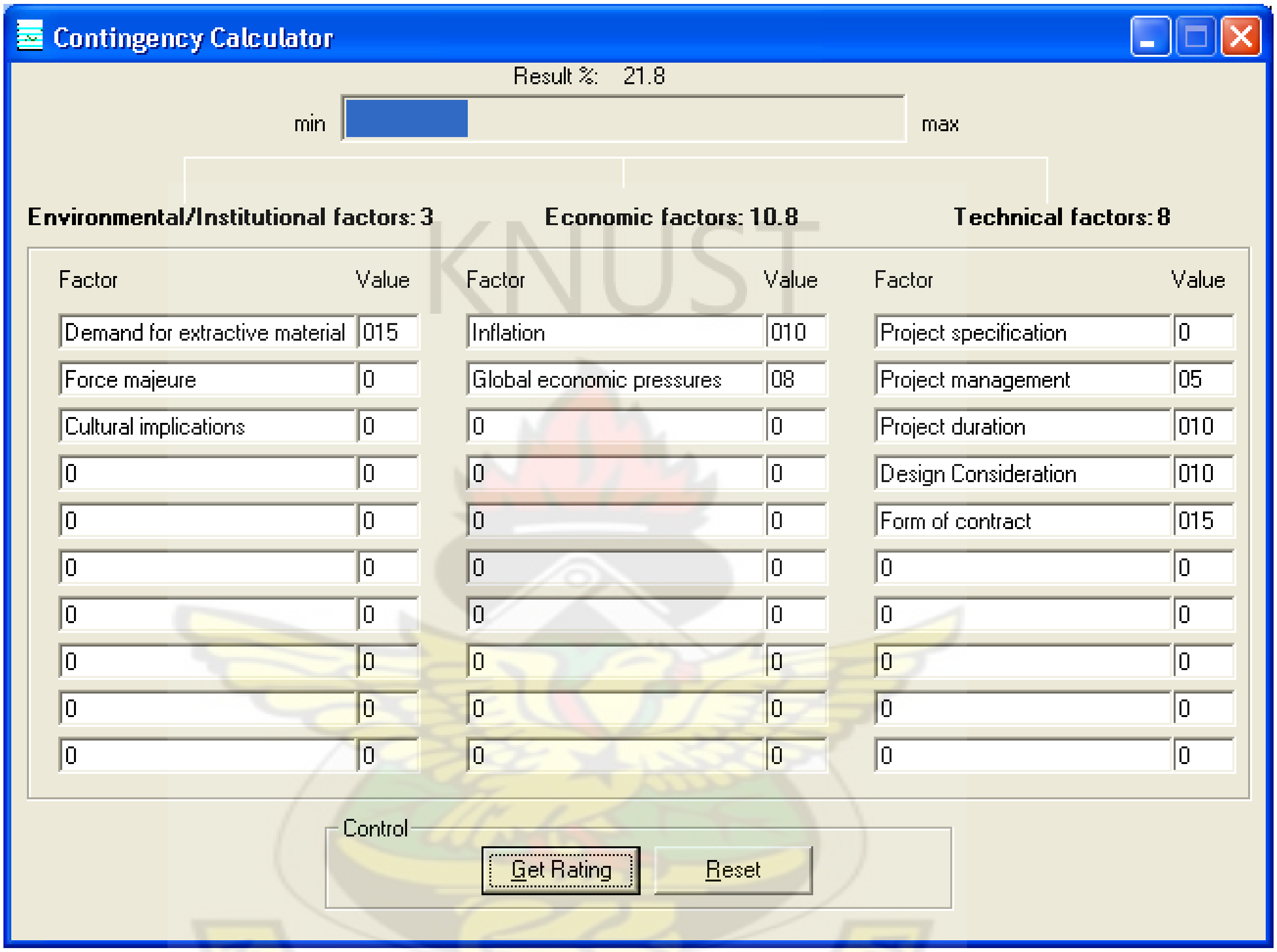
APPENDIX 7

The Proposed Contingency Calculator gives a contingency figure of 10.8 % for Basic Education Support Projects Adansi North District – Ashanti Region (BESP 2)



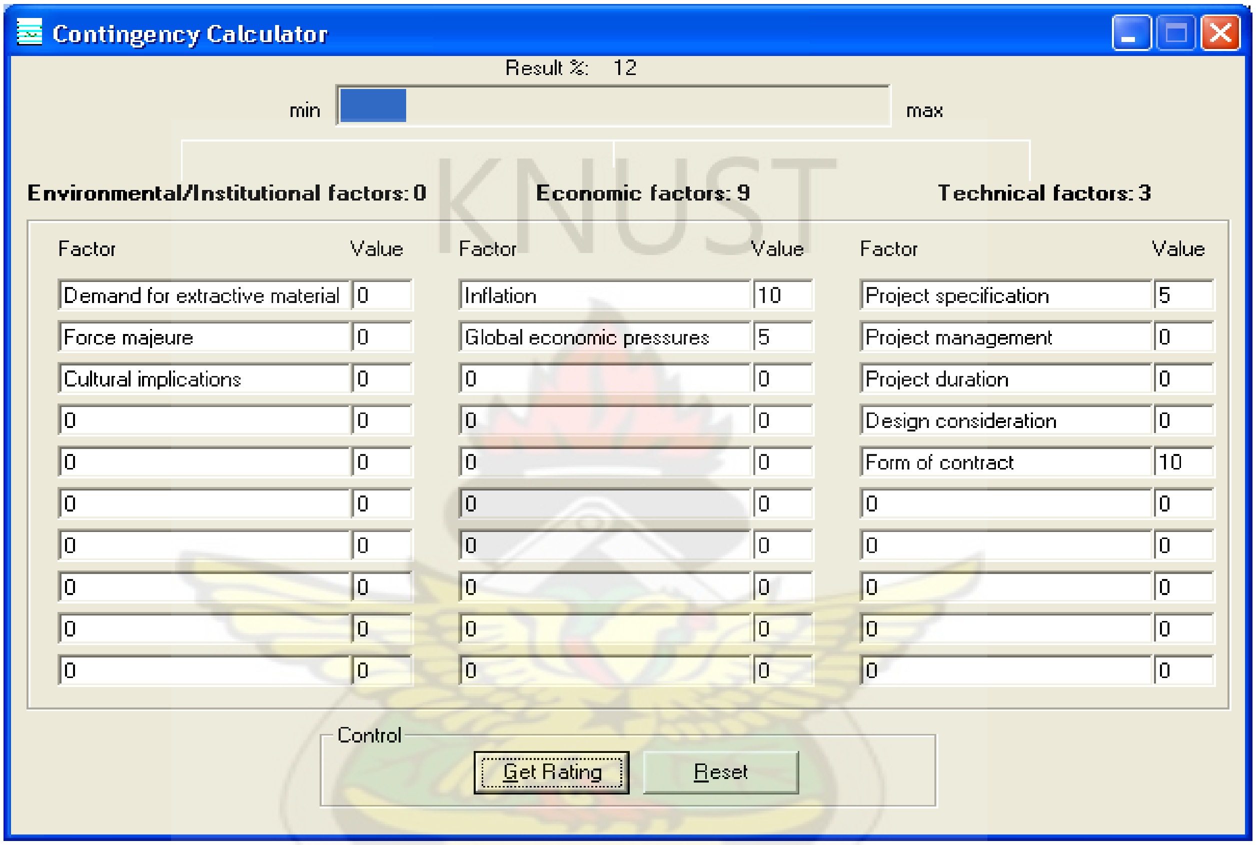
APPENDIX 7

The Proposed Contingency Calculator gives a contingency figure of 21.8% for Upgrading and Rehabilitation of Second cycle School – Effiduase Secondary Commercial School



APPENDIX 8

Proposed Contingency Calculator gives a contingency figure of 12% for Primary Education Rehabilitation.



APPENDIX 9

QUESTIONNAIRE FOR POST – GRADUATE RESEARCH PROJECT ON ALLOCATION AND MANAGEMENT OF PROJECT CONTINGENCY SUM FOR BUILDING DEVELOPMENTS IN ASHANTI REGION, GHANA

QUESTIONNAIRE

1. Which of the following categories of construction profession do you belong to?

   (A) Quantity Surveying ☐

   (B) Architecture ☐

   (C) Civil / Structural Engineering ☐

2. How long have you been in the construction industry?

   0-5years ☐ 5- 10years ☐ 10-20years ☐

   25 years and above ☐

3. Do you prepare building cost estimates? Yes ☐ ☐

4. If yes, do you consider project contingency sum in your estimates?

   Yes ☐ No ☐

5. The table below is a list of possible use of contingency sum during project execution. Please rank the uses of contingency sum according to their scale of 1-4 (1= Not frequent and 4 - Very frequent)

Table 1: The use of cost Contingency

Item	Use of cost contingency sum	Ranking			
		1	2	3	4
1	Reserve fund or Allowance				
2	Unexpected/ Unforeseen conditions				
3	Underestimation				
4	Cost overrun				
5	Other uses (please specify)				

6. The table below is a list of methods of determining contingency sum. Please rank the factors according to their scale of 1-4 (where 1= Not frequent and 4- Most frequent)

Table 2: Methods of determining of contingency sum

Item	Methods	Ranking			
		1	2	3	4
1	**Deterministic Methods** - The traditional method of estimating cost contingency sum which involves the computation of base estimate and the addition of a single contingency amount usually in percentage of the base estimate				
2	**Probabilistic Estimating –** It is a computation of cost based on probabilities and ranges of possibilities of the outcome of a project.				
3	**Range Estimating** - A technique in which the uncertainty of each line item of an estimate is determined by specifying the lowest and highest values that each element could assume based on an assessment of the related risks				
4	**Estimating using Risk Analysis (ERA)-**The ERA process is to identify risks by the project team. These risk items are then categorised into either fixed or variable. For each risk event, an average risk allowance and a maximum risk allowance are calculated.				
5	**Monte Carlo Simulation** - The risk analysis methodology for providing a means to quantify project risks, managing uncertainties, and determining project contingency using cost and schedule range estimating data inputs.				

7. Please tick the advantage(s) for the most frequent used method from Q6.

   Table 3 indicates the advantages of the most frequent used method

Item	Advantages	Tick
1	Quick and easy to determined	
2	Serves as financial control	
3	Eliminate the tendency of double – count of risk	
4	Monitors project performance and quality of risk	
5	Mechanism for accounting for public money	
6	Encourages creativity in estimating practices	

8. Please tick the disadvantage(s) for the most frequent used method from Q6.

Table 4 indicates the disadvantages of the most frequent used method

Item	Disadvantages	Tick
1	Inflating of cost contingency to cover for over spending and avoid the need to request for additional fund	
2	Arbitrarily arrived contingency is appropriate for specific project	
3	The tendency of double – count of risk	
4	No proper monitoring of project performance and quality of risk	
5	Does not indicate any source of cost reduction	
6	Does not encourages creativity in estimating practices	

9. Do you monitor the use of project contingency sum during project execution?

Yes ☐ No ☐

10. If yes, how is contingency sum monitored during project execution?

(A) Sensitivity Analysis

(B). Risk Management Communication

(C). Project Manager (Contingency under the control of project Manager)

(D). No method

11. The table below is a list of factors associated with the determination of Contingency Sum. Please rank the factors according to their scale of 1-4 (where 1= Not Significance and 4 Very Significance)

Table 5: Factors that can be considered during determination of project contingency sum

Item	Factors	Relative Significance			
		1	2	3	4
	Technical Factors				
1	Form of Procurement/Contract				
2	Project Specification				
3	Contract Period				
4	Project Management				
5	Design Consideration				
6	Unexpected Ground Conditions				
	Economic Factors				
7	Inflation				
8	Global economic pressure (increase in demand for fuel)				
	Environmental Factors				
9	Increase in demand for extractive materials (Timber, Steel etc)				
10	Force Majeure				

APPENDIX 12

VISUAL BASIC PROGRAMME FOR THE PROPOSED SYSTEM OF DETERMINING CONTINGENCY SUM.

```
Option Explicit
Dim grand Result, grandResult2 As String 'variable to hold final computation for progress bar

'Variables for institutional factors
Dim instResult, instSum As String
Dim instVal1, instVal2, instVal3, instVal4, instVal5 As Integer
Dim instVal6, instVal7, instVal8, instVal9, instVal10 As Integer

'Variables for economic factors
Dim ecoResult, ecoSum As String
Dim ecoVal1, ecoVal2, ecoVal3, ecoVal4, ecoVal5 As Integer
Dim ecoVal6, ecoVal7, ecoVal8, ecoVal9, ecoVal10 As Integer

'Variables for technical factors
Dim techResult, techSum As String
Dim techVal1, techVal2, techVal3, techVal4, techVal5 As Integer
Dim techVal6, techVal7, techVal8, techVal9, techVal10 As Integer


Public Sub gprTextBoxesDefaultValues ()
'Procedure for setting default values for textboxes

Dim Control
For Each Control In Me
If Type Of Control Is TextBox Then
Control. Text = 0
End If
Next

End Sub

Public Sub gprInitialiseVariables ()
'Procedure to initialise variables for computation

instVal1 = instVal2 = instVal3 = instVal4 = instVal5 = 0
instVal6 = instVal7 = instVal8 = instVal9 = instVal10 = 0

ecoVal1 = ecoVal2 = ecoVal3 = ecoVal4 = ecoVal5 = 0
ecoVal6 = ecoVal7 = ecoVal8 = ecoVal9 = ecoVal10 = 0
```

```
techVal1 = techVal2 = techVal3 = techVal4 = techVal5 = 0
techVal6 = techVal7 = techVal8 = techVal9 = techVal10 = 0

End Sub
Private Sub cmdReset_Click ()
'resetting all variables
On Error Go To errhan
Call gprInitialiseVariables
Call gprTextBoxesDefaultValues

'set default values for some textboxes
txtInst1.Text = "Demand for extractive materials"
txtInst2.Text = "Force majeure"
txtInst3.Text = "Cultural implications"

txtEco1.Text = "Inflation"
txtEco2.Text = "Global economic pressures"

txtTech1.Text = "Project specification"
txtTech2.Text = "Project management"
txtTech3.Text = "Project duration"
txtTech4.Text = "Unexpected ground condition"
txtTech5.Text =  "Form of Contract"

txtInstVal1.SetFocus

txtGrandResult.FontBold = False
txtGrandResult.ForeColor = &H80000008

prBarResult.Value = 0
prBarResult.Max = 100
prBarResult.Min = 0

Exit Sub
errhan:
MsgBox "The system cannot reset now. Please exit and start again", vbInformation, App.
Title
End Sub

Private Sub cmdResult_Click ()

txtGrandResult.FontBold = False
txtGrandResult.ForeColor = &H80000008
prBarResult.Value = 0

'Computation for institutional factors
```

```
instVal1 = txtInstVal1.Text
instVal2 = txtInstVal2.Text
instVal3 = txtInstVal3.Text
instVal4 = txtInstVal4.Text
instVal5 = txtInstVal5.Text
instVal6 = txtInstVal6.Text
instVal7 = txtInstVal7.Text
instVal8 = txtInstVal8.Text
instVal9 = txtInstVal9.Text
instVal10 = txtInstVal10.Text
lblInstResult.Text = Val(instVal1) + Val(instVal2) + Val(instVal3) + Val(instVal4) +
Val(instVal5) + Val(instVal6) + Val(instVal7) + Val(instVal8) + Val(instVal9) +
Val(instVal10)
lblInstResult.Text = 0.2 * Val (lblInstResult.Text)

'Computation for economic factors
ecoVal1 = txtEcoVal1.Text
ecoVal2 = txtEcoVal2.Text
ecoVal3 = txtEcoVal3.Text
ecoVal4 = txtEcoVal4.Text
ecoVal5 = txtEcoVal5.Text
ecoVal6 = txtEcoVal6.Text
ecoVal7 = txtEcoVal7.Text
ecoVal8 = txtEcoVal8.Text
ecoVal9 = txtEcoVal9.Text
ecoVal10 = txtEcoVal10.Text
lblecoResult.Text = Val(ecoVal1) + Val(ecoVal2) + Val(ecoVal3) + Val(ecoVal4) +
Val(ecoVal5) + Val(ecoVal6) + Val(ecoVal7) + Val(ecoVal8) + Val(ecoVal9) +
Val(ecoVal10)
lblecoResult.Text = 0.06 * Val (lblecoResult.Text)

'Computation for technical factors
techVal1 = txtTechVal1.Text
techVal2 = txtTechVal2.Text
techVal3 = txtTechVal3.Text
techVal4 = txtTechVal4.Text
techVal5 = txtTechVal5.Text
techVal6 = txtTechVal6.Text
techVal7 = txtTechVal7.Text
techVal8 = txtTechVal8.Text
techVal9 = txtTechVal9.Text
techVal10 = txtTechVal10.Text

lbltechResult.Text = Val(techVal1) + Val(techVal2) + Val(techVal3) + Val(techVal4) +
Val(techVal5) + Val(techVal6) + Val(techVal7) + Val(techVal8) + Val(techVal9) +
Val(techVal10)
```

```
lbltechResult.Text = 0.2 * Val(lbltechResult.Text)

'computation for progress bar value multiply by 100 to get actual value
txtGrandResult =  (Val(lblInstResult.Text) + Val(lblecoResult.Text) +
Val(lbltechResult.Text))

On Error Go To errhan
   prBarResult.Value = txtGrandResult
Exit Sub
errhan:
   'if value is more than the stipulated then change font colour to bold red
   If Err. Number = 380 Then
      txtGrandResult.FontBold = True
      txtGrandResult.ForeColor = vbRed
      prBarResult.Value = 100
   End If
'deinitialising variables
Call gprInitialiseVariables

End Sub
Private Sub Form Load ()
On Error Go To errhan

  frmMain.Left = (Screen.Width - frmMain.Width) / 2
  frmMain.Top = (Screen. Height - frmMain.Height) / 2

'Call procedures whiles main form loads
   Call gprTextBoxesDefaultValues
      'set default values for some textboxes
      txtInst1.Text = "Demand for extractive materials"
      txtInst2.Text = "Force majeure"
      txtInst3.Text = "Cultural implications"

      txtEco1.Text = "Inflation"
      txtEco2.Text = "Global economic pressures"

      txtTech1.Text = "Project specification"
      txtTech2.Text = "Project management"
      txtTech3.Text = "Project duration"
      txtTech4.Text = "Unexpected ground condition"

   Call gprInitialiseVariables

   prBarResult.Value = 0
   prBarResult.Max = 100
   prBarResult.Min = 0
```

```
   Exit Sub
errhan:
   MsgBox "This application cannot load now. Please try again or call for support",
vbError, App. Title
End Sub

Private Sub Form_QueryUnload (Cancel As Integer, Unload Mode As Integer)
On Error Go To errhan
If MsgBox ("Are you sure you want to exit this application?", vbYesNo + _
   VbQuestion + vbDefaultButton2, App. Title) = vbNo Then
      Cancel = 1

End If
Exit Sub
errhan:
   MsgBox "The application cannot exit now. Please try again.", vbInformation,
App.Title
End Sub

Private Sub Form Unload (Cancel As Integer)
'deinitialising variables for computation
   Call gprInitialiseVariables
End Sub
```