KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,

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PROJECT TOPIC:

DETERMINATION OF CONTINGENCY SUM FOR WORKS PROCUREMENT DURING TENDERING STAGE IN GHANA.

A THESIS SUBMITTED TO THE DEPARTMENT OF BUILDING TECHNOLOGY, COLLEGE OF ART AND BUILT ENVIRONMENT OF THE KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE (MSc.) DEGREE IN PROCUREMENT MANAGEMENT.

BY

NYAGORMEY JULIUS JUBILEE (BTech. Bldg Tech.)

(PG 1771714)

NOVEMBER, 2015.

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DECLARATION

I hereby declare that this thesis herein is my own work towards the award of Master of Science (MSc.) degree in Procurement Management and that, to the best of my knowledge, it contains neither material previously submitted to or published by any other person nor material which has been accepted for the award of any other degree of the University or to any other body, except where due acknowledgement has been duly made in the text.

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ABSTRACT

The degree of risks and uncertainties in a project results from a combination of factors which differ from one project to another. One of the attempts to handle risks is by allocating contingency sum. Traditionally, construction professionals determine contingency sum simply by adding; say 10% contingency onto the estimated cost of a project. The Traditional method is arbitrary arrived at and difficult to justify or defend by cost experts. It is coupled with so many weaknesses. The aim is not only to examine into practices of contingency allocation for works procurement in Ghana but also to identify factors that have the utmost influence on the determination of contingency sum by using Pareto Principle (the 80/20 Rule). Literature review was carried out in line with the set objectives of the study. Questionnaires were distributed to a sample size of 103 construction professionals determined using the Kish (1965) formula. A total of 68 were completed and returned out of which 67 representing 98.5% were responsive. Descriptive statistics and the relative important index were used to analyse and explore the variables in the study on the methods and factors. Traditional Percentage addition, Lump sum allowance, Cost item allocation and Probabilistic estimation methods were identified as the most frequently used and widely known by the construction experts in estimating contingency sum. Despite the existence of a more scientific methods of calculating contingency sum, cost experts and practitioners in the construction industry are yet to explore the benefits of scientific methods as they are still glued to the conventional method of percentage addition. Unexpected ground conditions, poor contract management, Political Interference, Fraudulent Practices and Kick-Backs, Site Characteristics, project Specification, Design Considerations, Global Economy and Exchange Rates have emerged as the influencing factors in making provisions for contingency calculation.

Revealed by 80%/20% Pareto principle that Unexpected Ground Conditions (Substructure works), Poor Contract Management, Political Interference, Fraudulent Practices and Kick-Backs, Site Characteristics, Project Specification and Design Considerations are the most critical and significant factors where attention is likely to yield the greatest benefit in the determination of contingency sum for works. The study concluded by advocating for a more scientific methods for calculating contingency sum and recommended among others the use of scientific approaches such as Monte Carlo Simulation, Estimating Using Risk Analysis and Regression. These methods are based on statistical analyses which rely on and require statistical or mathematical knowledge from the user hence one of its limitations since most of the Contract managers or Construction professionals do not have enough knowledge of these techniques to estimate contingency sum.

Keywords: Procurement, Tendering, Works, Projects, Contingency and Risks.

DEDICATION

This research work is dedicated to God Almighty for His grace on me throughout the study period, and to my Aunties Mrs. Aspelin Agnes Mawu Ramel-Dagbui, Mad. Silena Shuba Abla Dagbui, Peace Aku Dagbui and Nyagormey family especially Miss Cynthia Gbedemah, my sons Ablorde and Seyram and to the memory of my late Father Albert K.Y. Nyagormey who inspired me not to relent in my effort to achieving a higher laurel.

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LIST OF ABBREVIATIONS (ACRONYMS)

AACE	American Association of Cost Engineers
AESL	Architectural Engineering Services Limited
ANNs	Artificial Neural Networks
CFI	Critical factor index
CPI	Consumer Price Index
CTS	Contingency Tracking System
DOE	Department of Energy
ERA	Estimating Using Risk Analysis
FAA	Federal Aviation Administration
GDP	Gross Domestic Product
IMC	Interim Management Committee
ISO	International Standard Organization
MCS	Monte Carlo Simulation
MDAs	Municipal and District Assemblies
PERT	Programme Evaluation Review and Technique
PMI	Project Management Institute
PPA	Public Procurement Act
PTF	Petroleum Trust Fund
RII	Relative Important Index
WAGP	West African Gas Pipeline
WBS	Weight Base System

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Any construction work in Ghana is mainly achieved through a procurement system. Public procurement is generally well-defined as the acquisition of goods, services and works through contractual framework, financed in whole or in part from public funds (World Bank, 1995). In Ghana, public procurement remains a big part of the economy. Procurement stands around 24% of whole importations aside individual rewards. Ghana's Public procurement represents between 50% -70% of the nation-wide financial plan and about 14% of Gross Domestic Product (GDP) (Adjei, 2006). World Bank (2003) report revealed that the yearly cost of obtaining goods, works, as well as consultancy services was about US$600 million representing approximately 14 percent of Ghana's (GDP). In line with Public Procurement manual (Act 663 of 2003), Works shall means construction, reconstruction, demolition, repair or renovation of a building structure and includes activity under a procurement contract. Every work comes with cost referred to as total contract sum for which contingency sum forms an integral part of. The question then is how the Employer and the Construction firms arrived at this money?

Construction works in Ghana are commonly procured by means of tendering. Works procurement follows a chronological procedure where project design is principally accomplished after which tenders are invited for submission in a competitive environment. Cost estimation at pre-tender stage is the act of predicting the price of a project throughout planning and design phases (Serpell, 2005). At the pre-tender phase, Clients are concerned about the whole financial commitment of projects. All construction works are prone to various types of risks. Risk is inherent element in every construction works (Baccarini, 2004) and is always right from inception of a project through to its completion (Odeyinka, 1987). Accordingly, there is no construction works undertaken without an element of risk (Kwakye, 1997). Risks and uncertainties are experienced during any level of the construction process. According to Jaafari (2001) risk is an exposure to an economic loss or gain arising from construction activities which impact on project objectives. Risks identified in construction have either been divided into external or internal and force majeure risks (Odeyinka, 1987).

In Ghana, construction works are full of numerous uncertainties and risks. These risks are either predictable or unpredictable and are reasons why subsequently, construction organizations in preparing tenders make management decisions to determine the amount to be added to base estimate in the tenders for risk. The amount of money allocated for risks in tenders is commonly termed as contingency. Consequently, the estimation of contingency sum and its ultimate adequacy is of dire importance to projects (Baccarini, 2005). The amounts of contingency sum to be allocated as well as the methods used in their calculation have been a subject of worry. There is no project budget without a contingency sum. The common method used for allowing contingency sum is by considering a percentage addition to base estimate grounded on past experiences. Contingency Sum is an essential component of the whole valued expenses of projects and considered as additional funds to cater for unexpected features that come with cost within the defined project limits (Ford, 2002; AACE, 2000). Higher contingency sums are for projects which cannot be adequately defined but the sum decreases as the project progresses.

1.2 STATEMENT OF THE PROBLEM

Construction professionals in the construction industry have not been able to state the actual percentage range for Contingency Sum. In construction, too frequently risk is either overlooked or dealt with by allowing a percentage addition onto the base estimate to cater for unexpected conditions that experiences shown are likely to occur. The practice is subjective, typical and unscientific (Thomson and Perry, 1992).

In Ghanaian construction industry, Contingency Sums for works procurement have been across board percentage addition to base estimate. This Percentage allowance method is derived as a result of past experiences, intuition and sometimes historical data without much scientific bases (Baccarini, 2004). The practice is judgmental, illogical and arbitral, a reason why is difficult for Estimators to authenticate or defend (Yeo, 1990). It is an intuitive method hence a cause for numerous projects above financial plan (Hartman, 2000). The frequent usage of expert knowledge, experience, intuitive and judgment as rule of thumbs which are commonly ill-defined and ambiguous cannot be evaded due to limited statistical information (Dikmen et al., 2007; Kangari and Riggs, 1989). Though the method is simple, it has many demerits resulting into some problems including delay in completion of projects, loss of capital, litigations, vacating of projects tied up with high interest rates on loans, high cost of project overhead and loss of profit. Most cost and time overruns are attributable to this method. Severally, Ghanaian contractors have also been blamed for not capable to execute works to design stipulations and quality standards. In contrast to the validity of these claims, could be described dangerous to procuring entities in Ghana. With regards to these worries, one could enquire, what ways could be adopted to accurately calculate contingency sum and deal with factors that influence the provision of contingency amount? It is against this background that it has become necessary to discover the approaches adopted in calculating contingency sum in Ghana and assess the risk factors that have the greatest impact on the estimation of contingency sum.

1.3 AIM AND OBJECTIVES OF THE STUDY

1.3.1 Aim of the Study

The aim is not only to examine the best practices of contingency allocation methods for works procurement in Ghana but also to find out factors that have the utmost influence by using Pareto Principle (the 80/20 Rule) and where attention is probable to produce the utmost advantage in the determination of contingency sum for works.

1.3.2 Objectives of the Study

The exact goals below have been set up to achieve the aim of the study.

1. To identify the existing approaches used in estimating contingency sum in Ghana.
2. To identify the critical factors considered by construction professional in making provision for contingency sum in Ghana.
3. To reveal the most critical risk factors having the greatest impact on the estimation of contingency sum.

1.4 RESEARCH QUESTIONS

The study objectives are based on the following research questions;

1. What existing methods are used in estimating contingency sum for works in the construction industry in Ghana?
2. Which factors are critical in the determination of contingency amount for works in Ghana?
3. What are the most critical factors that have severe impacts on the estimation of contingency sum?

1.5 SIGNIFICANCE OF THE STUDY

The built environment plays a vital role in a nation-wide economy due to the usage of its end products. The industry is used as an economic regulator by government, who is a major Employer in the industry. The first estimate for construction works given to a Client often forms the foundation for others to be refereed. Unfortunately at the stage when this estimate is being prepared, there is limited information about the project. More so construction works are mostly subject to risks and eventualities at the commencement; hence the significance of the study intends to establish the methods used in determining contingency sum for works in Ghana. It would further assist in identifying the factors that sway the provision of contingency sum. Having a fair knowledge of the risk factors will put the professionals in a better position to thoroughly handle the risks factors during the tendering stage much better. Construction cost experts would specifically stand the chance in their practices to recognise variables that affect judgements on the calculation of contingency amount allowable to projects. Thus helping the Professionals engaged in construction industry to attain a well equal correctness, consistency and reliability of estimates to promote a healthy management of the works. Lastly, it is further expected to contribute to the knowledge base of present and future leadership and serve as a source of reference or a database for further research by students on related topic for academic purposes and impact on monitoring and productivity which contribute to national economic growth. The study will intend serve as a basis for Construction Professionals who may wish to carry out a professional practice or acquire more knowledge about how contingency sum is calculated.

1.6 SCOPE OF THE STUDY

The scope is to assess the concept of project contingency sum, with the aim of finding out how Contingency Sum is determined and or allocated and as well identify the most critical factors considered in the calculation of contingency amount for works procurement in the Built Environment in Ghana. The research focused on Construction professionals, preferably the registered Quantity Surveyors, Civil or Structural Engineers and Architects working in various establishments in Greater Accra and Volta regions, Kumasi and Cape Coast of Ghana.

1.7 RESEARCH METHODOLOGY

Research methodology refers to the techniques that are used to conduct research. According to Gray et al., (2007) it is defined as the study of the research processes, methods, principles, procedures and strategies for gathering information, analysing it, and interpreting it. It involves data collection instrument namely questionnaire, interviews, observations, as well as sampling techniques and statistical tools for organizing and interpreting both structured and unstructured data (Bryman, 2008). The methodology adopted comprises an extensive literature review of books, journals, publications, magazines, conference proceedings and reports of previous works in this research area. The processes before and on the field of survey are pivotal in information gathering techniques, kind of information to be gathered and methods of data analysis employed. The study adopted a survey research style to solicit information from the respondents. The study employed triangulated or mixed research approach which involved both quantitative and qualitative approaches. The respondents for the study were the Construction Professionals (Quantity Surveyors, Engineers and Architects). The respondents were selected using non-probabilistic purposive sampling techniques. These respondents were directly involved in the subject under investigation and can provide very useful information to achieving the objectives of the study. The Secondary information collected was used as a supplement to the primary data. Descriptive analysis technique was adopted, where a number of well-structured questionnaires were dispersed to the selected respondents in the building industry in Ghana so as to obtain primary data for the research. The questionnaires were closed ended questions in a simple language to elicit the required responses. Microsoft excel was used to analyse the gathered information from respondents.

1.8 ORGANIZATION OF THE STUDY

The study comprises of five chapters. Chapter One summaries historical background on works procurement, estimation and allocation of contingency sum, risks during tendering stage which emanate with disparity. The problem statement, aim and study objectives, study questions, significance of the study, scope of the study and the research methodology adopted have all been outlined to show the extent of coverage of the study. Chapter Two thoroughly deals with the review of literature in accordance with the set objectives for the research work. Methods used in calculating contingency amount and the risk factors have all been extensively reviewed. Chapter Three gives details of the research methodology which comprises research design, procedures, methods, sources of data, data collection instruments used in gathering the needed information for the study, the study population, sample size and sampling techniques and data analyses. Chapter Four deals with presentation, analysis and discussion of data collected using tables, descriptions and charts. Chapter Five further deals with conclusions as drawn from the analysis of the data collected. Considerable recommendations have also been outlined for implementation.

1.9 LIMITATIONS OF THE RESEARCH

A nationwide survey could not be embarked upon, aside time and financial constraints. The major limitation among others of this research work was the reluctance of some respondents in finding time to complete and return the questionnaires even after so many attempts calling on them. Others reached on their mobile phones were not willing to come to terms with the researcher to respond to the questionnaires, while some respondents were reluctant to give information out with a reason of not been safe.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

There are a number of terms used by many researchers in the construction industry around the topic Contingency determination. The chapter is solely dedicated and characterised with a thorough review of past literature from publications, textbooks, academic journals, magazines, websites and articles found to be relevant to the research topic. The study revised related literatures on the definition and concepts of contingency determination, methods used in estimating contingency sum during tendering stage, its management and improvements. Dynamics that sway the purpose of allowing contingency amount for works in the construction industry have been adequately reviewed. The review is done based on the set objectives for the study. The review provides a basis upon which the research is built to approve, compliment or form any new trends that probably might not have occurred.

2.2 WHAT IS PROCUREMENT?

Public procurement is generally well-defined as the acquisition of goods, services and works through contractual framework, financed in whole or in part from public funds (World Bank, 1995). Procurement is the process of buying, hiring or obtaining works, goods and services at a reasonable cost in the right quantity and quality, at the right time, in the right place for the direct benefit or use of governments, corporations, or individuals, generally via a contract' in accordance with the Public Procurement Act 663 of 2003. Construction works are usually obtained in Ghana through a competitive tendering. Hence Public Procurement in Ghana therefore is subject to the Act and it's implementing Regulations and Administrative Instructions.

2.3 CONCEPTS OF CONTINGENCY AND DEFINITIONS.

Every work comes with cost referred to as total contract sum of a project for which contingency sum forms an integral part (Ostwalt, 2001). Contingency sum is one of the important cost elements of works. There is no typical definition of contingency as found most appropriate (Patrascu, 1988). All contingency definitions point to the fact there is a risk which cannot be identified from the start of the project; hence contingency sum is tied up to risk. Consideration by allocating an amount for risks before the start of a project is paramount. The added amount of money to any base estimates for uncertainties is usually called a contingency sum (Pickens and Mak, 2001). According to Patrascu (1988) contingency as a term is mostly misunderstood, misinterpreted and misapplied in project implementation and means different packages to different individuals in different fields of study. Contingency as defined by American Association of Cost Engineers (AACE) (2000) is a specific provision of money in an estimate for unforeseeable or indeterminate cost of elements within a well-defined project scope which by statistical analysis of historical data have shown would occur (Clark and Lorenzoni, 1985). The Department of Energy (DOE) in the United States of America also defined Contingency Sum as a provision which covers cost resulting from incomplete design, unforeseen and unpredictable circumstances inside well-defined projects (Parsons Jr, 1999). Contingency Sum is reserve money put aside in the contract sum to attain exact project objectives or to permit for variations that may possible happen. Project Management Institute (PMI) (2004) says contingency is amount of funds, budget, or time needed above the base estimate to reduce the risk of overruns of project objectives. Contingency could be time but to many, money is considered as the only form of contingency which may not be totally right. The researcher’s observation is that, contingency is an amount added to base estimate to permit for items, circumstances, or events which state and occurrence, or effect is uncertain and will likely increase costs. In short, it is the money set aside to cope with uncertainties during construction. Contingencies are crucial to achieving project objectives. In summary Contingency is a function of uncertainty. Contingency = f (uncertainty).

2.4 USES OF PROJECT CONTINGENCY SUM.

The contingency fund contained in contract sum, tender, or development of budget may be classified as to its general purpose that is what it is intended to provide for. Typically, Quantity Surveyors would add contingency to a pre-tender estimates to cater for any unforeseen costs or events that may arise between the date of the estimate and the practical completion date of the project (Aibinu et al., 2011). It offers contract managers easiness necessary to discourse doubts as well as deviations which impend attaining objectives (Diekmann et al., 1988). The objective is to prevent a project from experiencing cost overrun. It serves as a monetary absolver in risk management plans. Yeo (1990) also opined that contingency allocation ensures that the financial plan set aside for works is precise, realistic and practically sufficient to cover the cost incurred by possibility of unexpected budget upsurges. Its establishment eliminates the adverse impact of unforeseen events. DOE observed Contingency should not be used to circumvent making an accurate assessment of expected base cost. Contingency amount must not be used to shelter deficiencies in cost developments for projects. Contingency is neither a cash allowance nor a profit at the tendering stage during works procurement.

In view of the researcher, the purpose of Contingency sum thereof is to serve as reserve funds, risk absolver and risk management strategy, sufficient enough to manage the inherent risks within projects durations and within project total budget. It is to shelter extra cost resulting from unexpected ground conditions, design alterations and other circumstances.

2.5 TYPES OF CONTINGENCY SUM IN CONSTRUCTION WORKS.

In defining the various forms of contingency, it is essential to determine how the dictionary describes it and compared with researchers' definitions. The 'Shorter Oxford' dictionary describes contingency as an item dependent on an indeterminate event. Webster describes it as 'something liable to occur as an assistant to something else'. In construction, the major types of contingencies identified namely are Design and Construction contingencies by (HM Treasury, 1993) and Special contingency (European Commission DG XVI, 1998; Oduro, 2008).

2.5.1 Design Contingency.

This is said to be an amount of money or an allowance set aside for usage throughout the technical design development of a facility to deal with disparities as a result of incomplete design development and inaccuracy in estimating approaches plus information gathered (Clark and Lorenzoni, 1985; European Commission DG XVI, 1998). Any unsettled design subjects at the time of award of contract must be incorporated and absorbed into the construction contingency (Gunhan and Arditi, 2007). At the initial budget stage, 30% to 50% is permissible for unfinished design plus 5% to 10% for estimating inaccuracies (Clark and Lorenzoni 1985). Therefore, as a rule of thumb, a 35 to 60% must be added to the early budget estimation cost.

2.5.2 Construction Contingency.

The money set aside for use during the practical construction phase to provide for alterations due to site conditions, or as a result of modification in construction methods or poor performance by contractors or sub-contractors (European Commission DG XVI, 1998). Love et al. (2013) Observed that it covers those variations that may happen throughout the actual execution stage. It allows the Contractor to have some degree of flexibility to alter or modify plans. Client should not view it as lost cost but as instrument to finish the work within the financial plan (Hart, 2007). It allows for changes specify by the variation clauses contain in the contract document which according to Baccarini (2005) exists to provide for these differences.

2.5.3 Special Risk Contingency.

This is a sum of money used to shelter risks rising from matters like land purchase, variations in external variables like legal tussles, force majeure and market conditions (European Commission DG XVI, 1998).

2.6 CONTINGENCY ESTIMATION METHODS.

Contingency estimation has been the subject of worry to many researchers. Contingency methods are either based on expert opinion or statistics. One of the more common methods is to consider a percentage addition to base estimate (Picken and Mak, 2001). Many methods and models have been developed for the estimation of the contingency at tender stage in the literature (Ahmad, 1992; Curran, 1989; Touran and Wiser, 1992). Some models are primarily traditional algorithmic methods (Moselhi, 1997). The scientific and statistical methods to estimate and manage risk are from Monte Carlo simulation (Al-Bahar, 1988), to regression and variance analysis (Ostwalt, 2001), linear regression (Sonmez et al., 2007), Artificial Neural Network (ANN) (Chen & Hartman, 2000), Programme Evaluation Review and Technique (PERT) with the aim attaining correctness and efficiency in contingency allocation. The professionals in the industry are hitherto to discover the benefits of these approaches as they are still stuck to lump sum and percentage addition (Bello and Odusami, 2008). A Range of existing methods for calculating project contingency have been detailed by (Baccarini, 2005a) as follows; see Table 2.1 on the next page.

Table 2.1: Shows the list of Contingency Estimating methods

Contingency Estimating methods	**References**
1. Traditional percentage	Ahmad, 1992; Moselhi 1997.
2. Lump Sum Allowance	Hogg, 2003.
3. Cost Item Allocation	Moselhi, 1997.
4. Probabilistic estimation (Allocation)	Moselhi, 1997.
5. Method of Moments	Diekmann, 1983; Moselhi, 1997; Yeo 1990.
6. Monte Carlo Simulation	Lorance & Wendling, 1999; Clark 2001.
7. Programme Evaluation Review and Technique (PERT)	Aquino, 1992.
8. Factor Rating	Hackney, 1985; Oberlander & Trost, 2001.
9. Individual risks – expected value	Mak et al., 1998; 2000.
10. Range Estimating	Curran, 1989.
11. Regression Analysis	Merrow & Yarossi, 1990; Aibinu & Jagboro, 2002.
12. Artificial Neural Networks	Chen & Hartman, 2000; Williams, 2003.
13. Influence Diagrams	Diekmann & Featherman, 1998.
14. Fuzzy Sets	Paek et al., 1993.
15. Theory of Constraints	Leach, 2003.
16. Analytical Hierarchy Process	Dey et al., 1994.

Source: Baccarini, 2005a.

2.7 REVIEW OF CONTINGENCY ESTIMATION METHODS.

The following methods have been thoroughly reviewed.

Traditional percentage, Lump Sum Allowance, Cost Item Allocation, Probabilistic estimation (Allocation), Method of Moments, Monte Carlo Simulation, Programme Evaluation Review and Technique (PERT), Estimating Using Risk Analysis (ERA), Regression Analysis and Artificial Neural Networks.

2.7.1 Traditional Percentage Addition.

This is also known as deterministic estimation or percentage allowance. The approach is subjective and allows across-the-board percentage addition (Baccarini, 2004) onto the base estimations. The percentage addition is derived from intuition; guess feeling, past experiences on similar projects, expert judgment of the cost Engineer and historical data. It only focuses on the objective percentage that should be allowed for contingency and this is an option for argument. The Contingency Sum is usually expressed as a percentage mark up on the base estimate (Pickens and Mak, 2001). The common percentage addition is the conventional 10% rule of thumb (Baccarini, 2005) onto the estimated cost of a project (Mills, 2001**).** For so long, ‘let’s just add 10 percent syndrome’ had continuously showed to be insufficient. The percentage ranges from (5% to 10 %) of the base estimates and added to same to have the contract sum (Burroughs and Jubtima, 2004). The method is characterized by some weaknesses as criticized by many researchers. It is arbitrarily arrived at, not appropriate for all projects and difficult to justify or defend (Ahmad, 1992; Thompson and Perry, 1992; Yeo, 1990). Considered an unscientific a motive why numerous projects are above financial plan (Hartman, 2000). It does not indicate any potential for cost reduction, and may therefore hide poor management of the execution of the project. It does not encourage ingenuity in estimation practice (Yeo, 1990; Mak et al., 1998). This practice has numerous overlaps, weaknesses and criticisms (Mak and Picken, 2000) notwithstanding a more scientific methods and models have been proposed.

The researcher observed and argued that the weaknesses percentage addition far outweigh its strengths. Professionals and Academicians in the field and training institutions lack creativity in estimation practice and cannot justify ways of arriving at contingency sum. It promotes and encourages poor monitoring and management of Contingency Sum. Increase in contract insecurity is inescapable in construction industry.

2.7.2 Lump Sum Allowance.

Lump sum Allowance according to Hogg (2003) relies on ‘intuitive perception’.

Lump sum allowances are Prime cost and provisional sums which are included in the contract sum to cover the cost or parts of works which cannot be entirely foreseen, defined or detailed at the time of tendering or for works which are not measured in the bills of quantity. The Quantity surveyor only permits a distinct amount for risks that reflect the universal component of projects.

2.7.3 Cost Item Allocation.

This method allocates different contingency amounts or percentages (called Ci) for each cost items (called Ti) (Moselhi, 1997) in the works breakdown structure (Ahmad, 1992). The overall contingency is then estimated as a weighted average. Ahmad (1992) opined that any work lot can be treated as a risk center, and that the allocated contingency sum to each will differ. The equations for contract sum and contingency with no other parameters used in the mark up estimation are given as follows;

$\mathrm{TCC} = \sum_{t=i}^{n} \mathrm{Ti} \times (1 \times \mathrm{Ci})$ ----------------------------eqn. 1

$\mathrm{PT} = \frac{1}{\mathrm{TC}} \sum_{t=i}^{n} (\mathrm{Ti} \times \mathrm{Ci})$ ------------------------------eqn. 2 Where,

TCC = Contract sum including contingency without using other parameters in mark up.

n = Total number of cost items described in the Bills of Quantity.

PT = Project Overall Contingency

TC = Base Estimate

The formula deals with every single cost item separately and allocates different contingency amounts to each cost items. This model helps to calculate the overall project contingency. Divide the sum of contingencies for all cost items listed in the bill of quantities by the base estimate to get the overall contingency amount of the project. This method is more detailed however it is time consuming.

2.7.4 Probabilistic Estimation

The approach is analogous to 'cost item allocation' but uses Pareto's Principle – recognized as the 80/20 rule of significant few and insignificant many (Moselhi, 1997). This states that 80% of the risk produces 20% of the billed items hence 80% of the risk produces 20% of the price. It closely observes and examines the significance of each item one-to-one and assign to each item a gamble value, rather than percentage addition. This method estimates and analyse the accounts for uncertainty or likelihood of it occurrence.

2.7.5 Method of Moments.

This method is also called Probability distribution and it defines exactly how values are dispersed. It has discrete and a continuous distributions. A discrete value has fixed results where an example is the tossing of a die that has six likely results. A continuous variable has limitless likely results in an anticipated choice. The probability distributions are generated from historical data or experiences in an organisation (Smith et al., 2006). Each cost item is expressed by a probability distribution, displaying risks within the billed item. The expected values and variances for all priced items are added-up to get total base estimates of the project (Baccarini, 2005a). Based on a desired confidence level, contingency can be derived from the probability distribution using probability tables (z scores) i.e. level of probability that the total project cost not been exceeded. For example using Table 2.2, with a baseline budget set at the EV of ¢116.67, add contingency that will have a 90% probability of not being exceeded, thus the contingency needed be ¢11.67. Established that with 90% confidence level the maximum likely addition is ¢11.67.

Table 2.2: Shows an example of method of Moments for Contingency Estimation

Variable(cost)	Distribution	a Min. ¢	b Most likely. ¢	c Max. ¢	*EV	**V	***SD
Foundation	Triangular	25	30	65	40.00	79.17	8.90
Walls	Triangular	40	60	80	60.00	66.67	8.17
Roofs	Triangular	10	15	25	16.67	9.72	3.12
Total Project Cost					**¢116.67**	**¢155.56**	**¢12.47**

Source: Baccarini, 2005a.

Where EV=Expected value, V=Variance and SD=Standard deviation.

***EV=(a+b+c)/3; **V=(a^2+ b^2 + c^2-ab-ac-bc)/18; ***SD=√V**

2.7.6 Monte Carlo Simulation (MSC).

Monte Carlo Simulation was industrialized by a statistician named Stanislow Ulan when operating on nuclear physics. Pidd (2010) describes a simulation as a model that is adopted to discover and examine future results. Firestone et al. (1997) indicates that Monte Carlo simulation aims at calculating uncertainties and exploring the unpredictability of risks. MCS is a quantitative risk analysis method (technique) principally employed to discover and control risks for projects and further offers a structured way for contingency estimation (Clark, 2001; Lorance 1992) and can be profitable to use (Akkoyun, 2012). Matstoms and Bjorketun (2003) say a Monte Carlo simulation involves four systematic stages. The prime step is to indicate which kind of possible arrangements suitable for use. The additional step is to produce random information within the precise range by using a statistical program called random number generator. To improve the spread, cost estimates data is divided into three ranges such as optimistic cost (Eo), pessimistic cost (Ep) and greatest probable cost (Em) for each cost items. In the third stage, each set of information must be assessed to examine if the set achieves the given standards. The final step is to make a sensitivity analysis from the produced information. The distribution of cost samples can be programmed to fall into normal "bell" curve distribution (Ahmad, 1992 and Moselhi, 1997). Many authors set Contingency at 50% chance with grounding that numerous projects make up the entire yearly budget, so that differences in one might balance the extra project. Lorance & Wendling (1999) advocate assigning contingency like Base Estimate + Contingency = 50/50 point (median) so as to have an equal chance of under-running or overrunning the estimate. The Federal Aviation Administration (FAA) of US uses (50/50) average point as the budget baseline and gets contingencies between 50% and 80% confidence level. It is used for large or big projects and classified as having high risk level. Main problem with MCS is that risks are usually resolute by positions like high, medium and low. It requires a person to have fair knowledge of effective computation of the software. MCS technique is time consuming and complex in usage, hence well suitable for small projects. In view of achieving a realistic result the model is run repeatedly to determine the range and probabilities of all possible outcomes of the model. The model during each run selects a value randomly for each variable, calculates and collects the results.

2.7.7 Programme Evaluation Review and Technique (PERT) Method.

In the late 50's (PERT) method was developed (Aquino 1992). It is well known and mostly used in scheduling. The technique is mostly founded on central limit theorem with total number of independent random observations such as X_1, X_2,…,X_n from any population with corresponding Variances $Vp(_1)$, $Vp(_2)$,…,$Vp(_n)$ and expected cost as $Ee(_1)$, $Ee(_2)$,…,$Ee(_n)$ which gives the random variable 'Y' within the normal probability distribution. The Variable 'Y' for Variance and Expected cost or values of the population are calculated using the following formulae (Ostwald, 2001; Johnson & Wichern, 1992).

1. $V(p_Y) = Vp(_1) + Vp(_2) + \ldots + Vp(_n)$ --eqn 1
2. $E(e_Y) = Ee(_1) + Ee(_2) + \ldots. + Ee(_n)$ --eqn 2

PERT is applied to the critical path of a project network to establish these three different cost estimates; optimistic cost (Eo), pessimistic cost (Ep) and most likely cost (Em) for each item. These cost estimates values are obtained quantitatively in judgmental manner based on the historical data collected from previous projects, feelings and experience. Yeo (1990) observed that if the 'Y' population has a standard probability distribution, then optimistic as well as doubtful values are usually considered to be in arrays of 5 and 95 percentiles. When there is not sufficient information obtainable to support the calculation, then the probable cost **Ee** (3) and the variance **Vp** (4) are respectively calculated as follows:

$$\textbf{Eqn 3,} \quad E_e = \frac{[\,(E_o + E_p + (4 \times E_m)\,]}{6}$$

$$\textbf{Eqn 4,} \quad V_p = \left[\frac{(E_p - E_o)}{3{,}2} \right]^2$$

Where the cost expert or the firm owns a set of historical information then the probable cost is the arithmetic mean of the sample information set.

2.7.8 Estimating using Risk Analysis (ERA).

ERA is introduced in all state projects by Hong Kong Government to be used to determine project contingencies (Mak et al., 1998; 2000). This approach is also known as Individual Risks - Expected Value. The preliminary stage for the ERA procedure is a projection of base estimate of known scope and is risk free. All the possible risks are identified and grouped into either fixed or variables. Those risk events which either happens in total or not at all are termed Fixed Risk. If the extent to which risk events will occur is indeterminate that risk would be called Variable risk. The average and maximum risk allowances for all risks proceedings identified are calculated. The contingency is obtained by adding all average risk allowances of the project (Pickens and Mak, 2001). Assumptions are that supreme risk allowance is assumed to have a 10% chance of being exceeded while average risk allowance also assumed to have a 50% chance of being exceeded. The calculations are done by project team based on experiences or records.

Table 2.3: A Typical ERA calculation worksheet for various risk elements (factors).

ERA CALCULATION Project: Construction of Central Library Client: Cape Coast Polytechnic						
Risk	Type	Probability (Fixed Risks Only)	Average Risk Allowance(A) Gh¢	Max. Risk Allowance (B) Gh¢	Spread X= (B-A) Gh¢	Spread Squared (X^2) Gh¢)
Design Considerations	V		8,400.00	12,600.00	4,200	17,640,000
Additional Space	F	.70	11,760.00	16,800.00	5,040	25,401,600
Site Conditions	V		525.00	1,000.00	475	225,625
Inflation (Market) Condition	V		4,000.00	8,500.00	4,500	20,250,000
Sources of Materials and Plant	V		250.00	1,250.00	1000	1,000,000
Culvert	F	.50	250.00	500.00	250	62,500
Project Specification	V		1,680.00	4,200.00	2,520	6,350,400
Contract Variation	V		8,400.00	12,600.00	4,200	17,640,000
Project Management	V		500.00	1,500.00	1000	1,000,000
Project Duration	F	.60	1,000.00	1,750.00	750	562,500
		TOTAL	**36765.00**			**90,132,625**
				Square Root =		**9493.82**

Source: Adapted from (Mak and Picken, 2001).

Maximum Likely Addition is = GH¢9,493.82

Base Estimate = GH¢168,000.00

Average Risk Estimate = Base Estimate + Total Average Risk Allowance

= GH¢ (168,000+36,765) = GH¢204,765.00(21.88% on base)

Max. Likely Estimate=Base Estimate + Average Risk Allowance + Max. Likely Addition

= GH¢ (168,000+36,765+9,493.82) = GH¢214,259.00(27.54% on base)

Note: The Maximum Likely Addition is the figure (the additional amount) which would flow from a situation where every identified risks noted by the project team occurs in total with maximum financial results. This is seen as a catastrophic set of circumstances.

2.7.9 Regression Analysis

This model is a powerful statistical tool used since the 1970s for predictive purposes (Kim et al., 2004). It uses the direct connection between a dependent variable and independent variables to forecast the behaviour of the dependent variables. Multiple regression analysis is generally given by the equation: $\mathbf{y = a + b_1x_1 + b_2x_2 + \ldots + b_nx_n}$. Where **'y'** is the estimated cost or actual cost and $\mathbf{x_1, x_2, \ldots, x_n}$ are the measures of variables such as project scope definition, unproven technologies etc. that may help estimate **'y'** (Merrow & Yarossi ,1990) and $\mathbf{b_1, b_2, \ldots, b_n}$ are the coefficients calculated by regression analysis. The calculation is primarily focused upon predicting the worth of a dependent variable (tender price) when the standards values of the independent variables are introduced.

2.7.10 Artificial Neural Networks (ANNS)

ANNs is information dispensation technique that mimics the living intelligence as well as its integrated neurons (Chen & Hartman, 2000). ANNs is a problem-solving technique from 'training' that detects hidden relationships among data. Kim et al. (2004) discovered ANNs as a viable and a better approach for estimating construction cost. ANNs is used to forecast project cost overruns and support in developing a suitable contingency. For instance, Chen & Hartman (2000) adopted ANNs to forecast the ultimate cost of finished oil and gas projects from one government using 19 risk issues as the contribution information and discovered that 75% of final cost forecast allied with the real variance.

2.8 CONCEPT OF CONSTRUCTION RISK FACTORS

Construction is a risky business and risk exists in all phases of a project development or life cycle (Moselhi, 1997). Risk is an inherent element in every construction works (Odeyinka, 1987) right from inception through to project completion. The building industry is continually enclosed by numerous risks. From Ashworth (1999) risk can be mathematically predicted, whereas uncertainty cannot. Risk is an integral element in estimating project contingency sum as showed by the' de facto' global standard for project management.

2.9 RISK FACTORS CLASSIFICATION

Numerous methods existed to classify project risk sources (Baloi and Price, 2003). The risk sources have been divided into external, internal and force majeure. There are several groupings of risks. In a recent review of risk and risk management in construction, risk has been categorized into natural and human risks; the latter has been further subdivided into nine sub-themes such as Social, Political, Economic, Financial, Legal, Health, Managerial, Technical and Cultural. Shen et al. (2001) also considered risk into six clusters in accordance with the nature of the risks. Idrus et al. (2011) selected 14 risk factors and used to construct a model called construction project risk hierarchy to give a clear image of threat factors. The hierarchy consists of two major risks such as internal and external risk factors as depicted in Fig.2.1.

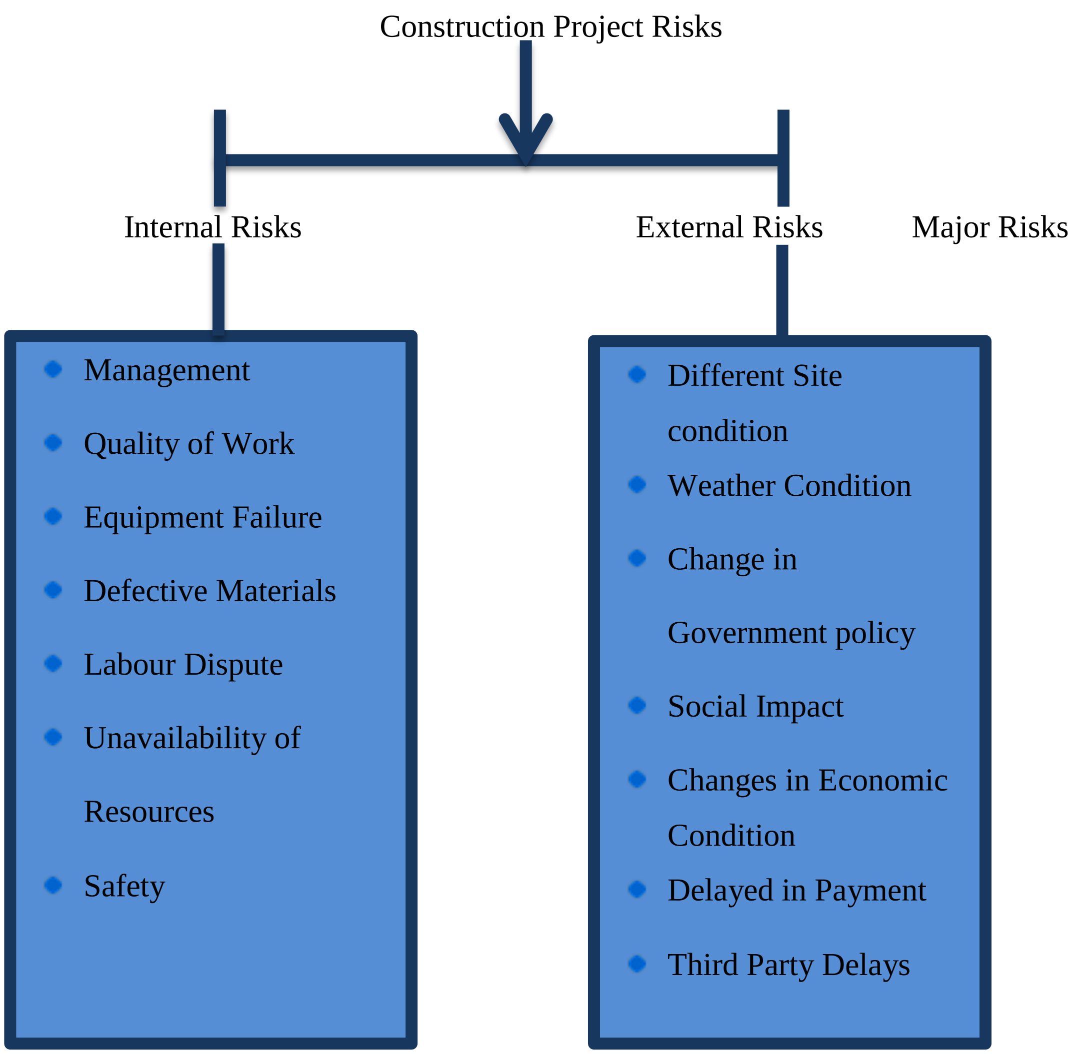

Figure 2.1: level of Project Risk Hierarchy

Source: Idrus et al. (2011)

Observed there are many ways adopted to categorise construction related risks (Shen et al., 2001). It is worth noting that in Ghana, there are several factors that influence the cost of a project. Owusu (1999) has grouped these factors into three categories namely; technical, economic and environmental factors. The diagram 2.2 below summarises these factors.

Categories of Cost Changing Factors (Risk Factors)

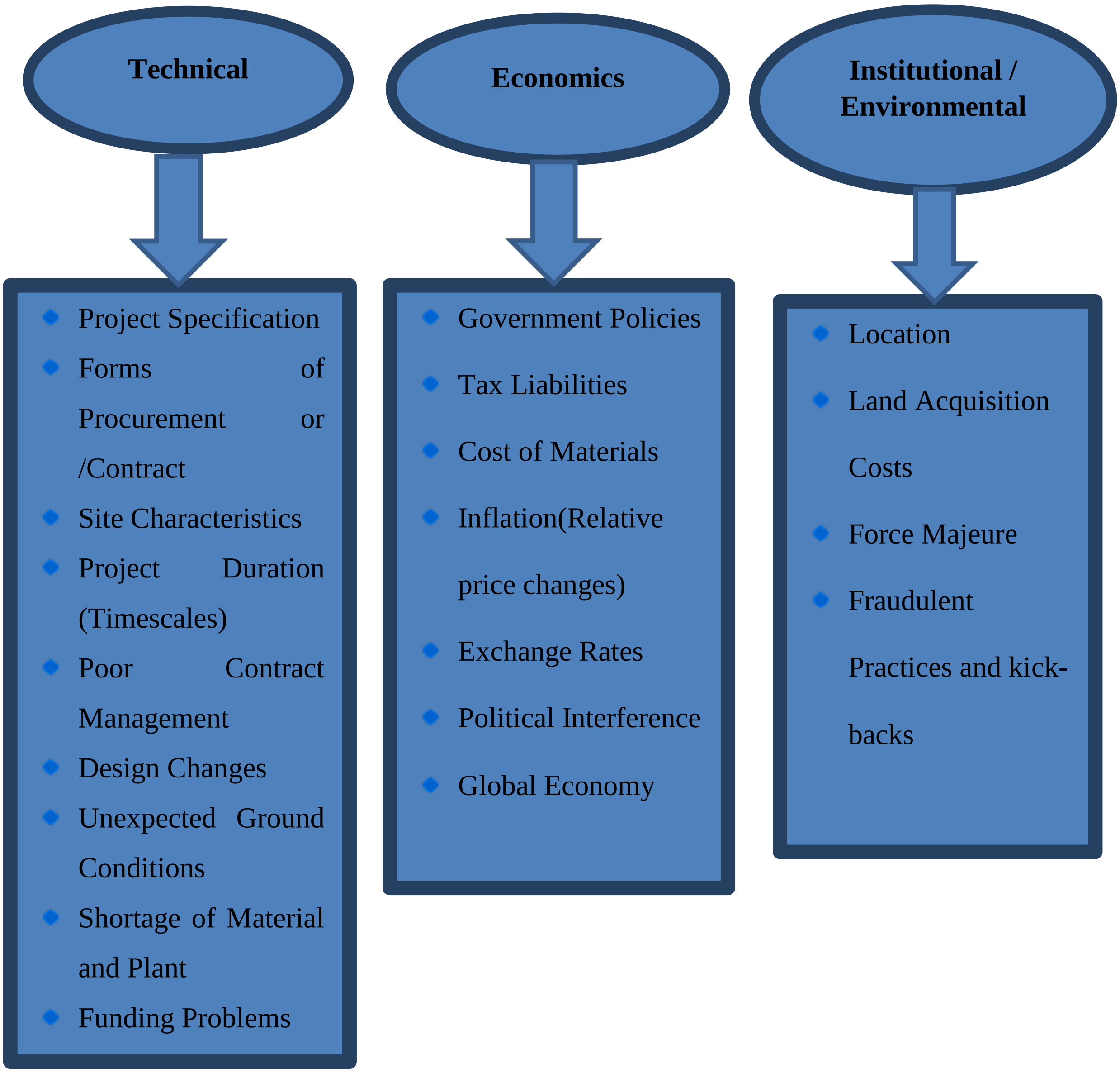

Figure 2.2: Shows a summary of sub factors that influences contingency cost.

Source: Nyagormey, 2012.

Cost Changing Factors of Project Contingency Sum

The diagram on this page illustrates the list of potential factors that impact on the determination or changing of project contingency sum.

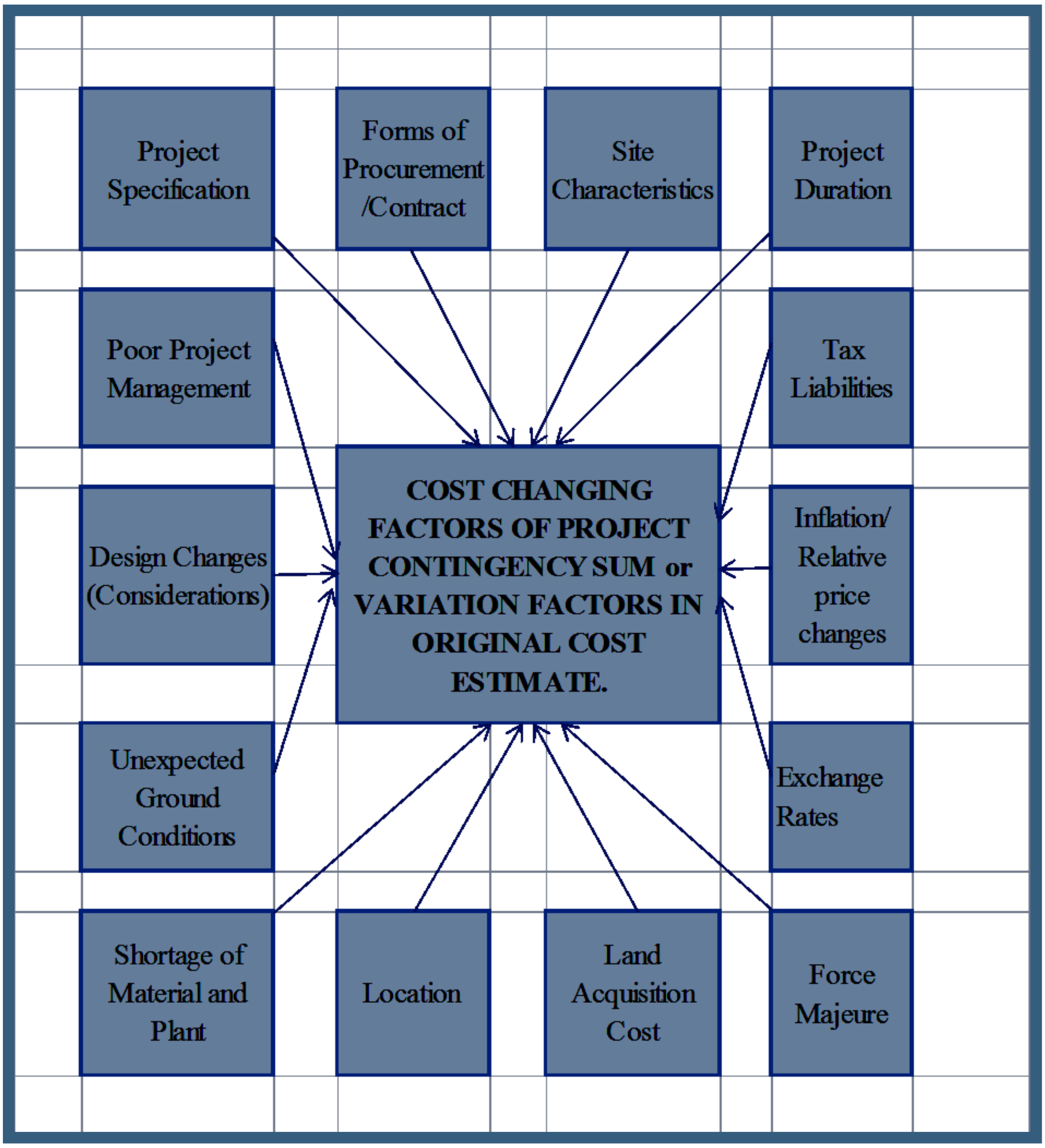

Figure 2.3: List of factors that influence the determination of project contingency sum.

Source: European Commission DGXVI, 1998

2.10 FACTORS INFLUENCING THE DETERMINATION OF PROJECT CONTINGENCY SUM.

2.10.1 Technical Factors

2.10.1.1 Project Specification

The physical attributes of any project is detailed in the specification. Taking road for instance, the design length, depth and width of the road pavement, the surfacing materials required, the number of lanes, bridges and intersections are all dependent on the given levels of traffic forecast. The required function and expected occupancy rate of a building initiates requirements for entire floor space, height of rooms, interior and exterior, floor loadings and the workmanship (European Commission DG XVI, 1998). Lesser the details of the specification for a larger project, the higher the risk occurrence the project incurs. Implying that much higher amount of contingency is added to project base estimates hence the more expensive it becomes.

2.10.1.2 Forms of Procurement

The award of a contract is essential to public procurement, both as the successful conclusion of the tendering procedure and as the starting point for contract execution. Each party to the contract is legally mindful about contractual agreement. Trends in the construction industry reveal that the forms of contract adopted by client can change the contract sum of a project. It is argued that contract conditions can be altered to suit the present day requirements to achieve value for money. lump sum, Unit Rate (Ad-Measurement/Re-Measurement), cost reimbursements or the negotiated contracts all have some clauses like contingencies, bid security, performance securities, ex-gratia payments (such as for losses incurred due to suspension of work) to manage risk.

2.10.1.3 Site Characteristics

The nature of soil, drainage conditions, the nature of the vegetation and accessibility to site can influence the initial project base estimates. Poor ground conditions can particularly affect the quantity of excavation and foundation activities required. Where there are uncertainties about site circumstances, precise estimates cannot be attained except a soil study is assumed by sinking boreholes to obtain soil samples for analysis (European Commission DG XVI, 1998).

2.10.1.4 Project Duration

Many developments required to be completed within a given time frame. Generally, longer period of a project requires more capitals commitment into the project. Delays in projects can lead to an escalation in contract sum (Eshofonie, 2008). Delays from contractors makes Client lose the chance to invest in the project. Likewise delays from Client also may make Contractors fail to obtain the opportunity to win other projects and suffer from non – utilization of occupied capitals. Delays contribute immensely to higher contingency cost, but with an efficient management system, this can be reduced to the minimum. Non-continuous phases of a project are typically expensive than one assumed deprived of break since it involves extra charges in re-mobilising plants and other resources (European Commission DG XVI, 1998).

2.10.1.5 Poor Contract Management

Poor contract management is attributable to a way a manner the contract is awarded. Observed projects are awarded to the lowest evaluated tenderer (Mansfield et al., 1994). The lowest evaluated tenderer may lack management capacities as well as have fewer appreciations in lieu of contract plans, cost control elements, complete site control and resource allocation. Roles of Contract Administrators or Project Management Team are important in containing the costs of projects. Good Contract management not only reflects satisfactory completion of a project but also increases profitability margin. Inadequate preparation plus organization, poor communication among Contractors team and Client team, failure to identify problems and lack of over time control and cost inputs are all poor contract management qualities (European Commission DG XVI, 1998).

2.10.1.6 Design Changes (CONSIDERATIONS)

Design changes can arise for a number of reasons notably for insufficient project planning at the initiation stage. Clients may have the desires for extra elements to be incorporated in the project or alter current design or complete changes to the original scope (European Commission DG XVI, 1998). Design changes require additional time, materials and cost. A distinctive example is West African Gas Pipeline (WAGP) which according to Asamoah (2002) has suffered some setbacks or interruptions, culminating in cost appreciation from an initial of US $500 million. The problem involves the altering of the initial plans to lay the pipelines offshore to an onshore conformation.

2.10.1.7 Unexpected Ground Conditions

Any substructure work is measured provisional due to unexpected ground conditions of projects. Although trial pits and boreholes sampling can be used to assess ground conditions of site, the actual or full site conditions would usually not be determined until construction works begin. Difficult ground conditions may be ignored by the early appraisal or sub-soil circumstances may have changed as a result of adverse climate. Changes in ground circumstances may require fundamental redesign of projects, acquisition of anticipated moving machinery and materials for the works execution at great expense (European Commission DG XVI, 1998). In short, all these increase the contract sums and demand the use of contingency sum.

2.10.1.8 Shortage of Materials And Plant

Importation of construction materials and plants due to shortage in the local market haunt contractors in Ghana. The result is speculative buying which intend reduces contractors' profit margins (Asamoah, 1982). Countless development activities in a particular area may result in shortage of building resources and servicing plant to be used for the project. If this was not anticipated in the original contract sum, delays might happen as well as the prices of materials and plant may increase (European Commission DG XVI, 1998).

2.10.1.9 Funding Problems

According to the researcher, the source of funding for a project is paramount to successful project completion. Slow payment of invoices by Client may make contractors to commit fewer resources to a project or ceased work entirely. Delays in honouring certificate for work done by Contractor can lead to substantial complications. Significant increase of a project cost far beyond the original Contract sum, may result in project suspension or be delayed until additional funds is secured. Diversion of funds allocated to say a revenue-generating project to other project within a Programme development due to lack of prioritization of projects can give arise to Funding problems (European Commission DG XVI, 1998). The entire situations underestimate the viability of a project such that Contractors are not only faced with high interest rates on loans, high cost of project overhead and loss of profit but also delays in completion of project, loss of capital and some litigations which intend vary the contract sum of the project.

2.10.2 Economic Factors

Economic factors are usually beyond the control of Contract Managers but are subject to government policies and global trends such as Tax liability, inflation and Exchange Rate.

2.10.2.1 Government Policies

According to Aibinu and Jagboro (2002) Government deregulation policies intended at relaxing the country's economy since 1986 are accountable for the unpredictability in prices. An example was the monetary policy in the year 2014 which aimed at containing inflation pressures to attain an end-year CPI inflation of 13.5per cent. As part of measures to contain the rapid depreciation of the cedi, the Bank of Ghana reviewed the existing foreign exchange regulations in February 2014 and ensured strict compliance with the measures. All these were meant to curb the use of foreign currency in the settlement of domestic transactions, ensure transparency, streamline foreign exchange market activities, decrease leaks in the distant conversation market, and statement anti-money cleaning subjects (Bank of Ghana, 2014).

2.10.2.2 Tax Liability

The construction companies are liable to pay taxes on its businesses and purchases or else they may face some sanctions (European Commission DG XVI, 1998). Captured in FIDIC sub-clause 73.2 of the standard bidding document for Procurement of works, World Bank (1995), the tender prices will comprise all customs duties, import duties, business taxes, and income and other taxes that may be levied in accordance with the laws and regulations in existence on the date 28 days prior to the latest date for submission of bids in the Employer's country. In Ghana, until 2006, Construction firms paid withholding tax of 5% for every Local government projects executed to the central government for public use. The current tax liability stands at 7.5%. Also revealed that Government receipts for the year 2014 that is taxes on Goods and Services amounted to GH¢6,434.3 million (5.7% of GDP), Tax on Income and Property GH¢ 8,486.6 million (7.5% of GDP) and Tax Revenue of GH¢19,229.8 million (17% of GDP) (Bank of Ghana, 2014). The tax component has a significant impact on Contractor's gross estimates, and returns. Contractors may make up for the tax element, thereby increasing the construction costs, hence increasing the contingency sum.

2.10.2.3 Cost of Materials

Material cost is tied up to demand appreciation and it impacts on many supplementary things, including quality, quantity, time, place, location of buyer and seller. Currency conversion, low or tall request, material requirements, inflation pressure and absence of materials substitutes in a country have effect on material cost. Omoregie and Radford (2006) revealed a price fluctuation of materials is the utmost cause of cost escalation. This is attributable to the restriction in exchange rate which intend disturbs building materials prices and the overall price level. Unstable inflationary trend in Ghana is another factor which is as a result of demand exceeding supply; creating insufficiency of goods which intend contributes to an increase in cost.

2.10.2.4 Inflation

Longer projects duration may require reserve or supplementary funds in order to caretaker for possible but unexpected high inflation rates in price increases over time. The Bank of Ghana interest rate ending 2010 stood at 12.3% from 21.3 at end 2009. The Monetary Policy Committee (MPC) raised the Monetary Policy Rate (MPR) from 16 per cent in 2013 to 21 per cent as at the end of 2014 (Bank of Ghana, 2014). This was in line with the tight monetary policy stance of the Bank during the year to deal with the high inflation expectations and sharp depreciation of the domestic currency.

Inflation in Ghana has been unstable over the years. The year 2010 ended with an inflation rate of 8.6 percent, lower than the targeted 9.2 percent, down from 16.2 percent in 2009 (Bank of Ghana, 2010). Headline inflation rose steadily from 13.5 per cent at the end of 2013 to end the year at 17.0 percent, breaching the end-year target of 13.0 ±2.0 percent (Bank of Ghana, 2014). These indicators are high for Contractors in Ghana to borrow from the local market and do business as compared to counterparts in the developed economies. Obviously, inflation may increase the original estimates of construction costs.

2.10.2.5 Exchange Rates

The cedi weakened significantly in both the inter-bank and forex bureaux markets during the year on account of increased demand pressures, speculative activities and declining inflows (Bank of Ghana, 2014). The Ghanaian cedi depreciated against the US dollar by 43% on the forex bureau market by August 2014. Ending the year the cedi depreciated by 31.3 percent, 26.3 percent and 20.5 percent against the US dollar, the pound sterling and the euro respectively in 2014 as compared with depreciation rates of 14.5 percent, 16.7 percent and 20.1 percent against the US dollar, the pound sterling and the euro respectively in 2013.

2.10.2.6 Political Interference

Omole (1986) revealed 80% of the Contractors remain local companies. The government organisations are linked up by party-political ‘big weight’ to give contracts to party loyalists at tall prices. The consultant’s estimates are ignored in most cases when giving contracts if possible manipulate contract sum to favour only one Contractor. There are no doubts about the fact that governments and procuring entities in Ghana predominantly during the last party-political era prior to general election give a very short time for the awards of contracts and prepare all necessary documents.

2.10.2.7 Global Economy

Unfavourable global developments such as softening commodity prices, subdued demand, reduced FDI flows and volatility in financial markets impacted adversely on the domestic economy (Bank of Ghana, 2014). The decline in commodity prices contributed to the rapid depreciation of the domestic currency. The world economies are depended on each other. The high economic rescission in developed countries such as United State of America has multiple effects on least developed Countries such as Ghana. Global inflation generally declined with a sharp fall in oil prices being the underlying factor in both advanced and emerging markets (Bank of Ghana, 2014). 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.

2.10.3 Institutional / Environmental Factors

2.10.3.1 Location

Location varies project base estimates in a number of ways through geographical realities. The more remote and isolate projects site the higher the variations. A distinctive case is in Northern state of Australia where resources are harder to acquire and there are more unknowns (Baccarini, 2004). Cost of projects executed in a principal, municipal and countryside areas varies significantly even within a particular region. The charge of moving building materials and equipment to a remote location makes the construction cost high. In an urban locations also, land costs are typically or considerably higher.

2.10.3.2 Land Acquisition Costs.

In Ghana no land is free; Chiefs and Family heads are the custodians of lands. Local government authorities acquire land only in agreement with legal statutes. The statutes entail that the land in addition to any other property on it is appropriately valued and that the owner is paid compensation on the basis of the valuations. Chiefs and Family heads can agree on the release of land for development following the payment of compensation by the Local Government Authorities. The amount of compensation that actually has to be paid can now and again be disputed especially if the land owner appeals to court against the original valuation. It is up to a Court to agree a fair price for the land. In some instances, the amount may be greater than the initial estimates by the project Client. Unavoidably, long drawn-out compensation suit will delay projects.

2.10.3.3 Force Majeure

The clause is encompassed in contract agreements to eliminate obligation for natural and inevitable disasters that disturb the predictable sequence of proceedings and restrict parties joined in the contract agreement from rewarding responsibilities (Investopedia, 2015). It covers events which are also commonly called “Act of God”. The event includes; Adverse weather, Earthquake, Economic instability, Fire, Landslip, Political instability, Revolution, Riot and War. Contractors insure against the occurrences of these events. The occurrence is normally associated with high risk, leading to significant delays and consequent cost increases. This therefore requires Contingency Sum to mitigate it.

2.10.3.4 Fraudulent Practices and Kick-Backs

The second important factor that affects construction cost (Elinwa and Buba, 1993). According to Husseini (1999) Fraudulent Practices and Kick-Backs are motivated by greed and perpetrated by some major players in the built environment. The Perpetrators are largely found within the rank and file of Politicians, Contractors, Consultants and Civil servants as evident from the report published by TELL (2002). Corruption cases in execution of certain contracts awarded by the Petroleum Trust Fund (PTF) were verifiable (TELL, 2002). Discovered by Interim Management Committee (IMC) that of the total 181.8 billion naira that accrued to PTF for the three years in operation, as much as 16 25.6 billion naira was erroneously paid to contractors. These include inflated contracts, fraudulent over payment of contractors by certain agency administrators and undue receipts of interest on funds deposited in banks by the agencies.

2.11 Attributes (Characteristics) of Project Cost Contingency.

Thorough scrutiny of the literature identifies the following basic attributes of the concept of project Contingency sum.

2.11.1 Risk

Samson et al. (2008) observed that there exist so many established risk definitions. In simple term Risk = probability of risk happening x impact of risk happening (McNeil et al., 2005). Risk is an exposure to loss/gain, or the likelihood of incidence of loss/gain multiplied by its respective magnitude (Jaafari, 2001). The researcher also defined risk as a probability of notwithstanding careful project appraisal and scheduling, unpredictable events occurring during the execution of the project which affect the final construction cost and completion timetable.

2.11.2 Reserve

Contingency sum is a reserve of money. A reserve is a provision in the project plan to mitigate costs associated with risks (PMI, 2004).

2.11.3 Uncertainty

There is no accepted definition generally for risk and uncertainty (Samson et al., 2008). Jaafari (2001) defined uncertainty as the probability that objective functions will not reach its planned target value.

2.11.4 Risk and Uncertainty

Risk is an indeterminate event with probability to have an influence on the development goals. Risk is either negative (threat) or positive (opportunity). According to Alessandri et al. (2004) there have been debates on the terminological differences between risk and uncertainty. There are claims that uncertainty is equivalent to risk whiles others opined risk and uncertainty are two different concepts. The second school of thought considered risk and uncertainty as two independent concepts. Other school of thought is that they are dependent on each other.

2.12 Risk Management

The degree of risk can often be reduced if Clients take time to identify, assess, analyse and manage the main factors leading to cost escalation. Risk management strategies basically involve three phases namely; risk identification, risk analysis and risk response.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The section describes in details approaches, research processes, methods, principles, procedures and the research instrument used to gather the needed information for the study (Gray et al., 2007). It describes the method used for data collection, selection of the sample size, how information would be collected from the survey for the research work, how the data would be handled and its presentation to achieve the objectives set for the study. The research has taken the form of a literature review and coupled with a questionnaire survey.

3.2 RESEARCH DESIGN

According Creswell (1998) a research design is a procedure for collecting, analysing, interpreting and reporting data in research studies. The research methodology adopted in the study is the descriptive survey method and was conceded in two stages. The first phase has taken the form of qualitative data gathering through not only an extensive but in-depth literature review of related books, journals, conferences, proceedings, articles, publications and reports of previous works in this research area. The second stage utilized multiple research approach which involved quantitative data collection through structured questionnaire and unstructured interview to solicit information from the target respondents. The target population for the study comprised construction professionals working in various establishments in Ghana. The sample for the research was designated on a purposive basis, rendering to the judgement of the investigator as to who can afford the greatest information to attain the objectives of the research (Kumar, 2005).

3.3 SOURCES OF DATA/ DATA COLLECTION

The data for the study was collected through primary and secondary sources.

3.3.1 Primary Data Collection

The primary data is one of the most reliable and credible ways used to gather information for researches. The instrument implored under this section to gather first-hand information was mainly questionnaire as it provides information quickly and cheaply. The primary data were collected from the chosen respondents in Construction or Engineering offices, Ghana Highway Authority, Departments of Urban Roads, Architectural Engineering Services Limited (A.E.S.L), Some Municipal and District Assemblies (MDAs), three Tertiary Institutions among others. Visits were made some sites to locate the Construction professionals where the researcher was subsequently granted permission by the heads of various sections in question to distribute the designed questionnaires to the target group of respondents.

3.3.2 Secondary Data Collection

Further information for the study was obtained from related secondary sources or published documents such as academic periodicals, textbooks, publications, magazines, research journals, past dissertations, articles and other relevant documents available in libraries and or from government departments. The internet resources have also been used to obtain supplementary information relevant to the study.

3.4. QUESTIONNAIRE

A questionnaire is set of questions submitted to individuals to discover statistically valuable information around an assumed theme (Merriam-Webster's Online Dictionary, 2015). A questionnaire survey is a cost effective way to involve a large number of people in the process in order to achieve better results (McQueen and Knussen, 2002). Closed structured questions were designed to collect information from the target respondents. The answers were limited to a fixed set of responses where the respondents ticked the category that best describes the situation. It was collectively administered to target respondents. The questionnaire was designed in line with the aims and objectives that are to be achieved at the end of the study. Relevant literature also offers additional help. The questionnaire was mainly designed for the Construction Professionals in Ghana. The questionnaire consists of a maximum of thirteen questions divided into two main parts. The first part dealt with the demographics of the respondents with respect to their professional background, the number of years of experience. The background information was imperative in order to ascertain the likely reliability and credibility of the data. The second part contained lists of potential methods and factors obtained from the literature, for which the respondents were provided the opportunity to rank on the perspectives of the awareness, knowledge, the frequency of use of the methods and as well factors influencing the determination of Contingency sun in Ghana. For effective and efficient assessment of the set objectives, a likert rating scale was developed to help extract the appropriate ratings and the respondents were asked to rate on a five-point Likert scale (Durdyev and Mbachu, 2011). Likert scale generally includes an equal number of positively and negatively phrased statements, all of which employed the same response scale and are randomly distributed throughout the questionnaire (Cheung, 2005). Numerical scores of 1 to 5 ratings were assigned to some statements in accordance to the direction of the statements.

3.4.1 Distribution of Questionnaires

The questionnaires were administered in person and electronically to the respective respondents namely; Construction Professionals in Construction or Engineering offices, Ghana Highway Authority, Volta River Authority, Departments of Urban Roads, Architectural Engineering Services Limited (A.E.S.L), Some Municipal and District Assemblies (MDAs), and some Staff in the department of Building Technology in three Tertiary Institutions. All the respondents were given the freedom to answer and rate the factors in a manner that they deemed fit.

3.5 INTERVIEW

This is where the researcher met the Construction professionals one-on-one or face-to-face to interact and asked questions spontaneously during the interaction. Unstructured interview was conducted to obtain further information on the study. This approach gave the researcher an opportunity to probe for more but unaware information on the study. It also allows for more complex stories to be told.

3.6 RESEARCH POPULATION AND SAMPLING TECHNIQUES

3.6.1 Population of the Study

The research population may be defined as the totality of a well-defined collection of individuals or objects that have a common, binding characteristics or traits. The study population comprised registered Construction Professionals practising in Ghana. The total population of registered professionals in the construction industry is One thousand three hundred and ninety-six (1396), scattered all over the country. These categories of people were chosen mainly because their activities have direct or indirect effect on the determination of project cost estimation.

Table 3.1: List of target population of Construction professionals practicing in Ghana.

Professionals	No: of Registered Professionals
Quantity Surveyors	439
Architect	308
Civil Engineers	649
Total	**1396**

Sources: Quantity Surveyors: Info@ghisonline.org, 2011.
Architects: Daily Graphic, June 14, 2011, No. 149797 page 18-19.
Civil Engineers: Daily Graphic, September 30, 2011, No. 18652 page 37-39.

3.6.2 Sampling

Sampling is a procedure of choosing a proportion of populace to signify the entire populace, as well as the results from the selected sample represent the rest in the group. The designated sample must consequently, have comparable appearances or attributes to the populace in the research to allow generalization of the outcomes to characterise the population (Burns and Groove, 2001).

3.6.3 Determination of Sample Size (n).

The sample size required for a study is influenced by several factors, including the purpose of the study, the population size, the level of precision, the level of confidence or risk and the degree of variability in the attributes being measured (Miaoulis and Michenser, 1976 Cited in Israel, 2012). According to Israel (2012), sample size for a study can be determined using for example figures in Published Tables, census for small populations, Formula etc. Only one of the strategies was adopted to determine the sample size for the research. The population size for that matter of the target professionals was big and at the same time scattered all over the country. The sample size from the population has been calculated using Kish (1965) formula as stated below.

$$\mathbf{n = n^1 / (1 + n^1/N)}$$

Where n = final required sample size after adjustment for the finite population**.**

$\mathbf{n^1 = S^2 / V^2}$, where,

$\mathbf{S^2 = P\ (1- P)}$

N = Population Size

V = Standard error of sampling distribution or acceptable margin of error (i.e. level of precisions) ±5% = 0.05, at a confidence level of 95% having a total error= 10% or 0.1.

P = The Estimate of the proportion of the population elements (P=0.5).

$\mathbf{S^2}$ = The Maximum Standard Deviation of the population, P (1 – P) = (0.5) (0.5) =0.25.

Using the above parameters in the above equation, an overall target sample size of 93 professionals was arrived at. Assuming a return rate of 50%, the sample size was increased by 10% to 103. Thereafter, a proportional representation was used to allocate the questionnaires as shown in Table 3.2 below.

Table 3.2: Sample frame of the Respondents

Target Respondents	Target Population	Minimum Sample Size Required	No of Questionnaires Allotted
Quantity Surveyors	439	30	33
Architects	308	20	23
Civil Engineers	649	43	47
Total	**1396**	**93**	**103**

Source: Field survey, August, 2015.

3.6.4 Sampling Techniques

3.6.4.1 Non Probability Sampling

A Purposive Sampling Technique was adopted and the samples were selected on the basis of the knowledge, connection and judgement of the researcher. Purposive sampling is a very useful technique for situations where you need to reach a targeted sample quickly. The other alternative such as Probability sampling was not considered due to limited time and resources. More so, the population is scattered all over the country and untraceable to any confined location. The study wanted to elicit views from professionals who have specific expertise and sufficient skills, knowledge and experiences on construction works thus the questionnaires were sent to the like of Quantity surveyors, Architects and Civil Engineers in the construction industry and in Academia. Again, the advantage of adopting this technique is that the researcher would not be bias and does not on his own trying to defend any decisions. The implication is that, there are acknowledged experts backings of the researcher's results.

3.7 DATA ANALYSIS PROCEDURE

Both descriptive statistics and qualitative approaches were used to analyse the data. The collected data were summarized and presented in tabular form. The questionnaires which were not completely answered were considered non-responsive. Microsoft Excel was considered to be user-friendly and subsequently used to store and analyse the collected project data and were used to create the "base file" for the statistical analysis. Frequency distributions Tables, percentages and bar chart were used to illustrate the results. The methods and factors were analysed and ranked in order to establish their criticality, relevance and level of influence in determining cost contingency for Construction projects in Ghana. Then before a relative importance index (RII) as stated in equation two (2) below was applied to prioritise the severity of the factors, the raw rankings were multiplied together to produce a critical factor index (CFI) as shown in equation 1.

(CFI) = ΣW [(f_1 x n_1) + (f_2 x n_2) + (f_3 x n_3) +... + (f_n x n_n)] ---------------- equation 1

Where,

ΣW = the summation of the weighting given to each factor.

$\mathbf{f_n}$ = score ranking.

$\mathbf{n_n}$ = corresponding number of responses.

Relative important index (RII) = $\left(\frac{100\sum(fx)}{A\,F}\right)$ − − − − − − − − − − − **equation 2**

Where, f is the frequency of score,(x) for the factor under consideration, A= highest weighting factor, (that is 5), F=total number of sample. The final results obtained were presented using Tables, percentages and bar charts. All these were done in order to ensure that the responses received would be reliable.

3.8 SUMMARY OF CHAPTER

The chapter introduces first the research methodology used for the study which includes the research design and the study area. Sources of data collection and how the survey questionnaire developed were all explained. A review of the research showed that, a survey Questionnaire was the most suitable approach for obtaining the relevant data. The survey characteristics including the population, sampling frame, the sample size and sampling techniques were explained. The analytical tool adopted has been given an expanded introduction.

CHAPTER FOUR

ANALYSIS AND INTERPRETATION OF DATA

4.1 INTRODUCTION

Chapter Four gives a comprehensive and analytical discussion of the result of the study in a form of tables and graphs. The section deals with an analysis of information gathered from the survey questionnaire issued to the respondents so as to achieve the objectives of the study. The initial aspect of the result deals with general background information of the respondents. Basic frequency tables, Charts and Relative Importance Index to identify the most important factors that impact the determination of Contingency sum estimation were all detailed.

4.2 BACKGROUND AND CHARACTERISTICS OF RESPONDENTS

4.2.1 Response Rate to Questionnaire

The data were collected from the questionnaires administered to the practicing Quantity Surveyors, Architects and Civil Engineers in Governmental, Institutional, Consultancy and Construction establishments. The Table 4.1 below had shown the sample size of the respondents. One Hundred and Three questionnaires were administered to professionals in the built environment out of which 68 representing 66% (n=103) were returned. A questionnaire was said to be responsive where all questions in relation to the topic were fully answered. A total of 67 questionnaires were said to be responsive representing 98.5% (n=68) of the questionnaires returned as displayed in Table 4.1 below. The result also shows that the return rate was high for the Quantity Surveyors with 93.9%, followed by civil Engineers second with 55.3%.

Table 4.1: Details of Response Rate of Respondents

Group of Respondents	No. of Questionnaires distributed	No. returned	Rate (%) of returned	No. Responsive	Percentage Responsive
Quantity Surveyors	33	31	93.9	31	45.6
Architects	23	11	47.8	10	14.7
Civil Engineers	47	26	55.3	26	38.2
TOTAL	**103**	**68**	**65.7**	**67**	**98.5**

Source: Field survey, August, 2015.

The results indicate that 45.6% (n=68) of the questionnaires returned and classified as responsive came from Quantity Surveyors representing the highest number of professionals that answered the questionnaires. The rest were for Civil Engineers and Architects representing 38.2% and 14.7% respectively. Thus the 1.5% determined not responsive came from Architects. The overall responsive rate stands at 98.5%. The result as displayed in Table 4.1 below revealed that majority of the facts or findings which stands at 83.8% is largely dependent on responses from Quantity Surveyors and Civil Engineers.

4.2.2 Profession of Respondents

The results display in Table 4.2 indicates the profession of the respondents. The survey identified three basic professions namely Quantity Surveyors, Architects and Civil Engineer. The Table 4.2 shows the breakdown of the results. 46.3% were Quantity Surveyors followed by Civil Engineers of 38.8%. The result cumulatively shows that 85% (n=57) of the professionals are mainly Quantity Surveyors and Civil Engineers. These findings are indications that fifth-sixth part of the respondents was Quantity Surveyors and Civil Engineers. This assertion was therefore critical to the quality of the data that was obtained.

Table 4.2: Details of Professions of respondents

Professions	Frequency	Relative Frequency	Valid Percent	Cumulative Percentage
Quantity Surveyor	31	0.45	46.3	46.3
Architects	10	0.20	14.9	61.2
Civil Engineers	26	0.35	38.8	100
Total	**67**	**1.000**	**100**	

Source: Field survey, August, 2015

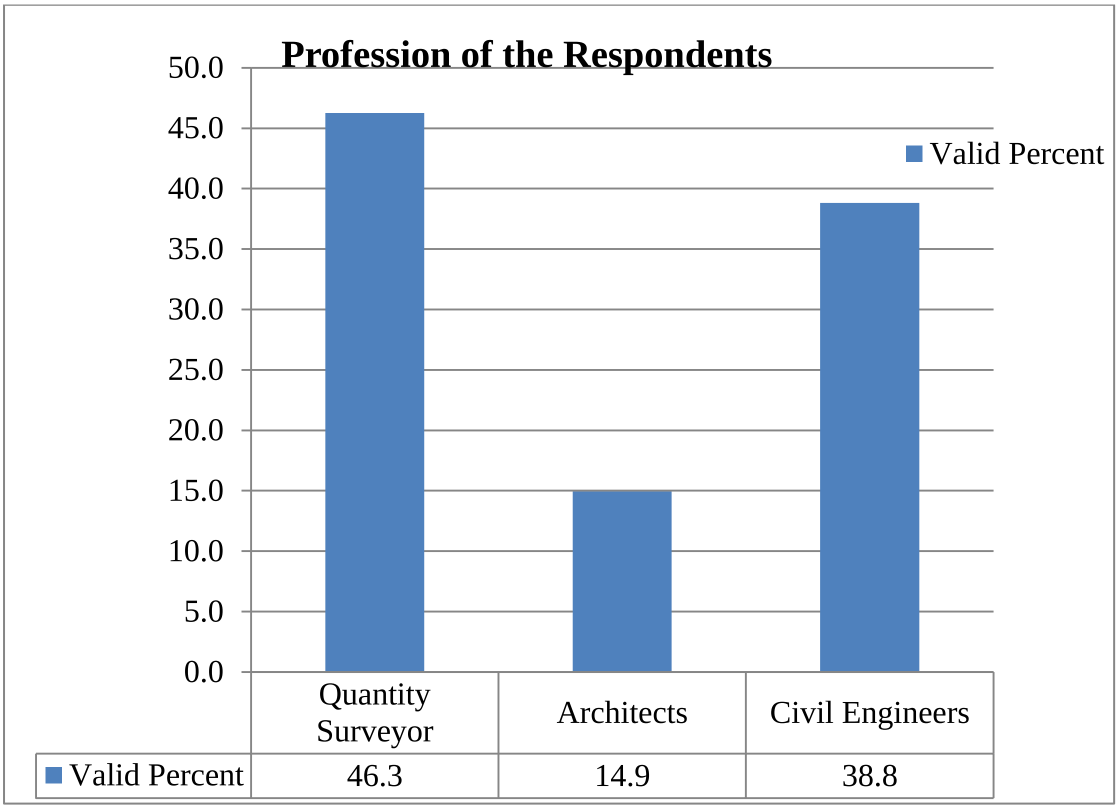

Figure 4.1 Professions of the Respondents

Source: Field Study, August, 2015.

4.2.3 Type of Establishment

Table 4.3 shows the details of the establishments in which the respondent worked. Forty-two percent (n=28) of the respondents is from government establishment such as Ministry of local government, Departments and Agencies, Twelve respondents representing 18% were from institutional organizations such as educational institution, Sixteen of the respondents representing 24% were from Consulting firms whiles Eleven out of the 67 respondents with a percentage rate of 16 also came from Construction firms in Ghana. It is worth to note that 42% of the responses came from professionals in Government institutions.

Table 4.3: Types of Establishment

Establishment	Responsive Respondents.			Total	Percent (%)
	Quantity Surveyors	Architects	Civil Engineers		
Government	16	1	11	28	42%
Institutional	5	3	4	12	18%
Consultancy Firms	6	4	6	16	24%
Construction Firms	4	2	5	11	16%
Total	**31**	**10**	**26**	**67**	**100%**

Source: Source: Field survey, August, 2015.

4.2.4 Years of Working Experience

Table 4.4 below displays that out of the 67 respondents surveyed approximately sixty-three percent (n=42) of the target professionals have had more than ten years working knowledge in the building business with a considerable total of 37% (n=25) which has less than ten years working knowledge in the same business. The findings demonstrations an indication that the trial scope is blend of both the old and young specialists in the business. The conclusion deduced consequently from the reading is not prejudiced on the information opening among the old and the young specialists in the industry. The result as displayed provided the level of working experience and knowledge which would help in creating confidence in the credibility of the data.

Table 4.4: Years of Working Experience of Respondents in the Industry.

Years	No. of Respondents	Percentage (%)
1 – 5 years	11	16.4
6 –10 years	14	20.9
11 –15 years	19	28.4
16 –20 years	15	22.4
21-years and above	8	11.9
TOTAL	67	100

Source: Field survey, August, 2015.

Figure 4.2 indicates that the age groupings were fairly distributed. The highest work experience was between 11-15 years representing 28.4%, 22.4% had worked for 16-20 years, 20.9% had also worked between 6-10 years as the third, 16.4% had worked for 1-5 years and stands as the fourth in percentage terms and finally approximately 12% had worked for than 21 years. These findings indicate that the respondents have had enough working experiences in the construction industry.

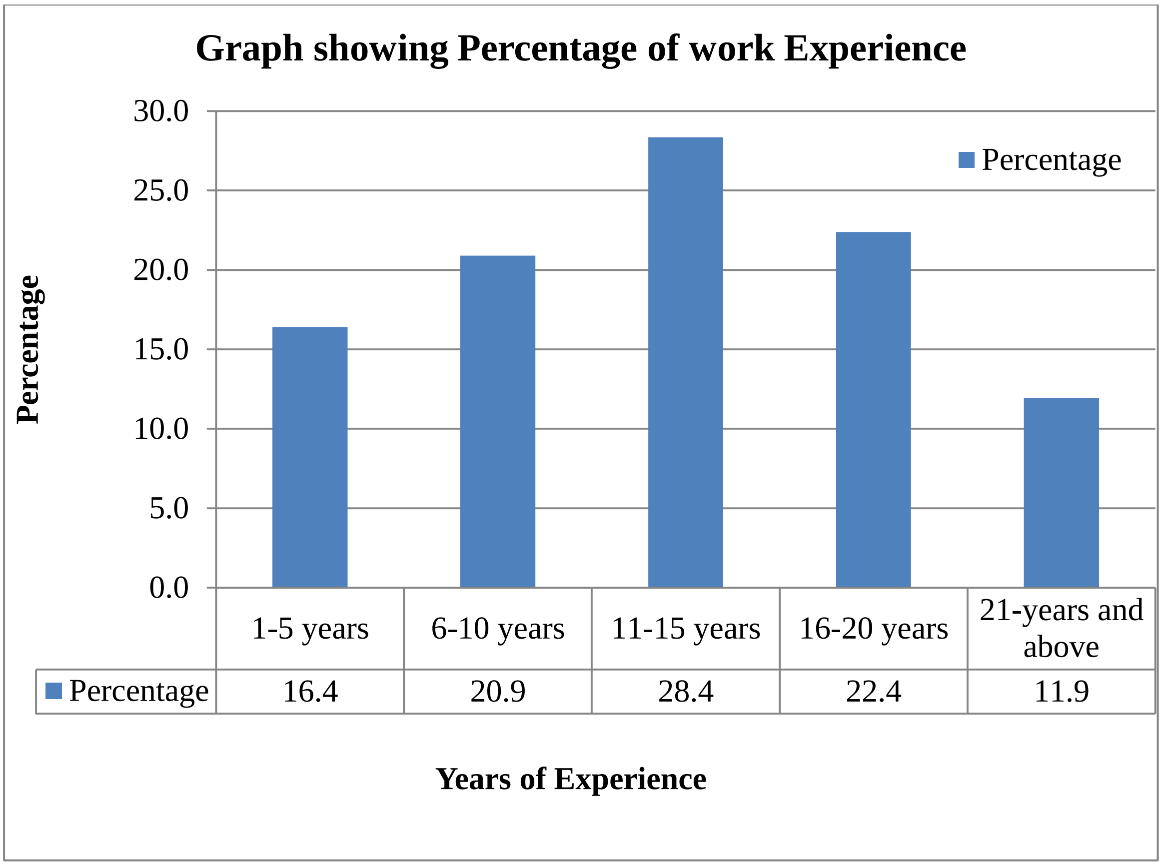

Figure 4.2: Working experiences of Respondents in the Construction Industry

Source: Field Study, August, 2015.

4.3. Analysis of Projects Undertaken

As presented in Table 4.5, the Sixty-seven (67) respondents who took part in the study were asked to indicate the number of projects undertaken within the last five years and out of this (n=56) representing 83% had undertaken between one (1) to ten (10) projects. This number clearly represents the majority of respondents as could be observed from the Table 4.5 below. The result also shows that only one (1) of the respondents falling between16-20 projects within the last five years. Lastly, no respondent fell within the 21 projects and above category. The bar chart as displayed in Figure 4.3 below shows the percentage distribution of the projects undertaken by construction professionals within the last five years.

Table 4.5: Breakdown of the projects undertaken within the last five years.

No of projects undertaken	Quantity Surveyors	Architects	Civil Engineers	Total	Percentage (%)
1 – 5 Projects	15	4	12	31	46
6 –10 Projects	11	5	9	25	37
11 –15 Projects	5	1	4	10	15
16-20 Projects	0	0	1	1	1
21 Projects and above	0	0	0	0	0
TOTAL	**31**	**10**	**26**	**67**	100

Source: Field survey, August, 2015.

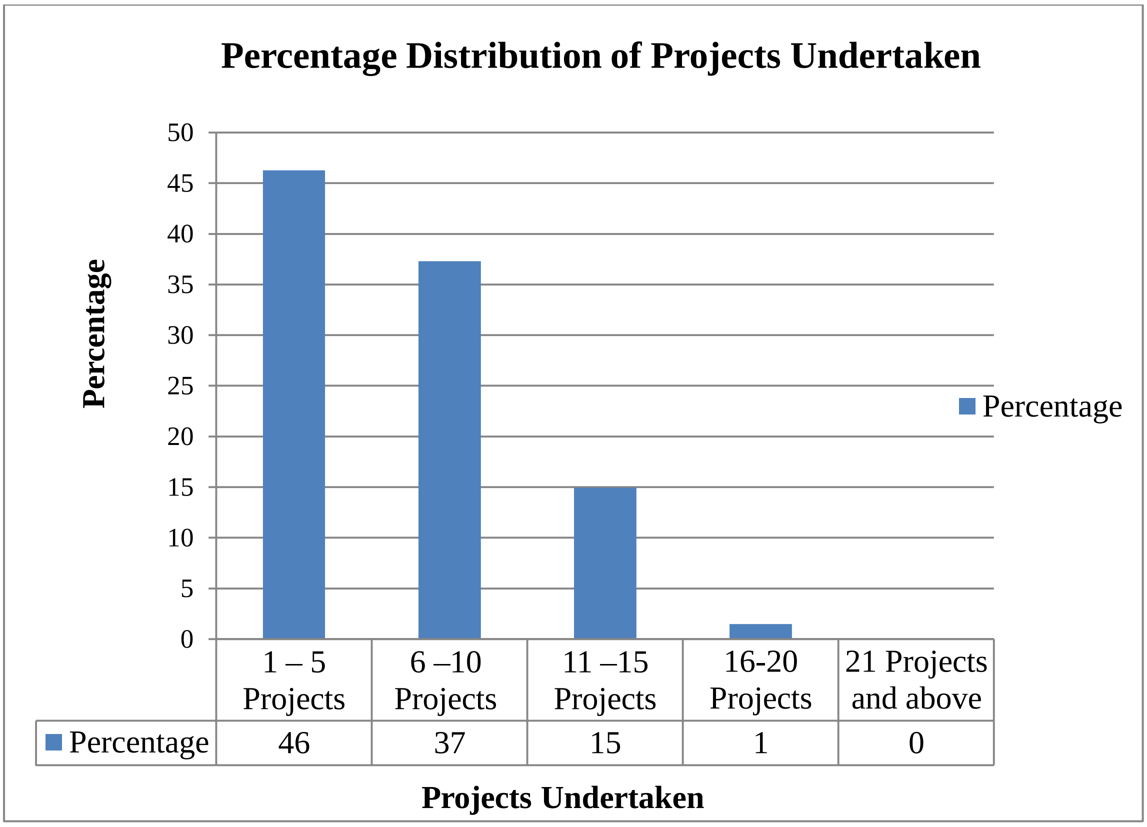

Fig. 4.3: Percentages of projects undertaken within the last five years by the professionals.

Source: Field Study, August, 2015.

In summary the professionals' background, work experiences in addition to the number of projects executed were sufficient enough to ensure the validity of the survey results. It indicates that responses provided could be relied upon for the study.

4.4 PROJECT COST CONTINGENCY ESTIMATION – CONCEPT

Contingency sum is part of Contract sum of any project during tendering period. The existence of data base for professionals to rely upon for the calculation of accurate contingency sum in Ghana and as to whether the Construction Professionals have refresher courses from time to time to boost the understanding of the concepts and methods for calculating contingency sum in the construction industry are questions of prove. Table 4.6 shows the breakdown of the result. It is evident that 100% (n=67) of the respondents consider and allow or provide project contingency sum in project cost estimates. This viewpoint is reinforced by the literature, which indicated that contingency funds are encompassed in development of accounts to represents the total financial commitment and provides clients an opportunity to solve uncertainties as well as irregularities that impend attaining the objectives of the projects. Approximately Sixty one percent (n=41) of the respondents revealed that their establishments do not have data base to help in the calculation of contingency. This vindicate the assertion in the literature that in the Ghanaian construction industry, contingency sum is an arbitral addition of percentage allowance which is illogical, unscientific, judgemental and that it becomes difficult for estimators to justify or defend as a result of limited statistical data. A detailed breakdown of the result is shown in Table 4.6 on the next page.

Table 4.6: Sample of Responses on the concept of Contingency Estimation.

Statements	Responses Category	Frequency	Percentage (%)
Contingency Allowance in Project cost Estimates	Yes	67	100
	No.	0	0
	Total	**67**	**100**
Availability of data for Contingency Calculations	Yes	26	38.8
	No.	41	61.2
	Total	**67**	**100**
Seminar or Workshop on Contingency Estimation.	Yes	16	23.9
	No.	51	76.1
	Total	**67**	**100**

Source: Field Survey, August, 2015.

It was discovered that 76.1% (n=51) of the respondents confirm that they hardly have seminar or workshops (Refresher courses) on the contingency estimation as a capacity building for the construction Professionals in the industry. It could be established that almost one-fourth of the respondents have been working without a professional capacity building within the last five years on contingency cost estimation.

4.5 THE USES OF CONTINGENCY SUM IN THE BUILDING INDUSTRY.

The viewpoint of the respondents in the construction was sought on the main uses of contingency sum. As displayed in Table 4.7 below it was identified that greater part of the respondents posed agreed and strongly agreed to the first two uses. From Table 4.7 three of the variables had the mean score above the average of (2.687). Comparatively, it was observed that Unexpected or unforeseen conditions with a mean score of 4.02 have been ranked first to be the leading risks element in the building industry to which contingency sum is provided to cover, followed by a reserve cost (2nd) and cost overrun (3rd). These findings are an indication that the first three elements need paramount attention. The findings are well supported by the literature which states that contingency sum is use as a reserve added to a pre-tender estimate to address any unforeseen cost that may arise between the date of the estimate and the practical completion of the project (Aibinu et al., 2011). Contingency is required to address uncertainties and variation that threaten achieving objectives (Diekmann et al., 1988). Supporting the fact that contingency sum is to prevent a project from experiencing cost overrun and is not a profit at the tendering stage.

Table 4.7: Analysis of Respondents' opinions on the uses of contingency sum.

Uses of Contingency Sum	**Rankings**					**Total**	**∑W**	**Mean**	**Rank**
	1	**2**	**3**	**4**	**5**				
Reserve fund (Allowance)	0	5	16	31	15	67	257	3.836	2nd
Unexpected/ Unforeseen conditions	0	1	15	33	18	67	269	4.015	1st
Underestimation	17	21	21	7	1	67	155	2.313	4th
Cost overrun	14	9	16	17	11	67	203	3.030	3rd
Cover Deficiencies	39	21	5	2	0	67	104	1.552	5th
Profit	42	25	0	0	0	67	92	1.373	6th

Source: Field survey, August, 2015.

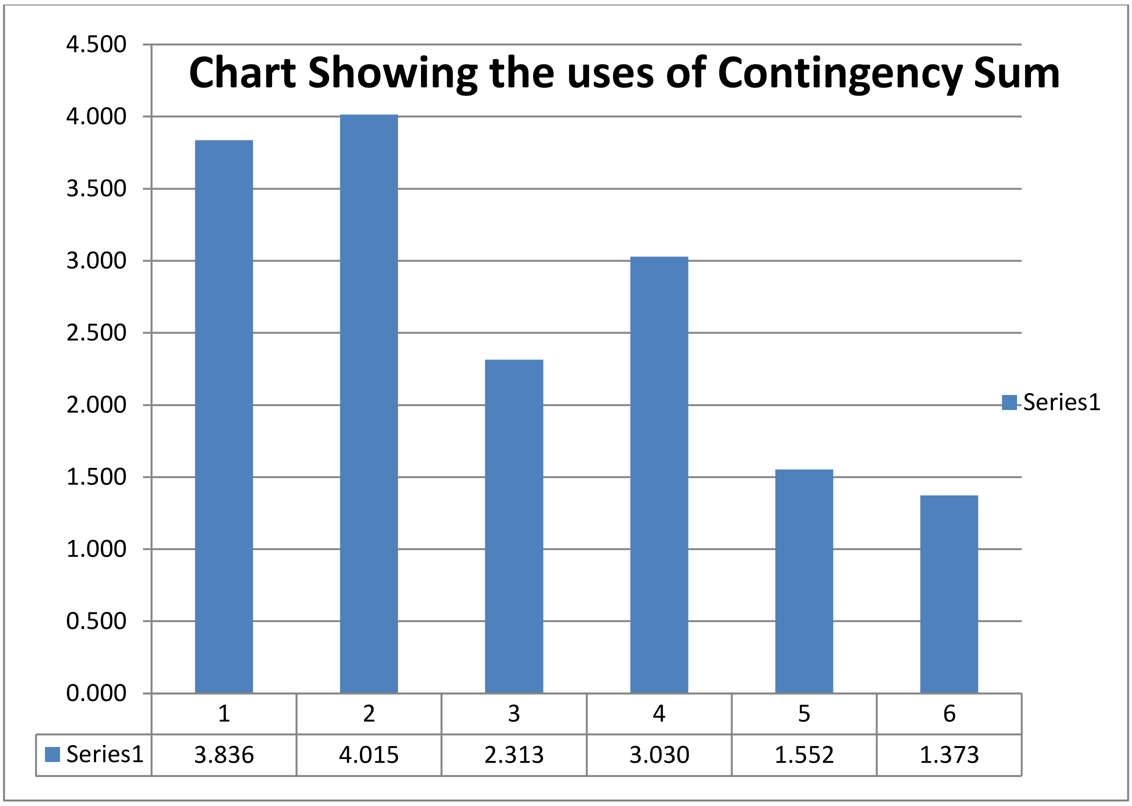

Figure 4.4: Uses of Contingency Sum in the construction industry.

Source: Field survey, August, 2015.

4.6 METHODS OF CONTINGENCY ESTIMATION.

From the literature, Contingency Sum can be estimated by several methods. This section elicited information on respondents' level of knowledge and awareness of contingency estimating methods in addition to frequency of use of the approaches. As indicated in Table 4.8.1 below, all the (n=67) respondents representing 100% confirmed that Traditional Percentage Addition as the first widely known method for allocating Contingency Sum in Ghana. Ninety - nine percent (n=66) of respondents also confirmed that Lump Sum Allowance is the second highest known method, followed by Cost item allocation with 88%, Regression analysis with 78%, probabilistic Estimation and Estimating using Risk analysis had 72% each. The other methods such as method of moment, Monte Carlo simulation, PERT and Artificial Neural networks methods recorded below average percentage of 55% indicating that the methods are virtually not known and that the respondents are not familiar with them. On methods of determining project contingency sum for works procurement, the respondents were consequently asked to rank the extent to which the methods were put to use.

Table 4.8.1: Respondents level of Knowledge and Awareness of methods of Contingency Estimation.

Methods	Quantity Surveyors	Architects	Civil Engineers	Total	Percentage
Traditional percentage	36	10	21	67	100
Lump Sum Allowance	36	9	21	66	99
Cost Item Allocation	36	6	17	59	88
Probabilistic estimation (Allocation)	27	4	17	48	72
Method of Moments	11	0	2	13	19
Monte Carlo Simulation	6	0	2	8	12
Programme Evaluation Review and Technique (PERT)	14	4	9	27	40
Estimating Using Risk Analysis	26	6	16	48	72
Regression Analysis	25	8	19	52	78
Artificial Neural Networks	7	2	5	14	21

Source: Field survey, August, 2015

The results of the responses were analysed using Relative Importance Index (RII) as shown in Table 4.8.2 below. It was observed that four methods had their RII values above the average score of 0.384. Traditional Percentage addition has been established as the most widely and frequently used method with RII of 0.854 and ranked 1st. Lump sum allowance was ranked second with RII of 0.812, followed by

Cost item allocation with an index of 0.725 and Probabilistic estimation with an index of 0.588 ranked fourth. These findings are an indication that although so many methods existed, the RII values of the first four methods are above the RII average score of 0.384 signifying that these four methods are the most frequently used in allocating Contingency sum.

Table 4.8.2: Frequency of Use of the Methods of Contingency Estimation

Methods	**Frequency of Use**					**Total**	**∑W**	**Mean**	**RII**	**Rank**
	1	**2**	**3**	**4**	**5**					
Traditional percentage	0	0	12	25	30	67	286	4.269	0.854	1th
Lump Sum Allowance	0	0	18	27	22	67	272	4.060	0.812	2nd
Cost Item Allocation	0	9	26	13	19	67	243	3.627	0.725	3rd
Probabilistic estimation (Allocation)	7	21	19	9	11	67	197	2.940	0.588	4th
Method of Moments	67	0	0	0	0	67	67	1.000	0.200	8th
Monte Carlo Simulation	67	0	0	0	0	67	67	1.000	0.200	8th
Programme Evaluation Review and Technique (PERT)	66	1	0	0	0	67	68	1.015	0.203	7th
Estimating Using Risk Analysis	67	0	0	0	0	67	67	1.000	0.200	8th
Regression Analysis	61	6	0	0	0	67	73	1.090	0.218	6th
Artificial Neural Networks	60	7	0	0	0	67	74	1.104	0.221	5th

Source: Field Study, August, 2015.

In contrast, Method of moment, Monte Carlo simulation, PERT, Estimating using Risk Analysis (ERA), Regression analysis and Artificial Neural Networks methods of calculating Contingency Sum have not been in use at all.

4.7 FACTORS THAT INFLUENCE THE DETERMINATION OF CONTINGENCY SUM FOR WORKS PROCUREMENT.

Twenty factors were gathered from the literature review to have influence on determination of contingency sum for works procurement. The respondents were asked to rank the factors that influence and how each impact on the determination of the Contingency sums of projects. The indices observed suggest that the higher the important index, the more significant and influential that factor. Based on Table 4.9 below, an unexpected ground condition emerged as the highest ranked factor with a RII value of 0.87 doubling as the most severe and dominant factor that affect contingency sum determination followed by poor contract management (RII=0.84) as the second ranked factor. Political Interference was 3rd major factor followed by Fraudulent Practices and Kick-Backs as 4th ranked factor. Site Characteristics was ranked 5th, with a RII of 0.76, project Specification with RII of 0.73 was ranked sixth, design consideration with RII of 0.69 as the seventh among other factors as displayed in the Table 4.9 below. Interestingly, most Construction Professionals interviewed in Ghana consider Economic factors such as Inflation, Exchange Rate and Global economic pressures as the most unstable influential factors that have varying tendency since most of them are beyond the control of the professionals, that they come with external pressures. Indications are that both Shortage of material and plant and Force majeure emerged as the lowest ranked factors 17th and 18th with RII value of 0.48 and 0.42 respectively. This implies that these two factors were hardly considered in the determination of contingency sum for works procurement.

Table 4.9: Ranking of factors influencing the determination of contingency sum for works Procurement.

Item	Factors	Influence ranked score					Total	∑W	Mean	RII	Rank
		1	2	3	4	5					
X1	Project Specification	1	6	26	18	16	67	243	3.63	0.73	6
X2	Forms of Procurement/ Contract	14	20	23	8	2	67	165	2.46	0.49	16
X3	Site Characteristics	1	7	18	20	21	67	254	3.79	0.76	5
X4	Project Duration	9	21	19	13	5	67	185	2.76	0.55	12
X5	Poor Contract Management	0	0	13	28	26	67	281	4.19	0.84	2
X6	Design Considerations	7	12	13	15	20	67	230	3.43	0.69	7
X7	Unexpected Ground Conditions	0	0	10	23	34	67	292	4.36	0.87	1
X8	Shortage of Materials and Plant	15	25	13	13	1	67	161	2.40	0.48	17
X9	Funding Problems	11	18	23	10	4	67	176	2.67	0.53	13
X10	Government Policies	12	11	15	19	10	67	205	3.06	0.61	11
X11	Tax Liabilities	7	14	18	15	13	67	214	3.19	0.64	10
X12	Cost of Materials	15	18	17	10	7	67	177	2.64	0.53	13
X13	Inflation	6	12	21	16	12	67	217	3.24	0.65	9
X14	Exchange Rate	9	10	13	19	16	67	224	3.34	0.67	8
X15	Political Interference	0	2	16	26	23	67	271	4.04	0.81	3
X16	Global Economy	7	11	16	18	15	67	224	3.34	0.67	8
X17	Location	15	18	20	10	4	67	171	2.55	0.51	14
X18	Land Acquisition	16	20	11	14	3	67	169	2.52	0.50	15
X19	Force Majeure	22	26	11	7	1	67	140	2.02	0.42	18
X20	Fraudulent Practices and Kick-Backs	0	5	13	29	20	67	265	3.96	0.79	4

Source: Field survey, August, 2015.

4.8 IDENTIFYING THE MOST CRITICAL RISK FACTORS IN DETERMINING CONTINGENCY SUM

With reference to Table 4.9 above it can be established that each of the variables in Table 4.10 had their RII values above the average of 0.55 as generated from Table 4.9 above. This is an indication that the twelve highest ranked factors are not only significant but also critical factors that influence the determination of contingency sum for works Procurement during tendering stage in Ghana. Relative index of Fifty-Five percent (55%) and above was considered to be highly critical and significant. This means that the first twelve ranked factors as displayed in Table 4.10 were highly significant. By ranking, it means approximately 85% (n=57) of the respondents had ranked Unexpected Ground Conditions as one of the extremely important factors in Contingency sum estimation.

Table 4.10: Critical factors considered in the determination of contingency sum for works Procurement.

Item	Factors	Influence ranked score					Total	∑W	Mean	RII	Rank
		1	2	3	4	5					
X8	Unexpected Ground Conditions	0	0	10	23	34	67	292	4.36	0.87	1
X6	Poor Contract Management	0	0	13	28	26	67	281	4.19	0.84	2
X17	Political Interference	0	2	16	26	23	67	271	4.04	0.81	3
X23	Fraudulent Practices and Kick-Backs	0	5	13	29	20	67	265	3.96	0.79	4
X3	Site Characteristics	1	7	18	20	21	67	254	3.79	0.76	5
X1	Project Specification	1	6	26	18	16	67	243	3.63	0.73	6
X7	Design Considerations	7	12	13	15	20	67	230	3.43	0.69	7
X18	Global Economy	7	11	16	18	15	67	224	3.34	0.67	8
X16	Exchange Rate	9	10	13	19	16	67	224	3.34	0.67	8
X15	Inflation	6	12	21	16	12	67	217	3.24	0.65	9
X13	Tax Liabilities	7	14	18	15	13	67	214	3.19	0.64	10
X12	Government Policies	12	11	15	19	10	67	205	3.06	0.61	11

Source: Field Study, August, 2015.

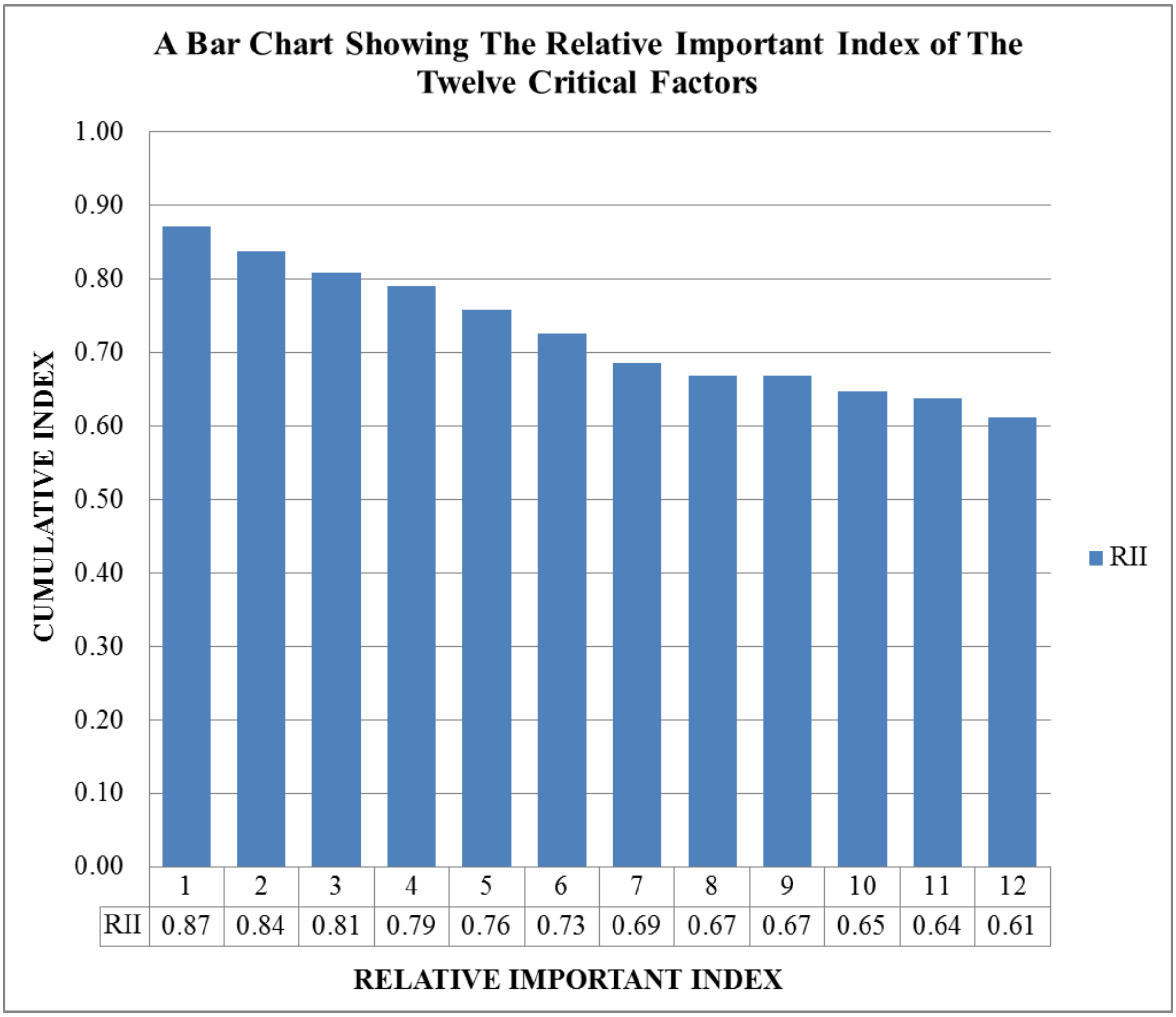

Figure 4.5: Critical factors influencing the determination of contingency sum for works Procurement.

Source: Field Study, August, 2015.

Pareto Chart Analysis

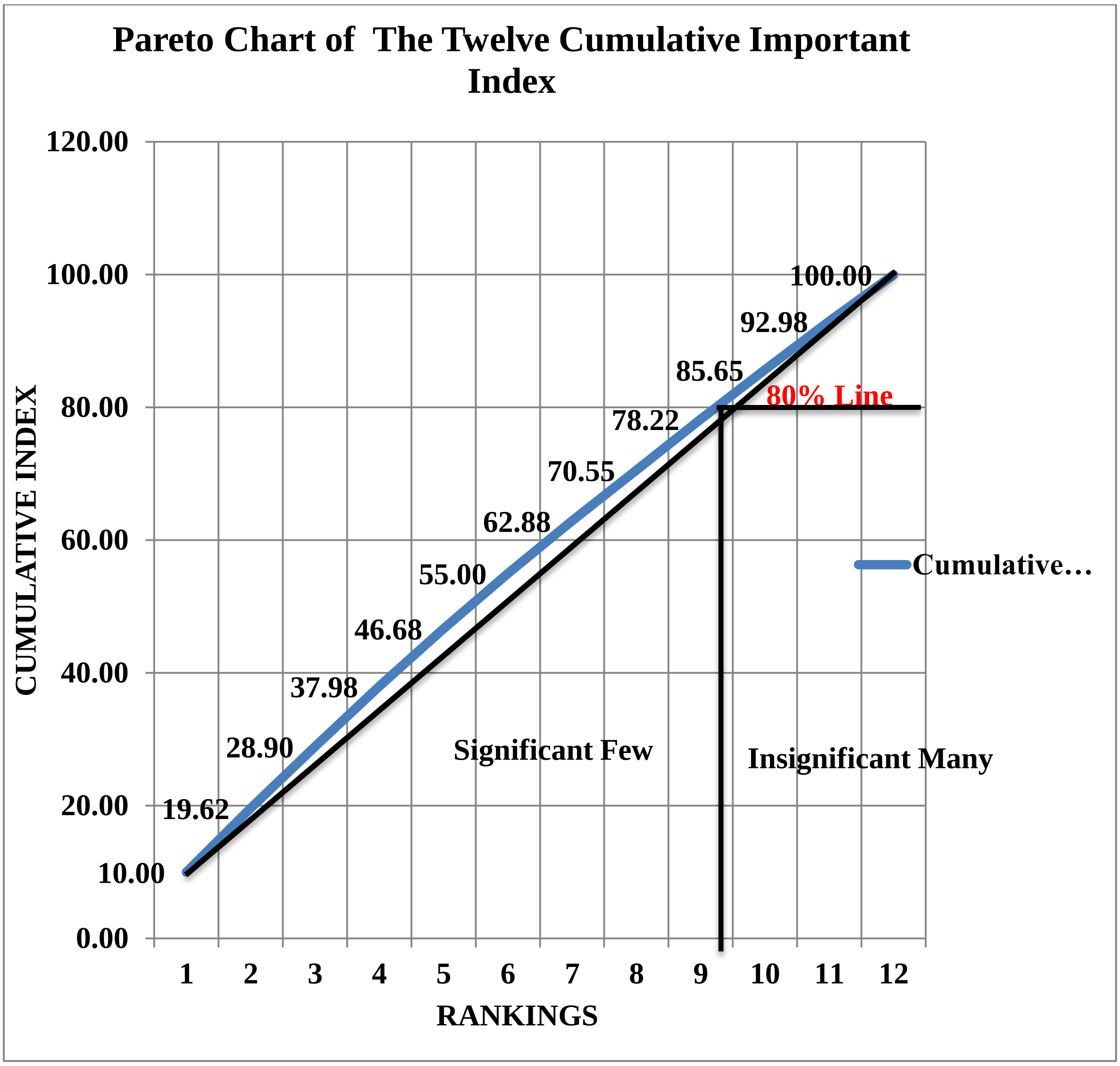

Figure 4.6: Pareto Chart of the Twelve Cumulative Important Index

Source: Field Study, August, 2015.

4.9 APPLICATION OF PARETO PRINCIPLE (THE 80/20 RULE)

Originally, the Pareto Principle referred to the observation that 80% of Italy's wealth belonged to only 20% of the population. More generally, the Pareto Principle is an observation (not law) that most things in life are not distributed evenly .The 80/20 rule observes that most things have an unequal distribution. The theory maintaining that 80 percent of the output from a given situation or system is determined by 20 percent of the input. The Pareto Principle helps realize that the majority of results come from a minority of inputs (Juran, 2015). Applying the Pareto analysis to the Figure 4.5 above, twelve critical factors were identified, weighted and ranked. It was revealed that 80% of the critical factors identified have 20% impact on the determination of contingency sum. The chart illustrates that Unexpected Ground Conditions, Poor Contract Management, Political Interference, Fraudulent Practices and Kick-Backs, Site Characteristics, Project Specification, Design Considerations, Global Economy and Exchange Rate were significant few whilst the rest three were insignificant many. These findings are indication that although all the twelve factors are critical and needs greater attention, the first nine was the most severe, critical and have the greatest impact on the estimation of contingency sum.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

Chapter Five highlights a summary of the main findings and the emerging issues that were exposed as an outcome of the examination of the responses. On the basis of these findings, conclusions have been drawn and are then followed with a summary of recommendations for not only possible actions but also further research work and possible implementation of the recommendations in the construction industry. The findings have been arranged under the set objectives of the research work such as:

1. To identify the existing approaches adopted in estimating contingency sum in Ghana.
2. To identify the critical factors considered by construction professional in making provision for contingency sum in Ghana.
3. To reveal the most critical risk factors that has the greatest impact on the estimation of contingency sum.

5.2 SUMMARY OF KEY FINDINGS

Originated from the review and analysis of the study results, the following outcomes are summarised below;

5.2.1 To Identify the Existing Methods used in Estimating Contingency Sum in Ghana.

Subsequently, this objective was addressed by establishing from the literature the methods used in estimating contingency sum worldwide as revealed by so many researchers. In all, sixteen methods have been identified from the literature (Baccarini, 2005a) out of which ten have been selected and reviewed. It is interesting to note that the surveyed result of the methods had RII value of 85% indicating that Traditional

Percentage addition has been the most widely and frequently used method and ranked 1st. Lump sum amount allowance was ranked second with RII value of 81%, followed by Cost item allocation with an index value of 73% and Probabilistic estimation with an index of 59% ranked fourth. These findings are an indication that although so many methods exist, there are only four methods with their RII percentage greater than the RII average score of 40%. The implication is that they are widely and frequently used in estimating contingency sum in Ghana.

5.2.2 To Review the Existing Approaches of Estimating Project Cost Contingency.

In an attempt to review approaches or methods of estimating project contingency sum, existing literatures have identified and proposed several methods and models for contingency estimation. The researcher identified sixteen methods from some of the existing literature (Baccarini, 2005a) out of which ten have been selected and thoroughly reviewed. It was found out that certain methods are deterministic and others are probabilistic accomplished by either expert opinion or statistical means. The reviewed methods are as follows, Traditional percentage, Lump Sum Allowance, Cost Item Allocation, Probabilistic estimation (Allocation), Method of Moments, Monte Carlo Simulation, Programme Evaluation Review and Technique (PERT), Estimating Using Risk Analysis, Regression Analysis and Artificial Neural Networks.

5.2.3 To Identify the Critical Factors Considered By Building Professionals in Making Provision For Contingency Sum in Ghana.

Twenty factors were gathered from literature review. The respondents were asked to rank the factors that influence and how each impact on the determination of the Contingency sums of project. Considering the average of 0.55 for all RII values and in ranking, twelve critical factors with their RII values above 0.55 have been identified by the respondents as critical, significant and influential in making provision for contingencies for works procurement in Ghana. Respondents opined that an unexpected ground condition is the first significant factor among the twelve factors ranked with RII value of 0.87, next by poor contract management as the second highest ranked factors. Political Interference was 3rd major factor followed by Fraudulent Practices and Kick-Backs as 4th ranked factor. Site Characteristics was ranked 5th, with a RII of 0.76, Project Specification with RII of 0.73 was ranked sixth. Design Considerations was ranked the seventh critical factor, Global Economy and Exchange Rates were each ranked eighth and finally down to Government Policies as the eleventh in the ranking with RII of 0.61.

5.2.4 To Reveal the Most Critical Risk Factors That Has the Greatest Impact on the Estimation of Contingency Sum.

In an attempt to reveal and establish the most critical risk factors that has the greatest impact on the estimation of contingency sum for works procurement, Pareto Principle and analysis have been applied on the twelve critical factors identified. The study established that 80% of the critical factors identified have 20% impact on the determination of contingency sum. The finding is that out of the twelve critical factors, nine namely; Unexpected Ground Conditions, Poor Contract Management, Political Interference, Fraudulent Practices and Kick-Backs, Site Characteristics, Project Specification, Design Considerations, Global Economy and Exchange rates were significant few whilst the rest two were insignificant many.

5.3 CONCLUSIONS

As noted throughout the study, Construction works are the most commonly procured in Ghana by means of tendering and that at the pre-tender stage, Clients are interested in knowing the total project cost commitments. Notwithstanding, the conclusion is based on the surveyed findings.

5.3.1 Methods of Contingency Sum Estimation for Works Procurement

There is no universal method for estimating contingency sum for works procurement. Although the survey indicated that approximately sixty-three percent (n=42) out of the target professionals have more than ten years working experiences in the building business which is considerable, 100% (n=67) of the respondents confirmed allowing or providing contingency sum in project cost estimates and strongly indicated that contingency sum is mainly used for Unexpected or unforeseen conditions, as Reserve fund or Allowance and also to cater for project cost overrun as established in the order of ranking, they are only aware of six methods such as Traditional Percentage Addition, Lump Sum Allowance, Cost item allocation, Regression analysis, probabilistic Estimation and Estimating using Risk analysis with 100%, 99%,88%,78%,72% and 72% respondents confirmation respectively. This is an indication that the respondents are virtually not aware and hardly have knowledge of the rest of the methods in the Ghanaian construction industry despite the vast experience. In short, the respondents are not familiar with them.

It is again concluded that only four methods had their RII value above the approximate average score of 40%. 85.4% RII value of Professionals allocate contingency sum using Traditional percentage addition to the estimate as contingency. 81.2% controls the contingency by a lump sum quantity request and indeed custom it as a normal exercise in their establishment. The rest two such as Cost Item Allocation and Probabilistic estimation were also originating to be the other approaches castoff by construction professionals in allocating contingency sum in Ghana notwithstanding the consciousness and existence of a good number of scientific methods. One can only conclude that a greater number of the respondents arrive at their contingency estimate by guesswork based on experience. In essence majority of the respondents used methods that rely heavily on experience and intuition to estimate or determine contingency sum for works procurement. Hence experience, intuition and judgment play a significant role in estimating contingency sum in tenders. This arbitrary method is still in used the Ghanaian construction industry. The use of the following methods such as Method of Moments, Monte Carlo Simulation, Programme Evaluation Review and Technique (PERT), Estimating Using Risk Analysis, Regression Analysis and Artificial Neural Networks by less than 40% of the respondents is an indication that it is not afterward entirely unbearable for the Ghanaian Specialists to create usage of them.

5.3.2 Factors Considered By Construction Professionals for the Determination of Contingency Sum.

The study established that by rating, the twelve critical better still significant factors that affect the estimation of contingency sum were Unexpected Ground conditions, poor contract management, Political Interference, Fraudulent Practices and Kick-Backs, Site Characteristics, project Specification, Design Considerations, Global Economy, Exchange Rates, Inflation, Tax Liability and finally Government Policies.

Interestingly, most Construction Professionals in Ghana consider Economic factors such as Inflation and exchange rate as the unstable factors and have varying degrees of influence at any particular point in time in the construction industry and may contribute a sizeable amount of influence. It is argued that these factors are beyond the control of construction professionals and come with external pressures.

5.4 RECOMMENDATIONS

The following recommendations are made based on the findings of the research. In general much needs to be done with regards to professional education and awareness creation on the methods for and factors that influences the determination of contingency sum for works procurement during tendering stage in construction industry in Ghana.

5.4.1 Methods of Contingency Sum Estimation for Works Procurement.

The Traditional Percentage addition Method which has emerged as the most widely and frequently used is based on subjective approach and has many limitations. As sited in the literature review by various researchers, the estimate is judgmental, arbitrarily arrived at and its calculation is problematic for the estimator to validate or protect (Ahmad, 1992; Thompson and Perry, 1992) and criticized by researchers. It has been considered an intuitive method as well as a motive why so numerous developments are above financial plan (Hartman, 2000). It is illogically arrived at and may not be suitable for all projects. This estimating method has serious flaws and detrimental to contingency allocation and successful execution of projects in the building industry. It is against these drawbacks therefore that professionals are encouraged to explore using more scientific methods such as Monte Carlo Simulation and the Estimating Using Risk Analysis (ERA). The Tertiary Institutions in Ghana for training cost experts and construction students should develop a curriculum covering a more scientific methods and teach the would-be future professional students at least at the first degree level such that, they would be able to address the estimating deficiencies in the building commerce.

The research institutions and professional governing councils for various associations should take up the challenge to mount frequent workshops and seminars for their members so as to introduce them to (how) usage of the scientific (statistical) methods of determining contingency sum and the advantages over the use of percentage and lump sum methods.

Government establishments should also try to develop scientific methods for use as a standard in MMDAs for real calculation of eventuality as is the exercise in United Kingdom and Hong Kong.

Both the Investigators as well as the registered specialised organisations like the Ghana Institute of Surveyors can take up the problem to advocate for the use of systematic approaches in addition to emerging statistically based models that would be reliable for determining a more accurate construction contingency.

5.4.2 Factors considered by construction cost experts for the determination of contingency sum.

Unexpected ground conditions, poor contract management, Political Interference, Fraudulent Practices and Kick-Backs, Site Characteristics, project Specification, Design Considerations, Global Economy, Exchange Rates, Inflation, Tax liability and finally Government Policies have been identified as the most significant factors. The study recommends among other things that professionals should plan at development stages of a project to gather all possible information to minimise the impact of technical factors and other related factors on the Construction Cost of the project. Much attention should be given to economic factors since most of them come with external pressures and are beyond the control of the professionals. In addition construction professionals should be encouraged to monitor the use of project contingency sum during the actual execution of the projects.

5.5 FURTHER RESEARCH WORK

The Traditional percentage addition and Lump sum allowance are established as the mostly popular and often used methods for determining contingency sum for works in Ghana. However, these methods are associated with so many weaknesses. Recommended strongly therefore that, further research studies be conducted into other mathematically based methods to develop more effective scientific methods for calculating contingency sum for the local construction industry as well as our tertiary institutions. To be précised, it is advocate among other methods the use of more scientific approaches such as Monte Carlo Simulation, Estimating Using Risk Analysis and Regression Analysis although these methods are based on statistical analyses which rely on and require statistical and mathematical knowledge from the user. This becomes one of its limitations since most of the contract managers or construction professionals do not have enough knowledge of these techniques to estimate contingency sum.

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APPENDIX A: SURVEY QUESTIONNAIRE

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,

KUMASI – GHANA

COLLEGE OF ARCHITECTURE AND PLANNING

DEPARTMENT OF BUILDING TECHNOLOGY

(MSc. Procurement Management)

RESEARCH TOPIC:

DETERMINATION OF CONTINGENCY SUM FOR WORKS PROCUREMENT DURING TENDERING STAGE IN GHANA.

BY

NYAGORMEY JULIUS JUBILEE

SUPERVISOR:

DR. THEOPHILUS ADJEI-KUMI

INTRODUCTION

The Researcher is a Master of Science in Procurement Management student, conducting a research into the determination of contingency sum for works procurement during tendering stage in Ghana with the aim of not only to examine the best practices of contingency allocation methods for works procurement in Ghana but also to find out factors that have the utmost influence by using Pareto Principle (the 80/20 Rule) and where attention is probable to produce the utmost advantage in the determination of contingency sum for works.

OBJECTIVES OF THE STUDY

The specific objectives below have been set up to achieve the aim of the study.

To identify the existing approaches used in estimating contingency sum in Ghana.

To identify the critical factors considered by Construction Professionals in making provision for contingencies in Ghana.

To reveal the most critical risk factors that has the greatest impact on the estimation of contingency sum.

INSTRUCTION TO RESPONDENTS

A maximum of thirteen (13) questions have been designed. **Please, kindly respond to the questions by ticking (√) the appropriate box or column for each item**. Please note that any information provided would be strictly treated to the highest confidentiality as this work is solely for academic purposes. Your assistance in responding to the questionnaire would be very much appreciated. You may please contact the researcher on 0246095551 or jubileejulius@yahoo.com for clarifications. The responses may also be sent electronically using the email address above.

QUESTIONS

1. Which of the following establishments do you work?

a). Government ☐ b). Institutional ☐

c). Consultancy Firm ☐ d). Construction Firm ☐

2. Please indicate your Profession.

a).Quantity Surveyor ☐

b).Civil / Structural Engineering ☐

c). Architect ☐

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

a). Below -5years ☐ b). 6- 10 years ☐ c).11-15 years ☐

d).16-20 years ☐ e). 21 years and above ☐

4. How many projects have you been able to undertake within the last five years?

a).1 – 5 Projects ☐ b).6 – 10 Projects ☐ c).11–15 Projects ☐

d).16 -20 Projects ☐ e).21 and above ☐

5. Do you allow project contingency sum in your project cost estimates?

a) Yes ☐ b). No ☐

6. Does your Organization have the necessary data to help in the calculation of contingency?

a) Yes ☐ b). No ☐

7. Do you have any seminar or workshop on the concept of contingency cost estimation within the last five years by your professional body?

a) Yes ☐ b). No ☐

8. The Table below shows a list of possible uses of contingency sum during projects execution. Please indicate the use of contingency sum according to their scale from 1-5. (1= Strongly Disagree, 2= Disagree, 3=Considerable, 4=Agree, and 5= strongly agree)

Items	**Use Of Contingency Sum**	**RATING**				
		(1)	(2)	(3)	(4)	(5)
1	Reserve fund or Allowance					
2	Unexpected/ Unforeseen conditions					
3	Underestimation					
4	Cost overrun					
5	Cover Deficiencies					
6	Profit					

9. The Table below shows a list of methods for estimating project contingency sum. Please tick **(√) Yes** or **No** of the methods you Know and aware of.

Items	**Contingency Estimating methods**	**Tick**	
		Yes	**No**
M1	Traditional percentage- Percentage addition to the base estimate.		
M2	Lump Sum Amount Allowance- Sum of money provided in the contract sum.		
M3	Cost Item Allocation-A percentage allocated to each cost item and estimated as weighted average.		
M4	Probabilistic estimation (Allocation) - It is a computation of cost using 80/20 Pareto's rule.		
M5	Method of Moments-Is a probability distribution of each cost item in an estimate to reflect the risk within the cost item.		
M6	Monte Carlo Simulation-Is a quantitative technique use to develop data through random number generator or by using a statistical program.		
M7	Programme Evaluation Review and Technique (PERT) - Is use to provide three different cost estimates for each item.		
M8	Estimating Using Risk Analysis- Is used to determine contingencies by identifying and costing risk events associated with the project.		
M9	Regression Analysis- Is a powerful statistical tool for analytical and predictive purposes in estimating cost.		
M10	Artificial Neural Networks- Is information processing technique that simulates the biological brain and its interconnected neurons.		

10. Please indicate the frequency of use of the following methods for Contingency estimation in your organization.1=not often, 2=less Often, 3=Often, 4=More Often and 5=Most Often

Item	**Contingency Estimating methods**	**RATING**				
		1	**2**	**3**	**4**	**5**
M1	Traditional percentage- Percentage addition to the base estimate.					
M2	Lump Sum Amount Allowance- Sum of money provided in the contract sum.					
M3	Cost Item Allocation-A percentage allocated to each cost item and estimated as weighted average.					
M4	Probabilistic estimation (Allocation) - It is a computation of cost using 80/20 Pareto's rule.					
M5	Method of Moments-Is a probability distribution of each cost item in an estimate to reflect the risk within the cost item.					
M6	Monte Carlo Simulation-Is technique use to develop data through random number generator or by using a statistical program.					
M7	Programme Evaluation Review and Technique (PERT) - Is use to provide three different cost estimates for each item.					
M8	Estimating Using Risk Analysis- Is used to determine contingencies by identifying and costing risk events associated with the project.					
M9	Regression Analysis- Is a powerful statistical tool for analytical and predictive purposes in estimating cost.					
M10	Artificial Neural Networks- Is information processing technique that simulates the biological brain and its interconnected neurons.					

11. Please rank the factors according to the level of impact on Project Contingency cost estimation with a scale from 1-5 (1=Not at All, 2=Insignificant, 3=Significant, 4=Serious and 5=Severe).

ITEM	FACTORS	**RATING**				
		1	2	3	4	5
X1	Project Specification					
X2	Forms of Procurement/ Contract					
X3	Site Characteristics					
X4	Project Duration					
X5	Poor Contract Management					
X6	Design Considerations					
X7	Unexpected Ground Conditions					
X8	Shortage of Materials and Plant					
X9	Funding Problems					
X10	Government Policies					
X11	Tax Liabilities					
X12	Cost of Materials					
X13	Inflation					
X14	Exchange Rate					
X15	Political Interference					
X16	Global Economic					
X17	Location					
X18	Land Acquisition					
X19	Force Majeure					
X20	Fraudulent Practices and Kick-Backs					

12. Would you advocate for an in-depth treatment of the concept of contingency cost estimation in Tertiary Institutions during the training of construction students?

a) Yes ☐ b). No ☐

13. State professional comments, suggestions or recommendations if any.

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THANK YOU VERY MUCH.