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Exploring Project Risk Management Practices of Ghanaian Building Contractors

by

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MASTER OF SCIENCE

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DECLARATION OF AUTHENTICITY

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

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ABSTRACT

The Construction Industry is embedded with risky situations that affect construction projects and therefore requires systematic processing to achieve project objectives and ensure business sustainability. In achieving project and business objectives, Contractors usually experiment many techniques and management practices in addressing construction risk. This study aims *to assess the risk management practices of Ghanaian Contractors towards typical construction project risk factors*. The risk factors (RF) were identified and their severity on construction projects assessed. The study investigated the relative use of various risk management practices and the popularity of available analysis techniques. The objectives of this research have been achieved through a questionnaire survey, which was used for data collection and the SPSS and relative importance index were employed for analysis. The results of analyzing the 41 questionnaires that were received from contractor respondents concluded that 41 out of the 42 listed risk factors were overwhelmingly identified as risk factors that significantly affect construction projects in Ghana, with the exception being „Lower work quality in presence of time constraints". The most important risk factors that affect construction projects based on the assessed severity are: Inflation, Delayed payments on contract, Difference in actual quantities and the executed quantities, Defective design and Poor safety procedures. The study findings show that contractors mostly refer to previous and ongoing similar projects for accurate program as the most effective used method for risk prevention. Close supervision of subordinates have also been found to be the most used remedial method in addressing risk factors in construction. The results however discovered that Contractors do not utilize risk analysis techniques but resort to the use of comparison of projects for the purposes of analysis. The results of this study recommended that there should be a compensation mechanism in place to mitigate or offset the impact of this risk on the financial wellbeing of the Contractor. The payment regime for executed contracts should be streamlined to offer financial stability to Contractors. The Contractor should be involved with a competent designer in the design process of projects to prevent situations where defective designs are passed to the Contractor. Contracting firms should utilize computerized approaches used for risk analysis and evaluation. Contractors should work on training their personnel to properly apply risk management principles.

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DEDICATION

This study is dedicated to my family who have loved me throughout a lifetime of learning. It is especially dedicated to my late mother Mma Rahinatu Iddrisu, who gave me faith and an unconditional love. May her soul rest in peace; to my father Chief Gulkpe Naa Alhassan Abdulai who has been the wind beneath my wings, whose love and support kept me balanced and gave me the fortitude to continue my education; to my family for their untiring support. This study is also dedicated to my lovely wife, Bukari Rahama Suhuyini, for her understanding and unflinching support and making me feel

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CHAPTER ONE

INTRODUCTION

1.1 Background

The construction sector is a critical part of the economy of most countries. The construction sector forms an important aspect in the socio-economic direction of emerging economies. For instance, in various emerging economies, construction activities are responsible for about Eighty Percent (80%) of gross equity assets, Ten Percent (10%) of Gross Domestic Product and over Fifty Percent (50%) of wealth invested in fixed assets. Probably next to agriculture, the construction industry has been a major source of massive employment opportunities (Jekale 2004; Ofori, 2006). According to the Revised Gross Domestic Product (2014) by Ghana Statistical Service, published in January 2015, of all the industrial activities the Construction subsector recorded the highest growth of 7.4% in 2014, contributing up to 12.3% to the GDP, only second to the crop sector of the Agricultural industry with 15.2%.

Although developmentally, the input of the construction industry to the economy of developing nations is significant, and plays key role in terms of development, the industry has over the years experienced low performance and has not been able to achieve the desired results. Considering the vital position of the industry in Ghana and other emerging economies, vis-à-vis the poor performance of the construction sector in these emerging economies, working to achieve the desired growth indicators should be a major agenda. Considering that Construction firms are one of the industry major stakeholders and the makers of the completed physical output, the capacity of Contractors towards improvement in terms of developmental initiative has to be explored (Ofori, 2006).

The industry, like any other business, has its own risks and challenges arising from the changes inherent in the construction industry. It is also pointed out in (Kartam & Kartam,

2001) that, there exist high levels of risk attached to the sector owing to the nature of the sector‟s business, chain of activities, external influences and firm‟s organizational structure. Regarding risk linkages, Shofoluwe & Bogale (2010) asserted that, construction project entails risks and uncertainties, irrespective of size, but then the relation is such that the risk associated to a project is directly proportional to the size and complexity of a project.

Given the project complexity and changing situations of construction projects, the sector is susceptible to risk in which a climate of great risk and uncertainty is created. The precipitating risk factors to the construction industry abound including various technical, socio-political and commercial risks. Historically these risk have proven to be detrimental to the growth of construction sector. This situation has a limiting effect on construction project participants with the results being quality compliance difficulties, overheads and project specific requirements, cost escalation and unforeseen time overrun of the project scheduled completion date (Abu Mousa, 2005). Project management uses skills, tools and techniques to accomplish project objectives aimed at meeting or exceeding the expectation of stakeholders. Risk management is an important part of the process to identify potential project risks and respond to such risks. It takes into consideration processes geared towards maximizing the effect of positive events whiles minimizing the influence of negative events (PMI, 2013).

The ten knowledge areas as listed and described by the Project Management Institute (PMI, 2013) among others also include Risk Management. Additionally, risk management in the area of managing construction projects is to identify a comprehensive and systematic manner, analyze and respond to risks to achieving the project objectives (ICE, 2005; PMI, 2007).

It is widely conceived that there is a choice in finding risk in a particular environment and cannot be reduced to mere fate and that the fulfillment of project and company business goals can be affected by the innate uncertainties in the system. Risks exist in all project tasks, but the amount varies from one activity to another (Ehsan et al, 2010).

1.2 Problem Statement

In construction projects, it is virtually not possible to record a zero risk. Risk is inherent in all construction activities. The inherent nature of risks contributes to the inability in achieving the triple constraint factors of time, budget, and quality objectives (Loosemore, 2006). Construction projects can be very complex and full of uncertainties. The risks and uncertainties can have potentially harmful effects on projects (Mills, 2001; Flanagan et al, 2006).

In order to fulfil project objectives with specific attention on quality, environmental sustainability, time, cost and safety, Construction Project Risk management has been identified as a key step to undertake. In a twist of events, most studies conducted in the area of risk management have directed attention on certain aspect of construction project risk management to the neglect of a comprehensive and holistic approach with a focused view aimed at identifying construction risks, their probability of occurrence and the impact on project objectives (Abu Mousa, 2005) .

The construction sector with its myriad of activities arguably is embedded more with risks and uncertainties compared with other industries. In dealing with risks, some industries have developed suitable risk management techniques to make them more proactive in handling risk associated with projects. The usage of these risk management techniques is not popular within the construction industry and therefore not generally used. Risk is inherently part of all projects, irrespective of area of operation and magnitude of project.

There isn‟t any absolute risk free project and therefore if the risks are not carefully identified, properly analyzed and workable risk management strategies put in place, then the likelihood of the project failure will be high (Mahendra et al., 2013).

From the aforementioned insights on risk and its management, it can be pointed out that players within the construction industry are faced with a challenge of an effective risk assessment and management system needed to help in the risk management process. Construction Risk management is presented to aid in identifying project risks, systematically analyze them and use appropriate tools and techniques in managing them. Hence, in order to unravel project complexity and reduce construction risk, there is the need for systematic risk management (Al-Bahar, 1990).

From the above foregoing challenges and issues relating to risk in the construction sector and using the Ghanaian Construction sector, this study sought to identify risks in the current construction sector and evaluate the severity through an extensive study of literature and to examine the risk management techniques and practices if any being used by the Contractors.

1.3 Aim and Objectives

1.3.1 Aim

This work aimed to assess the risk management practices of Ghanaian Contractors towards typical construction project risk factors.

1.3.2 Objectives

The study therefore sought to explore and investigate the following:

1. Identify risk factors that typically affect construction projects in Ghana

2. Assess the severity of the identified risks on projects
3. Identify the risk management techniques that are being practiced.

1.3.3 Research Questions

Drawing from the research problems, the following questions were posed:

1. What are the risks that affect the Ghanaian Construction Industry?
2. To what extent do the identified risk affect the Construction Industry?
3. What are the risk management techniques and practices being used to control the identified risks?

1.4 Significance of Study

Risk Management Practices have been critical issue encountered by construction professionals in their works. There is the need to provide an outlook of the various risk management practices as it is being carried out on projects.

This research is timely as it seeks to provide knowledge about construction firms and how to effectively manage risk on project. It will help managers and other professionals find the best way of planning and executing projects through the appropriate risk management tools. This research work will also provide the Ghanaian construction firms with guidelines of best risk management practices.

To the other players in the construction industry such as the client, consultants, subcontractors etc., it will provide them with the requisite ideas with regards to the risk management of construction firms. This will help to understand how the risk management practices of construction firms lead to the execution of projects.

This piece of work will also be of immense benefit to individuals in the academia. This will include Lecturers and students of various tertiary institutions, where it can be used as a teaching and learning tool.

Last but not the least, this work will serve as a basis for further research into the subject area of risk and provides more insight into the risk management practices of construction firms.

1.5 Methodology

In carrying out the design of this survey, the methodology used is the quantitative method. This was initiated through secondary data obtained through textbooks, journals, previous research works and the internet, structured questionnaires were administered to key management personnel of Construction firms and some in cases interviews were conducted on site.

Analysis of the gathered data was done with the help of Statistical Package for Social Sciences (SPSS) computer software and Relative Importance Index (RII). This helped to evaluate and analyse the results, from which conclusions and recommendations were done.

1.6 Scope of Study

Even though this survey is in the interest of all the participants in the Ghanaian construction industry, attention was concentrated on key personnel of first class building construction firms who had ongoing projects at the time of the study and also filed with the Ministry of Water Resources, Works and Housing. The study was limited to the cities of Accra, Kumasi and Tamale.

The study is confined to the application of risk management practices and techniques to control the severity of identified project risk.

1.7 Structure of the Report

The presentation of the report has been grouped under five chapters as follows: **Chapter One:** Contains the background of the study, problem statement, aim and objectives together with the research questions.

Chapter Two: Provides an outlook regarding reviewed literature on the construction industry economic contribution, project management, risks and its management in terms of practices and techniques employed in the construction industry.

Chapter Three: Provides information on the methodology, population and sample size consideration, limitation of the study, data collection procedures, instrumentation, and data analysis procedures.

Chapter Four: Provides findings and the discussion on the findings of the study. **Chapter Five:** Provides summary of the findings, conclusion and recommendation to the industry players and for further research.

1.8 Chapter summary

Risk and its management were presented in this chapter as a way of background information. The problem statement was discussed and a justification for the study made. Research questions were posed to help achieve the objectives and the aim of the study eventually. The practices of time management and their relationships to

workmanagement. Significance of the study, methodology employed and scope within which the study was done were also discussed.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter takes a look at relevant literature on the construction industry, project management and risk management. It however elaborates on "How to identify, mitigate and avoid risks in construction projects by stakeholders in the industry, especially contractors.

2.2 Overview of Ghana`s Economy and the Construction Industry

The construction sector is a critical part of the economy of most countries (Ofori, 2006). For instance, in various emerging economies, construction activities are responsible for about Eighty Percent (80%) of gross equity assets, Ten Percent (10%) of Gross Domestic Product and over Fifty Percent (50%) of wealth invested in fixed assets. Probably next to agriculture, the construction industry has been a major source of massive employment opportunities (Jekale, 2004).

According to IMF (2014) Ghana achieved a high growth of 15percent in 2011 though it could not be sustained in the subsequent years. However it is always above the average for the sub-Saharan region. In 2012 and 2013 Ghana`s growth rate was 7.9 percent and 5.4 percent respectively, showing a decline from the 2011 growth rate. Every sector of the economy is responsible for this growth and the construction industry is not an exception.

According to the 2014 Revised Gross Domestic Product by Ghana Statistical Service, (2015), of all the industrial activities the Construction subsector recorded the highest growth of 7.4 percent in 2014, contributing up to 12.3 percent to the GDP, only second to the crop sector of the Agricultural industry with 15.2 percent. Considering the vital position of the industry in Ghana and other emerging economies, vis-à-vis the poor performance of the construction sector in these emerging economies, working to achieve the desired growth indicators should be a major agenda. (Ofori, 2006).

The construction industry in Ghana thrives through various projects, which has to be managed to give the desire result or minimize risks and maximize benefits.

2.3 Overview of Project and its lifecycle

In defining a project, Larson and Gray (2011) described it as a non-permanent venture carried out to create a specific outcome of product, service, or results and it‟s characterized by the following: A set objective, Time constraint, Budget constraint, Desired performance criteria, and Engagement of distinct sectors and professionals.

Kerzner (2001) on the other hand describes a Project as a chain of activities with a set start and close date that holds a specific objective to be realized within the constraint of time, cost, and resources.

A project has a life cycle that defines how it begins and ends. The stages of the project life cycle vary depending on the source of the classifications or groupings. Larson and Gray, (2011) described the stages to include the following: Defining stage, Planning stage, Executing stage and Closing stage.

PMI (2004), illustrated five stages of the project life cycle as seen in Figure 2.1.
It is worth noting that the monitoring and controlling captured with the PMI (2004) has been fused with the executing stage in the case of Larson and Gay (2011).

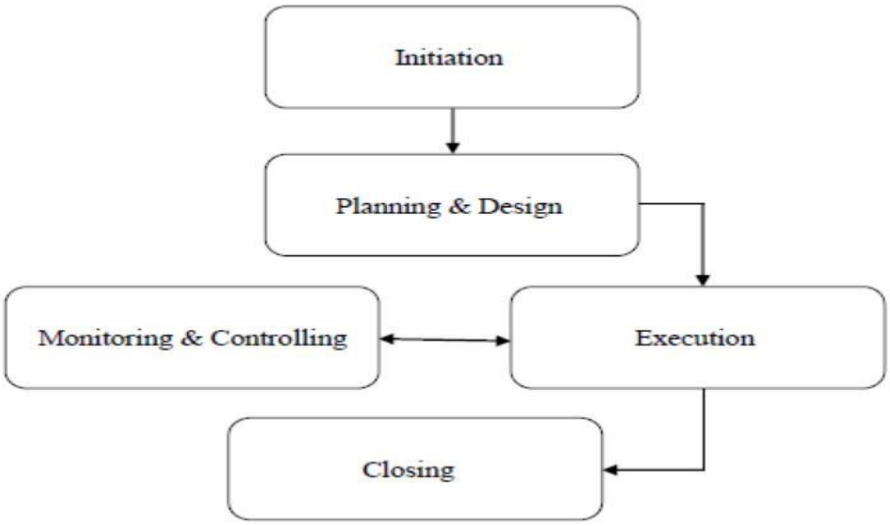

Figure 2.1 Construction project lifecycle

Source: (PMI, 2004)

Initiation Stage: This stage sets out the initial range of the project taking into consideration the environment and integrates the needed resources using Preliminary Scope Statement. Mainly consist of the key constraints such as cost, tasks and time schedule. Also includes the contract documentation, list of required equipment and required budget for the project. (PMI, 2004).

Planning and design Stage: The aim of this stage is to illustrate the management of the project through the rest of the stages. During this stage, tasks are defined, the sequence of operations set out and the needed resources determined against the various grouped activities. It makes sure that a project meets its target population and can be fulfilled within the identified constraints of the project which may include duration and budgetary limitations (PMI, 2004).

Execution Stage: This is the implementation phase of the project. The activities that have been defined in the Project Management Plan (PMP) are done in pursue of realizing the project objective. This also takes into account integrating activities and the coordination

involved mainly of people and other resources to achieve the desired outcome as outlined in the Project Management Plan (PMI, 2004).

Monitoring and controlling Stage: This stage mainly involve review of the progress in the project execution phase with the sole purpose of identifying execution challenges and to strike actions to rectify problems. This stage takes into account tasks that are still being done, the actual cost in executing the tasks, the duration within which the tasks have been carried out, and the effort invested in these tasks. All these are compared against the budgeted cost, estimated time and the expected output rate as indicated in the Project Management Plan. This stage also takes a closer view of the Project Performance Baseline, assess risks and set up corrective actions (PMI, 2004).

Closing Stage: This stage is the phase at which the completed project is officially handed over to the client with a formal acceptance. Tasks across the project are completed and certified at this stage, and contracts relevant to the project is finalized and closed out (PMI, 2004).

2.3.1 Construction projects

A construction project is defined as a physical structure that is initiated by the designers" drawings and gets transformed into finished product through a set of methods and processes (Levy, 2000). Executing a construction project is defined as a process of putting up an infrastructure. Extensive planning is key for a project to be executed successfully. Before the construction execution phase begins, the design together with the budgeted cost and timelines will have to be completed and approved. (Clough, 1979). According to Levy, (2000) for construction projects to be successful and achieve the set objective, the following key criteria must be met: Complete Project within the estimated time, Actual cost in executing the project is not more than the budgeted cost of project, The project

should be claims/disputes free during and beyond the project lifecycle, Good working rapport between Contractors and other stakeholders and The output of work meets the desired quality.

Construction projects have different stakeholders involved in it, but the following are the key players or participants:

Clients: They provide the financial resources needed for construction projects. The client‟s expectation is to receive the completed project within the budgeted cost and estimated time (Altoryman, 2014).

Consultants: These professionals are chosen by the client to represent and protect the interest of the client. They are resourced and backed by their professional expertise. They consultant may be a group of Designers, Project Managers or Specialist Engineers. The client seeks and receive advice on various section of the project from the consultants and in doing so, the consultants put in place management practices to take care of risks arising from incorrect advice which may lead to claims and disputes (Altoryman, 2014).

Contractors: They are responsible for the execution of the designed work and their product ranges from a building to varying form of construction unit. Contractors work to maximized profit from any project. Examples of contractors are: main contractors, subcontractors, Suppliers, etc. (Altoryman, 2014).

Usually, the inability of a Contractor to achieve the project objective of completing it within the budgeted cost and estimated time duration and required specifications may be as a result of ineffective management practices (Flanagan, 1993). The main linkage of claims and disputes is traced to the disruptions and delays in Contractor‟s progress (Braimah and Ndekugri, 2008). Construction projects are grouped into four categories (Gloud, 1997): Residential construction, Construction for businesses, Infrastructure and heavy construction and Industrial construction projects

This study is relating to construction projects. Gloud (1997), related that construction projects are deemed technically sophisticated than others, and client preferences determine the responsibility of the field of construction management. That means that the clients choose whether a consultant firm or a contractor firm is responsible for managing the construction projects.

2.4 Project Management

Project Management (PM) entails the process of planning, organizing and managing available resources in order to complete a project successfully within the defined project objectives. However, Project Management is defines as "*the art of directing and coordinating human and resources through the life of a project by using modern management techniques to achieve pre-determined goals of scope, cost, time, and quality and participants satisfaction*". There are a lot of constraints on projects but the triple constraints of time duration, budgeted cost and the pre-determined scope of work affects every project (PMI, 2004). The triangular relationship shown in figure 2.2 illustrate the triple constraint factors.

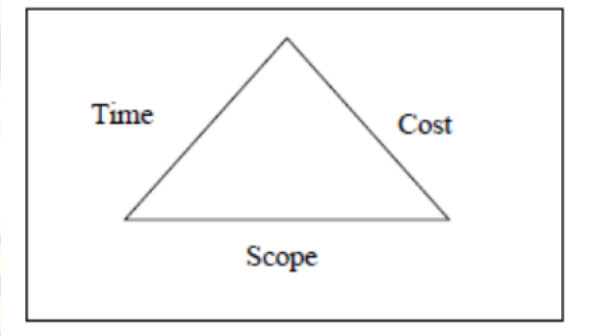

Figure 2.2 Project management constraints

Source: PMBOK, (2004)

According to Kerzner (2001), the planning stage of project management is made up of scope of work, quantity and quality of work and the required resources for the project.

This is followed by the monitoring stage which consists of progress tracking, comparison between the actual and predicted outcome, impact analysis and adjustment making. Achieving the project objective within the designated time and budget is called successful project management.

A successful project manager is required to achieve the project objective successfully. A project manager is defined as a person who is responsible to manage a project through coordinating and integrating project activities to achieve the desired objectives (Fewings, 2005). Therefore, the project manager should have excellent communicative and interpersonal skills (Kerzner, 2001). According to Nicholas (2004), the project manager‟s role is central, as it is the communication hub, the decision maker as well as an entrepreneur. Project management has a lot of benefits as mentioned by Kerzner, (2001), and includes: Identification of tools and techniques for analysis, Early identification of problems, Enhance skills for future projects, Easily identify whether the objectives would be met or exceeded and Examine time and achievements against schedules and plans.

2.4.1 Project Management Processes

Owing to the complex nature of projects, various projects may demand resources differently. For effective management of the complex nature of projects, there is the need to break down the project into separate interconnected parts capable of being handled by the manager as Walker, (2000) mentioned. Hillson, (2002) agreed that a system approach is required to handle the separate constituents of a project.

There exist 10 project management areas designed to offer a helping hand in handling the separate constituents of a project which are listed below (PMI, 2013): Project integration management, Project scope management, Project time management, Project cost management, Project quality management, Project human resources management, Project

communications management, Project risk management and Project procurement management and Project Stakeholders Management.

These 10 knowledge areas are critical for the successful completion of projects. However, this study concentrates on risk management and the subsequent sections and sub-sections will elaborate more on it.

2.5 Risk overview

By definition, risk is generally uncertainty circumstances or events which can produce a positive or negative impact on a project, if it occurs. Jaffari"s definition in the year 2001 was however complex, as it considered loss/gain and magnitude. In other words, risk is the exposure to gain or loss, or the probability of its occurrences multiplied by their respective magnitude. Jaffari (2001) further explained that a certain event is 100% if their probabilities of occurrences are achieved and conversely an uncertain event is when the probability of occurrence is zero. There are wide variations in between the two stated extremes opined by Jaffari. A simpler definition by the Project Management Institute (1996), described risk as separate and unconnected occurrences that positively or negatively affects a project. Kartam (2001), asserted that risk may be defined as the probability of occurrence of some unpredictable, uncertain and even undesirable events that may change the profitability on a given investment"s prospects (Kartam, 2001).

Any situation or thing that can cause harm may be defined as hazard and the likelihood that a recipient of harm could be influenced by hazard as the extent of exposure. Exposure is taken to imply notions of frequency and probability while hazard relates to damage, injury, loss of performance and finance. Risk is the triple characteristic of any project decision in the situation of uncertainty. The existence of a number of possibilities that has unknown occurrence is termed as uncertainty (Yoe, 2000). Yoe (2000) further affirms that

not all uncertainties are risks but some risks are uncertain. Risks and uncertainties however share similar characteristics in services, production and exchange. Planning, monitoring, implementation, adjustment, behaviour and explain choices are the fundamental variables that are influenced by risks and uncertainties according to Okema (2001). The nature of the risk and its application are the basis to define risk with a common element of subjectivity. The specification of correctly predicting the exact period during a project in the construction industry where certainty exists or assured is very uncommon (Flanagan and Norman, 1993). Some researchers based their definitions on the outcomes and probability of a project outcome been realised. Risk may exist when a decision is expressed in terms of range of possible outcomes and when known probabilities of the outcomes are attached, while as uncertainty is when there is one possible outcome of a course of action. There are unknown outcome of the probability of each outcome and in some occasions there are no reference to the chance of bad consequences on risk. Thus, good consequences should be relevant in the definition of risk (Education and Learning Wales, 2001).

Some renowned writers like Flanagan and Norman (1993), clearly distinguished between the definitions of risk and uncertainty. For risk to occur, the main dependent is probability which could be expressed quantitatively. Uncertainty, however, might be defined as a situation in which there are no historic data or previous history related to the situation being considered by the decision maker. Risk is an element subjected to empirical measurement, while uncertainty is of a non-quantifiable type as stated in the findings of a research conducted by ADB (2002). Thus, a situation where there are indication of its likelihood of the realized value of a fallen variable within stated limits is risk related and can be described by the fluctuations around the average of a probability calculus. If the fluctuations of a variable are such that they cannot be described by a probability calculus,

the situation is described as uncertainty. Greene (2001) viewed risk as the probability an adverse event that occurs during a stipulated time period, or results from a particular challenge. Greene (2001) also opined that there is the likelihood that statistical theory obeys all the formal laws affecting probabilities. Greene (2001) however asserted that, the main disadvantage about these statistical theories is that they depend mostly on guess work or the approximation of what is to occur.

In summary, a systematic way of dealing with hazards can be considered as risk. The assumption that there are uncertainties with predictions of hazard affirms that there are only uncertainties simply because there are only ever a prediction of likely events. For risk to exist there should be hazard, hence their correlation but hazards are entirely subjective and centered around previous experience, specialist training in an area of field of expertise, and cultural values to which the hazard relates (Greene, 2001).

According to a research conducted in 2007, the findings proved that the government of Ghana is the biggest client in the industry (Agyakwa-Baah, 2007; Tuuli et al., 2007). Frequent delays and cost overruns on a lot of projects are some of the challenges of the construction industry despite its contribution to economic development and growth (Frimpong et al., 2003) There are the need for serious measures and the right risk management processes to be put in place to prevent these cost overruns and delays as opined by Ahadzie et al.(2008), who observed that overall project cost and quality should be viewed as the most important criteria of success in the project performance in Ghana.

Rapid growth in most construction industries around the world brings about infrastructural development. The growth in the construction industry leads to increases in GDP of a nation and it is very essential to prioritize infrastructural development and make the necessary provisions in most governments‟ budgets to finance such operations (Odeyinka et al., 2007). Most at times new challenges are faced considering the risks involved in the design

and production in construction projects. By nature, risk management in construction industry allows for a lot of scope for many environmental and socio-political problems dating from pre contracts, contract up to post-contract stage leading to completion time problem, cost overruns and poor quality work (Okuwoga, 1998). In as much as project managers try to limit cost overruns, it is inevitable and will definitely affect project especially when it involves large amount of money (Odeyinka et al., 2007). In order to avoid or reduce the losses, management of the risk involved in the construction project is required. The components and materials needed for assembling, designing and producing by different suppliers from diverse disciplines and technological disparities so as to develop a build environment is the construction process.

PMI (2008) describes any temporary endeavour with the aim to create unique service or product as a project. The difference between project and an organisation‟s normal operation is that project eventually comes to an end. Projects are temporary in existence and therefore have a fixed lifeline and according to PMI (2008) every project must fulfil its explicit objective with a one-time effort within a specific time. Projects may vary within levels of an organization, while a project may be about one department of an organization, others might cut across all departments within the organization. Usually project might involve several or specific group of personnel in a team or a single person.

2.5.1 Risk and Uncertainty

Uncertainty and risk are closely related as threats associated with the implementation of construction projects. Usually risk is viewed completely as uncertainty although all statements defining risk contains some element of uncertainty. Uncertainty is express in terms of an event‟s probability of occurrence. If the probability of occurrence of an event is 100%, then it is termed to be certain. On the other hand a probability occurrence

recorded as 0%, means the event is uncertain. There exist a huge gap of uncertainty between the limit of 0% and 100% (Jaafari, 2001).

Uncertainty makes it difficult to have an exact outlook of future possibilities. To manage uncertainty effectively, the variability and ambiguity nature of uncertainty needs to be differentiated. A situation of usage where a measurable factor takes a unit of set of possible values describes its variability nature. Ambiguity situation is considered when there is no complete knowledge in relation to the situation being reviewed. (Hillson and Murray-Webster, 2007a).

Some situations although uncertain are not regarded as risk. If the uncertainty doesn‟t affect the set objectives, it wouldn‟t be considered as risk. There cannot be risk without it being defined in relation to certain objectives (Jaafari, 2001). Hilson and MurrayWebster (2007a) intimated that there is a distinction between risk and uncertainty; risk is defined in relation to specific objectives and takes into consideration the consequences while uncertainty does not take that into account. Figure 2.3 demonstrates the relation between risk and uncertainty for projects.

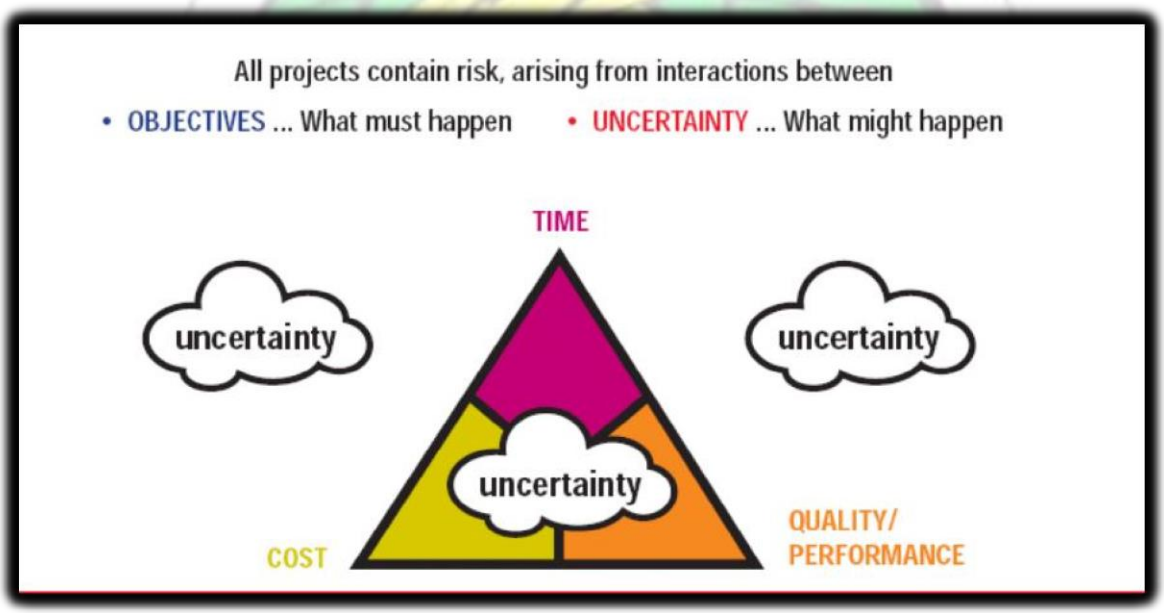

Figure 2.3 Relationship between Risk and Uncertainty

Source: Hillson, (2005)

As a concluding remark, it is to be noted that different definitions of risk and uncertainty have been made from different point of view by various researchers. However there is consensus to the effect that risk and uncertainty have unique separate meanings. Overall risk is linked to the prediction of an outcome using statistical probability. On the other hand, uncertainty is a situation of future outcome based on subjective probability.

2.5.2 Sources of risks

Risks in project management can come from different sources. Education and Learning Wales, (2001) indicated the following as sources of risks: Environmental risks, Political risks, Social risks, Financial risk, Legal risks, Technological risks, Commercial risk, Communications risks, Geographical risks, Management risks, Geotechnical risks, Construction risks, Operational risks, and Demand/product risks.

The sources of risk are unique to individual projects and as well related generally to all projects. The related risk in the two domain needs to be reviewed in the process of project risk identification. Figure 2.4 shows map of knowledge illustrating the sources of risk affecting the objectives of a project.

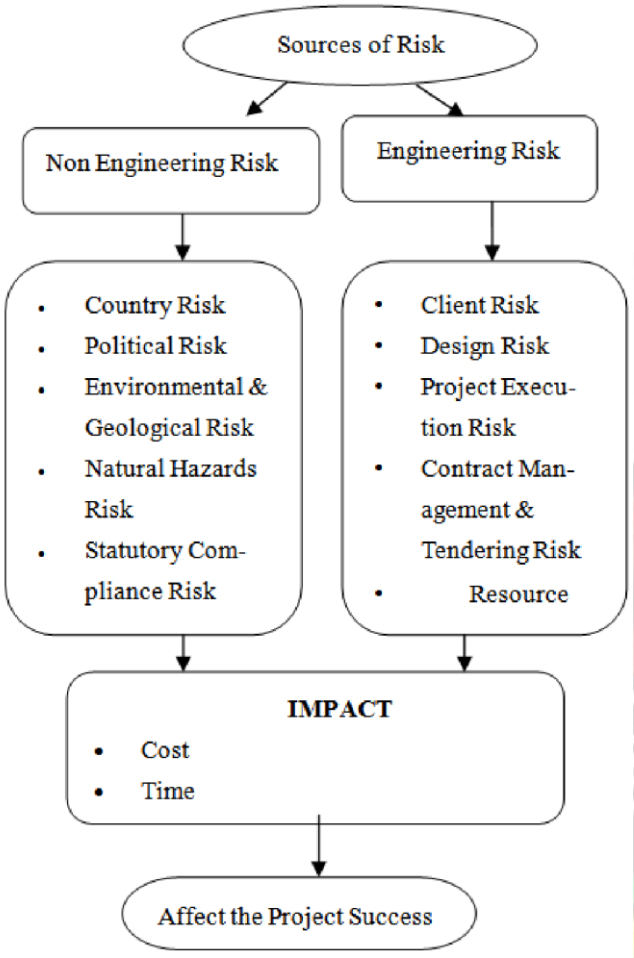

Figure 2.4 A map of knowledge illustrating the sources of risk affecting the objectives of a project

Source: Renuka et al., (2014)

Figure 2.4 grouped the risk factors under Engineering risk which can be predicted and Non-engineering risk factors which cannot be predicted. It is appropriate that the forecast of the engineering factors be made at the initial stages of the project since they are predictable. Whereas the non-engineering factors which affect the budgeted cost, estimated time and desired quality of the project, and mainly involve uncertainties should be analysed and estimated to achieve project objectives.

2.5.3 Identification of Risk Factors in Construction Projects

Table 2.1 summarises identified risk factors as suggested by researchers from various kinds of construction projects.

Table 2.1 shows risk factors identification in construction projects.

Researcher(s)/Work	Identified critical risks
Mustafa et al., (1991)	Inflation, Country Economic, Condition and rules and regulation, unavailability of funds, Financial failure.
Prasanta kumar dey, (2002)	Scope and design changes, Technology, Weather and climatic Conditions, Statutory clearance and approvals.
Ghosh et al., (2004)	Scope and design changes, Inflation, Country Economic Condition and rules and regulation, unavailability of funds, Financial failure, Construction Delays
Laryea, (2007)	Scope and design changes, Technology Implementation, Site conditions and Unknown Geological Condition, Inflation, Country Economic Condition and rules and regulation, unavailability of funds, Financial failure, Lack of availability of resources
Enhassi and Mosa, (2008)	Scope and design changes, Technology Implementation, Site conditions and Unknown Geological Condition, Inflation, Country Economic Condition and rules and regulation, unavailability of funds, Financial failure, Weather and climatic Conditions, Poor Safety procedures, Construction Delays.
Sun & meng, (2009)	Site conditions and Unknown Geological Condition, Inflation, Country Economic Condition and rules and regulation, unavailability of funds, Financial failure, Inadequate managerial skills, improper coordination between teams, Lack of availability of resources
Wang et al., (2010)	Inflation, Country Economic Condition, Statutory clearance and approvals, construction delays.
Eybpoosh, (2011)	Scope and design changes, Technology Implementation, Site conditions and Unknown Geological Condition, Inflation, Country Economic Condition and rules and regulation, Lack of availability of resources.
Rezakhani, (2012)	Scope and design changes, Technology, unavailability of funds, Financial, Weather and climatic Conditions, Poor Safety procedures.
Goh et al., (2013)	Scope and design changes, Technology Implementation, Site conditions and Unknown Geological Condition, Inadequate managerial skills, improper coordination between teams Lack of availability of resources, Construction Delays.

Source: Renuka et al., (2014)

Table 2.1 shows the identified risks in construction projects confirmed by popular risk management researchers and authors. To be able to handle the identified risks appropriately, the risks have been prioritize in order of urgency as seen in figure 2.1 below.

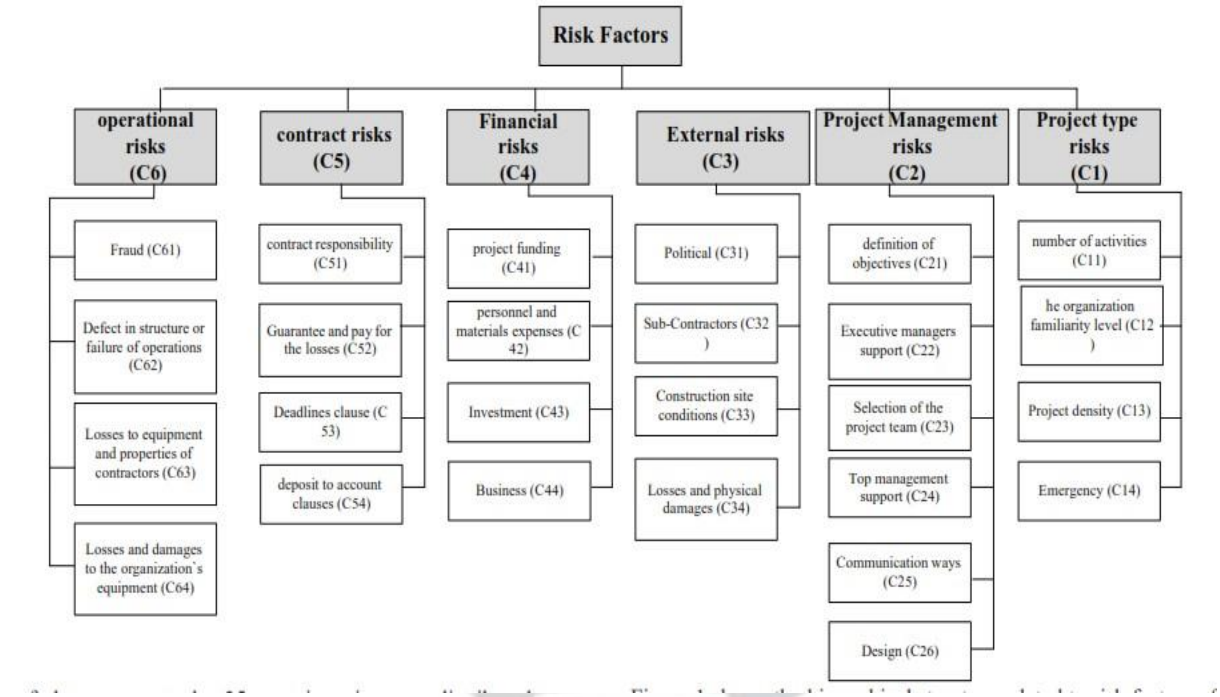

Figure 2.5 The hierarchical structure of identified risk factors

Source: Tah & Carr (2000)

To be able to handle identified risks well, it is developed into a system of WBS (Work Breakdown Structure). WBS refers to the identification of tasks together with the required resources in order to deliver the design to execute the project (Smith, 2008). It is useful to seek answers to the three essential questions in risk identification including; what could go wrong? How likely is it? (Probability), and how it will affect the project? (Impact). Project manager and the team could use the experience and lessons learnt from the past, use a simulation model to present possible risks in addition to brainstorming in order to recognise the potential risk factors (Lockyer and Gordon,

1996).

2.5.4 Classification of risks

From the perspective of the PMI (2008), risk classification is defined as a structure that provides an exhaustive process of systematic risk identification to a constant detailing and which match its contribution to the quality and effectiveness to the risk identification process.

Depending on the nature of risk, Researchers through the identification process have found and classified into different types. Such classification includes Contractual / legal, Construction, Political, Management, Physical, Environmental, design, Financial, , Natural hazards, Safety and Delay risk (Mustafa, 1991; Akincl et al., 1998; Prasanta Kumar Dey, 2002; Ghosh et al.,2004; Wiguna and Scott, 2005; Enshasi and Mosa, 2008; Wang et al., 2010; Razakhani, 2012; Goh et al., 2013 cited in Renuka et al., 2014).

The leading six categories related to risk factors were external, materials, labour and equipment, design, financial, and management. A review of the literature regarding this categorisation offers the following explanations and how they affect projects as illustrated in Table 2.2.

Table 2.2 A Table showing Risk classification

Category	Description
Management	In project management there are two major aspects: the art and the science of the project. The art deals with the people involved in the project, while the science deals with defining and coordinating the work to be done; for example, it involves the knowledge, understanding, and skilful application of a project management process (Heerkens, 2001)

Design	One of the most important requirements to minimise time delay and cost overrun is the allocation of sufficient time and money at the design phase (Koushki et al., 2005). Design is one of the most critical categories because its related factors were identified as key risks in construction projects (Fereig and Kartam, 2006).
Financial	This category takes into account factors with respect to possible financial difficulties on the project, which may be due to cash flow problems, delayed payments, and external economic issues. (Alaghbari et al., 2007). Delayed payment for executed projects is the key related risk factor that affect the financial category as concluded by various studies (Sweis et al., 2008) and (Aibinu and Odeyinka, 2006).
Materials	The effect of risk factors can have a direct bearing on tasks and the cost implication on the project can be serious (Manavazhi and Adhikari, 2002). Type of materials, their availability and the selection time are critical risk factors when it comes to material issues.
Labour- and equipment	Shortage of workface and the existence of unskilled labour are risk factors in relation to Labour issues. (Sweis et al., 2008)
External	External risks are usually ranked low and do not have a contributory role in the delay of the project (Sugiharto and Keith, 2003). Most of the studies show that external risks, including weather and site conditions, have the lowest impact on the completion of a project (Alaghbari et al., 2007).

Source: Altoryman (2014)

It is essential to look at the possible internal and external risk factors to the various stakeholders. The risk source and its effect are critical when identifying risks (Raftery, 1999).

2.6 Overview of Risks Management

Managing risk has existed since the beginning of civilisation when people needed to store their harvest for future use, and when forts and fences were built to protect villages and possessions. Another example is when a tradesman manages his risk when moving goods from one place to another by having the buyer pay the seller a security deposit to be returned once the buyer receives the merchandise in good condition, so if the tradesman faces any disasters during his journey he receives compensation. From Babylonian times

until the Age of Enlightenment, risk was not managed thoroughly, but was based on „gut feeling". However, a more orderly methodology was seen after statisticians and theorists developed quantified techniques for assessing risk (Douglas, 2009).

In construction project management, management of risk is an integral of the decisionmaking channel (Tang et al., 2007). Risk management (RM) improves the future prospects of a project as it identifies uncertainties and probabilities (Borge, 2001). It is defined as a systemic process by which all project related risks are identified and evaluated by quantifying them, in order to take a sound decision in handling the risk

(Zou et al., 2007).

According to Walker(2000), Construction project management is defined as:

" The planning , co-ordination and control of a project from conception to completion (including commissioning) on behalf of a client requiring the identification of the clients' objectives in terms of utility, function, quality, time and cost, and the establishment of relationships between resources, integrating, monitoring and controlling the contributors to the project and their outputs, and evaluating and selecting alternatives in pursuit of the client's satisfaction with the project outcomes." The Institute of Risk Management (IRM) states that risk management (RM) is a rapidly developing discipline with no clear viewpoints or consensus on what is involved in risk. The IRM identifies risk as having two dimensions: positive and negative. Positive risks could have positive impacts on the success of a project, and negative risks are associated with the possible failures of a project (IRM, 2002).

2.6.1 Risk Management Process

Different researchers have suggested various risk management process. The works of Boehm (1991) proposal consisted of a two phases which are Risk assessment (made up of risk identification, risk analysis and risk prioritization) and Risk control (consisting of risk management planning, risk resolution and risk monitoring planning, tracking and corrective action. Chapman and Ward (1997) outlined a generic risk management process consisting of nine phases:

1. Defining principal sections of the project;
2. Paying attention to strategic approach to risk management;
3. Identification of potential sources of risks;
4. Outline requisite information about risk assumption and relationships;
5. Allocate responsibility of risks and responses;
6. Evaluate the degree of uncertainty;
7. Estimate the relative weight of the various risks;
8. Strategize response;
9. Ensure monitoring and controlling of the execution phase.

In the risk management process, four phases have rather been presented by PMI (1996) which are:

1. Identification,
2. Quantification,
3. Development of responses,
4. Control.

The process of risk management entails Identification, Assessment, Allocation and managing all project risks (APM, 2000). Figure 2.6 illustrate risk management process.

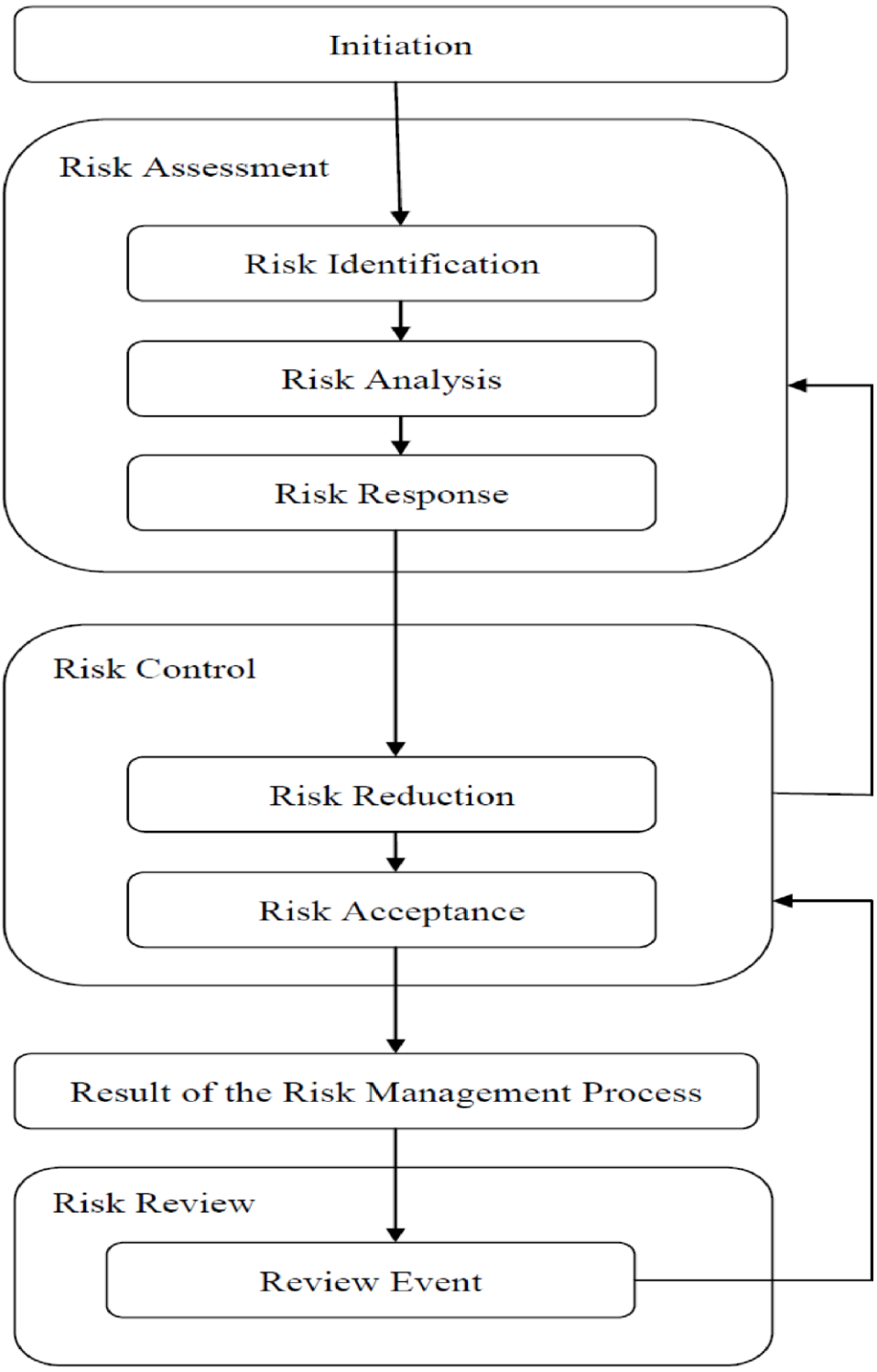

Figure 2.6 Process of risk management

Source: (Simon and Gunn, 2009), (Gray and Larson, 2003) and (Murch, 2001)

2.6.2 Construction risk management approach-Conceptual Model

Taking behavioural responses, organization structure and techniques and technology, the model describes a sound decision making process. The construction risk management conceptual model illustrates framework for quantitatively identifying, analyzing, and responding to risk in construction projects. The model is more focused on initial planned risk identification and its management rather than after, when actual losses and claims have been manifested (Enshassi & Mayer, 2001). Figure 2.7 depicts a conceptual model of construction risk management.

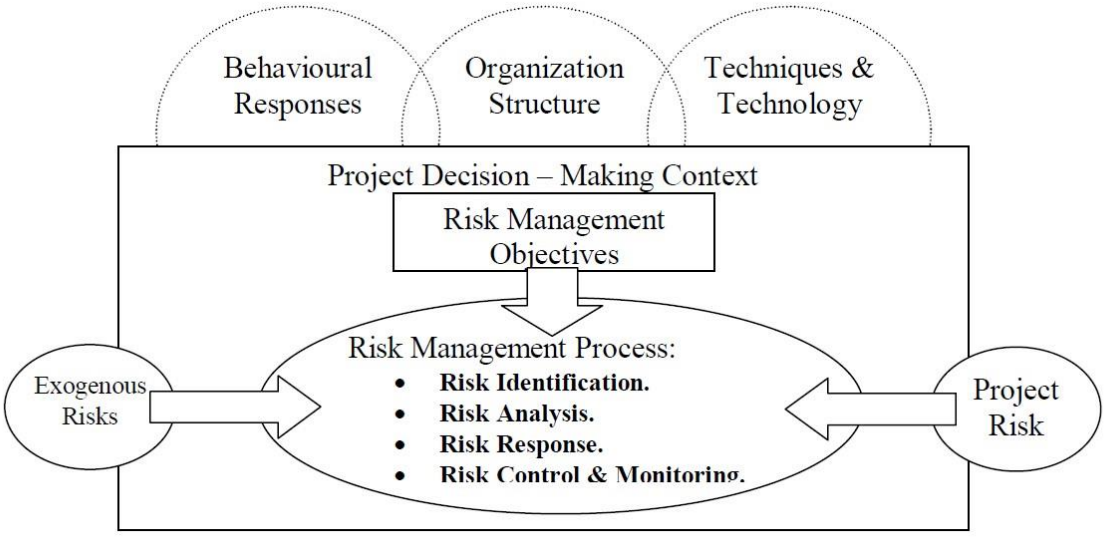

Figure 2.7 Conceptual Model of Construction Risk Management

Source: Enshassi & Mayer, (2001)

2.6.2.1 Risk identification

Events that affect the achievement of objectives and negatively cause problem, according to Moavenzadeh and Rossow (1999) are risks. Identification of potential threats follows the first step of risk planning, discovering and out ling those elements that affect the objectives of an organization. In addition to identifying the sources of risks and it is when the source of risk is identified that the consequences of that source are known.

Investigation the consequences of sources or the problem it causes is very important under this very risk management process.

Identification of risk reveals two types of risks (controllable and uncontrollable). Controllable are voluntarily undertaken and its outcome is part of the direct control of a project while those risks which do not influence a project is termed as uncontrollable risks as observed by Chege and Rwelamila (2000). The identification the constituents of risks determines which risks are likely to affect the project and documenting the characteristics of each. Risk identification should be performed on a regular basis throughout the project, it is not a one-time event according to (PMI, 1996). A thesis conducted in 1995 by Isaac defined the main constituents of risk identification as a method used to serve as a guide on what those risks should look like when written down to generate risks (Isaac, 1995). In every project there are internally and externally generally risks and it is the objective of risk identification to address these two elements. The elements or things that can be influenced by the project team, be it cost estimation and staff assignments, are internal risks. However, there are some things beyond the influence and control of the project team, typical example is the actions of government. In every project context, risk identification is not only concerned with positive outcomes or opportunities but also the negative outcomes or threats (PMI, 1996). This is a critical stage as a broader and clearer view is taken by the project team to ascertain the risks that are likely to impede the project in meeting its cost target without any constraint. The significance and criticality of this project risk management is affirmed in a study by Enshassi and Mayer (2001) which adds to literature that there should be proper recognition to the existence of one or more potential risks which may result in disaster or forgoing an event or opportunity for gain resulting from proper corrective action; failure to do so will lead delays or cost overruns.

Identifying risk can be compared to mapping the world which is centred on the location of the map maker. Wherever one stand to mark the world from a map, may be entirely reveal the whole world to you and some places familiar to you may not be obvious to other project teams and vice versa. Every project when viewed from the top has complex layers of planning, multiple interactions of vertical and horizontal as well as sequential problems and it is the ability of the management team to influence the outcome of a project by what they see, though outcome of projects are limited. There should be greater concentration on what could happen rather than attempting to focus on what should happen (Flanagan and Norman, 1993). Going further, Flanagan and Norman (1993) again observed the first equipment of risk identification is focusing on the effects of the risks and its sources. There can be a catalogue of extensive risk devised; however, they could be incomplete and inadequate leading to decision failing simply because most decision makers do not consider the full spectrum of the potentially events or things that may harmfully affect a project. One way of catering for this is by proper identification and categorization of risks so as to minimize the risks embodied in projects (Enshassi and Mayer, 2001).

2.6.2.2 Risk Analysis

Risk management process is a crucial field of project management process in the construction industry. It is the process of risk management where the effects and causes of events which might cause havoc are identified and dealt with. A defined and accurate estimation of risk events is the aim behind such analysis and to some extent makes the decision making of the process to be specific and definite (Estate Management Manual, 2002). The significance of analyzing risk is not far-fetched as it analyze the various outcomes of any decision and captures all feasible options. Clients more often are interested in the likely price of a building project, but however, projects mostly and

consistently experience cost overrun, too most often the more important questions of 'what if' are not asked by clients (Flanagan and Norman, 1993).

Assessing the identified risks is the main principle of risk analysis. Risk analysis are done by assessing values on the effect risk have on time and cost. The economic processes or parameters of their respective effects could be analysed and three generalized kinds of risk treatment can be applied: that is, transfer, avoiding or reducing and accepting or retaining risk (Education and Learning Wales, 2002). Flanagan and Norman (1993), opined that the likely situations if a project is terminated or does not follow the initial plan, the use of risk analysis comes into play. There will be clearer vision of the risks when active minds are applied to the best available data in a systematic and structured way rather than the achievement it would have gained by intuition alone. There is recognition of uncertainty that surrounds the best estimate in risk analysis approach by generating a probability distribution based upon an expertise judgment. This therefore improves the effects of uncertainties and offers a better understanding of projects. Risk analysis is not a standalone activity; rather they are components of all decisions continually made to respond to project dynamics as stated by (Jaafari, 2001).

Evaluation of risks and interacting of risks are also critical to risk and it assesses the potential results on the project (PMI, 1996). Although, it is complicated in nature but it is not limited a number of sequences or factors including: Threats and opportunities can interact in an unexpected way, for example, scheduling delays may force adopting new strategies which reduces the duration of the overall project. According to a study conducted by Bender and Ayyub (2001), the use of mathematical techniques protect project managers control cost but some over rely on these techniques creating false impression of reliability and precision. These techniques are used throughout the whole

life span of the project and most importantly the experience of construction experts throughout the construction project.

Risk analysis also indicates what could happen in the event that the project does not travel along the planned route (Flanagan & Norman, 1993). Figure 2.7 outlines the sequence of risk analysis in a construction project.

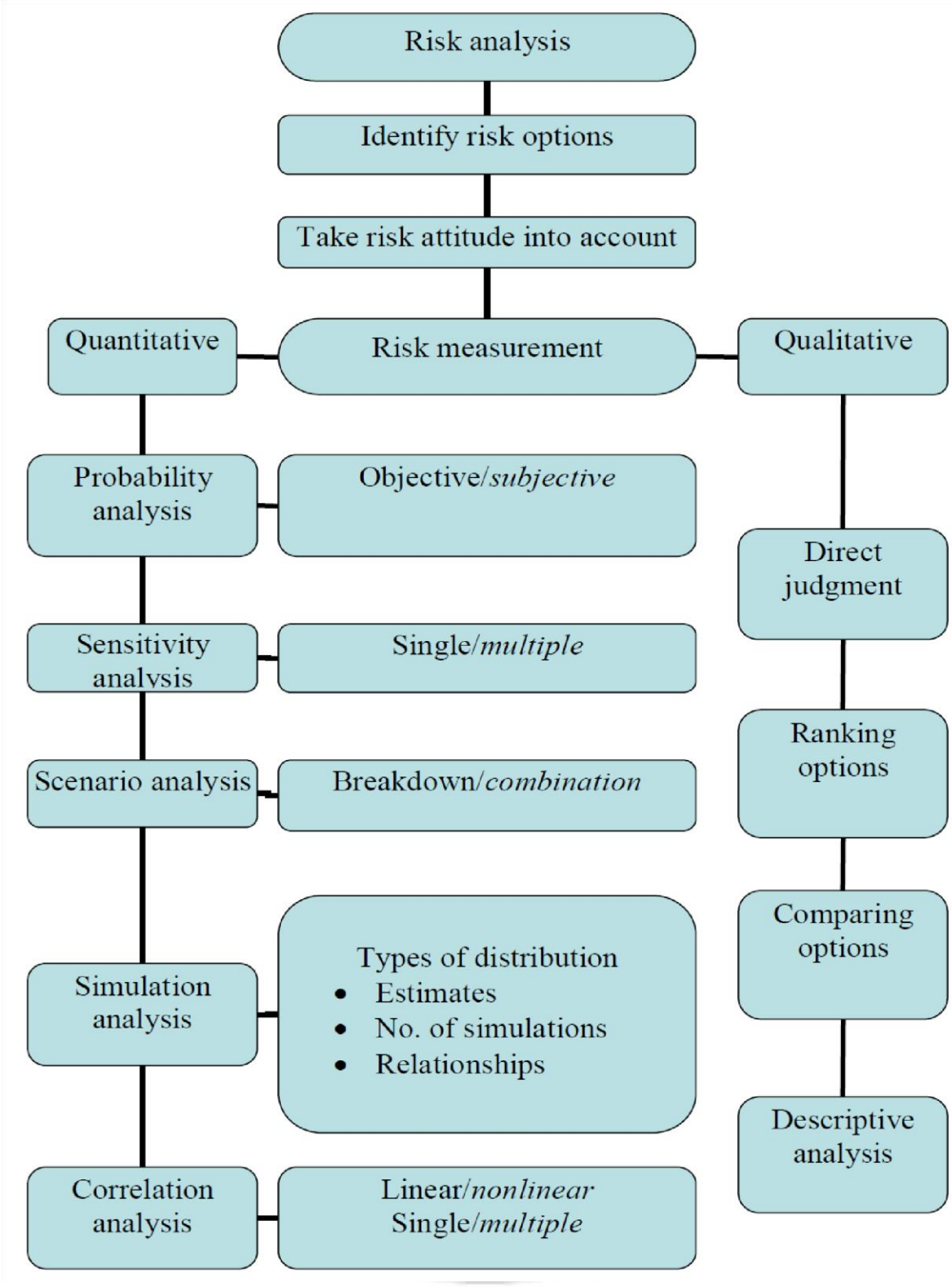

Figure 2.8 Sequence of Risk Analysis

Source: Flanagan & Norman, (1993)

Table (2.3) summarizes the various techniques used for risk analysis.

Table 2.3 Various risk analysis techniques

Risk Analysis	
Qualitative	**Quantitative**
Direct judgment	Probability analysis
Ranking options	Sensitivity analysis
Comparing options	Scenario analysis
Descriptive analysis	Simulation analysis

Source: Chapman and Ward, (1997)

2.6.2.3 Risk response

The Project Management Institute (1996) highlighted three ways of risk responding in projects: avoiding is eliminating a specific threat by removing the cause. Most at times specific risk can be eliminated as not all risks can be eliminated by project management teams; mitigation is the introduction of new technology or buying insurance, for example, to reduce the expected monetary value by reducing its probability of occurrences; accepting as the name implies is accepting whatever the consequences of the risks might be. Dealing with a lower profit of some activity is passive while developing a contingency plan executable when risks occur is active PMI (1996). There had been suggestions as to how to respond to residual risks by reducing uncertainties by obtaining additional relevant information leading to a re-evaluation of risk impacts. Another school of thought is the elimination of the risk factor through complete or partial re design. There were suggestions of transferring the risk to other sub-contractors and insuring the occurrences of the risks factors. Abu Rizk (2003) added to the assertion above that a further abortion of these project when the risks are intolerable and no favourable mechanisms could be taken to mitigate the damages. Four identifiable and discreet appropriate methods of treating

construction related risks are avoiding, reduction, transfer and risk retention as buttressed by the findings of similar studies (Akintoyne and MacLeod, 1997;Ahmed et al.,2001; Enshassi and Mayer

2001; Education and Learning Whales, 2001).

2.6.2.3.1 Mitigating risk

This is a general terminology used to signify the reduction of probability its adverse on the project. There might lead to an entirely elimination of risk events as observed in risk avoidance. According to Piney (2002), it is only prudent to not stress on the impact of the risk because it becomes unacceptable when the promising effect reaches a level. The adoption of one of these approaches will work in reducing the potential risk impact on a project (Piney, 2002).

2.6.2.3.2 Avoiding risk

Risk avoidance at times is called risk elimination is not a generalized risk response practice in construction industry as the avoidance of placing a bid or the reluctance in project funding, for example, terminate the life of the project even during the earlier days of the project. In a bid to totally eliminate risks in construction industries, the above cited examples are impracticable and lead to delays and cost overruns. A rather constructive approach/condition could be adopted in order to avoid risk. A contractor may tender for a contract with a higher bid, or place conditions on the particular bid, or signing a pre-contract or negotiating a favourable pre-contract condition, for not bidding on contracts that harbour higher risks as observed by Flanagan and Norman (1993) in their conducted research.

2.6.2.3.3 Transferring risk

As the name denotes; this risk response practice employs the transfer of risk from one management team to another or from one project to the other. The introduction of insurance premiums in construction projects are beneficial, however, it does not discharge all the identified risks of the project but covers a portion of risks (Tummala and Burchett, 1999). Moreover Tummala and Burchett (1999) further indicated that the transfer of risk essentially can be done in two ways: transferring the risk from the responsible entity for by hiring sub-contractor on the hazardous projects; and retention of the property or activity but transferring the financial risk through surety and insurances packages.

2.6.2.3.4 Sharing risk

There are situations in which the main players agree to share the risk involved using contractual instrument. In such instances, parties take and handle risk they are comfortable with or they think is within its capabilities. Risk sharing responsibilities vary contractually (Nicholas, 2004), and are as follows:

1. Fixed-price: Risk responsibility is mainly on the contractor.
2. Fixed-price with incentive fee: Risk responsibility is split with the contractor having the highest of 60% and the client taking the rest.
3. Cost plus incentive fee: Risk responsibility is shared with the contractor having the less responsibility of up to 40% and the client having the biggest share of up to 60%.
4. Cost plus fixed fee: Risk responsibility is placed entirely on the client.

2.6.2.4 Retaining risk

This risk response practice involves an internal management mechanism channelled at reducing controlling risk (Zhi, 1995). Akintoyne and MacLeod (1997) suggested that, it is conducive when avoiding the risk been handled by a particular company is impossible, there might be a small or insignificant financial loss and the probability of its occurrences are insignificant, making it uneconomical to transfer. Akintoyne and MacLeod (1997) explained that the foreseeable or unforeseeable risks are financed and controlled by the contractor or company and there are two methods devised to retain risk in construction projects. A passive retention method occurs when the contractor performing the work borne all the risks which may occur through ignorance, negligence, or absence of decision. Passive retention method is non-insured.

Akintoyne and MacLeod (1997) further indicated that a self-insurance is a deliberate management mechanism devised to handle risks upon making a thorough analysis of the likely losses to be encountered and finding alternative strategies. Agyakwa-Baah (2007), identified that risks are mostly handled by construction companies by adding a contingency of 10% to the cost of the project cost to address any risk. Moreover, the importance of the industry is seen in its contribution to GDP and the percentage allocated to construction works in the national budget of Ghana (Agyakwa-Baah et al.,

2010).

Akoi-Gyebi (2009), also noted the contribution of the construction industry ranging from the direct importation of building materials and components to supplemental domestic production and to the use of design and implementation expertise provided by foreign consultants and contractors. Akoi-Gyebi (2009) identified other areas of contribution which were within road transportation, as it was the widely available form of transport in Ghana: it carries in excess of 97% of all passenger and freight traffic. Aside linking

agricultural production areas with local, regional and national markets, road transportation links all major cities, towns and villages. There has been abundant channeling of funds into the road sector in recent time by Governments with the goal of maintaining or improving the state of the roads. Risk contingencies are a result of past experiences concealed within the bidding process, according to Mills (2001), and further elaborates that contingencies protect the contractor‟s interests in the event that a risk occurs.

In the construction industry, the simple use of contingency sums to deal with risk is unlikely to encourage more effective management of projects, nor to lead to greater efficiency. Rather there should be a more comprehensive understanding of the nature of risks they encounter, their chances of occurrence and impact on a stakeholder‟s organization.

2.6.2.5 Risk Monitoring

Checking on identifiable risks and new risks as well as monitoring of residual risks are expected as the project progresses. This stage of the management process ensures that implementation of risk schedule and evaluation how to reduce it and special reports prepared often to ascertain the possibility of new risks and ways to handle them. This is a life time cycle as well as the project is existent and managers in industries, according to Kremlijak (2010), should have a complete data on future events by providing contingency plans based on the system in question objective Kremljak (2010). In the developing construction sectors, this phenomenon is common and experimental tools should be tried to bring acceptable solutions.

Many research works have been done on risk management practices in construction industry; a common similarity among all the studies is the significant outcome of risks influencing the delivery of a construction project. Chen et al., (2004) identified 15 risk

factors on the basis cost of a project. Chen et al., (2004) found escalation of material price and inaccurate budget as the highly ranked risk events. Shen (1997) study also revealed eight significant risk events accounting for delay in construction projects using construction professionals as respondents. Shen (1997) also suggested that, the most important as of risk is the ability to treat it and constantly monitor how measures are been effected.

Tam et al., (2004) also conducted a study in a study with the aim of identifying factors affecting safety dimension of construction performance, the study also revealed management and project managers inability to create the awareness of satey on construction sites, lack of capacity building workshops and managers unwillingness to inject resources in safety related issues. Other studies have been done on risk management on phases of a project to ascertain the prevailing risk factors and their effects on the project objectives.

Uher and Toakley (1999) also studied on the social and cultural issues affecting the implementation of risk management practices on a project life cycle, it was discovered that, there is relatively low risk at the conceptual phase of the project. And according to Abdou (1996), classified risks in construction under financial, time, design phase, contractual, organizational and the construction itself. The signification step in undertaking risk management exercise is risk classifications which involve structuring diverse risks factors affecting a construction project. Perry and Hayes (1985) presented a critical approach in managing risks effectively and divided them in terms of risks retainable by the three main parties to the project, thus the client, contractor and consultant. They combined a general approach backed by a system showing the levels of the work.

Some researchers classified risks under four main classes; industry, client, project and the project environment (Chapman (2001). While Shen (2001) also grouped it under market, political, institutional policies, management, legal and financial.

2.7 Contributory Risk Factors in Ghana

External and internal factors could be attributable to risk in the construction industry. These factors drive the project and should be regarded as a strategic planning for the project. Ayirebi-Dansoh (2005) posited that, Ghanaian Construction Companies are going through series of challenges as it is confronted with competition from both foreign and local firms, political interference and hard economic environment.

Ahmed et al., (2007) established in their study that, there is an association on the procurement approach and economic situation of the project. On similar studies, Gunderman and Applegate (2005) recommended that, firms should develop their capacity by striking a balance between the opportunities that confront them and the possible negative consequences of risk and the ability to undertake such exercise places the firm in a higher pedestal to arrive at an acceptable conclusions.

2.7.1 External factors of Risk in Ghana

2.7.1.1 Financial Risk Factors

Financial failure and delay in payments in construction projects poses a major risk. Berko (2007) stated that, about 70% of infrastructure projects done in Ghana are not funded by the Government of Ghana but from foreign organizations and countries. Contractors are always complaining of delay in payment because of the unwinding bureaucratic system in governmental departments and agencies. Moreover, when these foreign organizations and companies delay in the release of the required funds, the progress of the projects are slowed down (Berko, 2007).

2.7.1.2 Economic Risk Factors

Poor financial markets, inflation and price hiking are among of the variables associated with economic risk drivers which has a direct consequence on projects‟ overrunning (Agyakwa-Baah, 2007; Denini, 2009). Currency instability may result in cost overruns mainly because of inflation. Edwards and Bowen (1998), identified economic risks in Ghana as exchange rates, material supply, labour supply, fiscal policies and inflation. Frimpong *et al*. (2003) added that, the rise in inflation should also be considered in risk studies.

2.7.1.3 Government

In developing countries like Ghana, Road projects are politically motivated and viewed by many as additions to satisfy public demand. Many roads are left at the mercy of politicians and according to Agyakwa-Baah (2009), it is the ultimate goal of government to lead and fast-track infrastructure project the society and moreover, the performance of the government is assessed in the developing countries by developmental projects. This creates unnecessary pressure on government to start something which will be terminated because it is not accommodated in the government‟s budget.

It was argued by De la Cruz et al. (2006) that, winning political scores leads to unplanned infrastructure development which lacks the necessary funding and required coordination of such projects.

2.7.1.4 Environmental Risk Factors

These risks associated with the natural environment has to do with the weather and this factor is hardly experience in Ghana such as harsh weather condition like typhoon or tornados but the two seasonal changes are witness in Ghana such as the wet and dry season seasons. De la Cruz *et al*. (2006) opined that, any time risk factors are to be considered, events such as the conditions of the ground and likely contaminants and site conditions should be notes as well as time restrictions imposed on the project by the client.

2.7.1.5 Technical Risk Factors

In a study conducted by Ofori (1994), there was the mention of technological development in Ghana requiring investment, sound economic environment, a physical infrastructure, top management support and assistance. However, it is difficult to credit these factors to the construction sector in developing countries including Ghana. Moreover, technical incompetence of designers has resulted to inaccurate design details or the inexperience of working on complex projects and risk prone projects. In addition,

Oladapo (2007) identified that, variations is very profound in construction projects and its effect is inevitable on project objectives such as time and cost. To provide a simple understanding of variations, Baxendale and Schofield (1986) said the addition or subtractions made to the scope of the project amount to variation.

2.7.2 Internal Risk Factors in Ghana

Inadequate and faulty Plants and equipment have been suggested to be an influential problem in construction firms, although local contractors mostly use labours for their works (Berko, 2007). Moreover, materials shortage, defective materials unavailability of

the required skills and the abysmal performance of labour as well as the lack of technical expertise to operate plant and equipment have also been identified as risk most local contractors are experiencing internally (Berko, 2007; Agyakwa-Baah, 2009)

2.7.2.1 Project team relationships and communication

Team work, communication and positive human dynamics are intertwined as a result of their efforts in risk management on a project and their impact on the project goals. Additionally, the inadequate flow of information amongst project stakeholders is an indictment on the health of the project. Earlier Lester (2007), observed that within the project environment, different kinds of relationships are established such as cordial or aggressive from the stakeholders which should be managed in a professional manner to offsite its ugly effect on the project. Communication and team work are very critical and should be endorsed by the coordinator of the project because the document that even govern the project is a form of communication and such has a bearing on the project. Santoso *et al*. (2003) evaluated 130 risk factors and found that, communication is the highly ranked factor and has an average impact and probability of occurring.

2.8 Conclusion

Risk management in construction projects is essential for the successful outcome of every project, irrespective of size. But the energy and resources required to manage the projects may differ. Contractors as one of the parties of construction of projects will do anything possible for the success of projects; hence risk management is important to them. The risk management process including risk identification, analysis and risk response, which are used by contractors to manage risks in projects.

2.9 Chapter summary

This chapter looked at the reviewed literature on how risk and uncertainty, how the project management processes are affected by risk and the risk management, practices and techniques employed in the construction industry.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The chapter gives the procedure which was used in collecting data for the study. Information regarding the strategy, design, target population and drawn sample size are also described. A detailed methodology and tools used are described. Two methods were used in achieving the aim and objectives of this study. First of all vital information relating to the thesis topic was gathered through the literature review and the second, was through questionnaires survey by sending structured questionnaires to targeted respondents in order to obtain feedback. Once the data was available, analyses was made and the yielded results discussed, and finally recommendations made.

3.2 Research Strategy

The suitable methodology to address the identified research questions and hypothesis of a study is said to be research strategy (Bouma and Atkinson, 1995). Kothari (2004) suggested that, qualitative and quantitative researches are the recognized forms of research strategy. Kothari (2004) further explained that Quantitative or qualitative strategy is adapted based on the object of the study, the research aim and objectives and the information available.

Berg (2001) indicated that Qualitative research emphasize on the ways of understanding social theories by stressing on the linkage between the study area and the researcher in question. Berg (2001) further opined that, qualitative is subjectivity in nature because it seeks the views of people by observation, descriptions and making implied meanings into a concept.

Creswell (1994), quantitative data is a numerical investigation into world issues by testing theories or hypothesis to know the viability and the trueness of such theories. Bouma and Atkinson (1995) opined that, it is better to use quantitative data if the study want to achieve objectivity, credible and real features of the world. Quantitative data are expressed with numbers and uses statistical tools for analysis (Burns and Grove, 2001).

3.3 Research design

Research design involves the organization of scientific investigation. The process of designing study entails a plan that will serve as a guide for the collection and analyses of data (Polit & Hungler, 1985).

A questionnaire is an instrument for soliciting information for statistical purposes with regard to a given topic. When properly constructed and responsibly administered, questionnaire become a vital instrument by which statements can be made about specific groups or people or entire populations (Berg, 2001). In designing the questionnaire, the objectives of the study were first established. This was done to help in determining what questions to ask and how to ask them. Again, very short and concise questions were fielded as questions that are long and wordy may appear confusing to respondents.

3.4 Research population

Statistically, Population is explained to be units that have the chance to be involved in the survey sample. The units could be people, employee or members of a particular set (Groves et al., 2009). For the purposes of this study, the considered population is the number of identified first class (D1K1) building contractors registered with the Ministry of Water Resources, Works and Housing and have on-going projects within the cities of Accra, Kumasi and Tamale. Sixty (60) of such contractors were identified and considered as the population. The choice of first class building contractors for this study is based on the consideration of their strong organisational nature coupled with their financial and technical capacity in the execution of very large demanding projects.

3.5 Sample Size

Wood and Haber (1998) defined the sampling as the process used in selecting representative units of a population for the study in a research investigation.

Scientific knowledge are derived from samples. Sampling procedures helps in solving problems in scientific research works (Wood & Haber, 1998).

Burns & Grove (1987), posited that historically a minimum of 30 subjects as a sample size can be used but describes 30 subjects as inadequate as a sample size for most research works (Burns & Grove, 1987).

The sample size for the study was arrived at using statistical calculation. The formula as shown below derived by Creative Research Systems (2005) was used to determine the sample size of unlimited population:

$$SS = \frac{Z^2 \times P \times (1 - P)}{C^2}$$

Where SS = Sample Size.

Z = Z Value (e.g. 1.96 for 95% confidence interval).

P = Percentage picking a choice, expressed as decimal, (0.50 used for sample size needed).

C = Confidence interval (0.05)

$$SS = \frac{1.96^2 \times 0.5 \times (1-0.5)}{0.05^2} = 384$$

Correction for finite population

$$SS_{New} = \frac{SS}{1 + \frac{SS-1}{pop}}$$

Where pop is the population = 60 identified D1K1 Contractors having on-going projects within Accra, Kumasi and Tamale.

$$SS_{New} = \frac{384}{1 + \frac{384-1}{60}}$$

$$= \mathbf{52.01 \approx 52}$$

52 questionnaires are to be administered to contracting firms.

3.6 Sample method

Sampling serves to provide practical ways of ensuring that data collection and processing aspects of research are done whilst making sure that the sample is a true reflection of the population (Fellows & Liu, 1997).

Purposive sampling was emplyed to represent the total sample size, since the study is concerned with Contractors having on-going building projects in Accra, Kumasi and Tamale. A list of contractors was compiled from the identification of on-going projects being executed by D1K1 Contractors and the samples were selected from the stratum of target population of these on-going projects.

3.7 Limitation of the research

Because of limited time and resources available, the study is focused on building construction projects only and heavy civil engineering works and other remedial craft works will not be considered. This research is limited to the D1K1 building contracting firms registered with the Ministry of Water Resources, Works and Housing and have ongoing projects in Accra, Kumasi and Tamale.

3.8 Questionnaire design

The survey which involves the questionnaire was carried out to seek the view of contractor in respect to risk factors. A four pages questionnaire accompanied with a covering letter was delivered to 52 contracting companies.

The questionnaire used consisted of five sections in an attempt to satisfy the aim of the study. The sections are as follows:

1. The organization profile (contractor).
2. Identified risk factors and their severity.
3. Relative usage of risk preventive methods on projects
4. Relative usage of risk mitigative methods on projects.
5. Relative usage of risk analysis techniques on projects.

The appendix attached to this work provides details about the structure of the questionnaire.

3.9 Data collection

Data simply means proof. Scientific educational researches need data to buttress its argument. Data serves as the foundation for any research (Singh, 2006). It is the data which direct the researcher towards his aim. Data collection was solely done using a closed ended

questionnaire. The questionnaire was delivered to various respondents by the researcher and were collected back after the questionnaire had been filed within a scheduled time frame.

3.10 Data analysis

The study used the SPSS and Microsoft excel to analyze data. The results were analysed in percentages and figures using descriptive statistics and presented in the form of bar charts and tables. The Importance Index was also used to assess the severity of identified risk factors, relative of the various risk management practices and techniques. It was also used to rank the identified risk factors and the risk management practices being used by contracting firms.

In order to generate the result, the researcher used the Statistical Package for Social Sciences (SPSS) version 16.0. The Relative Importance Index (RII) helped in determination the severity of risk factors and the usage relativity of management practices. The Index is computed in Adnan et al. (2007) as:

$$\text{Importance Index} = \frac{\Sigma (1n1 + 2n2 + 3n3 + 4n4 + 5n5)}{5(n1 + n2 + n3 + n4 + n5)}$$

Where:

n1 - number of respondents who answered "very insignificant" n2 - number of respondents who answered "insignificant" n3 - number of respondents who answered "neutral" n4- number of respondents who answered "significant" n5- number of respondents who answered "very significant"

2.6 Chapter Summary

The chapter provided information on the research strategy, the research population and sample size, limitation of the study, data collection, procedures and the data analysis techniques used.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The results of the study is discussed in this chapter. The organizational profile of the responding firms starts off the discussion. The identified risk factors and their severity are

discussed. Furthermore the risk management practices such as (Preventive methods, Remedial methods and Risk Analysis Techniques) are also discussed.

Out of the 52 questionnaire that were issued to the target respondents, 41 valid response representing 78.85% was received.

4.2 Organization Profile of Respondents

The first section of the questionnaire asked for the participating firm‟s details, such as the position of the respondent in the firm or project, the class of the firm, Projects executed in Number of projects done in the last five years, Number of years of experience in construction.

Table 4.1 shows the breakdown of participant‟s organizational background information. The results shows that of the total of 41 participants, sixteen (16) management staff and at 39% made up the largest proportion of the total responses; Four Directors who participated made up the smallest proportion of the total, at 9.8%. Twenty-nine respondents were Senior Management staff, making up 29.3% of the total, and the remaining 22% was made up of nine Site/Office Engineers.

Table 4.1. Organizational Profile of Respondents.

	Contractor's Response	
	Valid Returns	**Percentage of Valid Returns**
Position		
Director	4	9.8%
Senior Management	12	29.3%
Management	16	39%

Site/Office Engineer	9	22%
Total	41	100%
Number of executed projects		
10 Projects or less	5	12.2%
11-20 Projects	24	58.5%
20-30 Projects	12	29.3%
Total	41	100%
Number of Construction Experience (Years)		
More than 3 years ≤ 5 years	4	9.8%
More than 5 years ≤ 10 years	8	19.5%
More than 10 years	29	70.7%
Total	41	100%

Source: Field Survey (2016)

Table 4.1 also gives information regarding the number of projects executed by the firms in the last five years.

The above tabled results indicate that the participating contractors who had executed 1120 projects made up the largest proportion of total responses at 58.5%. Twelve respondents with 20-30 executed projects in the last five years made up 29.3% of the total. The remaining 12.2% was made up of five contractors with ten or less executed projects.

The Table 4.1 also gives the number of years of experience of Contractors in construction.

The table shows that majority of the construction organisation numbering Twenty-nine and at 70.7% of the total have practiced or executed projects for more than ten years. 19.5% of the construction organisation representing eight respondents have between six to 10 years‟ experience in construction. Few of the organisation numbering four and at

9.8% have more than three years but less than five years.

Significant, much of the information used for this study is obtained from very experienced Contractors in terms of projects executed and from respondents (senior managers) who are at the decision making positions and thus will have better information regarding risk and its management in the firm and can be considered as expert judgement on behalf of the firm and thus credible for the purposes of the study carried out.

4.3 Risk Factors Identification and Severity

Part two of the questionnaire presented categorized Forty-two risk (42) factors that possibly affect construction projects.

4.3.1 Identified Risk Factors

The first objective of this work sought to identify risk factors that typically affect construction projects in Ghana. Respondents were required to indicate which of the categorized risk factors affect their project(s) by choosing "YES" against risk factors that affect their project(s) or "NO" for factors that usually don"t affect their project(s).

Table 4.4 below gives detail information on the identified risks based on the individual risks and as well as the categorized risk factors.

Table 4.2. Identified risk factors that affect Projects

Risk Factors			Valid Returns		Percentage of Valid Returns		Percentage of Valid Returns for Risk Category	
			Yes	No	Yes	No	Yes	No
Physical	RF1	Poor safety procedures resulting into Accident Occurrence.	37	4	90.2	9.8	30.1	3.3
	RF2	Supplies of defective materials	29	12	70.7	29.3	23.6	9.8

	RF3	Varied labour and equipment productivity	29	12	70.7	29.3	23.6	9.8
Environmental			**95**	**28**			**77.2**	**22.8**
	RF4	Acts of God	33	8	80.5	19.5	26.8	6.5
	RF5	Difficulty to access the site	21	20	51.2	48.8	17.1	16.3
	RF6	Adverse weather conditions	33	8	80.5	19.5	26.8	6.5
			87	**36**			**70.7**	**29.3**
Design	RF7	Defective design (incorrect)	41	0	100.0	0.0	16.7	0.0
	RF8	Not coordinated design	37	4	90.2	9.8	15.0	1.6
	RF9	Inaccurate quantities	37	4	90.2	9.8	15.0	1.6
	RF10	Inconsistency between bill of quantities, drawings and specifications	33	8	80.5	19.5	13.4	3.3
	RF11	Rush design	33	8	80.5	19.5	13.4	3.3
	RF12	Awarding the design to unqualified designers	37	4	90.2	9.8	15.0	1.6
			218	**28**			**88.6**	**11.4**
Logistics	RF13	Unavailable labour, materials and equipment	25	16	61.0	39.0	12.2	7.8
	RF14	Undefined scope of working	29	12	70.7	29.3	14.1	5.9
	RF15	High competition in bids	33	8	80.5	19.5	16.1	3.9
	RF16	Inaccurate project program	25	16	61.0	39.0	12.2	7.8
	RF17	Poor communications between the home and field offices	37	4	90.2	9.8	18.0	2.0
			149	**56**			**72.7**	**27.3**
	RF18	Inflation	41	0	100.0	0.0	16.7	0.0

Table 4.2 Cont'd

Financial	RF19	Delayed payments on contract	41	0	100.0	0.0	16.7	0.0
	RF20	Financial failure of the contractor	33	8	80.5	19.5	13.4	3.3
	RF21	Unmanaged cash flow	41	0	100.0	0.0	16.7	0.0
	RF22	Exchange rate fluctuation	37	4	90.2	9.8	15.0	1.6
	RF23	Monopolizing of materials due to closure and other unexpected political conditions	29	12	70.7	29.3	11.8	4.9
			222	**24**			**90.2**	**9.8**
Legal	RF24	Difficulty to get permits	29	12	70.7	29.3	14.1	5.9
	RF25	Ambiguity of work legislations	29	12	70.7	29.3	14.1	5.9
	RF26	Claims and disputes among the parties of the contract	29	12	70.7	29.3	14.1	5.9
	RF27	Delayed disputes resolutions	29	12	70.7	29.3	14.1	5.9
	RF28	No specialized arbitrators to help settle fast	21	20	51.2	48.8	10.2	9.8
			137	**68**			**66.8**	**33.2**
Construction	RF29	Rush bidding	33	8	80.5	19.5	13.4	3.3
	RF30	Misinterpretation of drawings and specifications leading to implementation gaps.	33	8	80.5	19.5	13.4	3.3
	RF31	Undocumented change orders	33	8	80.5	19.5	13.4	3.3
	RF32	Lower quality of work	17	24	41.5	58.5	6.9	9.8
	RF33	Changes in design	41	0	100.0	0.0	16.7	0.0
	RF34	Difference in actual and contract executed quantities	41	0	100.0	0.0	16.7	0.0
			198	**48**			**80.5**	**19.5**

Table 4.2 Cont'd

Political	RF35	Change of government	33	8	80.5	19.5	26.8	6.5
	RF36	Change of government policy	33	8	80.5	19.5	26.8	6.5
	RF37	New governmental acts or legislations	33	8	80.5	19.5	26.8	6.5
			99	**24**			**80.5**	**19.5**
Management	RF38	Ambiguous planning due to project complexity	25	16	61.0	39.0	12.2	7.8
	RF39	Resource management	37	4	90.2	9.8	18.0	2.0
	RF40	Changes in management ways	29	12	70.7	29.3	14.1	5.9
	RF41	Information unavailability (include uncertainty)	37	4	90.2	9.8	18.0	2.0
	RF42	Poor communication between team members	33	8	80.5	19.5	16.1	3.9
			161	**44**			**78.5**	**21.5**

Source: Field Survey (2016)

From the table of identified risk factors that affect projects above, it can be seen that all the suggested forty-two (42) risk factors with the exception of Lower quality of work risk factor (i.e. RF32) affect construction projects in Ghana although the identified risks is organizational and projects dependant.

On the individual risk factors, the following are the most identified risk factors that typically affect construction projects with hundred percent (100%) affirmative response:

1. Defective design (incorrect)
2. Inflation
3. Delayed payments on contract
4. Unmanaged cash flow
5. Changes in design

6. Difference in actual and contract executed quantities.

The table also shows some risk factors that were the least identified. From the table these risk factors were identified as less likely to affect construction projects in Ghana. The following with percentages in decreasing order have the least effect on construction projects:

1. Lower quality of work with 58.5%
2. Difficulty to access the site, No specialized arbitrators to help settle fast with 48.8%
3. Unavailable resources in terms of labour, materials and equipment, Inaccurate project work program, Ambiguous planning due to project complexity with 39.0%

The results was also considered from the Risk category view using the aggregated responses from the individual listed factors under each category to make a general statement on them.

From the tabled results the Financial risk category with a high aggregate affirmative response of 90.2% have more influence on risk effects on construction projects.

The Legal risk category on the other hand has a less aggregate affirmative response of 66.8% to reflect the fact that it is the least identified risk category that typically affect projects in Ghana.

4.3.2 Severity of Identified Risk Factors on Construction Projects

The study set a second objective of assessing the severity of the identified risks that typically affect construction projects in Ghana. Respondents were required to assign severity weight to the identified risk factors under each of the risk categories.

The results of the various identified risk grouped under their categories are tabled below with emphasis on the aggregate weight, Severity and risk class.

Table 4.3. Severity of Identified Risks

No.	Identified Risk Factors	Weight	Severity (1-3)	Risk Class
	PHYSICAL			
RF1	Poor safety procedures resulting into Accident Occurrence	95	2.57	High
RF2	Supplies of defective materials	59	2.03	Medium
RF3	Varied labour and equipment productivity	75	2.59	High
	ENVIROMENTAL			
RF4	Acts of God	75	2.27	High
RF5	Difficulty to access the site	39	1.86	Medium
RF6	Adverse weather conditions	75	2.27	High
	DESIGN			
RF7	Defective design (incorrect)	99	2.42	High
RF8	Not coordinated design	71	1.92	Medium
RF9	Inaccurate quantities	83	2.24	High
RF10	Inconsistency between bill of quantities, drawings and specifications	79	2.39	High
RF11	Rush design	75	2.27	High
RF12	Awarding the design to unqualified designers	95	2.57	High
	LOGISTICS			
RF13	Unavailable labour, materials and equipment	59	2.36	High
RF14	Undefined scope of working	63	2.17	High
RF15	High competition in bids	63	1.91	Medium

Table 4.3 Cont'd

RF16	Inaccurate project program	59	2.36	High
RF17	Poor communication between team members	75	2.03	Medium
	FINANCIAL			
RF18	Inflation	111	2.71	High
RF19	Delayed payments on contract	107	2.61	High
RF20	Financial failure of the contractor	75	2.27	High

RF21	Unmanaged cash flow	79	1.93	Medium
RF22	Exchange rate fluctuation	83	2.24	High
RF23	Monopolizing of materials due to closure and other unexpected political conditions	59	2.03	Medium
LEGAL				
RF24	Difficulty to get permits	51	1.76	Medium
RF25	Ambiguity of work legislations	55	1.90	Medium
RF26	Claims and disputes among the parties of the contract	59	2.03	Medium
RF27	Delayed disputes resolutions	69	2.23	High
RF28	No specialized arbitrators to help settle fast	39	1.86	Medium
CONSTRUCTION				
RF29	Rush bidding	71	2.15	High
RF30	Misinterpretation of drawings and specifications leading to implementation gaps	51	1.55	Medium
RF31	Undocumented change orders	67	2.03	Medium
RF32	Lower quality of work	35	2.06	Medium
RF33	Design changes	87	2.12	High
RF34	Difference in actual and contract executed quantities	103	2.51	High
POLITICAL				
RF35	Change of government	87	2.64	High
RF36	Change of government policy	79	2.39	High
RF37	New governmental acts or legislations	71	2.15	High
MANAGEMENT				
RF38	Ambiguous planning due to project complexity	55	2.20	High
RF39	Resource management	79	2.14	High

Table 4.3 Cont'd

RF40	Changes in management ways	43	1.48	Medium

RF41	Information unavailability (include uncertainty)	67	1.81	Medium
RF42	Poor communication between parties involved	75	2.27	High

Source: Field Survey (2016)

4.3.2.1 Severity of Physical Category

Results from the category show that Poor safety procedures resulting into Accident Occurrence is the most identified risk factor with a significant effect on projects, varied labour and equipment productivity was the second from importance in terms of weight and third was the Supplies of defective materials. Both Poor safety procedures resulting into Accident Occurrence and varied labour and equipment productivity have been classified as High Risk factors in construction projects. The results shows the important role safety procedural adherence play in achieving project objectives.

The position of supplied of defective materials as the least factor affecting construction projects is partly inconsistent with similar study conducted by Ahmed, et al. (1999) in a different environment in which it was concluded that the most important risks affecting construction projects are safety measures and defective materials.

4.3.2.2 Severity of Environmental Category

As observed from Table 4.3, Contractors considered Acts of God and Adverse weather conditions as significant high risk factors that affect construction projects in Ghana. The only classified medium risk under the environmental category was identified to be

Difficulty to access the site.

Since two out of the three environmental risks are classified as High Risk Factors, the environmental category impact on projects creates an atmosphere of uncertainty and the

consequences maybe unpleasant on the construction projects. It is worth noting that it is only the risk of Difficulty to access the site that is classified as Medium Risk Factor. Nonetheless this risk factor cannot be ignored as it may have a potential negative on the project.

Although the risk factors under the environmental category seldom occur, , the consequences of their occurrence can have a far reaching effect on the construction projects as it is evidenced by the most of the risk factors under the category being classified as High Risk Factors. These classification and nature of the environmental risk factors is reflective and consistent with the observation of (Kartam, 2001).

4.3.2.3 Severity of Design Category

The surveyed risks categorized under the Design category are usually considered critical to the success of construction projects. As illustrated in Table (4.3), the two most significant risk factors affecting construction projects in terms of design category are:

Awarding the design to unqualified designers with (2.57) severity and

Defective design (incorrect) with (2.42).

Since the design of a project most often is out of the contractors control, it can be inferred from the results that contractors are usually presented with incomplete design and/or insufficient information needed to execute the works. The consequences of this is that it exposes the contractor to a high design risks especially if proper documentation is not ensured. This is consistent with the results obtained in the works of Kartam (2001).

Among the risk factors under the design category, contractors assigned un-coordinated design as the only medium significance risks. The Contractors assessed the rest of the design categorized risk factors to be high significant risk factors as well.

4.3.2.4 Severity of Logistics Category

From Table (4.3) showing the contractor‟s assessed severity in respect of risk factors listed under the category of logistics, Contractors considered the risks of Unavailable resource (labour, materials and equipment) and Inaccurate project program are the two top rated risk factors with each having a severity of (2.36). The categorized risk factors under logistics are critical to the execution of construction projects. Undefined scope of working with severity of (2.17) and Poor communication between team members with severity of (2.03) were also identified as high risk to the construction projects. Contractors concern regarding this risk is a reflection of its occurrence. In order to address this, it is advised that contractors establish a well-structured communication channel with a central point of contact to coordinate affairs.

High competition in bids was identified to be the only classified medium risk with severity of (1.91) in construction projects.

4.3.2.5 Severity of Financial Category

Looking at table (4.3), most of the high rated significant risks assessed by the contractors are categorized under the Financial risks.

The inflation risk factor with severity of (2.71) is assessed by the contractors as the most significant high risk factor in the financial category that affect construction projects.

Financially the following may account for contractors‟ failure as posited by Hallaq (2003):

- Bank dependency with its associated high borrowing rates.
- Unavailability of capital.
- Inexperience in the execution of specific works.
- Lack of efficient cash flow management.
- Insufficient profit margin attributable to competition.

- Inexperience in matters relating to contracts.
- Offering contracts to a contractor using the lowest bidder criterion.
- Project completion.

Hallaq (2003), relates that the attention being offered by contractors regarding financial ratios vary and that bigger construction firms gives premium attention compared to the smaller firms.

Apart from unmanaged cash flow risk factor with a severity of (1.93) and classified as medium risk, all other risk factors listed under the financial category were deemed to be high risk factors by contractors. The classification of unmanaged cash flow as medium risk could result from the fact that it is more internally related to the Contractor‟s inhouse cash flow management rather than a direct bearing on execution of the projects.

4.3.2.6 Severity of Legal Category

The results from Table (4.6) relating to the legal category shows that Delayed disputes resolutions and Claims and disputes among the parties of the contract were identified as the most rated risk factors that affects construction projects. The results reflects the relevance of alternate dispute resolution in construction projects.

The rest of the identified risk factors under the category were rather marked as medium risk factors. This also indicates that contractors in Ghana do not suffer significantly from these medium classified risk factors, compared to situations in Hong Kong where getting a permit is a major requirement to the start of construction projects and therefore poses a great risk to contractors (Ahmed et al, 1999).

4.3.2.7 Severity of Construction Category

From table (4.3) risks within the construction category were mainly classified as high risks with the exception of Misinterpretation of drawings and specifications leading to implementation gaps.

The risk with the highest severity among the Construction category was identified by the Contractors to be Design changes.

The risk of rush bidding, Lower quality of work, Changes in design and undocumented change orders, were also identified as high risk factors and creates a picture where contractors pushed for payment for works done outside the scope since such claims cannot be made along the main works. Contractors concerned with the lower quality of work, implies that contractors are cost conscious and prefer spending quality time doing works than have repetition of works which will require expending of more resources to the disadvantage of the contractor. The risk of Misinterpretation of drawings and specifications which leads to implementation gaps which has been identified as a medium risk can but if not corrected and rightly interpreted can have a time effect on the works and possibly requiring redoing of some of the works.

4.3.2.8 Severity of Political Category

Table (4.3) features an all high classified risk factors associated with the political category. All the risk factors categorized under the political risks assessed by the contractors have been rated High Risk Factors.

Change of government with a severity of (2.64) was identified as the highest ranked risk factor in the political category. This can be attributed to the polarised nature of the country politically and because of difference in developmental agenda of political parties. New governmental acts or legislations was identified as the lowest ranked risk factor in the political category. It appears that respondents are less concerned with issues relating to

new acts or legislations compared to the other listed risk factors. The possible reason could be that because these acts have limited effects on construction issues.

4.3.2.9 Severity of Management Category

The results of the management category risk factors as illustrated in Table (4.3), shows that Poor communication between team members ranked first with (2.27) severity, ranked in second place was Ambiguous planning due to project complexity with (2.20) severity, Resource management with (2.14) severity was third.

Two risk factors were identified as Medium risk to construction projects namely: Information unavailability with (1.81) severity and Changes in management ways with (1.48).

The dominance of the classified high risk factors under the management category reveal the relevance of prudent management of construction projects.

4.3.3 Overall risk significance

Table (4.6) shows all the identified risk factors ranked according to their severity on construction projects.

The results indicate that Ghanaian Contractors considered the following as the top five significant risk factors that affect construction projects in Ghana:

1. Inflation with score of (111)
2. Delayed payments on contract with score of (107)
3. Design changes with score of (103)
4. Defective design (incorrect) with score of (99)
5. Poor safety procedures resulting into Accident Occurrence and Awarding the design to unqualified designers with score of (95)

The top least significant risk factors that affects construction projects in Ghana as identified by the Contractors are as follows:

1. Lower quality of work with score of (35)
2. No specialized arbitrators to help settle fast (39)
3. Difficulty to access the site with score of (39)
4. Resource management with score of (43)
5. Difficulty to get permits with score of (51)

On a general distribution of the classified risk factors, the results display that (61.90%) of the identified risk factors are assessed to be high significant risks by contractors and the medium risk factors accounted for (38.10%).

4.4 Risk Management Practices of Ghanaian Contractors

The third objective set in this study is to examine the risk management techniques that are practiced by Ghanaian contractors. The risk management actions as indicated on the questionnaire were grouped into Preventive methods, Remedial methods and Risk Analysis Tools and Techniques. Contractors were required to indicate how often they use each management method in their construction projects on a Likert scale of 1 to 5.

4.4.1 Preventive Risk Management Actions

From the results obtained (Figure 4.1), Ghanaian Contractors in managing risk by the preventive methods usually refer to previous and ongoing similar projects for accurate program and that is the most used preventive management method. In estimating for accurate time among the Ghanaian contractors, the use of quantitative risk analyses techniques is the least used preventative method when addressing risk issues.

In determining the likelihood of risk exposure and the outcomes, the experience of the contractor from similar projects is usually used and that is some form of subjective probability. These observations are correlated by the works of Kartam (2001). Such previous Judgment and experience from other projects can become pivotal source of information in aligning other project program control when time is of essence. With the changing nature of the construction environment, risk experts must work to ensure improvement in construction estimates. There is thus the need to have an enhanced project information as sole reliance on experience and judgement may be short of the right approach. Contractors believed that to have an effective risk preventive method, up-to-date project information and accurate time information will have to be considered.

In mitigating the effects of risks on construction projects, contractors seldom consider Primavera Monte Carlo program to be effective method. This is supported by Kartam (2001) in which he indicates that managers usually brainstorm on possible risk factors and then arrange tasks through the use of checklists.

This approach by managers could be due to the following:

Low level of knowledge and experience of analysis techniques and

The stress involved in obtaining the probability distribution for risk in practice In their quest to obtain accurate project program, Contractors prefer to refer to similar projects as it deemed to be the most effective preventive method.

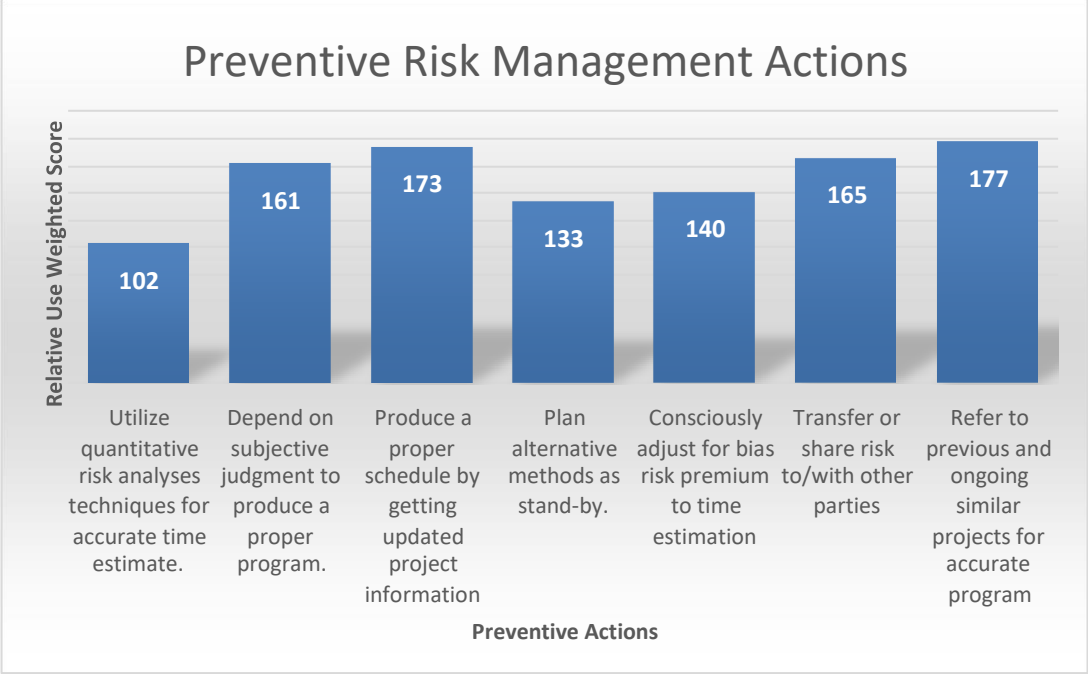

Figure 4.1. Relative Use of Preventive Risk Management Actions by Contractors Source: Field Survey (2016)

4.4.2 Remedial Risk Management Method (Actions)

The results of the six mitigative risk methods with their respective weighted score are displayed in Figure (4.2). The most used mitigative method as identified by the contractors is close supervision of subordinates whiles changing the construction method is the least used remedial method among the contractors.

In an effort to mitigate the negative consequences of construction projects, working and coordinating closely with subcontractors has been another most utilized method although placed second according to the weighted score as observed in Figure (4.2). The effect is that construction project progress is directly related to the collective input of available resources, since project activities usually entails a lot of man-hours in carrying out operations. Consequently, with the required resources available, increasing manhours will have a positive impact on the project progress.

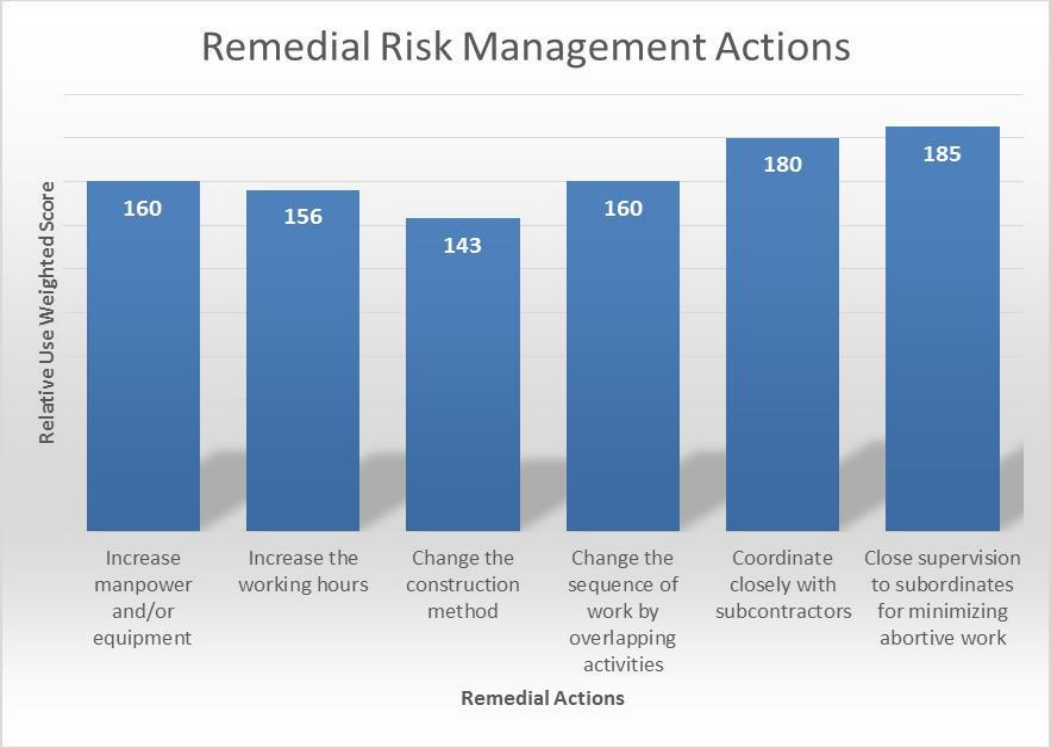

Figure 4.2. Relative Use of Remedial Risk Management Actions by Contractors Source: Field Survey (2016)

4.4.3 Risk Analysis Technique

The results displayed in Figure (4.3) shows that the use of comparison as an analysis technique is the most used Risk Analysis Technique by Ghanaian Contractors. Simulation analysis using simulator computer packages appears unpopular as it is the least used technique.

The results shows a deficit in knowledge and lack of experience in the application of the various risk analysis technique. In order to get an accurate risk estimation, there is a need for integration of expert techniques such as @Risk system and other relevant schedules and software.

Figure 4.3. Relative Use of Risk Analysis Techniques by Contractors Source: Field Survey (2016)

4.5 Chapter Summary

The chapter presented the findings of the study, descriptive statistics of the findings, quantitative data analysis of the data received and a discussion of the findings of the study. It touched on the findings in relation to the identified risks, the assessed severity from respondents and the risk management practices popular with contractors.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter submits the review of the research questions and objectives. The limitation of the study follows next and the conclusion of the study completes the chapter. Recommendations for further research are also highlighted. The concluding remarks of recommendations sums up this chapter.

This research was conducted with the aim of identifying construction project risk factors and their severity on construction projects. The relative usage of various risk management actions and the employed risk analysis techniques were also looked at. The study was conducted from the perspective of Ghanaian building contractors.

5.2. Summary of Findings

The research questions that were posed are as follows:

1. What are the risks that affect the Ghanaian Construction Industry?
2. To what extent do the identified risk affect the Construction?
3. What are the risk management techniques and practices being used to control the identified risks?

5.2.1 Identify risk factors that typically affect construction projects in Ghana The study objective number one was to identify the relevant risk factors in construction projects. Through the process of literature review, the identification and categorization of the relevant risk factors was done. A list of forty-two relevant risk factors (RF) were grouped within nine categories. Taking out Low quality of work risk factor, the other 41 listed risk factors have been identified to significantly affect construction projects in Ghana.

5.2.2 Assess the severity of the identified risks on projects

The study also sought to weigh the effects of the identified risk factors on construction projects by their severity. It emerged that most of the identified risk factors (61.90%) have been identified to be High Risk Factors and significantly affect construction projects. In a relative manner, (38.10%) of the risk factors have also been classified as Medium Risk Factors in respect of severity.

5.2.3 Examine the risk management techniques that are being practiced

The management of the identified risk and its impact is an area of interest to the study. The work took into consideration some Preventive and Remedial methods in risk management and as well Risk Analysis Techniques being used by the Contractors. In

preventive measures, reference to other projects (previous and ongoing similar projects) in order to obtain precise program with weighted score of (177) is the most used action in construction projects whiles the results shows that Contractors seldom employ the use of quantitative risk analyses techniques as it is the least scored weight with (102).

Examining risk management using the Remedial methods reveal that close supervision to subordinates is the most frequently use method in managing risk with a weight score of (185). Changing the construction method is not the first choice effective action when addressing risk using the remedial method as it is the least ranked action with weight score of (143)

The assessment of the relative use of Risk Analysis Techniques reveals that contractors usually compare analysis of similar projects through similar conditions with weighted score of (197) and use it as the most effective risk analysis technique in construction risk management. Simulation analysis using simulator computer packages is the least used Risk Analysis Technique with a weighted score of (109).

5.3 Conclusion

The construction industry has unique features that differentiate it from other areas of the economy. It is widely dispersed, responds to economic changes, and involves large number of firms. These and among other distinguishing characteristics makes it risk prone. The study thus concludes as follows:

1. Almost all the risk factors reviewed affect construction projects in Ghana,
2. Majority of the identified risks have significant effects on construction projects with (61.90%) classified as High Risk Factors,
3. The finance category has the highest severity impact on construction projects,

4. The Physical category has the lowest severity impact on construction projects.

The top ten (10) ranked risk factors affecting construction projects in Ghana are as follows:

1. Inflation
2. Delayed payments on contract
3. Difference in actual and contract executed quantities
4. Defective design (Incorrect)
5. Poor safety procedures resulting into Accident Occurrence
6. Awarding the design to unqualified designers
7. Changes in design
8. Change of government
9. Inaccurate quantities 10. Exchange rate fluctuation

a) Contractors reference to other projects (previous and ongoing similar projects) for accurate program is the most used Preventive method for risk management purposes

b) Ensuring close supervision to subordinates in order to minimize abortive work is the most used Remedial method for managing risk

c) Contractors comparing analysis of similar projects through similar conditions is the most used Risk Analysis Technique by Ghanaian contractors.

5.4 Recommendation

1. Inflation and routine fluctuation in exchange rate fluctuation should be needs to be looked at as a significant risk factor by stakeholders and appropriate compensation mechanism be put in place to mitigate or offset the impact of this risk on the financial wellbeing of the Contractor.

2. The payment regime for executed contracts should be streamlined to offer financial stability to Contractors. This can help contractors from collapse of their financial resources by using strict and enhance cash flow system and reduce the option of reliance on financial institutions loans.
3. The Contractor needs to be involved with a competent designer in the design process of projects to prevent situations where defective designs are passed to the Contractor and subsequently have to redo the works because of design changes.
4. Contractors should look at integration of various expert risk management system with other schedules and systems already being operated such as Microsoft Project and Microsoft Excel.
5. Training of staff towards the risk and its management should be a priority in order to advance the business of the firm.
6. This study is limited to the contractors, but future research on the topic should take into consideration the client and the project consultant perspective. Future research should also look into the allocation of risks on a construction project.

5.5 Chapter summary

The chapter looked at the summary of findings in relation to the identified risks, the assessed severity of the identified risks and examined the risk management techniques that are being practised. Based on the summary of findings, conclusion and recommended were made. Recommendations on future research on the topic of risk management were also made to help close the gaps left by this study.

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APPENDIX – QUESTIONNAIRE

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF ART AND BUILT ENVIRONMENT

DEPARTMENT OF BUILDING TECHNOLOGY

Dear Sir/Madam,

QUESTIONNAIRE SURVEY: EXPLORING PROJECT RISK MANAGEMENT PRACTICES OF GHANAIAN BUILDING CONTRACTORS.

I am currently undertaking a study aim at assessing risk management practices of Contractors in Ghana.

In addressing the stated aim, I am conducting a questionnaire survey to solicit information from contractors in Ghana. This study will help in assessing identified risks and the management practices being employed in addressing them. This will help in suggesting best risk management practices in the Construction Industry.

This study is solely for academic purposes and your responses will be treated as STRICTLY CONFIDENTIAL. Participating Contractors will be provided with the findings of the study upon request.

I would like to thank you for accepting to assist and cooperate towards this study.

Yours Sincerely,

MOHAMMED MABRUK ALHASSAN

MSc Researcher

Email – sirmabruk@yahoo.co.uk

Tel: 0246215202/0509065555

First Part: Organization Profile

1- The position of the respondent:

☐ Director ☐ Deputy Director

☐ Project Manager ☐ Site/Office Engineer

☐ Other (please specify):

2- Number of executed projects in the last 5 years

☐ 10 Projects or less ☐ 11-20 Projects

☐ 20-30 Projects ☐ 31- 40 Projects

☐ More than 40 projects

3- Experience of the organization in construction (Years)

☐ 1 year or less ☐ 1-3 years

☐ More than 3 years -5 years ☐ More than 5 years – 10 years

☐ More than 10 years

Part 2-A: Risk Factor, Severity and Allocation

1. Below is the table which contains the risk factors, please indicate "YES" for risk factors that typically affect your projects and "NO" for those that don't affect your projects. Assign the severity of each "YES" response factor.

Symbol	Meaning
1	Low risks
2	Medium risks
3	High risks

		Factors	*Affect Projects*		Severity

	Risk Category		YES	NO		1	2	3
RF	**Physical**	Poor safety procedures resulting into Accident Occurrence	☐	☐		**2** ☐	**5** ☐	**9** ☐
RF		Supplies of defective materials	☐	☐		☐	☐	☐
RF		Varied labor and equipment	☐	☐		☐	☐	☐
RF3	**Environmental**	p Aroducts cotfi vGitody	☐	☐		☐	☐	☐
		Difficulty to access the site	☐	☐		☐	☐	☐
RFRF		Adverse weather conditions	☐	☐		☐	☐	☐
RF	**Design**	Defective design (incorrect)	☐	☐		☐	☐	☐
		Not coordinated design	☐	☐		☐	☐	☐
RF		Inaccurate quantities	☐	☐		☐	☐	☐
RF10		Lack of consistency between bill of quantities, drawings and	☐	☐		☐	☐	☐
RF11		s Rpeucshif icdaetsionigns	☐	☐		☐	☐	☐
RF12		Awarding the design to unqualified designers	☐	☐		☐	☐	☐
RF13	**Logistics**	Unavailable labour, materials and equipment	☐	☐		☐	☐	☐
RF14		Undefined scope of working	☐	☐		☐	☐	☐
RF15		High competition in bids	☐	☐		☐	☐	☐
RF16		Inaccurate project program	☐	☐		☐	☐	☐
RF17		Poor communications between the home and field offices	☐	☐		☐	☐	
RF18	**Financial**	Inflation	☐	☐		☐	☐	☐
RF19		Delayed payments on contract	☐	☐		☐	☐	☐
RF20		Financial failure of the contractor	☐	☐		☐	☐	☐
RF21		Unmanaged cash flow	☐	☐		☐	☐	☐
RF22		Exchange rate fluctuation	☐	☐		☐	☐	☐
RF23		Monopolizing of materials due to closure and other unexpected	☐	☐		☐	☐	☐
RF24	**Legal**	poDiflfitiiccuallt y contod giteiot npse rmits	☐	☐		☐	☐	☐
RF25		Ambiguity of work legislations	☐	☐		☐	☐	☐

Part 2-B:

	Risk Category	Factors	Affect Projects		Severity		
			YES	NO	1	2	3
RF26	Legal	Legal disputes during the construction phase among the	☐	☐	2 ☐	5 ☐	9 ☐
		Dpaerlatiyeesd o df itshpeu tceosn trreascto lutions	☐	☐	☐	☐	☐
RF28		No specialized arbitrators to help settle fast	☐	☐	☐ ☐	☐ ☐	☐ ☐
RF29	Construction	Rush bidding	☐	☐	☐	☐	☐
RF30		Gaps between the Implementation and the specifications due to misunderstanding of drawings and	☐	☐	☐	☐	☐
RF31		Undocumented change orders	☐	☐	☐	☐	☐
RF32		Lower quality of work .	☐	☐	☐	☐	☐
RF33		Changes in design	☐	☐	☐	☐	☐
RF34		Difference in actual and contract executed quantities	☐	☐	☐	☐	☐
RF35	Political	Change of government	☐	☐	☐	☐	☐
RF36		Change of government policy	☐	☐	☐	☐	☐
RF37		New governmental acts or legislations	☐	☐	☐	☐	☐
RF38	Management	Ambiguous planning due to project complexity	☐	☐	☐ ☐	☐ ☐	☐ ☐
RF39		Resource management	☐	☐	☐	☐	☐
RF40		Changes in management ways	☐	☐	☐	☐	☐
RF41		Information unavailability (include uncertainty)	☐	☐	☐ ☐	☐ ☐	☐ ☐
RF42		Poor communication between parties involved	☐	☐	☐	☐	☐

Remedial Methods

1. **In the table shown below, please determine the relative use of each preventive method in the table:**

I	Preventive Method	Never 1	Rarely 2	Sometim 3	Often 4	Always 5
	Utilize quantitative risk analyses techniques for accurate time	☐	☐	☐	☐	☐

RM2	Depend on subjective judgment to produce a proper program.	☐	☐	☐	☐	☐
RM3	Produce a proper schedule by getting updated project information	☐	☐	☐	☐	☐
RM4	Plan alternative methods as stand-by.	☐	☐	☐	☐	☐
RM5	Consciously adjust for bias risk premium to time estimation	☐	☐	☐	☐	☐
RM6	Transfer or share risk to/with other parties	☐	☐	☐	☐	☐
	Refer to previous and ongoing similar projects for accurate	☐	☐	☐	☐	☐

3. In the table shown below, please determine the relative use of each Mitigative method in the table:

I	***Remedial Method***	Never **1**	Rarely **2**	Sometimes **3**	Often **4**	Always **5**
	Increase manpower and/or equipment	☐	☐	☐	☐	☐
MM2	Increase the working hours	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐
	Change the sequence of work by overlapping activities	☐	☐	☐	☐	☐
	Coordinate closely with subcontractors	☐	☐	☐	☐	☐
MM6	Close supervision to subordinates for minimizing abortive work	☐	☐	☐	☐	☐

Part 2-C: Risk Analysis Techniques

4. The table below contains some techniques used in risk analyses, please assign the relative use of each technique:

	Risk Analysis Technique	Never **1**	Rarely **2**	Sometim **3**	Often **4**	Always **5**
	Expert Systems (including software packages, decision support systems computer-based analysis techniques such as @Risk	☐	☐	☐	☐	☐
	Probability analysis (analyze historical data)	☐	☐	☐	☐	☐

RA	Sensitivity analysis	☐	☐	☐	☐	☐
	Simulation analysis using simulator computer packages	☐	☐	☐	☐	☐
	Direct judgment using experience and personal skills	☐	☐	☐	☐	☐
RA	Comparing analysis (compare similar projects through similar conditions)	☐	☐	☐	☐	☐

Thank you for your time