KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,

KUMASI

COLLEGE OF ARCHITECTURE AND PLANNING

DEPARTMENT OF BUILDING TECHNOLOGY

STRATEGIES TO IMPROVE THE RISK FACTORS THAT AFFECT COST ESTIMATION IN THE BUILDING CONSTRUCTION INDUSTRY IN GHANA

BY

ANNOR OSEI-FOSU (BSc. Hons)

A Dissertation submitted to the Department of Building Technology, College of Architecture and Planning, in partial fulfilment of the requirement for the award of

Master of Science (MSc) in Construction Management

APRIL, 2014

DECLARATION

I hereby declare that this submission is my own work towards the MSc. and that, to the best of my knowledge, it contains no material previously published by another person or material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

Annor, Osei-Fosu ....

(PG 7140912) **Signature** **Date**

Certified by:

Prof. E. Badu ....

(Supervisor) **Signature** **Date**

Certified by:

Prof. J. Ayarkwa ....

(Head of Department) **Signature** **Date**

ACKNOWLEDGEMENT

I want to thank Ms. Vera Fabea Annor for inspiring and supporting me financially on this project. I would like to give the biggest thanks to my supervisor Prof.E.Badu for helping me make decisions on my own as to what I had to write on.

I will also like to thank Mr. Kissi Ernest for opening up to me for discussions when I needed some views on the topic. Ms Irene Godi, I would like to thank you also for the assistance you gave to me during the research and the entire project.

And finally I give all thanks to the Lord God almighty for His abundant grace.

DEDICATION

I dedicate this project to my wife Rose Twum- Ampofo and my children.

ABSTRACT

Strategies for improving risk factors affecting cost estimation in the building construction industry continue to be a major feature of construction projects in an attempt to deal effectively with uncertainty and to achieve project success. The dissertation presents strategies for the improvement of risk factors affecting cost estimation in the building construction industry. The study is on risk allocation (both contractors view and as practiced); risk importance and risk effects on a construction project; and analyses contractors' perception of allocating construction risks to the common practice of allocating these risks. To achieve the study objectives of this dissertation the researcher conducted a literature review of the subject, defined important risk parameters and categories related to construction risks, designed a questionnaire related to allocation of risks, importance and effects of these risks on a construction projects. However, questionnaire was distributed to 25 construction contractors of D1K1 working with Ghana Cocoa Board. Responses from 23 contractors were received, analysed, summarized and reported which represent 92% of response rate. The findings of the results indicated that the perception of construction contractors in Ghana in allocating measured risks is different from the common practice of allocating these risks. In practice, according to the respondents the measures that will help mitigate the risks that have been identified in cost estimation in this order:

(i) Eliminate over design

(ii) Risk Management must rely on tools and techniques that will help the likelihood of future events

(iii)Use of Value Engineering

(iv) Design Professionals should understand not only the project but also the external environment in which that project will be constructed

(v) Risk management should really be considered the responsibility of everyone involved in a project. An effective way of tackling risk is to prepare for it adequately. Every organisation must have a plan to tackle risk.

There is the need to look at the past experiences of the organisation and others in the same sector and identify some of the risk that has been confronted by them. Waiting for the risk to occur and tackling it is often the weakest part of the risk management process. There should also be the use of qualified estimating personnel throughout the life of the project from budget preparation, design, and tendering, post-tender review and construction phases. The use of unqualified estimators will result in inaccurate estimates and, hence, inappropriate budgets. The implication of the study is that the lessons drawn from the research will serve as early warning to contractors to risk management in the running of their businesses and also ensure that proper measures are put in place to address issues of improving risk in cost estimation in the construction industry. The government and the stakeholders in the industry are also expected to take a cue from the research to ensure that these contractors have the necessary tools to manage risk in cost estimation.

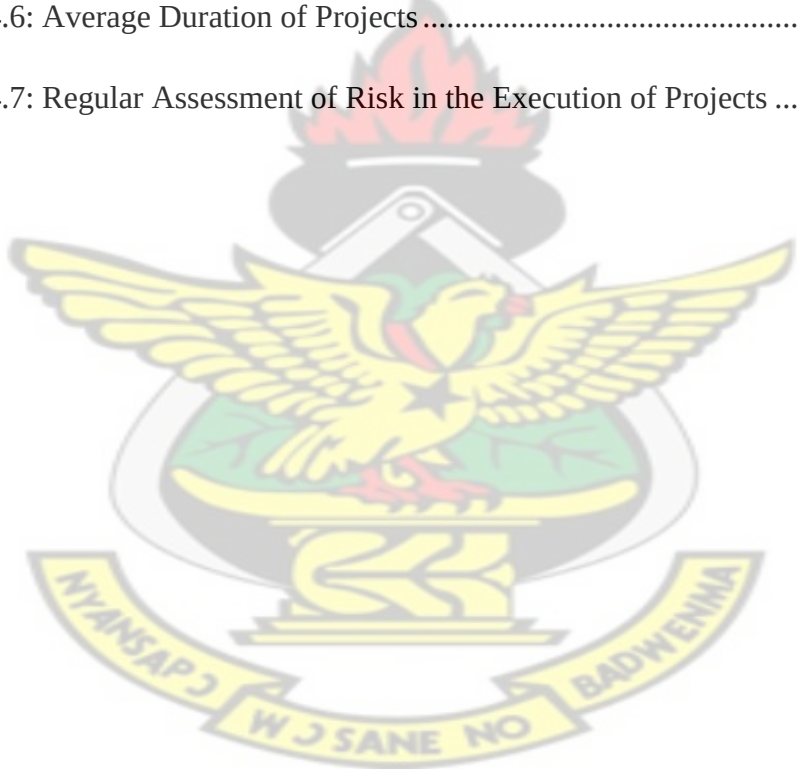
Keywords: Risk management, Construction industry, strategic measures and cost estimation

TABLE OF CONTENT

PAGE

LIST OF TABLES

LIST OF FIGURES



CHAPTER ONE

GENERAL INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Cost estimation in building construction is one of the most critical tasks in the stages of a building project. According to Sung-Hoon An, et al., (2010), estimators must deal with numerous uncertainties in the project. These uncertainties are the risks that affect the determination of the probable construction cost of any given project. The greater the uncertainties the less reliable a cost estimate will be. Clients of construction projects are very concerned about the reliability of cost estimates.

The success or failure of any building project depends on the accuracy of costs estimates. Accurate estimates optimize good contracting (Ahuja, et al., 1994). Hence it remains the process of calculating and analysing all the costs which will enter into a particular job and arriving at a total. In nearly all contract types, the preparation of a realistic cost estimate is a necessary part of any construction operation (Holm, et al, 2005). However, cost estimate is an approximation of the probable cost of a product, program, or project, computed on the basis of available information. Cost estimation procedure is a process undertaken by consulting firms or estimation department in clients' agencies to develop cost estimate of a project from available information (Assaf & Al-Hejji 2006). In Ghana, however, the estimate for a construction project is often prepared by Quantity Surveyors (QSs) from the universities, QSs who graduate from a number of polytechnics across Ghana, with a Higher National Diploma (HND) in Building Technology (Fugar and Adinyira, 2009) or a Construction Technician Course (CTC) Certificate. Strategies for improving the effect of risk affecting cost estimating therefore, requires understanding of cost estimation issues and

considerations that will make estimation an effective component of overall cost and project management. In addition, it is essential that those using an estimate and those producing it completely understand why the estimate is being produced and how it will be used.

The process of preparing detailed cost estimates starts with establishing clear definitions of the scope of the estimation tasks and the physical nature of the project being estimated. The next step is to follow an organized and consistent work plan for preparing and reviewing the estimate. The final step is to present the estimate and, if necessary, reconcile it with estimates prepared by others (Dell'Isola, 2003).

In cost estimation, risk is always a significant factor in determining a project's cost (Dell'Isola, 2003). Any transfer of risk to a contractor will likely result in a higher price for the work. Stringent work requirements, liquidated damages, excessive retention, and extreme bonding requirements indirectly affect risk and cost and, furthermore, may cascade from subcontractor to subcontractor. Some owners feel that transferring risk will protect them, but they may be unaware that the transfer of risk will be reflected in the contractor's bid price (Dell'Isola, 2003).

1.2 STATEMENT OF THE PROBLEM

The uncertainty in undertaking a construction project comes from many sources and often involves many participants in the project. In approaching the problem of uncertainty, it is important to recognise that incentives must be provided if any of the participants is expected to take a greater risk in order to control costs (Chapman, 2001). Some clients attempt to use fixed price contracts so that the risks of unforeseen contingencies related to an overheated economy are passed on to contractors. However, contractors will raise their cost to compensate for additional risks.

The construction industry in Ghana has a very poor reputation for coping with risks (Amoah, et al., 2011). Risk analysis affecting estimation is either ignored or done subjectively by simply adding a contingency figure or amount. As a result many major projects fail to meet schedules deadlines and cost targets with an attendant loss of both contractors and owner.

Many contractors are unfamiliar with these risk factors and do not have the experience and knowledge to manage them effectively. As a consequence, conflicts, poor quality, late completion, poor cost performance and business failures are common features in the Ghanaian construction industry.

It has been realised that most contractors fail to keep within the cost estimated, fail to achieve the required completion date and the required quality and operational requirements and thus the need to investigate into the risk factors directly affecting project estimation (Fugar and Adinyira, 2009).

1.3 RESEARCH QUESTIONS

The research questions are as follows:

- What is the current management practices of risk associated with cost estimate of construction works?
- What are the risk factors affecting cost estimation of construction works?
- What are the strategies that will help mitigate these risk factors in cost estimation?

1.4 AIM AND OBJECTIVES OF THE RESEARCH

To propose strategies for improvement of the risk factors in cost estimation in building construction industry.

1.4.1 OBJECTIVES

The specific objectives of this research are:

1. To document the current risk management practices associated with cost estimate of construction works,
2. To identify significant risk factors affecting cost estimation of construction works, and
3. To propose strategies that will help mitigate these risk factors in cost estimation.

1.5 SIGNIFICANCE OF THE STUDY

Cost estimation in building construction is one of the main elements of the building industry. It is an important aspect of building construction and as such extensive research needs to be carried out on this element. There are many groups inside and outside of the building industry that will benefit from this study. Among these groups are: owners, consultants, designers, and academicians. Some of the benefits that this research offers include:

Provide possible improvement of consulting cost estimation system and its benefits to clients, consulting firms and the constructor of the project;

Clients will benefit tremendously from unnecessary risk; by avoiding or reducing the risk.

Contractors can use the knowledge to forecast or hedge cost estimates, that is in pricing, protecting against exchange rate and inflation

1.6 METHODOLOGY

1.6.1 RESEARCH METHODOLOGY

The research methodology involves primary and secondary data collection. Secondary information involved literature review of journals, books and other relevant

publications. Primary data will involve the use of close and open ended questionnaires on the basis of the literature review.

- A self-administered questionnaires was sent to contractors and consultants
- The questionnaires comprised of four sections. Sections seeking a general view on professional characteristics and their responses on the objectives of the topic and the other sections on the risk factors.

The sample size of this research was determine using the Kish formula out of a population class.

- Response was collected computed and analysed descriptively using SPSS.

1.6.2 RESEARCH STRATEGIES

The five steps followed to arrive at the analysis of the data were:

- Preliminary study;
- Determination of sample size;
- Design and development of structured questionnaire;
- Distribution of questionnaire; and
- Data collection.

1.7 SCOPE OF THE STUDY

The study was limited to risk factors affecting detail cost estimation of construction works of the use of procurement process and standards contractors in Ghana since these firms are mostly well managed in terms of cost estimation.

1.8 ORGANISATION OF THE STUDY

The study is divided into five chapters. Chapter one is the introduction of the study and it comprised the background of cost estimation in the Ghanaian building industry and justification of the study. Chapter two presents related literature concerning risk analysis and contingency estimation in construction and general classification of different types of estimates. The research methodology is presented in chapter three while data presentation and analysis was organised in chapter four. Chapter five includes the summary of the research, conclusion and recommendation based on findings of the study.

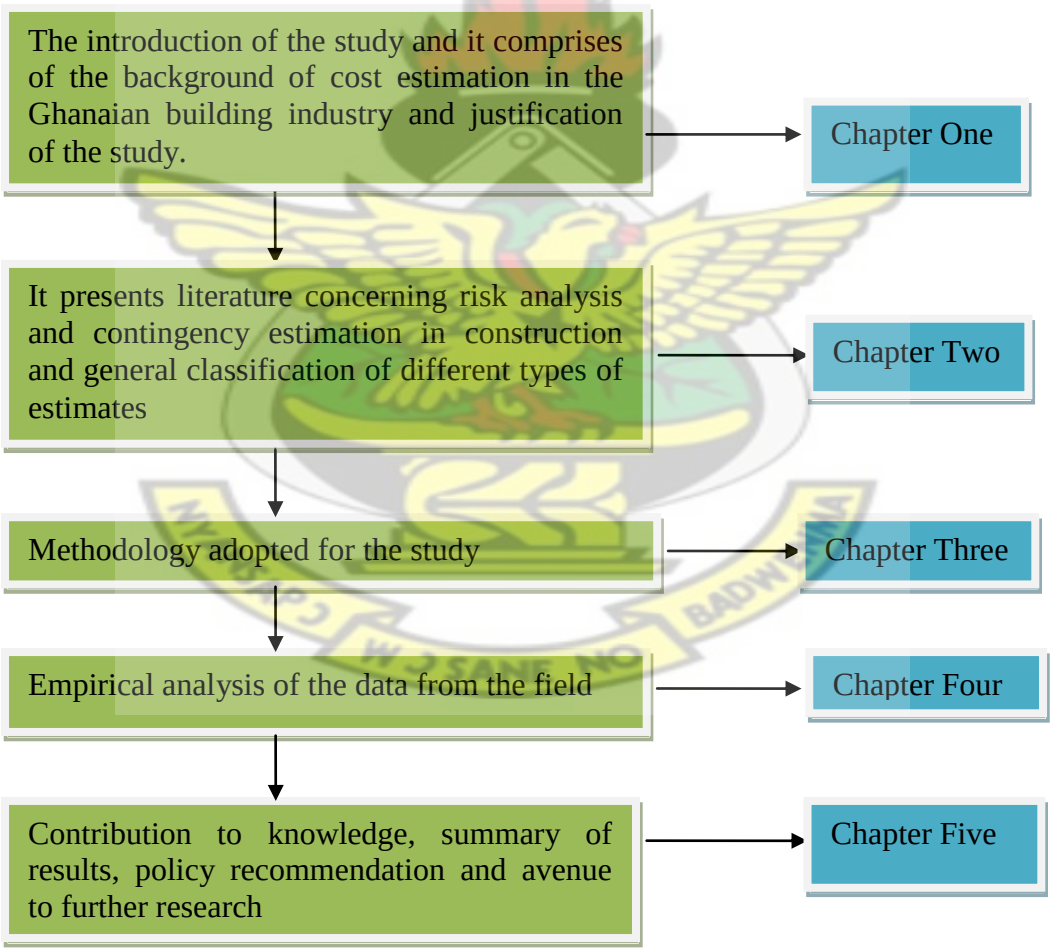


Figure 1.1 Flow diagram of research process

1.9 SUMMARY OF CHAPTER

As noted in the previous sections this chapter has discussed the general introduction and background to the research. The problem statement was also presented and the need for the research justified. The chapter also introduced the research aim, objectives and the limitation of the study. To arrive at objectives of the study the research questions were formulated and a summary of the methodology adopted for the study also presented in the chapter. Chapter one was concluded with discussions on the significance of the study, scope of the study and the organization of the research. The next chapter which begins the literature review discusses the introduction, overview of risk factors, risk factors in construction cost estimation, over view of estimating construction costs, types of estimates, risk factors associated with cost estimating, risk management, effects of risk in cost estimation and strategies or ways to improve risk management associated cost

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

The success of every research work depends greatly on the already existing data or information about the research topic. Based on that fact, this research work depended on the number of studies that have been done to determine the impact of variation orders on project performance. The review has been organized around these main themes:

- Overview of risk factors;
- Risk factors in construction;
- Cost estimation;
- Overview of estimating construction cost;
- Types of estimates;
- Risk factors associated with cost estimation;
- Risk management;
- Effects of risk in cost estimation;
- Strategies Or Ways To Improve Risk Management Associated Cost;
- Current solutions to reduce risk factors in cost estimation.

2.2 OVERVIEW OF RISK FACTORS

According to Rezakhani (2012) a risk is defined as the potential for complications and problems with respect to the completion of a project and the achievement of a project goal and as an uncertain future event or condition with the occurrence rate of greater than 0% but less than 100% that has an effect on at least one of project objectives (that is, scope, schedule, cost, or quality). In addition, the impact or consequences of this

future event must be unexpected or unplanned (Chia, 2006). Risk is seen as the uncertainty surrounding the outcome of an event or variable. However, Knight in 1921 as cited by NYU Stern School of Business summarised the difference between risk and uncertainty thus:

"Uncertainty must be taken in a sense radically distinct from the familiar notion of Risk, from which it has never been properly separated. The essential fact is that "risk" means in some cases a quantity susceptible of measurement, while at other times it is something distinctly not of this character; and there are far-reaching and crucial differences in the use of the words depending on which of the two is really present and operating. It will appear that a measurable uncertainty, or "risk", as a term, is so far different from an un-measurable one that it is not in effect an uncertainty at all." (Abdou, 1996) wrote that "Risk! Construction projects have an abundance of it, contractors cope with it and owners pay for it" (Flanagan & Norman, 1993). All projects or business ventures involve risks of various kinds and types. According to Flanagan and Norman (1993), the construction industry is subject to more risks than other industries. In construction projects, risks and uncertainties are of several types.

Some of these are: political, financial, economic, environmental and technical. Many of these uncertainties will involve a possible range of financial outcomes that could be better or worse than predicted. The construction industry in particular has been slow to realize the potential benefits of risk management (Flanagan and Norman 1993).

According to Akintoye & MacLeod (1997) construction risk is generally perceived as events that influence project objectives of cost, time and quality. Analysis and management of risk in construction depend mainly on intuition, judgment and experience. Because of the lack of knowledge and doubt on the suitability of risk

analysis procedures, formal and 14 systematic risk analysis and management procedures are rarely used in the construction industry. Cullen, (2012) stated that the application of risk management procedures in construction can give early visibility to potential "problem areas" and opportunities, where effort and money can be expended early in the design and construction phases to reduce vulnerability, insurance costs, business or mission interruption, and claims.

Al-Bahar & Crandall (1990) in their article stated that risk is inherently present in all construction projects. Quite often, construction projects fail to achieve their time, quality, and budget goals. A risk model entitled construction risk management system (CRMS) is introduced to help contractors identify project risks and systematically to analyse and manage them. The CRMS model is a logical substitute for the traditional intuitive unsystematic approach currently used by most contractors. Bing, et al., (1999), state that a systematic approach to risk management is not a widely-spread practice in the construction industry due to the complex nature and involvements of this industry.

2.3 RISK FACTORS IN CONSTRUCTION

PMBoK (2008) defines risk classification as a provider of a structure that ensures a comprehensive process of systematically identifying risks to a consistent level of detail and contributes to the effectiveness and quality of the risks process identification. Risk classification is an important step in the risk assessment process, as it attempts to structure the diverse risks that may affect a project. There are many approaches in literature for construction risk classification. Perry & Hayes (1985) give an extensive list of factors assembled from several sources, and classified in terms of risks retainable by contractors, consultants and clients.

Abdou, (1996) classified construction risks into three groups, that is, construction finance, construction time and construction design. Also Shen, (1997) in an article identified eight major risks accounting for project delay and ranked them based on a questionnaire survey with industry practitioners. Tah & Carr, (2000) classified project risks by using the hierarchical risk breakdown structure (HRBS) and classified them into internal and external risks. This shows the magnitude of project risk factors. Chapman, (2001) grouped risks into four subsets; environment, industry, client and project. Shen, et al., (2001) categorized them into six groups in accordance with the nature of the risks, that is, financial, legal, management, market, policy and political.

According to Rezakhani, (2012) as cited in Chen, et al., (2007) proposed fifteen (15) risks concern with project cost and divided them into three groups: resource factors, management factors and parent factors. Assaf & Al-Hejji, (2006) mentioned the risk factors as the delay factors in construction projects. Dikmen, et al., (2007) used influence diagrams to define the factors which have influence on project risks. Zeng, et al., (2007) classified risk factors as human, site, material and equipment factors.

With reference to the aforementioned findings the construction risks include cost overrun, project life cycle risks, quality risks, safety risks as well as environmental sustainability. Construction group includes risk factors that occur due to faulty construction techniques, managerial issue, cost escalation, and delay in construction project. Politics and contract provision risk are the risk factors that occur due to legal changes and unsupportive government policies. In terms of finance, risk factors occur due to inadequate hedging of revenue streams and financing costs. In design risk category, the risk factors occur due to faulty from technical aspect and late amendment, while risk factors occurring due to the lack of enforcement are categorised as environmental risks

Table 2.1 Categories and factors of risk.

Risk Category	Risk Factor
Construction	Land acquisition
	Shortage of equipment
	Shortage of material
	Poor quality of workmanship
	Late delivery of materials
	Site safety
	Insolvency of subcontractors
	Inadequate planning
	Weather
	Insolvency of suppliers
	Change in law and regulation
Politics and contract provisions	Delay in project approval and permit
	Inconsistencies in government policies
	Excessive contract variation
	Poor supervision
	Bankruptcy
	Compliance with government
	Delay in payment for claims
Finance	Cash flow difficulties
	Lack of financial resources
Design	Improper design
	Change of scope
Environmental	Compliance with law and regulation for environment issue
	Pollution

Source: Abd Karim, 2012

2.4 COST ESTIMATION

Butcher & Demmers, (2003)'s definition for cost estimation is a well-formulated prediction of the probable construction cost of a specific building project. A cost estimate can be an important management tool to library planners during the design phases of a project providing information about the facility and the project budget. This implies that cost estimating is cost of physically constructing the project in the time required.

Clough, (1986) defines the construction estimation as the compilation and analysis of the many items that influence and contribute to the cost of a project. Stewart, (1991) quotes a definition of cost estimation from the Society of Cost Estimating and Analysis (SCEA), as "the art of approximating the probable worth or cost of an activity based on information available at the time". Ritz, (1994) gives another definition which is, "the project cost estimate is the predicted cost of executing the work". As defined by Ahuja, et al., (1994) cost estimate is "the estimate at best is an approximation of the expected cost of the project.

2.5 OVERVIEW OF ESTIMATING CONSTRUCTION COSTS

According to Manfredonia, et al., (2010), accurately forecasting the cost of future projects is vital to the survival of any business or organization contemplating future construction. Cost estimators develop the cost information that business owners or managers, professional design team members, and construction contractors need to make budgetary and feasibility determinations. According to PMBook, (2008) virtually all cost estimation is performed according to one or some combination of the following basic approaches.

Production Function: In microeconomics, the relationship between the output of a process and the necessary resources is referred to as the production function. In construction, the production function may be expressed by the relationship between the volume of construction and a factor of production such as labour or capital. A production function relates the amount or volume of output to the various inputs of labour, material and equipment. For example, the amount of output Q may be derived as a function of various input factors x1, x2, ..., xn by means of mathematical and/or statistical methods. Thus, for a specified level of output, we may attempt to find a set

of values for the input factors so as to minimize the production cost. The relationship between the sizes of a building project (expressed in square feet) to the input labour (expressed in labour hours per square foot) is an example of a production function for construction (PMBok, 2008).

Empirical Cost Inference: Empirical estimation of cost functions requires statistical techniques which relate the cost of constructing or operating a facility to a few important characteristics or attributes of the system. The role of statistical inference is to estimate the best parameter values or constants in an assumed cost function. Usually, this is accomplished by means of regression analysis techniques (PMBok, 2008)

Unit costs for bill of quantities: A unit cost is assigned to each of the facility components or tasks as represented by the bill of quantities. The total cost is the summation of the products of the quantities multiplied by the corresponding unit costs. The unit cost method is straightforward in principle but quite laborious in application. The initial step is to break down or disaggregate a process into a number of tasks. Collectively, these tasks must be completed for the construction of a facility. Once these tasks are defined and quantities representing these tasks are assessed, a unit cost is assigned to each and then the total cost is determined by summing the costs incurred in each task. The level of detail in decomposing into tasks will vary considerably from one estimate to another (PMBok, 2008).

Allocation of joint costs: Allocations of cost from existing accounts may be used to develop a cost function of an operation. The basic idea in this method is that each expenditure item can be assigned to particular characteristics of the operation. Ideally, the allocation of joint costs should be causally related to the category of basic costs in

an allocation process. In many instances, however, a causal relationship between the allocation factor and the cost item cannot be identified or may not exist. For example, in construction projects, the accounts for basic costs may be classified according to (1) labour, (2) material, (3) construction equipment, (4) construction supervision, and (5) general office overhead. These basic costs may then be allocated proportionally to various tasks which are subdivisions of a project (PMBok, 2008).

There are four types of cost estimates. They are conceptual, preliminary, engineering and bid estimates, development, delivery and exit. Below is a table detailing the types of cost estimates.

2.6 TYPES OF ESTIMATES

There are different types of estimates used at various levels of the construction process and these are illustrated in table 2.2 below.

Table 2.2 Types of Estimates

Type	When?	How?
Conceptual	Prior to the commencement of Design	A representative unit is multiplied by a price per unit to obtain a gross estimate (± 10% accuracy) of the facility cost.
Preliminary	40% completion of the total Design	By the architect or architect/engineer to reflect expected costs based on more Definitive data.
Engineer	Detail design is accomplished	• Total job cost minus mark up • Should achieve approximately ±3% accuracy
Bid	Bidding phase	Bidding phase • On the basis of the bidding documents, • Include a mark up for profit.

Source: www.assakkaf.com/Courses/ENCE%20302/Lectures/Chapter9a.pdf4.Cost Estimating Simplified.2003.

According to Charles Sturt University, (2013), inaccurate time estimates can result in inefficient use of resources and late delivery. Inaccurate cost estimates can result in insufficient budget being allocated or excess budget being set aside for the project when it could be used for other projects. If the cost or benefits estimates are inaccurate this can lead to incorrect decisions about proceeding with the project being made.

2.7 RISK FACTORS ASSOCIATED WITH COST ESTIMATING

Risk factors are factors that could bring a change in the objectives or plan of a contractor or client. Risk factors could be grouped under:

- Physical factors;
- Construction factors; and
- Financial factors; (Chapman, 2001).

2.7.1 PHYSICAL FACTORS

Physical factors are factors that can bring about damage or change to the project. Some physical factors are stated below:

- Damage to structure;
- Theft at the site;
- An accident to operative;
- Damage to equipment;
- Loss due to fire outbreaks;
- Floods;
- Weather conditions;
- Change in design; and
- Insufficient detailing (Chapman, 2001)

2.7.2 CONSTRUCTION FACTORS

Construction factors are the factors that affect the equipment and labour of a project. Some construction factors are stated below: (Chapman, 2001)

- Equipment/plant availability;
- Suitability of plant;
- Maintenance facilities of plant;
- Equipment failure (breakdown)
- Plant operation's skill level;
- Level of productivity of Labour;
- Strike by the Labour force causing disruption;
- Availability of experienced & Skilled Labour;
- Level of skill of management;
- Level of supervision;
- Materials availability;
- Unforeseen adverse ground conditions;
- Security and safety of Labour on site;
- Latent defects occurring in the structure through poor workmanship;
- Familiarities with such work; and
- Security equipment of the project area.

2.7.3 FINANCIAL FACTORS

Finance plays an important role in construction. It can increase or decrease the pace at which the work is done. Some financial factors that affect a project include:

- Inflation;
- Fluctuation; and

- Cash flow administration. (Chapman, 2001)

Also Banaitiene & Banaitis; (2012) research findings classified risk factors on construction projects can be split into two major groups:

Internal risks, which fall within the control of clients, consultants and contractors.

External risks, which include risk elements that are not in the control of key stakeholders.

The external factors include

- Fiscal policy;
- Natural forces; and
- Political controls (Chapman, 2001).

2.8 RISK MANAGEMENT

According to Flanagan & Norman, (1993), Risk Management may by describe as a systematic way of looking at areas of risk and consciously determining how each should be treated. Managing risk in construction projects has been recognized as a very important management process in order to achieve the project objectives in terms of time, cost, quality, safety and environmental sustainability. Risk management is the identification of countermeasures necessary to meet the requirements identified in risk analysis. For each risk to be managed there is the need to identify what cost-effective counter measures can be applied. Possible counter measures are:

- Avoiding the risk;
- Reducing the risk (likelihood or impact)
- Transferring the risk to others (insurance)
- Risk Planning

- Risk Identity
- Analysis

2.8.1 AVOIDING THE RISK

Avoiding the risk means removing the risk totally from the work to be done. If the risk occurs to be one of the key elements in the project, avoiding the risk could mean not doing the project. The consequences of certain risks may cause a reappraisal of the project or a replacement of the project by an alternative project (Flanagan & Norman, 1993)

2.8.2 REDUCING THE RISK

Reducing the risk means to minimize the likelihood or the impact of the threat. Risk reduction can be improved through the following:

Education and training to alert staff on a job on potential risks;

- Physical protection to reduce likelihood of loss. For example, the use of an independent quality assurance company as a check on all projects, reduces the incidence of defects going undetected;
- Systems to ensure consistency and encourage staff to question situations; and
- Physical projection of people and property. For example, the likelihood of loss by fire can be reduced by installing a sprinkler system even though regulations might require doing so (Flanagan & Norman 1993).

2.8.3 TRANSFERRING THE RISK TO OTHERS (INSURANCE)

This is the transfer of the risk such that the consequences of the risk if they occur are borne by a party other than the contractor. Insurance is a means of transferring the financial impact of having a risk occur. Insurance is a way of reducing the potential

financial loss or hardship. It can help cover the cost of unexpected events such as theft, illness or property (Financial Consumer Agency of Canada, 2011)

2.9 EFFECTS OF RISK IN COST ESTIMATION

The effect of risk in cost estimation according to Arain & Phen (2005) are increase in project cost, additional payment for the contractor, progress is affected but without any delay, completion schedule delay, increase in overhead expenses and rework and demolition of construction project.

According to the survey findings by Arain & Phen, (2005), the most frequent effect of risk in cost estimation was the increase in project cost. It was not unexpected for the project cost to increase due to frequent variations in the project. This was because the cost estimates may affect the project's total direct and indirect costs. Therefore, any major addition or alteration in the design may eventually increase the project cost. In every construction project, a contingency sum is usually allocated to cater for possible variations in the cost, while keeping the overall project cost intact. However, frequent major variations in cost may lead to cost overrun in the contingency sum (Arain & Phen, 2005).

Additional payment for contractor was perceived as the second most frequent effect of risk of cost estimation. This was because risks in cost estimation are considered as a common source of additional works for the contractor. The contractors would consider risk in estimation in the project as additional opportunities to achieve their desired profit margins. This situation was frequently faced by the owner in projects where the terms for valuing the estimates were not considered at the inception of the project (Arain & Phen, 2005). Progress is affected but without any delay. Progress is affected but without any delay was considered as the third most frequent effects of

risk in cost estimation. This was because the construction team usually strives to keep the project completion schedule intact because time has an equivalent money value. The contractors are usually compelled to accommodate the implementation time for differences in estimates by utilizing the free floats in the construction schedules. Hence, the differences affect the progress but without any delay in the overall project completion (Arain & Pheng, 2005).

The fourth most frequent effect of risks in cost estimation was the completion schedule delay. Major risks may affect the project adversely, leading to delays in the project completion. Furthermore, frequent minor variations in cost estimates can also affect the project adversely depending on the timing of the occurrence of the variations. This is because the impact of a variation in cost during the construction phase can be more severe than in the design phase (Arain & Phen, 2005).

The fifth most frequent effect of variation in cost estimates was the increase in overhead expenses. This was because the process and implementation of variations in construction projects increased the overhead expenses for all the concerned participants. Normally these overhead charges are provided for from the contingency fund allocated for the construction project (Arain & Phen, 2005).

Rework and demolition were considered as the fifth most frequent effect of variation in cost estimates according to Arain & Phen (2012). This was because rework and demolition are frequent results of most of the variations that occurred during the construction phase. Any addition or alteration in design during the construction phase may result in reworks and demolitions on site. Furthermore, the reworks and demolitions may affect the subsequent construction activities, eventually leading to

delays in the project completion. Therefore, the impact of a variation in costs during the construction phase is more severe than in the design phase.

2.10 STRATEGIES OR WAYS TO IMPROVE RISK MANAGEMENT ASSOCIATED COST

One of the most important rules in preparing a good estimate is to follow established and proven estimating procedures. For example, value engineering should be used during both the estimating and the construction stages. The contractor should try to eliminate over design or exotic materials that needlessly increase the price of a project (Holloway, 2013).

Investopedia, (2013) defined value engineering as a systematic and organized approach to provide the necessary functions in a project at the lowest cost. Value engineering promotes the substitution of materials and methods with less expensive alternatives, without sacrificing functionality. It is focused solely on the functions of various components and materials, rather than their physical attributes also called value analysis.

According to Ponte, (2009), design professionals engaged in the development of construction cost estimates for their clients should understand not only the project for which they are providing design services, but also the external environment in which that project will be constructed. This additional insight into the various external nuances of a project will enable the design professional to select the best method, or combination of methods, to adequately develop the construction cost.

Cullen, (2012) in his article stated that for risk management to be effective, risk management must rely on tools and techniques that help predict the likelihood of future events, the effects of these future events and methods to deal with these future

events. Risk management should really be considered the responsibility of everyone involved in a project.

2.10.1 SUMMARY

From the aforementioned, one can conclude that relatively, construction industry is subject to riskier than other industries. Out of these uncertainties will involve a lot of financial outcomes that could be better or worse than predicted. There is therefore the need for a systematic approach to risk management

It is also clear that an extensive list of factors coming from several sources, and group in terms of risk retainable by contractors, consultants and clients. Some are construction finance, construction time and construction design. This implies that cost estimation should be done well to predict the probable construction cost to any project based on information available.

Managing risk in construction projects in therefore seen as a very important management process if a successful project's objective is to be achieved. for each risk to be managed carefully, there is the need to identify cost-effective counter measures in risk analysis. the effect of risk in cost estimation are numerous such as increase in project cost, additional payment for the contractor, delays in project completion and increase in overhead expenses among other.

In conclusion, it is important to follow all rules in preparing a good construction cost estimate. All stakeholders must be involved in risk management of projects

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter basically outlines the methods by which the research was conducted. It provides an overview of how the survey was conducted and the methods with which the responses elicited were analyzed.

3.2 PHILOSOPHICAL POINT OF THE STUDY

According to Guba, 1990 as cited by (Konsolaki, 2012) the methodology of a research also determines the philosophical paradigm adopted. Both qualitative and quantitative research techniques were used in this study, justification for which is provided in the next section of this paper. As a result, empirical experimentalism, which is the dominant methodology in positivism, cannot be applied here (Guba, 1990).

Lastly, axiology is taken into consideration in the study in the context of both the adoption of a philosophical paradigm and the scientific ethics. Given the fact that being a constructivist researcher is probably more demanding in terms of reflexivity than being a positivist or a critical realist (Weber, 2004) the constructivist researchers need to be extremely cautious about the reflexion of their beliefs on their own research (Alvesson, 2000) In other words, the interpretation of data requires an ability to recognize and explicitly name the philosophical assumptions embodied into one's work (Lektorskii, 2011).

In fact, the interaction, which takes place between the researchers and their objects under investigation in a constructivist study, has been an issue of debate among scholars (Guba, 1990). According to Lindgren, (2009) constructivism can be seen 'as a source of challenges to traditional perspectives, theories and empirical work'.

Adopting a positivist or critical point of view, enables researchers to justify their work through validity tests while being a constructivist researcher is often criticized for the lack of rigorous practices in data analysis (Corley & Gioia, 2011). Nevertheless, given the aim and objectives of the present study, the constructivist approach seems to be the most suitable one.

Furthermore, the present study has a focal point on improving the risk factors affecting cost estimation in building construction industry. As a result, scientific constructivism is believed to be the most appropriate paradigm for this research.

3.3 RESEARCH DESIGN

A research design is a careful planning of a successful investigation for conducting and analyzing data with specified to enhance the validity of the study (Polit-O'Hara & Hungler, 1993). This study sought to explore and investigate into the risk factors that affect cost estimates, as well as propose some ways of overcoming these risk factors of construction projects in the country.

The design was exploratory and descriptive using qualitative methods. It was exploratory because knowledge about risk factors in estimation on construction project was researched in depth and descriptive because management of construction and factors to facilitate the effective and efficient implementation of construction projects are described. Responses from the questionnaire was coded and assigned numerical values to describe the data. Also information gathered was described using frequencies and percentages.

3.3.1 STUDY SETTING

Even though the study seeks to outline the strategies to improve the effects of risk factors affecting cost estimation in the construction industry in Ghana, it is

specifically based on the Greater Accra Region and D1K1 contractors working with Ghana Cocoa Board as a case study. The Greater Accra Region is the smallest of Ghana's ten (10) administrative regions in terms of area, occupying a total land surface of 3,245 square kilometers or 1.4 per cent of the total land area of Ghana. However, in terms of population, it is the second most populated region, after the Ashanti Region, with a population of 3.9 million. The Greater Accra region also harbors the seat of government in the capital city of Accra. The concentration of population in the Greater Accra region is located in the following areas: the Accra Metropolis, Tema Metropolis, Adenta Municipality, Ashaiman Municipality, Ledzokuku Municipality, Krowor Municipality, Ga East Municipality, Ga West Municipality and Ga South Municipality.

Accra Metropolis is the exact setting of this study. Accra Metropolis is the second most industrialized area in Ghana, contributing over 10% to the GDP over 30% of the manufacturing activities, representing over 50% of value added are located in the area. (Services, 2006)

3.3.2 TARGET POPULATION

A population can be defined as the complete set of subjects that can be studied: people, objects, animals, plants, organizations from which a sample may be obtained (Shao & Steel, 1999)

Chava, (1996) describes population as the entire group or set of cases that a researcher is interested in generalizing. For the purpose of this research, the population consists of selected contractors, D1/K1 and consultants who are undertaking construction projects in Accra Metropolis with Ghana Cocoa Board.

3.3.3 SAMPLING SIZE AND SAMPLING TECHNIQUE

Sampling is the process of selecting units (e.g., people, organizations) from a population of interest so that by studying the sample we may fairly generalize our results back to the population from which they were chosen (Trochim, 2006).

Kumar, (1999) explains that a sample is a sub-group of the population which is an ideal representative of the entire population. Since the issue of risk in construction is a multifaceted issues involving all the stakeholders involved in the planning, design, finance and implementation of the projects. It is expedient that this study gives adequate representation to all the stakeholders.

As a result the purposive sampling technique was used in data collection. Therefore contractors in the area were considered in this research. This assisted the researcher to determine strategies to improve the risk factors affecting cost estimation at the different levels and within the different construction sites and how it imparts on their construction delivery. These are D1/K1 contractors actively working with Ghana Cocoa Board.

This work used a descriptive and investigative study technique to survey the present state of effects of risk in cost estimating in construction projects in Ghana Cocoa Board- Accra.

It also shows the sampling techniques used in arriving at the number of questionnaires to be administered as well as the sample size for the administration of the questionnaire.

3.3.4 SAMPLE SIZE

The Kish, (1965, 1995) formula would be used in determine the sample size for the respondents for this survey,

Kish Formula: $n^I / (1+n^I /N)$

Where n = sample size

N= Total Population size

n^I =S2 /N2

S = the maximum standard deviation of the population size (total error 0.1 at confidence of 75%)

$S^2 = P (1- P)$

P = the proportion of population elements that belong to the defined class.

V = the standard error of sampling distribution assumed to be 0.05

The Kish Formula

Kish Formula: $n^1 / (1 + n^1 /N)$

From the Ghana Cocoa Board, Accra there are a number of one hundred contractors (100) .The total classified as actively working with Accra, Ghana Cocoa Board is twenty-five (25) ,who are also D1K1 contractors. Therefore N =25

P =25/100 =0.25

S^2 =P (1- P)

= 0.25(1 – 0.25) = 0.19

$N1 = S^2 / V$ but $V = 0.05$

$= 0.19 / 0.05^2 = 76$

$N = n^1 / (1 + n^1 / N)$

$= 76 / (1 + 76 / 100) = 43.18$

However, the expected rate of unresponsiveness is 25 %

That is

$25 / 100 * 43.18 = 10.79$

Total number of questionnaires administered

$= N + 10.79$

$= 43.18 + 10.79$

$= 53.97$

Therefore fifty-four questionnaires were sent out to the various contractors and consultants.

3.3.5 DATA COLLECTION METHOD AND INSTRUMENTS

Instruments used in this study was questionnaires with both quantitative and qualitative sections that had structured and unstructured questionnaires containing open – ended, closed – ended type questions. Likert scales were also used in gathering some of the data. The questionnaires were made up of four sections with a total of 40 questions.

An introductory letter from Building Technology Department, KNUST, was given to the people in charge of the sites. On two consecutive Wednesday, data was collected from the sites between the hours of 11am to 4pm. Establishing of rapport of each selected respondent was briefed on the study and its importance to the construction profession.

The survey involved literate participants. Some of them were willing to fill the questionnaires themselves and they were given a copy of the questionnaires to fill but those who were not ready to fill were interviewed reading the questions from the questionnaires.

In all fifty-four participants of various backgrounds were approached and given questionnaires or interviews giving them enough time to complete them. English was the main language used because it was the preferred medium of communication for the respondents.

3.4 DATA ANALYSIS

Data elicited from the questionnaires were analyzed via both qualitative and quantitative methods. SPSS for the tool used for analyzing the data which was later on presented in tables, pie charts and bar graphs.

3.5 PRETESTING

Before the commencement of the data collection, it was important to carry out a pretest in order to address any challenges that might occur during the research. Pretesting was therefore carried out on 5 contractors in the Tema Metropolis. This was done to determine the clarity of questions and to note ambiguity. From this some of the questions were modified. To ensure the validity and reliability of the tool for the

study, the questionnaires were critiqued by the study supervisor after which the questionnaire was modified.

3.6 SUMARY OF CHAPTER

This chapter demonstrates the way the data would be collected and the approach that was developed which resulted in the final questionnaire. The responses will be collected personally. The data would be analyzed using the descriptive statistics. The next chapter is devoted to the analysis and discussions of the survey results.

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSIONS

4.1 INTRODUCTION

This chapter of the research work presents the data that was gathered and carefully analysed in order to achieve the research objectives.

4.2 GENERAL INFORMATION OF RESPONDENTS

The background of respondents was first ascertained to ensure the respondents qualifies for the research study and it was realised that all 54 (100%) of them are contractors.

Figure 4.1: Years of Experience in Construction Industry

Source: Field Data, 2013

The respondents also indicated the number of years they have been involved in the construction industry. It was realized that 42% of the respondents have worked in the construction industry for between six to ten years. Thirty per cent (30%) of the respondents have worked in the construction industry for less than six years (0-5years) and 28% have worked in the construction industry for more than 10years.

The background of respondents was first ascertained to ensure the respondents qualifies for the research study and this is presented below.

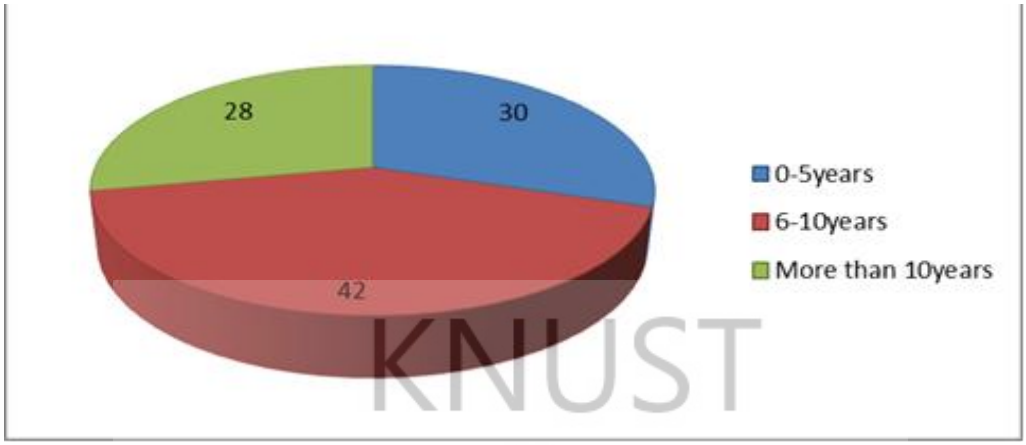


Figure 4.2: Years of Experience in Construction Industry

Source: Field Data, 2013

The respondents also indicated the number of years they have been involved in the construction industry. It was realized that 42% of the respondents have worked in the construction industry for between six to ten years. Thirty percent (30%) of the respondents have worked in the construction industry for less than six years (0-5years) and 28% have worked in the construction industry for more than 10years.

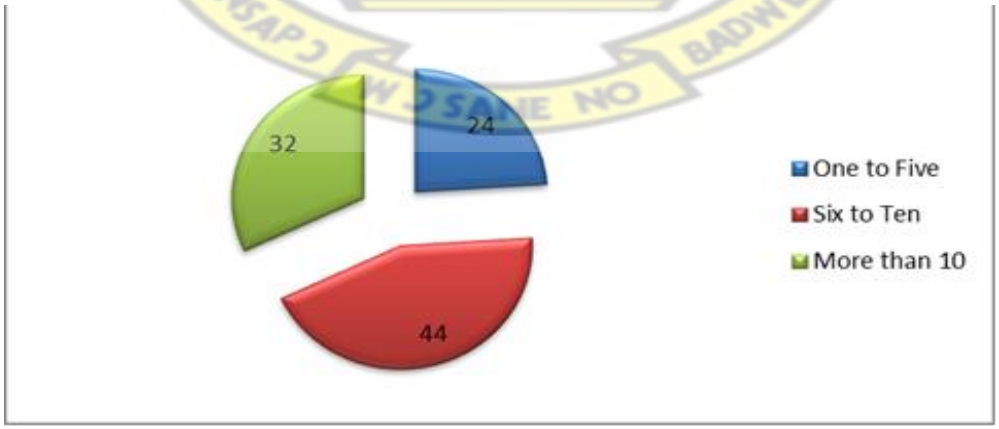


Figure 4.3: Number of Construction Projects Executed

Source: Field Data, 2013

The respondents were asked to indicate the number of construction projects they have been involved in. From the responses received 44% of the respondents have worked on between six to ten construction projects, 32% have worked on more than ten construction projects and 24% have worked on between one and five construction projects.

Figure 4.4: Type of Projects Organisation Engages In

Source: Field Data, 2013

The respondents were asked to indicate the type of projects that their respective organisation engages in. From figure 4 above, it could be said that most of the organisations work on Office and Administration Building projects. They were represented by 36%. Twenty-two percent (22%) of the respondents said that their organisations work on Building School projects. Twenty percent (20%) of the respondents indicated that their organisations work on Hotel and Business Center Building projects. Civil Engineering Projects was indicated by 10% of the respondents, Hospital Building projects was indicated by 8% of the respondents while 4% indicated other building projects such as building and maintenance of homes.

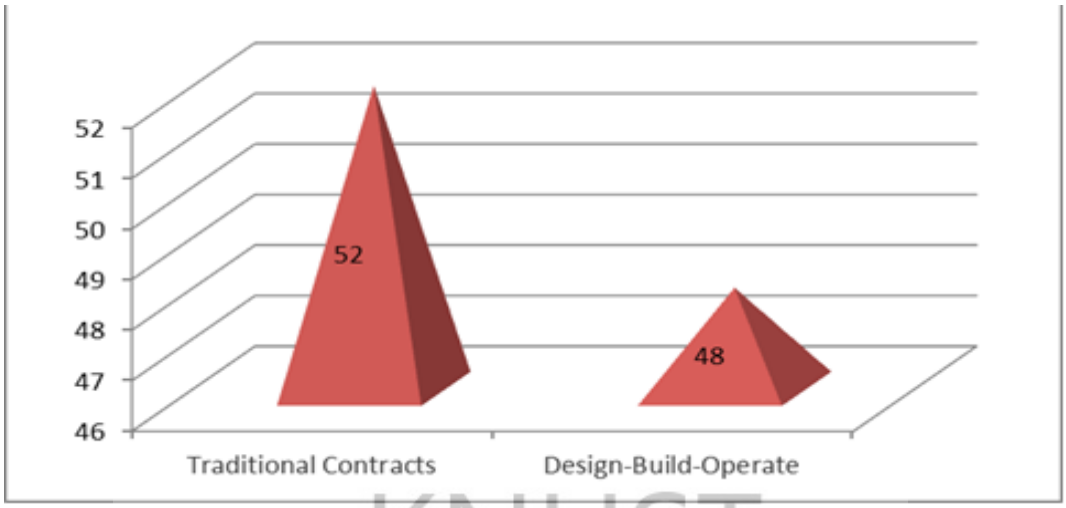


Figure 4.5: Main Types of Contracts

Source: Field Data, 2013

The respondents were asked to indicate the main types of contracts that they are engaged in. Majority of the respondents (52%) indicated that they are engaged in Traditional Contracts while 48% of the respondents indicated that they are engaged in Design-Build-Operate Contracts.

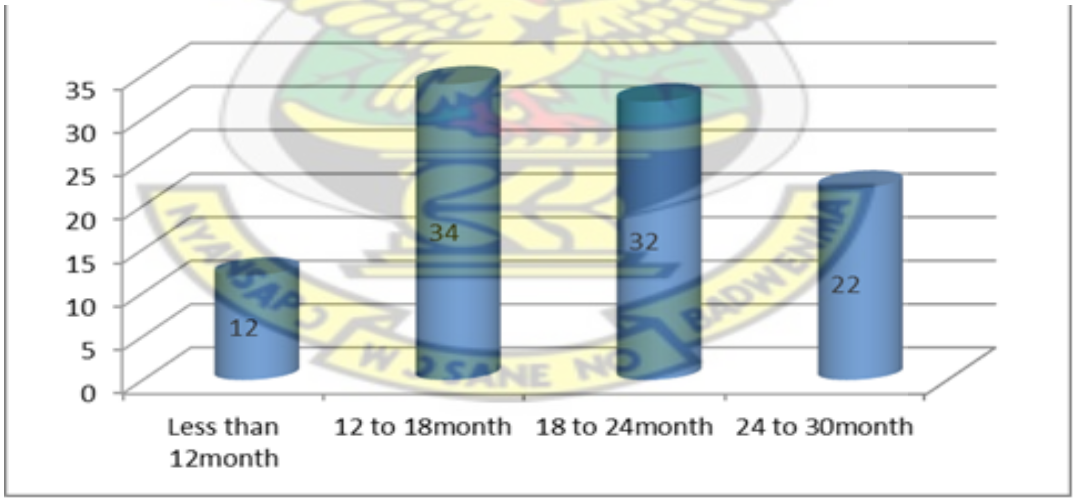


Figure 4.6: Average Duration of Projects

Source: Field Data, 2013

The average duration of the projects that respondents are engaged in had 12 to 18 months having the highest frequency of 34% of responses, 32% indicated that the average duration of the projects are between 18 and 24months, 22% of the

respondents indicated that the average duration of the projects are between 24 and 30months while 12% of the respondents indicated that the average duration of their projects last less than 12months.

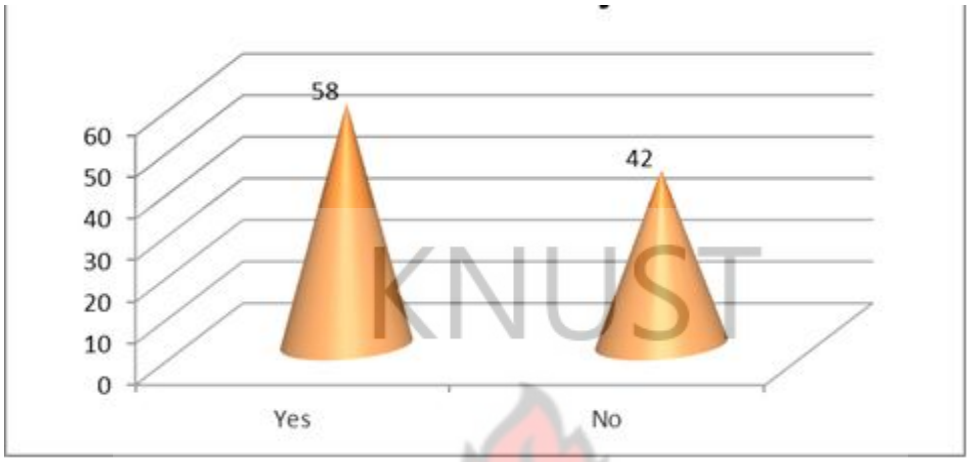


Figure 4.7: Regular Assessment of Risk in the Execution of Projects

Source: Field Data, 2013

The respondents were asked to indicate whether there is regular assessment of risk in the execution of the projects they are engaged in. Majority of the respondents (58%) indicated that there is regular assessment of risk in the execution of the projects they are engaged in while 42% of the respondents indicated that there is no regular assessment of risk in the execution of the projects they are engaged in.

For the respondents who indicated 'YES', these were their responses:

1. Particular aspect of risk is taken then assessed if any, an aspect of risk is taken and assessed for future projects
2. Assess risk factors and put measures to address them
3. Construction risk is more tackled during the execution of the jobs
4. High percentage of cost is added to cater for risk

5. Identify and devise ways of mitigating these risks

For the respondents who indicated 'NO', most of their responses were

1. Because avoiding risk is not possible
2. Because insurance companies take care of risk
3. Because risk is taken care of during pricing
4. It is factored in the profit and overheads

4.3 CURRENT RISK MANAGEMENT PRACTICES

According to Flanagan & Norman (1993), Risk Management may by describe as a systematic way of looking at areas of risk and consciously determining how each should be treated. Managing risk in construction projects has been recognized as a very important management process in order to achieve the project objectives in terms of time, cost, quality, safety and environmental sustainability. Risk management is the identification of countermeasures necessary to meet the requirements identified in risk analysis. For each risk to be managed there is the need to identify what cost-effective counter measures can be applied. Possible counter measures are:

- Avoiding the risk;
- Reducing the risk (likelihood or impact); and
- Transferring the risk to others (insurance);

This part of the analysis outlines the current risk management practices of the respondents.

Table 4.1: Current Risk Management Practices

Items	1	2	3	4	5	Mean	SD	Rank
Reducing the Risk (Likelihood or Impact)	4.0	8.0	38.0	38.0	12.0	3.46	0.95	1st
Transferring the Risk to Others (insurance)	4.0	14.0	30.0	38.0	14.0	3.44	1.03	2nd
Avoiding the Risk	8.0	18.0	30.0	18.0	26.0	3.36	1.27	3rd

Source: Field Data, 2013

NB: 1= not effective; 2= less effective; 3= quite effective; 4= more effective; 5: Highly effective

The respondents were asked to indicate and rank their current risk management practices on a scale of one to five. On the practice of reducing the risk (likelihood or impact), it was realised that most of the respondents indicated a rank of '3' and '4' (38%) showing that it is quite effective and more effective. On the practice of transferring the risk to others (insurance), most of the respondents indicated a rank of '4' (38%) showing that it is more effective. On the practice of avoiding the risk, most of the respondents indicated a rank of '3' (38%) showing that it is quite effective.

On the basis of means and standard deviation, all the three current risk management practices scored above an average (2.5 out of 5), meaning that the practice of risk management is above the rank of quite effective. A more critical look at the risk management practices shows that most of the organisations prefer to reduce the risk (likelihood or impact) with a means of 3.46. This is followed by organisations who prefer to transfer the`` risk to others (insurance) with a mean of 3.44 and then the organisations who prefer to avoid the risk with a mean of 3.36.

4.4 SIGNIFICANT RISK FACTOR AFFECTING COST ESTIMATION OF CONSTRUCTION WORKS

Risk factors are factors that could bring a change in the objectives or plan of a contractor or client. Risk factors could be grouped under:

- Physical factors;
- Construction factors;
- Financial factors; (Chapman, 2001).

Also Banaitiene & Banaitis (2012) research findings classified risk factors on construction projects can be split into two major groups:

Internal risks, which fall within the control of clients, consultants and contractors.

External risks, which include risk elements that are not in the control of key stakeholders.

The external factors include

- Fiscal policy;
- Natural forces;
- Political controls. (Chapman, 2001)

The research sought to unearth the risk factors affecting cost estimation in construction works in Ghana and these are presented in the following table.

Table 4.2: Significant Risk Factors Affecting Cost Estimation of Construction Works: Physical Factors

Physical Factors	1	2	3	4	5	Mean	SD	Rank
Loss due to fire outbreaks	2.0	8.0	30.0	30.0	30.0	3.78	1.04	3rd
Design error	6.0	10.0	24.0	38.0	22.0	3.60	1.13	5th
An accident to operation	4.0	22.0	12.0	36.0	26.0	3.58	1.21	6th
Weather conditions	6.0	12.0	20.0	44.0	18.0	3.56	1.11	4th
Insufficient detailing	0.0	10.0	44.0	30.0	16.0	3.52	0.89	1st
Improper design	6.0	18.0	20.0	32.0	24.0	3.50	1.21	6th
Change of scope	0.0	22.0	32.0	36.0	10.0	3.34	0.93	2nd

Source: Field Data, 2013

NB: 1= Not important; 2= Least important; 3= Averagely important; 4= Very important, 5= Highly important

The respondents were asked to indicate and rank the significant physical risk factors that affect cost estimation of construction works. In terms of loss due to fire outbreaks, it was realised that most of the respondents indicated a rank of '3', '4' and '5' (30%) showing that it is averagely important, very important and highly important respectively. In terms of design error, it was realised that most of the respondents

indicated a rank of ‘4’ (38%) showing that it is very important. In terms of an accident to operation, it was realised that most of the respondents indicated a rank of ‘4’ (36%) showing that it is very important. In terms of weather conditions, most of the respondents indicated a rank of ‘4’ (44%) showing that it is very important. In terms of insufficient detailing, most of the respondents indicated a rank of ‘3’ (44%) showing that it is averagely important. In terms of improper design, most of the respondents indicated a rank of ‘4’ (32%) showing that it is very important. Finally, in terms of change of scope, most of the respondents indicated a rank of ‘4’ (36%) showing that it is very important.

On the basis of the means, all the physical factors scored above the average (2.5 out of 5), meaning that the effect of physical risk factors that affect the estimation of construction works is ranked above the level of averagely important. A more critical look at the physical factors that affect the estimation of construction works shows that most of the construction works are affected by loss due to fire outbreaks (3.78). The rest are as follows; design error (3.60), an accident to operation (3.58), weather conditions (3.56), insufficient detailing (3.52), improper design (3.50) and change of scope (3.34).

Apart from the significant risk factors (physical factors) affecting cost estimation of construction works it was also important to outline factors related to construction and these are presented in table 4.3 below

Table 4.3: Significant Risk Factor Affecting Cost Estimation of Construction Works: Construction Factors

Construction Factors	1	2	3	4	5	Mean	SD	Rank
Level of skill of management	2.0	4.0	30.0	36.0	28.0	3.84	0.96	4th
Insolvency of subcontractors	6.0	12.0	48.0	26.0	8.0	3.82	1.14	14th
Shortage of equipment	2.0	12.0	34.0	38.0	14.0	3.80	1.01	7th
Suitability of plant	0.0	4.0	30.0	52.0	14.0	3.76	0.74	1st
Equipment/plant availability	2.0	14.0	24.0	32.0	28.0	3.70	1.09	11th
Strike by the labour force causing disruption	4.0	18.0	16.0	32.0	30.0	3.66	1.21	16th
Availability of experienced & skilled labour	4.0	14.0	18.0	42.0	22.0	3.64	1.10	12th
Inadequate planning	4.0	8.0	24.0	50.0	14.0	3.62	0.97	6th
Maintenance facilities of plant	2.0	16.0	28.0	32.0	22.0	3.56	1.07	10th
Insolvency of suppliers	2.0	8.0	38.0	36.0	16.0	3.56	0.93	2nd
Poor quality of workmanship	8.0	10.0	28.0	32.0	22.0	3.50	0.95	3rd
Late delivery of materials	8.0	8.0	22.0	52.0	10.0	3.50	1.18	15th
Weather	4.0	16.0	24.0	38.0	18.0	3.50	1.10	12th
Site safety	4.0	10.0	20.0	32.0	34.0	3.48	1.05	9th
Level of productivity of labour	6.0	12.0	32.0	40.0	10.0	3.36	1.03	8th
Land acquisition	4.0	8.0	14.0	52.0	22.0	3.18	0.96	4th

Source: Field Data, 2013

NB: 1= Not important; 2= Least important; 3= Averagely important; 4= Very important, 5= Highly important

The respondents were asked to indicate and rank the significant construction risk factors that affect cost estimation of construction works. In terms of level of skill of management, most of the respondents indicated a rank of '4' (36%) showing that it is very important. In terms of insolvency of subcontractors, most of the respondents

indicated a rank of ‘3’ (48%) showing that it is averagely important. In terms of shortage of equipment, most of the respondents indicated a rank of ‘4’ (38%) showing that it is highly important.

In terms of suitability of plant, most of the respondents indicated a rank of ‘4’ (52%) showing that it is highly important. In terms of equipment/plant availability, most of the respondents indicated a rank of ‘4’ (32%) showing that it is very important. In terms of strike by the labour force causing disruption, most of the respondents indicated a rank of ‘4’ (32%) showing that it is highly important. In terms of availability of experienced and skilled labour, most of the respondents indicated a rank of ‘4’ (50%) showing that it is very important. In terms of inadequate planning, most of the respondents indicated a rank of ‘4’ (32%) showing that it is very important. In terms of maintenance facilities of plant, most of the respondents indicated a rank of ‘4’ (32%), showing that it is very important.

In terms of solvency of suppliers, most of the respondents indicated a rank of ‘3’ (38%), showing that it is averagely important. In terms of poor quality of workmanship, most of the respondents indicated a rank of ‘4’ (32%), showing that it is very important. In terms of late delivery of materials, most of the respondents indicated a rank of ‘4’ (52%), showing that it is very important. In terms of weather, most of the respondents indicated a rank of ‘4’ (38%), showing that it is very important. In terms of site safety, most of the respondents indicated a rank of ‘4’ (32%), showing that it is highly important. In terms of level of productivity of labour, most of the respondents indicated a rank of ‘4’ (40%), showing that it is very important. In terms of land acquisition, most of the respondents indicated a rank of ‘4’ (52%), showing that it is very important.

On the basis of the means, all the construction factors scored above the average (2.5 out of 5), meaning that the effect of construction risk factors that affect the estimation of construction works is ranked above the level of averagely important. A more critical look at the construction factors that affect the estimation of construct0ion works shows that most of the construction works are affected by level of skill of management (3.84), insolvency of subcontractors (3.82), shortage of equipment (3.80), suitability of plant (3.76), equipment/plant availability (3.70), strike by the labour force causing disruption (3.66), availability of experienced & skilled labour (3.64), inadequate planning (3.62), maintenance facilities of plant (3.56), insolvency of suppliers (3.56), poor quality of workmanship (3.50), late delivery of materials (3.50), weather (3.48), site safety (3.36) and level of productivity of labour land acquisition (3.18).

Another important risk factor the research study outlined was financial factors and the results are presented in table 4.4 below.

Table 4.4: Significant Risk Factor Affecting Cost Estimation of Construction Works: Financial Factors

Financial Factors	1	2	3	4	5	Mean	SD	Rank
Lack of financial resources	4.0	6.0	36.0	32.0	22.0	3.62	1.03	5th
High cost and schedule contingencies	2.0	12.0	24.0	48.0	14.0	3.60	0.95	2nd
Cash flow administration	4.0	6.0	38.0	36.0	16.0	3.54	0.97	3rd
Cash flow difficulties	6.0	2.0	34.0	50.0	8.0	3.52	0.91	1st
Fluctuation	4.0	18.0	22.0	38.0	18.0	3.48	1.11	6th
Inflation	10.0	14.0	30.0	30.0	16.0	3.28	1.20	7th
Funding uncertainties	4.0	18.0	32.0	38.0	8.0	3.28	0.99	4th

Source: Field Data, 2013

NB: 1= Not important; 2= Least important; 3= Averagely important; 4= Very important, 5= Highly important

The respondents were asked to indicate and rank the significant financial risk factors that affect cost estimation of construction works. In terms of lack of financial resources, most of the respondents indicated a rank of '3' (36%) showing that it is averagely important. In terms of high cost and schedule contingencies, most of the respondents indicated a rank of '4' (48%) showing that it is very important. In terms of cash flow administration, most of the respondents indicated a rank of '3' (38%) showing that it is averagely important. In terms of cash flow difficulties, most of the respondents indicated a rank of '4' (34%) showing that it is very important. In terms of fluctuation, most of the respondents indicated a rank of '4' (38%) showing that it is very important. In terms of inflation, most of the respondents indicated a rank of '3' and '4' (30%) showing that it is averagely important and very important. In terms of

funding uncertainties, most of the respondents indicated a rank of '4' (38%) showing that it is very important.

On the basis of the means, all the financial factors scored above the average (2.5 out of 5), meaning that the effect of financial risk factors that affect the estimation of construction works is ranked above the level of averagely important. A more critical look at the financial factors that affect the estimation of construction works shows that most of the construction works are affected by lack of financial resources (3.62), high cost and schedule contingencies (3.60), cash flow administration (3.54), cash flow difficulties (3.52), fluctuation (3.48), inflation (3.28) and funding uncertainties (3.28).

4.5 MEASURES THAT WILL HELP MITIGATE RISK FACTORS IN COST ESTIMATION

One of the most important rules in preparing a good estimate is to follow established and proven estimating procedures. For example, value engineering should be used during both the estimating and the construction stages. The contractor should try to eliminate over design or exotic materials that needlessly increase the price of a project (Holloway, 2013).

Cullen (2012) in his article stated that for risk management to be effective, risk management must rely on tools and techniques that help predict the likelihood of future events, the effects of these future events and methods to deal with these future events. Risk management should really be considered the responsibility of everyone involved in a project.

The measures that will help mitigate risk factors from the perspective of the contractors, the clients and consultants in the construction industry are described in the ensuing paragraphs.

Table 4.5: Measures That Will Help Mitigate Risk Factors in Cost Estimation

Measures	1	2	3	4	5	Mean	SD	Rank
Use of Value Engineering	4.0	8.0	16.0	40.0	32.0	3.88	1.08	3rd
Design Professionals should understand not only the project but also the external environment in which that project will be constructed	10.0	0.0	22.0	36.0	32.0	3.80	1.20	4th
Eliminate Over Design	2.0	4.0	38.0	40.0	16.0	3.64	0.88	1st
Risk Management must rely on tools and techniques that will help the likelihood of future events	4.0	6.0	28.0	46.0	16.0	3.64	0.96	2nd
Risk management should really be considered the responsibility of everyone involved in a project	8.0	12.0	20.0	30.0	30.0	3.62	1.26	5th

Source: Field Data, 2013

NB: 1= Very low; 2= Low; 3= High; 4= Very high; 5= Excellent

The respondents were asked to indicate and rank the measures that they perceive will help mitigate risk factors in cost estimation. In terms of use of value engineering, most of the respondents indicated a rank of '4' (40%) showing that it is very high. In terms of the fact that design professionals should understand not only the project but also the external environment in which that project will be constructed, most of the respondents indicated a rank of '4' (36%) showing that it is very high. In terms of elimination of over design, most of the respondents indicated a rank of '4' (40%) showing that it is very high. In terms of the fact that risk management must rely on tools and techniques that will help the likelihood of future events, most of the respondents indicated a rank of '4' (46%) showing that it is very high. In terms of the fact that risk management should really be considered the responsibility of everyone

involved in a project, most of the respondents indicated a rank of '3' and '4' (30%) showing that it is high and very high.

On the basis of the means, all the measures that will help mitigate risk factors in cost estimation scored above the average (2.5 out of 5), meaning that the measures can mitigate risk factors at more than a high level. A more critical look at the measures that will help mitigate risk factors in cost estimation shows that the use of value engineering is perceived to be the best with a mean of 3.88. This is followed by that affect the estimation of construction works shows that most of the construction works are affected design professionals should understand not only the project but also the external environment in which that project will be constructed (3.80), eliminate over design (3.64), risk management must rely on tools and techniques that will help the likelihood of future events (3.64) and risk management should really be considered the responsibility of everyone involved in a project (3.62).

The respondents were further asked to specify other strategies in practice. And in summary some made the following suggestions as, avoiding over borrowing to finance construction works, continuous education for stakeholders, others were of the view that effective resource management will be the solution to strategies for mitigating the effect of risk factors affecting cost estimating in building construction industry.

In addition to that some of the respondents advocated for working within the required schedule as much as possible to reduce the effect of these risk

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

The final chapter of this research work provides a summary to the entire work and recommendations for policy making in Ghana to enhance productivity in the construction industry.

5.2 REVIEW OF OBJECTIVES

1. To document the current risk management practices associated with cost estimate of construction works.

This was achieved through the review of literature and set of questionnaire sent to contractors asking them to express their views on the current risk management practices associated with cost estimate of construction works.

The responses were analysed and verified using one T –test approach. The most preferred method was to reduce the risk (likelihood or impact), followed by the practice of transferring the risk to others (insurance). The least preferred method was the practice of avoiding the risk completely as it was difficult to completely ascertain the risk that one would involve in during construction.

2. To identify significant risk factors affecting cost estimation of construction works.

To identify significant risk factors affecting cost estimation of construction works, Set of questionnaire was administered to contractors, the data collected, analysed and verified and ranked by the Likert scale approach. Comparing with literature review, the respondents also indicated significant physical risk factors that affect cost

estimation of construction works. Insufficient detailing had the highest impact while improper design and an accident to operation had the least impact on cost estimation.

In terms of construction factors suitability of plant ranked highest as having the greatest impact while strike by labour force causing disruption was seen as having the lowest risk in estimating cost of construction.

For financial risk factors affecting estimation of construction works cash flow difficulties had the highest ranking while inflation was seen as having the least impact.

3. To propose strategies that will help mitigate these risk factors in cost estimation.

Finding out the propose strategies that will help mitigate the risk factors in cost estimation, questionnaire were sent to contractors and few interviews were conducted on the contractors, data collected, analysed and verified and the outcome was as follows. According to the respondents the measures that will help mitigate the risks that have been identified in cost estimation are ranked as:

- Eliminate Over Design (1st)
- Risk Management must rely on tools and techniques that will help the likelihood of future events (2nd)
- Use of Value Engineering (3rd)
- Design Professionals should understand not only the project but also the external environment in which that project will be constructed (4th)
- Risk management should really be considered the responsibility of everyone involved in a project (5th)

5.3 LIMITATION OF THE STUDY

A major setback of this research is that owing to time and financial constraints the number of respondents interviewed in the survey were not an adequate representation of the population (stakeholders in the construction industry).

5.4 CONCLUSION AND FINDINGS OF THE STUDY

Respondents who took part in the research study was made up of contractors (100%) with forty-two per cent of them having between six and ten years of experience in the construction industry followed by thirty per cent having between zero and five years in the industry and the highest number of years (10+ years) being twenty-eight per cent. This shows that the respondents have a good idea of our Ghanaian construction industry.

The main types of contracts the respondents are involved in are traditional contracts (52%) and design-build-operate employing forty-eight per cent. Out of these types of contracts the construction of office and administration buildings ranked the highest of thirty-six per cent while the least was construction and maintenance of homes with four per cent of contracts awarded. Most construction works (34%) take between twelve and eighteen months while the least (12%) number of contracts took less than twelve months to complete. Regular assessment of construction was however low (58%) while those that did not engage in regular assessment of risks was forty-two per cent.

The respondents were asked to indicate their current risk management practices and the most preferred method was to reduce the risk (likelihood or impact), followed by the practice of transferring the risk to others (insurance). The least preferred method

was the practice of avoiding the risk completely as it was difficult to completely ascertain the risk that one would in involved in during construction.

The respondents also indicated significant physical risk factors that affect cost estimation of construction works. Insufficient detailing had the highest impact while improper design and an accident to operation had the least impact on cost estimation.

In terms of construction factors suitability of plant ranked highest as having the greatest impact while strike by labour force causing disruption was seen as having the lowest risk in estimating cost of construction.

For financial risk factors affecting estimation of construction works cash flow difficulties had the highest ranking while inflation was seen as having the least impact.

According to the respondents the measures that will help mitigate the risks that have been identified in cost estimation are ranked as:

Eliminate Over Design (1st)

Risk Management must rely on tools and techniques that will help the likelihood of future events (2^{nd})

Use of Value Engineering (3^{rd})

Design Professionals should understand not only the project but also the external environment in which that project will be constructed (4^{th})

Risk management should really be considered the responsibility of everyone involved in a project (5^{th})

5.5 RECOMMENDATION FOR INDUSTRY

As a result of this research, the following recommendations can be made:

- All construction contractors in Ghana are encouraged to consider the results revealed by this research to have a better understanding when dealing with risks in the construction industry.
- All construction industries in Ghana are advised to consider trends of allocation, importance and effect of important risk categories to help them facilitate proper management of these risks based on the results of this research.
- Although this research was done in the Greater Accra, Ghana Cocoa Board, the results and conclusions can be applied to the construction industry in other areas of Ghana because of the similarities of rules, regulations and business environment. Moreover, most of the construction contractors have offices in other areas of Ghana.
- In order to improve upon cost estimation in construction there is the need to do risk analysis as it is the presence of risk that can affect the success of the construction sector
- An effective way of tackling risk is to prepare for it adequately. Every organisation must have a plan to tackle risk
- There should also be the use of qualified estimating personnel throughout the life of the project from budget preparation, design, and tendering, post-tender review and construction phases
- One also has to include sufficient contingency to address market volatility, timing of construction, and other exclusions in the estimate

5.6 SUGGESTIONS FOR FURTHER STUDIES

Although this research discussed the strategies of improving effect of risk in construction industry and practices of construction contractors working with Ghana Cocoa Board, some areas of this subject need further research. These studies might include:

- Similar study of assessments of risks management perception and practices of construction from the viewpoint of owners
- Research of development of a Knowledge Based Expert System to manage the common and re-occurring risks in the construction industry in Ghana incorporating the expertise of the project managers, project engineers and owners, such a system will help contractors and owners in the area.
- Consider including the added risk categories in the next study

REFERENCES

Abdou. (1996). Managing Construction Risks. Journal of Architectural Engineering, vol.2, pp 3-10.

Ahuja, H., Dozzi, S., & AbouRizk, S. (1994). Project Management Techniques in Planning and Controlling Construction Projects. New York: John Wiley & Sons Inc.

Akintoye, A. S., & MacLeod, M. J. (1997). Risk Analysis and Management in Construction. International Journal of Project Management, vol 15, pp 31-38.

Al-Bahar, J., & Crandall, K. (1990). Systematic Risk Management Approach for Construction Projects. Journal of Construction Engineering and Management, vol 139 (8), pp 533–546.

Amoah, P., Ahadzie, D. K., & Dansoh, A. (2011). The Factors Affecting Construction Performance In Ghana:The Perspective Of Small-Scale Building Contractors. Surveyor Journal, vol 4, pp 41 - 48.

A1, V. A.(2010) Realism, Antirealism, Constructivism, and Constructive Realism in Contemporary Epistemology and Science. Journal of Russian and East European Psychology , vol 48, pp 5 - 44.

Alvesson, M. &. (2000). Reflexive Methodology,New Vistas for Qualitative Research. London: Sage Publications Ltd.

Arain, F., & Phen, L. (2005). The Potential Effects of Variation Orders on Institutional Building Projects. Journal of Facilities, vol 21, pp 496-510.

Assaf, A. and Al-Hejji, S. (2006), "Causes of Delays in Large Building Construction Projects", ASCE Journal of Management in Engineering, vol 11(2), pp 45–50.

Banaitiene, N., & Banaitis, A. (2012). Risk Management in Construction Projects. In Risk Management - Current Issues and Challenges.

Bing, L., Tingo, R. L., and Chew, D., (1999). " Risk Management in International Construction Joint Venture " Journal of Construction Engineering and Management, ASCE, vol 125;4, pp 277-284.

Business, N. S. (2013, september 29). What is risk? Retrieved from pages.stern.nyu.edu/~adamodar/pdfiles/valrisk/ch1.pdf

Butcher, N., & Demmers, L. (2003). Cost Estimating Simplified. Libris Design Project.

Charles Sturt University. Retrieved from Charles Sturt University: http:// www.csu.edu.au/ division/ psc/ pmguides/(2013, september 12)

Chapman, R. (2001). The Controlling Influences on Effective Risk Identification and Assessment for Construction Design Management. International Journal Of Project Management,vol. 19, pp 147-160.

Chen, H., Hao, G., Poon, S., & Ng, F. (2007). Cost Risk Management in West Rail Project of Hong Kong. ACCE International Transport. Vol. 126 (4): pp 320–324.

Clough, R. ((1986)). Construction contracting. New York: John Wiley and Sons.

Corley, K. & Gioia, D.A., (2011) Building Theory about Theory Building: What Constitutes a Theoretical Contribution?, Academy of Management Review, Vol.36 No.1, pp 12-32.

Cullen, S. (2012). Risk Management. Retrieved from wbdg.org: http:// www.wbdg. org/ project/ riskmanage.php. (Accessed 11th November, 2013.)

Chava Frankfort- Nachmias, D. N. (1996). Research Methods in the Social Sciences. St. Martin's Press Corley, K. &. (2011). Theory about Theory Building: What Constitutes a Theoretical Contribution? Academy of Management ReviewVol .36 No.1, pp 12-32.

Dell'Isola, M. D. (2003). The Architect's Handbook of Professional Practice. John Wiley & Sons, Inc.

Financial Consumer Agency of Canada. (2011). Understanding Insurance Basics. Canada. Accessed 11th November, 2013.

Flanagan, R., & Norman, G. (1993). Risk Management and Construction. Wiley.

Fugar, F. D., & Adinyira, E. (2009). Quantity Surveying Education in Africa: The Role of Stakeholders in Sustaining Professionalism

Guba, E. (1990). The Paradigm Dialog Chapter 1. USA: Sage Publications Inc., USA,.

Holm, L., Schaufelberger, J. E., Griffin, D., & Cole, T. (2005). Construction cost estimation – process and practice. . Pearson Prentice Hall,.

Holloway, S. (2013). Conceptual construction cost estimating. Retrieved from The Holloway Consulting Group Website: http://www.hcgexperts.com/contractors-risks-in-conceptual-estimating-part-1.php. Accessed 11th November, 2013.

Investopedia Retrieved from Investopedia.com: http:// www.investopedia.com/ terms/ v/ value-engineering.asp (2013, September 29).

Kish. (1965, 1995). The Design Effect: Do We Know All About It? American Statistical society

Kumar, R. (1999). Research Methodology: A Step-by-Step Guide for Beginners. Thousand Oaks, CA: Sage Publications.

Konsolaki, K. (2012). The philosophical and methodological aspects of a research being conducted in the field of marketing and advertising. Sorèze, France: 20th EDAMBA Summer Academy.

Lektorskii, 2. (2011). Realism, Antirealism, Constructivism, and Constructive Realism in Contemporary Epistemology and Science. Journal of Russian and East European Psychology , vol 48, (6) pp5-44.

Lindgren, M. &. (2009). Social Constructionism and Entrepreneurship: Basic Assumptions and Consequences for Theory and Research. International Journal of Entrepreneurial Behaviour & Research,, vol 15 (1) pp 25-47

Manfredonia, B., Majewski, J. P., & Perryman, J. J. (2010). Retrieved from wbdg.org: http://www.wbdg.org/design/dd_costest.php. (Accessed 11th November, 2013.)

Ponte, D. M. (2009). Minimizing Risks Associated with Construction Cost Estimates. Massachusetts. American Council of Engineering Companies of Massachusetts.

Polit-O'Hara, D., & Hungler, B. P. (1993). Essentials of nursing research: Methods, appraisal, and utilization. (Philadelphia): Lippincott.

Perry, J. G., & Hayes, R. (1985). Risk management - an approach for project managers. Project Management, vol 4, pp 211-216.

PMBoK. (2008). A Guide to the project Management body of knowledge,. Upper Darby: Project Management Institute.

Rezakhani, P. (2012). Classifying Key Risk Factors In Construction. Buletinul Institutului Politehnic Din Iaşi, vol 2, pp 27-38.

Ritz, G. (1994). Total Construction Project Management. McGraw-Hill.

Shen, L. Y. (1997). Project Risk Management in Hong Kong. International Journal of Project Management, vol 15 (2), pp 101-107.

Shen, L., Wu, G., & Ng, C. (2001). Risk Assessment of Construction Joint Ventures in China. Journal of Construction Engineering and Management, vol 8, pp 76-81.

Stewart, R. D. (1991). Cost Estimating. New York: John Wiley & Sons, Inc.

Services, A. P.-P. (2006). Improving Sanitation in Poor Urban Areas: The Role of Non-State Actors in the Sanitation Service Delivery in Ashaiman Municipality, Ghana. Retrieved from Ghanadistricts.com: http://www.ghanadistricts.com/home/. Accessed 11th November, 2013.

Shao, J., & Steel, P. (1999). Variance Estimation for Imputed Survey Data with Variance Estimation for Imputed Survey Data. Journal of American. Statistical. Association, vol 94, pp 254-265.

Sung-Hoon An, Hunhee Cho and Ung-Kyun Lee,. (2010). Reliabilty assessment of conceptual cost estimates for building construction projects. International Journal of Civil Engineering, vol 9, pp 9-16.

Tah, J., & Carr, V. (2000). Information modelling for project risk analysis and management. Journal of Engineering, Construction and Architectural Management, vol 7, pp 107-119.

Trochim, W. (2006). Sampling. Research Methods Knowledge Base. Retrieved November 30, 2007 from http://www.socialresearchmethods.net /kb/ sampling.php

Weber, B. (2004). The Rhetoric of Positivism Versus Interpretivism A Personal View,. MIS Quarterly , Vol.28 No.1, pp 3-12.

Zeng, J., An, M., & Smith, N. (2007). Application of a Fuzzy Based Decision Making; Methodology to Construction Project Risk Assessment. International Journal of Project Management, vol 26, pp 586-600.

APPENDIX

QUESTIONNAIRE

INTRODUCTION

Hello, I am Osei-Fosu Annor, a student of the Kwame Nkrumah University of Science and Technology conducting a research on the **"Strategies to improve the risk factors that affect cost estimation in the construction industry"** in partial fulfillment for a Master's degree in Construction Management. The objectives of the research are to:

a) To document current risk management practices associated with cost estimation of construction works.

b) To identify the significant risk factors affecting cost estimation of construction works.

c) To propose strategies that will help mitigate these risk factors in cost estimating.

I will be very grateful if you would complete the attached questionnaire. The information provided will be treated with strict confidence and respondents will not in any way be identified.

Yours faithfully,

OSEI – FOSU ANNOR

SECTION A

GENERAL INFORMATION

1. Which of the following category of personnel best describes you?

   a. Client b. Contractor c. Consultant

2. How many years of experience do you have in the construction industry?

   a. 0-5 years b. 6-10 years c. More than 10 years

3. How many construction projects have you been involved in?

   a. 1-5 b. 6-10 c. More than 10

4. What type of projects has your organization been engaged in?

   a. Building School b. Office and Administration Building

   c. Hospital d. Hotel and Business Center Building

   e. Civil Engineering Project f. Others, please specify ……

5. What main types of contracts are you engaged in?

   a. Traditional contracts b. Design – Build – Operate

   c. Others please specify:……

6. What is the average project duration?

   a. Less than 12 month b. 12 month to 18 month

   c. 18 month to 24 month d. 24 month to 30 month

   e. 30 month to 36 month f. Others please specify…

7. Are there regular assessment of risk in the execution of projects?

a. Yes b. No

8. If yes specify briefly how it is carried out……..

……

And if NO why ……..

SECTION B

CURRENT RISK MANAGEMENT PRACTICES

Which of the following current risk management practice stated below are associated with cost estimation of construction works?

Please use the following scales to answer the questions below. Please tick where appropriate

1. Not effective 2. Less effective 3. Quite effective 4. More effective 5. Highly effective

CURRENT RISK MANAGEMENT PRACTICES	RANKING				
	1	2	3	4	5
Avoiding the Risk					
Reducing the Risk (Likelihood or Impact)					
Transferring the Risk to Others (insurance)					
Any Other (Please Specify)					

SECTION C

Significant risk factor affecting cost estimation of construction works. Please use the following scales to answer the questions below. Please tick where appropriate.

1= not important 2= least important 3= averagely important 4=very important 5=highly important

CODE	SIGNIFICANT RISK FACTORS	RANKING				
		1	2	3	4	5
	PHYSICAL FACTORS					
1	Improper design					
2	Change of scope					
3	Weather conditions					
4	Insufficient detailing					
5	Loss due to fire outbreaks					
6	An accident to operative					
7	Design error					
8	Any other (please specify)					
	CONSTRUCTION FACTORS					
1	Equipment/plant availability					
2	Suitability of plant					
3	Maintenance facilities of plant					
4	Level of productivity of labour					

5	Strike by the labour force causing disruption					
6	Availability of experienced & skilled labour					
7	Level of skill of management					
8	Land acquisition					
9	Shortage of equipment					
10	Poor quality of workmanship					
11	Late delivery of materials					
12	Site safety					
13	Insolvency of subcontractors					
14	Inadequate planning					
15	Weather					
16	Insolvency of suppliers					

	FINANCIAL FACTORS	RANKING				
		1	2	3	4	5
17	Inflation					
18	Fluctuation					
19	Cash flow administration					
20	Lack of financial resources					
21	Cash flow difficulties					
22	Funding uncertainties					

23	High cost and schedule contingencies					
24	Any other (please specify)					

SECTION D

WHICH OF THE FOLLOWING MEASURES STATED BELOW WILL HELP MITIGATE RISK FACTORS IN COST ESTIMATING?

In terms of importance, how would you rate the following variables for measures to mitigate risk factors using the scale below:

1= very low 2= low 3 = very high 4= high 5= Excellent

CODE	PROPOSED MEASURES	RANKING				
		1	2	3	4	5
1	Use of Value Engineering					
2	Eliminate Over Design					
3	Design Professionals should understand not only the project but also the external environment in which that project will be constructed					
4	Risk Management must rely on tools and techniques that will help the likelihood of future events					
5	Risk management should really be considered the responsibility of everyone involved in a project					

Please specify any other strategies in practice ……

Thank you.