Assessment of effects of construction risks on project delivery among contractors in Kenya

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A thesis submitted in partial fulfillment for the degree of Master in Construction Project Management in the Jomo Kenyatta University of Agriculture and Technology

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DECLARATION

This thesis is my original work and has not been presented for a Degree in any other University.

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This research proposal has been submitted for examination with our approval as supervisors.

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DEDICATION

This research Thesis is dedicated first and foremost to the Lord almighty, who sustained me right through it all. In addition this Research is dedicated to my wife Esther for her compassionate love, encouragement and unfailing support and to my children Njogu, Waithira, Muiruri and Waweru who stood with me and believed in me. To all those who ceaselessly stood with me in prayers, this Research is dedicated to you as well.

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ABSTRACT

The construction industry is crucial in the country's economy growth. The Kenyan construction industry has been contributing immensely towards the Gross Domestic Product (GDP), Gross Fixed Capital Formation (GFCF) and employment. Despite this acclaim, studies in recent years have shown poor performance of construction projects. This has among other things provoked increased interest in the nature and mechanism of risk analysis and management. The main objective of this study was to determine the extent to which construction risk affects project delivery among contractors in Kenya. The study assessed the likelihood of occurrence of construction risks and their impact on project objectives namely cost, time, quality, environment and health and safety. Risks were ranked thus determining the key risks influencing project delivery. This study was conducted through a review of literature and a self-administered structured questionnaire to the contractors. Contractors registered by the National Construction Authority in category NCA 5 and above were targeted. A sample of 190 respondents was selected through stratified random sampling to participate in this study. Senior managers, project managers, technical managers, architects, quantity surveyors and engineers were the respondents in this study; one professional was selected from every contractor included in the sample. Data analysis involved cleaning, sorting and coding of raw data collected from the field and processing for purposes of interpretation by use of statistical package for social science (SPSS) and Microsoft Office Excel. The data provided by the questionnaires was analyzed using both descriptive and inferential statistical methods. Findings were presented using statistical tools like pie charts, graphs and tables. Based on a comprehensive assessment of the risks probability and their impact on the project objectives, the study identified and ranked 23 key risks affecting project delivery. Finally this study made recommendations to contractors on risk management procedures and strategies aimed at improving project delivery. It also recommended areas of future research.

Key words: *risk, risk management, key risks, construction projects objectives, project delivery*

CHAPTER ONE

INTRODUCTION OF THE STUDY

1.1 Background of the study

The construction industry is vital to every country's economy. The role and the importance of the industry in the development of a country need not be over emphasized. The Kenyan construction industry contributes significantly in terms of scale and share in the development process of the country. According to the Kenya Bureau of Statistics, the construction industry contributed 4.2%, 4.1%, 4.2%, and 4.4% towards the Gross Domestic Product (GDP) for the years 2010, 2011, 2012 and 2013 respectively (Republic of Kenya, 2014). This is apparent that the output from the construction industry is a major and integral part of the national output, accounting for a sizeable proportion in the Gross Domestic Product (GDP) of the country. The industry also generates products that are the necessary public infrastructure and private physical structures for many productive activities such as services, commerce, utilities and other industries. The industry is not only important for its finished product, but it also employs a large number of people (directly and indirectly) and therefore has an effect on the economy of a country/region during the actual construction process. In Kenya the industry employed 100,100 people in 2010, 106,000 people in 2011, 116,100 people in 2012 and 130,300 people in year 2013 (Republic of Kenya, 2014).

In recent years, poor performance of construction projects has provoked an increased interest into the nature and mechanism of risk analysis and management (Smith *et al.*, 2006). They have observed the industry as having a very poor reputation for coping with the adverse effects of change, with many projects failing to meet deadlines and cost and quality targets. Mbatha (1986), Talukhaba (1988) and Mbeche and Mwandali (1996) in their studies have established that project time and cost are greatly affected. 70% of project initiated are found to have time overruns of over 50 % while 50 % of the project have cost escalation exceeding 20 percent. This is attributed to risk factors influencing the project objectives.

Construction risks have been mostly found to exhibit dynamism and continuity across a project's life cycle (Chan *et al.,* 2009; Nieto-Morote & Ruz-Vila, 2010). Mark, Cohen and Glen (2004) have defined a risk as potential for complications and problems with respect to the completion of a project and the achievement of a project goal. In addition, the impact or consequences of this future event must be unexpected or unplanned (Chia, 2006). Construction project risks can be defined as an uncertain event or condition that, if it occurs, has a negative effect on at least one project objective, such as time, cost, or quality (Jomaah, Bafail, & Abdulaal, 2010). Risks are therefore threats to project delivery. Failure to adequately deal with risks has been shown to cause cost and time overruns in construction projects (Andi, 2006). Trying to eliminate all risks in construction projects is impossible. However, it is well accepted that a risk can be effectively managed to mitigate its' adverse impacts on project objectives, even if it is inevitable in all project undertakings. Sources of risks includes inherent uncertainties and issues relative to company's fluctuating profit margin, competitive bidding process, weather change, job-site productivity, the political situations, inflation, contractual rights, and market competition (KarimiAzari *et al.*, 2011). It is important for the construction companies to face these risks by assessing their effects on the project objectives. Risk management helps in deciding which of the project is more risky, planning for the potential sources of risk in each project, and managing each source during construction (Zayed, Amer, & Pan, 2008). It is important that risk is distinguished from uncertainty. Smith, Merna, and Jobling, (2006) defines uncertainty as a chance of occurrence of some event where the probability and distribution is not known. They distinguish uncertainty from risk as being where the outcome of an event or a set of outcomes can be predicted on the basis of statistical probability. This implies that there is some knowledge about a risk as opposed to an uncertainty about which there is no knowledge.

1.2 Statement of the problem

According to Kishk and Ukaga (2008) the success of any project is judged by the satisfaction of stakeholders' needs and is measured by the extent of meeting standards laid down at the start of the project. This is in regard to delivery of construction projects by contractors within budget, time, quality, environment, safety and performance. Hayes, Perry, Thompson and Wilmer (1986) observe that construction industry is one of the most dynamic, risky and challenging business nevertheless, the industry is characterized by poor management of risks with many projects failing to meet deadlines and cost targets. Studies carried out in Kenya by Mbatha (1986), Talukhaba (1988) and Mbeche et al. (1986) have supported these observations. Wanyona (2005) attributes risks related to project finance to the ineffective cost planning and control of building projects by the cost consultants. Al-Bahar and Crandall (1990) noted that the risk management performed in the construction industry had traditionally been of gut feel or series of rules-of-thumb and most of the times risks are either ignored or handled in an arbitrary way. Because of the complex nature of construction projects, this approach has resulted to delays, litigation and even bankruptcy (Hayes *et al*. (1986). Kishk and Ukaga (2008) note that the degree of risk management process undertaken during the project lifecycle impacts directly on the project success. Failure to manage construction risks in a systematic way make the project suffer in cost overruns, delayed completion, non-completion or may fail to meet the quality specifications and the benefits they were intended for.

Against this background the principal problem researched is:

> *"Contractors are faced with several risks in their construction business and fail to meet the principal project objectives of budget, time, quality, environmental conservation and health and safety. This has been attributed to lack of knowledge of key risks influencing each of the objectives and how best to manage them"*

This research therefore, undertakes to assess construction risks likelihood of occurrence and their impact on project objectives then determine the key risks affecting project objectives and consequently project delivery.

1.3 Objectives of the study

1.3.1 General Objective

The main objective of this study is to determine the key construction risks which affect project delivery by contractors and to recommend to contractors adequate risk management strategies**.**

1.3.2 Specific Objectives

The study will be guided by the following specific objectives.

i. To assess the likelihood of occurrence of construction risks among contractors in Kenya.
ii. To assess the impact of construction risks on project objectives among contractors in Kenya.
iii. To rank risks depending on their significance in relation to project objectives.
iv. To determine the key risks related to project delivery among contractors in Kenya.

1.4 Research Questions:

The project was geared towards answering the following questions:

i. What is the likelihood of occurrence of construction risks among contractors in Kenya?

ii. What is the impact of construction risks on project objectives among contractors in Kenya?

iii. What is the order of significance of construction risk in relation to the different project objectives?

iv. What are the key risks related to project delivery among contractors in Kenya?

1.5 Justification of the study:

Criticism of the construction industry has arisen because of projects that have taken a longer time to complete than stipulated (Aibinu & Jagboro, 2002). The possible reasons for these are: budget overruns; a large number of claims and litigation; technical; social; physical; economic, and political factors. All these constitute risk factors which contractors need to analyze in order to deliver on project objectives. The consequences of delays in project delivery are grave, ranging from litigation to claims and disputes, to outright abandonment of the project. Aibinu and Jagboro (2002) support these assertions by declaring that the contribution of the construction industry to national economic growth necessitates efforts geared towards improving construction efficiency by means of precision and cost-effectiveness. They believe that such effort will be beneficial and contribute to cost saving for the country as a whole.

Dawood *et al.* (2001) claim that in the current practices in the construction industry there is a lack of structured methodology of assessing risks and cost escalation in the construction project. Various risk factors ranging from design changes to high cost of materials; machinery and labour has resulted to cost escalation causing the construction industry to suffer for lack of predictability.

Khosravi and Afshari (2011) have identified time, cost, quality, environmental and safety requirement fulfillment as the main criteria in measuring the overall success of construction projects. This study will identify key construction risks affecting construction projects in terms of these objectives and suggest risk management measures and strategies to contractors for improving their risk management capacity consequently performance.

1.6 Significance of the study

The findings of this research would inform the contractors, Government and other Public and private sector bodies on key construction risks which affect project delivery. Construction risks affects all industry players both client and contractors and cause cost overrun and delays in project.

The state, corporations, contractors and other stakeholders in the construction industry would benefit from this study because it highlights key construction risks which when mitigated would augment project delivery. When the recommended risk management measures and strategies are realized, there should be improved contractor risk management capacity consequently performance is guaranteed. The information gathered and presented in this study will serve as a guideline in the decision making for the parties concerned.

For researchers and academicians, this study would add to the existing body of knowledge thereby acting as a source of reference. In addition, this study has provided areas for further research where future scholars could explore to widen the knowledge base on construction management.

1.7 Scope of the study

The study was carried out among contractors registered in Kenya, with the National Construction Authority (NCA). Contractors in category NCA 1 to category NCA 5 were considered. The choice of NCA is because it is believed to be a representation of the entire construction industry since they operate under a formal organization and is a criterion for choosing a contractor for a project in Kenya. Contractors in categories NCA 1, NCA 2, NCA 3, NCA 4 and NCA 5 were chosen because of their expertise in the construction industry. They have handled large number of big projects and have highly qualified staff with extensive knowledge in construction activities (Appendix 4 and 5).

The scope of this research was limited to only five project objectives. These are: Project cost, Project time, Quality, Environment and Health and Safety. The selection for these variables was arrived at after an exhaustive literature review (Chapter 2) to determine which variables to consider for this research.

Project Management Institute (2013) defines project risk as an uncertain event or condition that, if it occurs, has positive or a negative impact on one or more of the project objectives. For the purpose of this study the negative impacts were considered. These includes time overruns; cost overruns; compromised quality standards and specifications; compromised environmental requirements; and compromised health and safety requirements.

1.8 Limitations of the study

The study realized minimal challenges in data collection as some of the respondents especially the consultants felt uncomfortable to respond to some sections of the questionnaire due to their role in advising the contractors on the project delivery. There was also fear that some respondents would give false statement regarding risks. To counter this check questions had been introduced in the questionnaire. A pilot study was also carried out to test the questionnaires and to ensure that the questions were clear to the respondents and were comfortable with them.

1.9 Definition of terms

i) **Risk -** uncertain event or condition which if it occurs has positive or negative effect on project objectives (PMI, 2013).

ii) **Key risks -** these are risks that significantly influence the the delivery of construction projects (Zou, Zhang & Wang, 2006).

iii) **Risk probability -** is the likelihood that a risk will occur (PMI, 2013).

iv) **Risk impact-** is the effect on project objectives if the risk event occurs(PMI, 2013).

v) **Risk trigger -** risk symptoms or warring sign, indicators that a risk has occurred or is about to occur. (PMI, 2013).

vi) **Risk management-** Risk management is the systematic application of procedures to the task of identifying and assessing risks and then planning and implementing risk responses (TSO, 2009).

vii) **Project success** – Project that meets the time target, budget, quality requirements, health, safety and environment and client satisfaction (Khosravi & Afshari, 2011).

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter looked into past research on several areas related to construction industry, project objectives and risk management. The purpose was to review what others had done in relation to construction risks, determine why the problem of risk impact on construction projects still persists and try fill the existing research gap in risk management and project delivery.

Due to the one-off nature of construction projects there is no one best way to manage them. Therefore contingency theory was considered as an appropriate theoretical framework for this study. A conceptual framework was also constructed for this study.

The study also endeavored to establish the role of the construction industry globally, in Africa and in Kenya. This showed that the construction industry is important to the economy, not only in Kenya but all over the world.

Different risks influence the project at different stages of construction and at varying magnitude. This study has explored the process of construction and determined the stages most vulnerable to construction risks. Construction objectives were exhaustively reviewed. Five objectives, that is, cost, time, quality, environmental performance and health and safety were found to be more significant in determining project delivery and were considered in this research.

Risk and risk management process was then reviewed in detail. Risk management process has been divided into six stages, namely, risk planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response and risk monitoring and control. This review helped to appreciate what others has contributed in relation to risk management.

Existing risk management systems are not sufficient for managing risks and the key barrier to proper risk management is lack of adequate management mechanisms. This study has assessed what is currently happening in Kenya in relation to the effect of risks on project delivery.

2.2 Theoretical framework

Oxford Advanced Learner’s Dictionary (2015) defines a theory as an assumption or a system of ideas intended to explain something; especially one based on general principles independent of the thing to be explained. Camp (2001) defines a theory as a set of interrelated constructs, definitions, and propositions that present a rational view of phenomena by explaining or predicting relationships among variables for example, relationships, events, or a behavior. He further defines theoretical framework as set of theoretical assumptions that explain the relationships among a set of phenomena. A theoretical framework has provided a rationale for predictions about relationships among variables in this research study thus has served as a guide to systematically identify logical, precisely defined relationships among these variables.

2.2.1 Nature of construction projects and risks

Before looking into the appropriate theoretical framework for this study, it is important to understand the nature of construction projects and the nature of risks influencing the objectives of these projects. According to PMI (2013), all projects are temporary, unique, and portray a progressive elaboration. Construction projects are no exception. They are dynamic, require a lot of finance, encompass complex procedures, have lengthy duration of operation in offensive environment and involve dynamic organizations. (Ghahramanzadeh, 2013). Dikmen, Birgonul and Arikan (2004) point out that the construction project has high number of parties involved in the achievement of its goals and objectives and one off nature of the construction process. Table 2.1 below shows these unique characteristics.

Table 2.1 Unique characteristics of construction projects

Category	**Unique characteristics**
Internal characteristics	• Diverse stakeholders in the project • Involves major capital investments • Great diversity of end users • Many work sites and use of large, mobile equipments • Works not movable • Often high-value and long lasting
External Environment	• Prone to natural hazards (floods, lightning, earthquakes, storm) • Site conditions • Surrounding vegetation, structures/properties • Theft, war, unproductive labour strikes
Management aspects	• Contractual obligations • Cost control • Time control of a length period spanning from planning, investigation, design construction and completion of construction project • Quality control • Contract management involves temporary project management teams put together to complete the project • Environment protection • Health and safety management

Source: Lui, Li and Zhang (2004)

The unique nature of construction project makes it complex and subject to serious management challenges. The geographical dispersion, significant number of players, technical variability, technical complexity and large number of inputs are some of the variables that make construction projects challenging (Baloi, 2012).

These characteristics of construction projects explain why the construction projects are prone to many risks. These risks have varying probability and impact on project objectives differently. Construction risks, as shall be seen later in chapter 4, have underlying relationships in relation to their impact on project objectives. A change in one of the risks may trigger a change in another risk thus making management of risks in construction projects a complex exercise.

2.2.2 Contingency theory in context of construction risk management

There are a number of theories that can be drawn upon developing risk management strategies. Among all these theories related to management and risk management, contingency theory was found to be the best suited for this study. This is in reference to the nature of construction projects and the concept of risk. Each construction project is unique and with its own complexities therefore should be managed according to its specific characteristics and environment in the particular period of time. Contingency thinking recognizes the uniqueness and complexities of construction projects and attempts to identify practices that best fit with the unique demands of different situations. This therefore highlights the complexity involved on managing of risks in construction projects.

The application of various management tools and techniques must be appropriate to the particular situation because each situation presents unique problems. This theory rejects the idea that there is one best way to manage because of the varying management situations (Ghahramanzadeh, 2013). According to Mutema (2013), contingency theory takes into account the interaction and interrelation between the organization and its environment. This includes the recognition and accommodation of those elements that cannot be controlled. He articulates that contingency theory involves recognizing that those elements that can be controlled and influenced must be addressed in ways that vary depending on prevailing situations. In applying this theory it is emphasized that each project is unique and has got its own specifications which therefore requires suitable management practice according to its situation and specifications.

Contingency theory recognizes that there are a range of contextual variables (risk factors), each influencing the projects objectives differently. Examples of these variables are: External environment, technology, organizational structure and size, cost, culture, people involved, strategy. The theory focuses on the relationship between these contextual variables and the organization. These variables (risks factors) influence the organization and therefore the projects they are implementing. As a result, to manage any project the specific variables associated with it should be considered and evaluated (Gong & Tse, 2009).

Zeithaml *et al*. (1988) conceptualizes contingency theory-building as involving three types of variables: contingency variables, response variables and performance variables. Contingency variables represent situational characteristics which are exogenous to the project manager or organization. Response variables are the managerial or organizational actions taken in response to the current or probable contingency factors. Performance variables are the dependent measures and present specific aspects of effectiveness that are suitable to evaluate the fit between contingency variables and response variables for the situation under consideration. This study thus employed the contingency theory by establishing the various risks that influence the different performance objectives and determining appropriate response measures to improve performance of contractors.

Despite the fact that contingency thinking rejects the existence of “one best way” for managing risks it proposes “one most appropriate” approach for each specific situation (Ghahramanzadeh, 2013). Smith *et al.* (2006) asserts that projects are heavily influenced by external factors and they also influence the world outside them. These external factors are termed as the project environment. The interactions and interrelations between the organization and its environment make it prone to several external risks. According to Zeithaml *et al.* (1988) effectiveness in any organization can be achieved in more than one way. For example responding to risk with an aim of reducing their impact on project. However, she claims that each way is not equally effective under all conditions and situations. The contingency approach suggests we can employ various response strategies to varying situations to achieve effectiveness. Therefore, “one best way” to manage all the construction project risks cannot be defined and for this study the most appropriate way depends on the nature of environments in which projects are taking place. In our case we are considering the Kenyan construction environment. So, contingency theory is used in this study in order to describe an approach in managing of risks of construction projects that best suits the current Kenyan situation. Construction risks have varying influence on particular project objectives and hence the contingency theory is appropriate for this study in relation to the situation in Kenya.

2.2.3 Contingency cost allocation

The focus of this study is managing risk of construction projects and asserting that due to one-off nature of the projects there is no one best way to manage them. Several unavoidable outcomes of a construction project may lead to adverse impacts on time, cost, quality, safety and environment. Contingencies are crucial to achieving project objectives. Buerty, Abeere-Inga and Kumi (2009) assert that a contingency is an amount of funds needed above the estimate cost of a project to buffer against the risk of overruns of project objectives to a level acceptable to the organization or project management team. Contingency is therefore predominantly created for elimination or mitigation of adverse impacts of unforeseen events and therefore improves performance. Ghahramanzadeh (2013) finds a contingency cost as a significant element of contingency theory for confronting these uncertainties. He suggest that it is important when preparing estimate for construction projects to include a contingency to cater for some costs which cannot be readily determined or they are significant in aggregate but too small to be estimated individually.

Contingency allowance can be determined through various approaches. According to Aibinu and Jagboro (2002) contingency allowance allocation in most cases is based on assumption and intuition. A study they did in Nigeria revealed that a fixed value of 5-10% of pre-contract estimate is in most cases allowed. Ghahramanzadeh (2013) also notes that the same percentage on total costs has been suggested by many text books to be added to project cost as the contingency allowance.

However, given that construction projects are unique, as they may have distinctive set of objectives, require distinctive technical approaches to achieve the expected results, vary in terms of design, geographical location, players et cetera., the common traditional practice of allocation of a fixed percentage (ranging from 5% to 10%) of the estimated budget or the contract value as the contingency may not be adequate and is inappropriate (Aibinu & Jagboro, 2002). In their study in Nigeria, they found that 17.34% of project cost estimate should be included in the pre-contract estimate as a contingency. Study by Gwaya, Masu, and Wanyona (2014) has come up with an empirical model for estimating contingency allowance rather than the intuitive way of fixing 5% or 10% and has fixed contingency for construction projects at 14.5%. From his professional experience, Ghahramanzadeh (2013) appreciate that the complexity of the construction projects and inherent uncertainty in their implementation and involved parties' performance make it very difficult to forecast their precise budget. As a result of this, it is necessary to include a contingency as a funding source in projects budget in order to cater for these deviations. Contingency cost should be adequate to cover the impacts of risks but not to exceed the needs of the project.

To avoid assumptions and consequent errors, Ghahramanzadeh (2013) provides that contingency may be derived through statistical analysis of past projects, by applying experience or through a projection based on assessed probability of what may occur. This explains why the fixed range of (5-10%) cannot be allocated to all construction projects. The range for each project is dependent on various factors specific to that project as earlier mentioned. In view of the preceding literature, it is patent that the contingency theory is risk-based, it can be sufficient to manage risks and consequent realization of project objectives.

2.3 Conceptual Framework

A concept is an image or symbolic representation of an abstract idea. Chinn and Kramer (1999) define a concept as a "complex mental formulation of experience". A conceptual framework is a structure of concepts and theories which are pulled together as a map for a study. Figure 2.1 represents a conceptual framework for this study. This study seeks to explore the effect of risks on project objectives. Project objectives investigated were cost, time, quality, environment and health and safety. Risks are supposed to be managed to reduce their likelihood and impact on the project objectives. This ensured the achievement of these objectives thus project success.

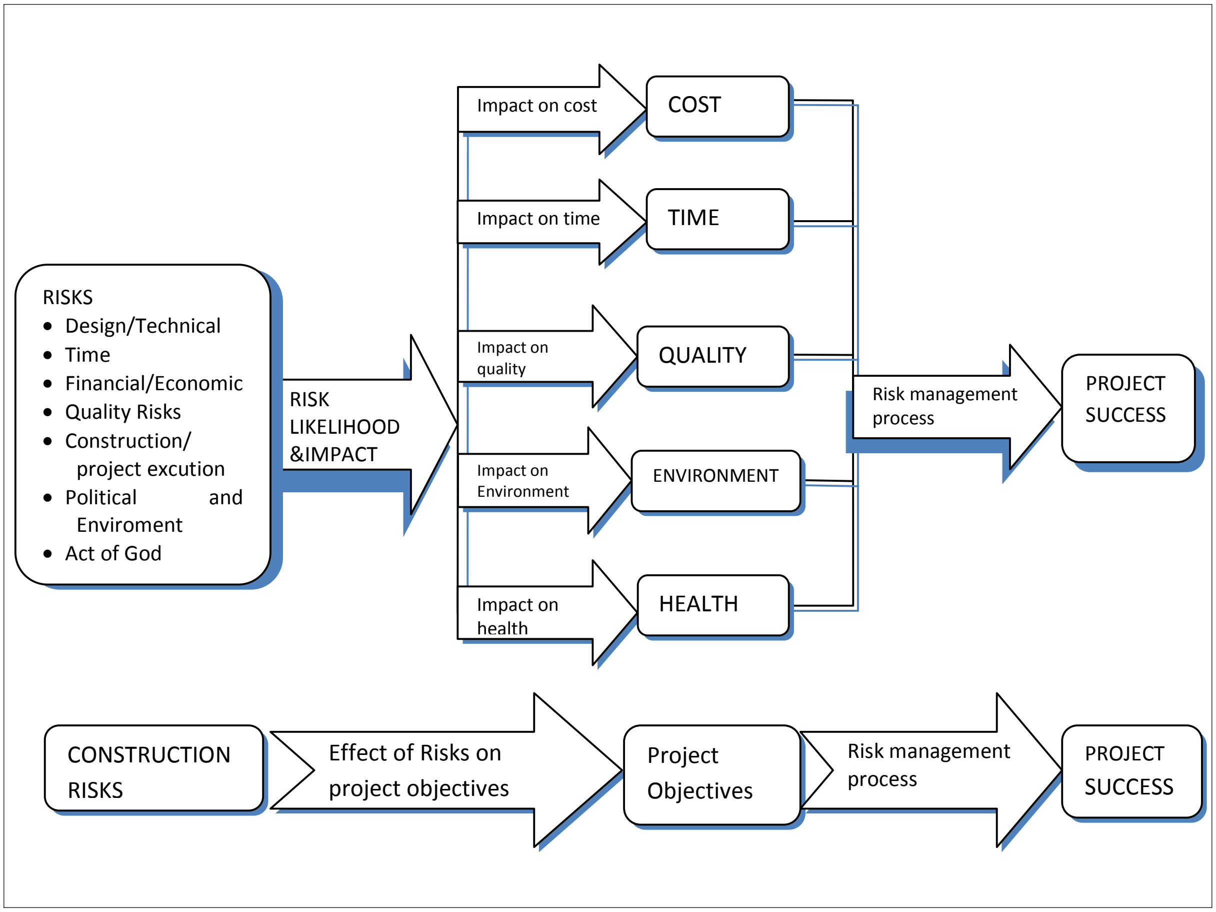

Figure 2.1 Conceptual framework.

Source: Author, 2015

2.4 The role of construction industry in the economy

2.4.1 Introduction

Construction is a major industry throughout the world accounting for a significant proportion of development process of both developed and developing countries (Wibowo, 2009). The significance of construction industry in the social economic development cannot be over emphasized. The importance of the industry is not only related to its size but also to its role in economic growth. The construction products (roads, railways, airport, schools, hospitals, offices, shops, factories, water supply, power systems, irrigation and agriculture systems; telecommunications and the like) provide the necessary public infrastructure and private physical structures for many productive activities such as services, commerce, utilities and other industries. Thus construction activities can be considered as major source of economic growth, development and economic activities. According to Wibowo (2009) the industry is not only important for its finished product; it also employs a large number of people (directly and indirectly) and therefore has an effect on the economy of a country during the actual construction process. It can therefore be regarded as a mechanism of generating employment and offering job opportunities to Millions of unskilled, semiskilled, and skilled workforce. The activities of the industry have great significance to the achievement of providing infrastructure, shelter and employment.

Construction deals with all economic activities geared towards creation, repair or extension of fixed assets in the form of building; and improvement of an engineering nature. It provides constructed physical facilities which provide space where other activities may take place. The industry has significant interaction with other economic sectors and has multiplier effects through its backward and forward linkages. This provides impetus to other industries. It is essential therefore that this vital industry is nurtured for health growth of the Kenyan economy.

2.4.2 Global overview

The global construction output trend has been on the rise. The total construction value worldwide was estimated just over $ 3,000 billion in 1998 (ILO Geneva, 2001). According to (Engineering News Record, USA) the estimate of annual construction output was probably closer to US$ 4.5 trillion in 2004. World construction output grew by 3% in 2007, to reach US$ 4.7 trillion compared to almost 5 percent growth in 2006 (WTO, 2011). The global GDP was estimated at US$ 75 trillion with construction output taking 10 per cent, that is, US$ 7.5 trillion (Chris, 2012). In 2013, according to World Bank, the nominal Gross World Product (WGP) was approximately US$ 75.59 trillion. According to WTO (2011) the construction industry accounts for around one-tenths of worlds GDP and 7% of employment. Thus the global construction output in 2013 can be approximated at US$ 7.59 trillion. The study on risks involved is therefore imperative to ensure efficiency and effective performance in the construction sector.

As shown in figure 2.2 and figure 2.3, the global construction output is heavily concentrated (77 per cent) in the high income countries (Western Europe, North America, Japan & Austraasia) with 26 percent of total employment. The contribution of the other countries (comprising of low and middle income countries) was 23% of total world construction output with 74 percent of total employment (ILO Geneva, 2001). The US market dominates the global scene as the largest national construction market representing 2.5% of the world total. Japan is second, followed by China. After China are Germany, Italy, France, the United Kingdom, Brazil, Spain, Korea, Mexico, Australia and India in that order. Developing country market have been the most dynamic in recent years. China and India have their spending on construction growing annually with more than 8%. Next are Korea, Brazil and Mexico. Growth is also remarkable in Russia and United Arab Emirates (WTO, 2011).

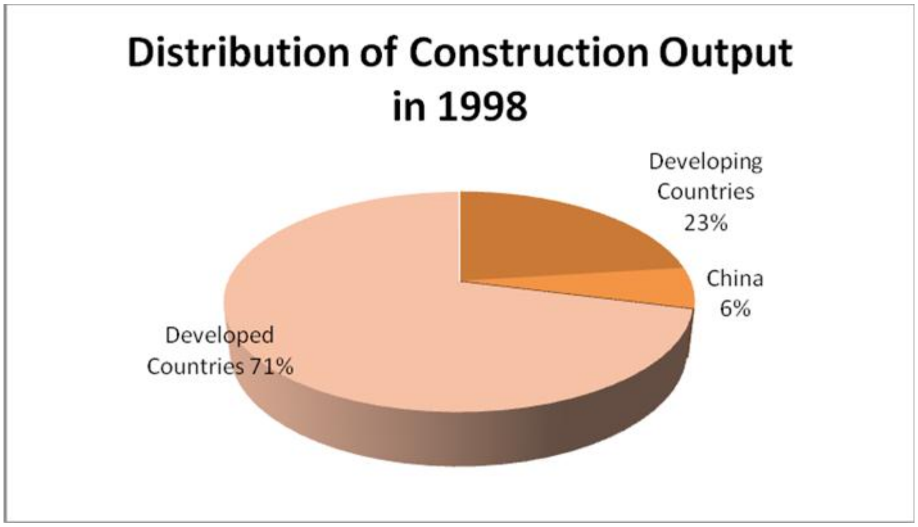

Figure 2.2 Distribution of Construction output in 1998
Source: ILO Geneva, 2001

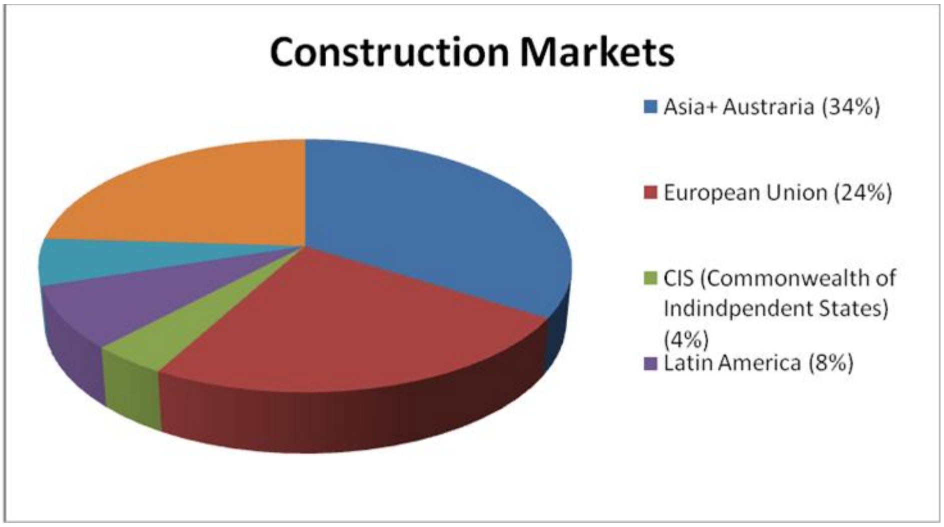

Figure 2.3 Regional Distribution of Global Construction Output
Source: Chris Sleight, 2012

2.4.3 The Kenyan scenario

Table 2.2 shows that Kenya is a developing country with a GDP growth rate of 4.7% in 2013 compared to a growth rate of 4.6% in 2012. Kenya is generally an agricultural country with the agricultural sector being the leading contributor of GDP, contributing 24.6% in year 2012 and 25.6% in the year 2013 (KNBS, 2014)

		2009	2010	2011	2012	2013
1.	**Total GDP**	2,375,971	2,570,334	3,047,392	3,403,534	3,797,988
	GDP Growth Rate	2.7%	5.8%	4.4%	4.6%	4.7%
2.	**Construction output (Ksh. Millions)**	265,754.50	289,023.80	319,730.50	353,314.70	394,881.30
	♦ Growth of the construction sector	12.7%	4.50%	4.30%	4.80%	5.50%
	♦ Percentage Construction contribution to GDP	4.10%	4.20%	4.10%	4.20%	4.40%
3.	**Gross Fixed Capital Formation (GFCF) at current prices**	465,111	518,538	609,255	702,223	735,352
	♦ Building and Structures	227,624	247,656	273,685	302,946	340,075
	♦ Percentage contribution to GFCF	48.90%	47.80%	44.90%	43.10%	46.20%
4.	**Cement consumption in tones**	2,671.20	3,104.80	3,870.90	3,991.20	4,266.50
5.	**Total wage employment ('000 persons)**	1,959.00	2,016.20	2,084.10	2,155.80	2,265.70
	Contribution by construction Industry					
	♦ Public Sector ('000 jobs)	73.00	81.40	88.80	98.70	112.0
	♦ Private Sector ('000 jobs)	19.50	18.70	17.30	17.40	18.30
	Total Contribution by construction Industry('000 jobs)	92.50	100.10	106.1	116.10	130.3
	♦ Percentage Contribution	4.72%	4.96%	5.09%	5.39%	5.75%

Table 2.2 Construction Economy Indicators in Kenya; 2009 - 2013

Source: Economic Survey 2014 (KNBS, 2014)

Table 2.2 further shows that in 2013, the building and construction sector expanded by 5.5% from growth of 4.8% registered in 2012. The contribution of the sector into the (GDP) increased from 4.2% in 2012 to 4.4% in 2013. This was the largest record in the four years. According to CBS (2014) this can be attributed to increase in spending on infrastructural development by the Government and improved private sector construction activities. Cement consumption which is a key indicator in the construction industry grew by 6.9% during the period under review from 3,937.30 metric tonnes to 4,226.50 metric tonnes in 2013. The commercial banks credit extended to the sector increased by 2.3% in 2013.

Wibowo (2009) defines Gross Fixed Capital Formation (GFCF) as an expenditure on fixed assets (buildings, vehicles, machines) either for replacing or adding to the stock of fixed assets. The formation of the fixed capital investment is a vital concern for the state of nation as it represents investment in the future of the economy of the country. Fixed assets usually consist of houses and infrastructure in public and private sectors as well as business investment in plant and machines of all industries. Wibowo (2009) indicates that the construction sector contributes about 40% - 60% of GFCF in developing industry accounting for approximately one third of the total investment in physical assets in the economy.

From Table 2.2 the estimated value of gross fixed capital formation (GFCF) by asset type at current prices rose from Kshs. 702.2 Billion in 2012 to Kshs. 735.4 Billion in 2013, representing a nominal growth of 4.7 percent. Since 2009 the share of building and structure in fixed capital formation has been on the increase. It increased to 47.8% from 48.9% in 2009. In 2013 it increased to 46.2% from 43.1 % in 2012.

KNBS (2014) categorizes employment into three categories namely; formal (Modern), informal and small scale agriculture or subsistence farming and pastoralist activities. Excluding small scale agriculture or subsistence farming and pastoralist activities, the number of people engaged in both formal and informal sectors improved from 12,782.0 thousands persons in 2012 to 13,524.8 thousand person in 2013, representing an increment of 5.8 %. Consequently, in 2013, 742.8 thousand jobs were created out of which 116.8 thousand were in the formal sector. This increase in new jobs created in the modern sector can be partly attributed to increased activities in the construction industry (KNBS, 2014). Construction industry registered the highest increase in private sector employment with a growth of 13.5% in 2013 providing highest number in absolute terms following the wholesale and retail trade, repair of motor vehicle and motorcycle sector.

From the above discussion it is apparent that construction industry is fundamental to any country for its contribution in social and economic growth. It generates substantive employment and provides a growth force to other economic sectors through backward and forwarded linkage. It is on these grounds that this industry should not be neglected and is a key justification of this study.

2.5 Overview of Construction Process

2.5.1 The nature of construction projects

According to PMI (2004), all projects have the following characteristics:-

- Temporary –this means every project has a definite beginning and a definite end. The project comes to an end when it has accomplished its objectives or when it is apparent that it shall not meet its objectives.
- Unique products, services or results – every project has its unique deliverable – unique products, services, results.
- Progressive elaboration –project develops in steps. At the beginning of a project, the project team has a broad understanding of the project but as the project progresses; the team understands better its objectives and deliverables.

Construction projects are no exception. Ghahramanzadeh (2013) has observed that construction projects are dynamic, require a lot of finance, encompass complex procedures, have lengthy duration of operation in offensive environment and involve dynamic organizations. Dikmen et al (2004) indicates that the construction project has high number of parties involved in the achievement of its goals and objectives and one off nature of the construction process. The characteristic of construction projects explains why the construction industry is subject to more risks compared with other industries. It also explains why project management in construction projects is intensive.

Construction project like any other type of project pose serious management challenges. The geographical dispersion, significant number of players, technical variability, technical complexity and large number of inputs are some of the variables that make construction projects challenging (Baloi, 2012).

2.5.2 Construction Delivery Process

Construction projects are type of projects dealing with the process of creating physical infrastructure such as residential building, industrial and commercial buildings, highways, and utilities. Generally construction involves the organization and coordination of all the resources for the Project - labor, construction equipment, permanent and temporary materials, supplies and utilities, money, technology and methods and time to enable completion of a desired Project on schedule, within budget and according to the standards of quality specified by the Architectural and Engineering Drawings. The delivery process itself occurs in a number of phases (Lim & Mohamed, 1999).

Phases in construction project are more or less like all the other types of projects and different authors and institutes have suggested their own division of phases leading to the similar project life cycles. Zou et al. (2006) have divided the phases of a construction project into feasibility, design, construction, and operation, whereas Liu and Zhu (2007) noted division of construction phases are as follows: conceptual, design, tender, preconstruction, and build. Phases of the construction project as defined by PMI (2004) are Concept, Planning (& Development), Detailed Design, Construction, and Start-up and Turnover. A more suitable classification of project phases has been set out in studies by Takim, Akitonye, & Kelly (2003) and Ahadzie et al. (2006). They conceptualize construction projects as having six phases, that is, conception, planning, design, tender, construction and operational phase. This is shown in figure 2.4.

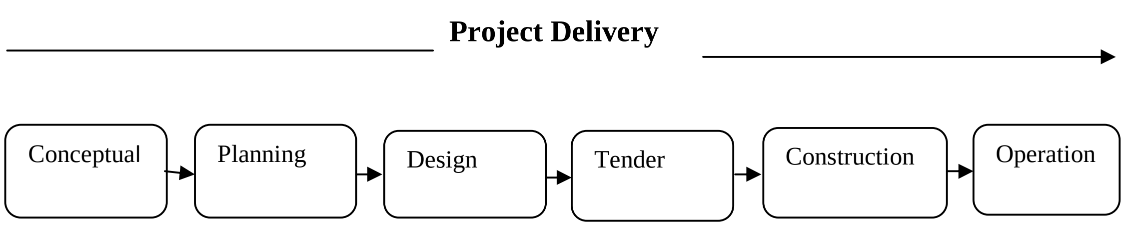

Figure 2.4 The process for delivering a construction project.

Source: Lim Mohamed (1999)

Smith *et al.,* (2006) emphasizes that although a project is divided into a number of separate phases, at the end of each phase an appraisal is necessary and assessment of risk involved in proceeding with the project. This therefore indicates risk management process as continuous spanning all the phases of a project. Although the successful execution of the project in each of these phases is critical to the overall success of the project (Ahadzie et al., 2006), very often in examining project success, the construction phase tends to be the focal point. This is because according to Takim et al., (2003), the construction phase is the phase where all the project goals like time, cost, quality, safety and the like are put to the test.

Smith et al., (2006) to the contrary views appraisal phase as the most crucial phase of risk management. This is because this is the phase during which the key decisions regarding the choice option is made. It is in this phase where alternative ways of achieving the project objectives are defined and choosing the best between them.

2.6 Project objectives

PMI (2013) defines project as a temporary undertaking to create unique product, service and result. It further defines project management as the application of knowledge, skills, tools and techniques to project activities to meet the project requirements. Project are carried out to achieve a given set of objectives, project management shall therefore involve planning, organization and controlling of resources to achieve these objective throughout the project cycle. That is through the process of project initiation, planning, execution, monitoring and control, and closing. Achievement of this set of objectives is referred to as the project success. This is the ultimate goal of every construction project. Risks are believed to be the major constraints hampering the achievement of this goal. In construction project one or more of the primary targets- cost, time and quality will likely be subject to risk and uncertainty (Smith et al., 2006). A project manager should therefore undertake actions which eliminates the risks before they occur or reduces the effects of them if they occur where this is possible and cost effective.

Time, cost and quality are the basic criteria to project success (Chan, 2001). Idrus, Sondangi and Husin (2011) view the concept of successful project as subjective that is, having different meaning to different people. According to Lim and Mohamed (1999) in his study has found that ambiguities on criteria for project success do exist even in the minds of experts. A review of studies undertaken by research reveals that various criteria have been considered in evaluating success for determining success in project delivery.

Table 2.3 Summary of criteria for measuring project performance based on past studies

Previous study	**Criteria to measure project performance**
Lim &Mohamed (1999)	Cost/ financial, project duration, quality, client and project manager satisfaction, user expectation and satisfaction, quality of workmanship, meeting specifications, dispute minimization.
Love & Holt (2000)	Product, service performance, corporate ability, individual ability, productivity, quality, environment and financial aspects.
Chan &Chan (2004)	Cost, financial project duration, quality speed of construction, transfer of technology, quality of workmanship, health and safety.
Haponava & Al-jibouri (2010)	Time, cost/ financial, quality, safety, value and objective, stakeholder's requirements and communication.
Idrus et al. (2011)	Quality of finished project, construction cost, construction time, occupational health and safety, labour dependency, coordination by construction team, contractor's manpower capacity, construction flexibility, environment friendliness, level of technology.
Khosravi & Afshari (2011)	Time performance, cost performance, quality performance, health, safety and environment, client satisfaction.
Gwaya et al.(2014)	Cost, quality, time, scope, human resources and project performance.

Source: Author, 2015

Apart from the three basic criteria, that is, cost, time and quality, researchers have advocated for the consideration of more aspects of performance. Pinto and Pinto (1991) maintains that project success criteria should also include the satisfaction of interpersonal relations with the project team members. Table 2.3 summarizes the criteria for measuring project performance based on past studies.

Lim and Mohamed (1999) believed that project success should be reviewed from different perspectives of individual owner, developer, contractor user, and project and so on. They proposed two categories of viewpoints: the Macro and Micro view points of project success as shown in figure 2.5 below.

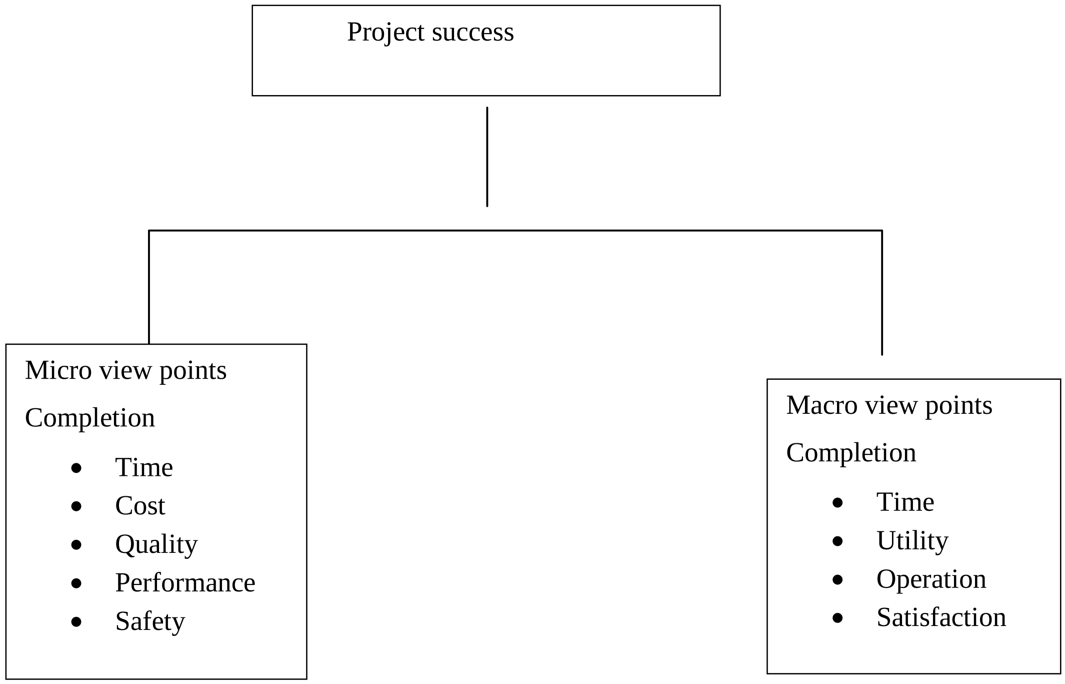

Figure 2.5 Macro and Micro view points of project success

Source: Lim and Mohamed (1999)

According to Chan and Chan (2004), cost, time and quality are the three basic and most important performance indicators in construction projects. They observe that other measures such as safety, functionality and satisfaction among others are attracting attention.

In their study, Haponava and Al-jibouri (2010) tried to establish the influence of design process performance on end-project goals in construction using process-based model. Analysis of the research results indicated that two end project goals of "meeting financial requirements" and meeting "functional requirements as the most sensitive and are basically influenced by performance of most design sub-process of design stage. "Build quality" and "health and safety" are important end- project goals. Meeting "financial requirement" was ranked as the highest priority goal followed by "meeting schedule requirements". "Meeting functional requirements" and "client satisfaction" were ranked third and fourth respectively while "build quality" and "health and safety" took fifth and sixth position.

Research by Idrus et al. (2011) on performance criteria in the Malaysian construction industry, most important performance indicators for evaluating project performance were quality of finished project, construction cost and construction time ranked in that order. Quality coordination's and occupational health and safety take position five and six respectively.

Khosravi and Afshari (2011) in their research in Mapna Special Project and Development Company, time performance was ranked as the most important, followed by cost performance and quality performance client satisfaction was ranked the least important while health safety and environment was ranked as the second least important.

According to Gwaya et al. (2014) project success is executing the project that meets the quality standards within set time and budget, taking into consideration the project lifecycle to ensure that the facility is adequately maintained over the long term. In his study cost, quality, time, scope, human resources, and project performance were viewed as being the most critical factors influencing construction project management in the Kenyan construction industry.

The literature reviewed shows that the subject of measurement of project performance and success is debatable with no one agreeable method of measurement. However, according to Gwaya et al. (2014) research in this area is essential in that it gives opportunity to change and leads to improvements in performance.

Five objectives, namely, cost; time; quality; environmental performance; and health and safety have been found to be more significant in determining project delivery and were considered in this research. These objectives are discussed below:-

1. Cost objective

This refers to the extent to which the project is completed within the project estimated budget. According to Chan (2001) cost is not only confined to the tender sum only, it is the total cost of the project from inception to completion including variations and legal claims arising from litigation and arbitration. Smith et al. (2006) defines increased cost as the additional cost above the estimate of the cost of a project. In the context of this research the additional cost above the evaluated cost is a result of risk factors impacting on the project.

2. Time objective

Chan (2001) defines time as the duration for completing the project from start date to practical completion. A project schedule is usually drawn in line with the client's future plans. Adherence to this schedule determines the effectives of a contractor. Time variation is measured by the percentage of increase or decrease in the estimated project time, discounting the effect of extension of time (Chan, 2001) granted by the client. Smith et al. (2006) defines the increased time as the additional time beyond the completion date of the project through delays in the construction process.

3. Quality objective

Parfit and Sanvido (1993) defines quality as the totality of feature required by a product or services to satisfy a given need; fitness for purpose. According to Chan 2001, the assessment of quality is rather subjective. Quality is generally the guarantee that the product shall meet the client's requirements. PMI (2013) asserts that quality involves quality standards, how they are satisfied and ensuring conformity and eliminating unsatisfactory performances. This is an indication that modern quality management practices recognize the importance of customer satisfaction. This combines meeting customer requirements through conformance to project requirements and fitness for use. Product performance and stakeholder satisfaction being critical factors determining project success are thus addressed under quality.

4. Environment performance objective

Construction industry is a major contributor to environment impacts. Shen et al (2000) has noted that construction projects affects environment in numerous ways across their lifecycle. This is notably in terms of construction wastes damping and extraction of construction materials.

National Environment Management Authority – Kenya (NEMA) has been formed to ensure quality environment. The main function of NEMA is to ensure integration of environmental considerations into development policies, plans, programmes and projects with a view of ensuring proper management and rational utilization of environmental resources, on sustainable yield basis, for the improvement of quality of human life in Kenya.

Environment Impact Assessment (EIA) is getting appreciated in the construction industry as the statutory framework for the prediction and assessment of potentially adverse environmental impacts from development projects. The enforcement of Environment Act and NEMA regulations provides as good measure for environment aspects. Therefore conformity to these laws and regulations can be used as a measure of project success by contractors. Risks related to environment are therefore relevant in determining project delivery in Kenya.

5. Health and Safety objectives

Health and safety objective at construction site concerns with both physical and psychological well being of construction workers on construction sites as well as other persons whose health and safety is likely to be adversely affected by construction activities (Muiruri & Mulinge, 2014). Health and safety is a key concern for all the stakeholders in construction project. Muiruri and Mulinge (2014) have established that various challenges are encountered in the management of health and safety. Construction work places are exposed to hazards of occupational diseases and adverse effects of excessive long hour of work, machines and other shophiscated construction equipment pose danger to operators which in most cases do not have prior skills for operating such machines or plants worse still they lack adequate protective gadgets. Health and safety measures are inadequate and effective enforcement mechanisms of health and safety are lacking.

The extent to which contractors conform to occupational health and safety is used as a measure of success of a project. The contractors are supposed to ensure adequate health and safety management practices to reduce accidents and to maintain a health working environment.

2.7 Risk and Risk Management

Several definitions for risk have been brought forward.

- The Oxford English Dictionary (2013) defines Risk as a situation involving exposure to danger.
- The Project Management Institute (PM1, 2013) consider risk as uncertain event or condition that if it occurs has either positive or negative impact on one or more of project objectives.
- The Stationery Office (2009) defines risk as uncertain event or set of events that, should it occur, will have an effect on the achievement of objectives.
- Caltrans (2007) defines project risk as an event or condition that if it occurs, has a positive or a negative effect on at least one project objective.

From the above definition the following characteristics of risk are apparent:-.

1. It involves exposure to danger.
2. It is uncertain event or condition.
3. Should it occur has a positive or negative impact on project objectives.

The definition of risk used in this study is the one proposed by the Project Management Institute (2013) and Caltrans (2007). Both definitions consider both the negative and positive aspects of risk. However, this study is limited to negative aspects only.

Risk in projects is inevitable since projects are enablers of changes, brings about uncertainty hence risk (The Stationery Office (TSO), 2009). Risks and uncertainties are more in the construction industry than in any other industry (Ehsan, Mizra, & Ishaque, 2010). This can be attributed to the process of planning executing and maintaining all project activities which is complex and time consuming. According to Ehsan et al., (2010), the whole process requires a myriad of people with diverse skills and proper coordination of a vast amount of complex interrelated activities. This situation is made more complex by various external factors that influence the industry and its operations. Ehsan et al, (2010) have noted that construction industry is very poor in handling risks. This results in projects failing to meet time schedule, set budgets, defined specification and standards and in some case the scope of work. TSO (2009) put forward that construction companies should establish and maintain a cost effective risk management in their projects the aim being to ensure better decision making through good understanding of risks. Management of risks should be a continual activity, performed throughout the project life cycle. This way it is possible to tell with confidence whether the project is worthwhile for it to continue.

TSO (2009) have described risk management as the systematic application of procedures to the task of identifying and assessing risks and then planning and implementing risk responses. AS/ NZS 4360 (1999) have referred to risk management as the culture, process and structure that are directed towards the effective management of potential opportunities and adverse situations. Risk management involves the identification of influencing factors which could negatively impact on cost, schedule or quality objective of the project, quantification of the impact of potential risk and implementation of measures to mitigate the potential impact of the risk (Ehsan *et al.*, 2010). Mahendra, Jayeshkumar and Bhavsar (2013) defines risk management as a process which identifies the risk related to a project, analyze these risks and determine the actions to avert the threats on any of the project objectives. PMI (2013) proposes an almost similar definition for project management, as to include the process concerned with conducting risk management planning, identification, analysis, responses and monitoring and control on project. All these process are applied throughout the project lifecycle. All these steps of the risk management process should be included to deal with risk in order to implement the processes of the project management (Mahendra et al., 2013).

2.8 Management of Construction Risks

Risks irrespective of their type should be adequately managed to achieve the desired project goals and objectives. A part from time, cost and scope of the project which need to be well defined, the quality requirements, safety criteria and environment criteria should be adequately defined (Ghahramanzadeh, 2013). According to Ehsan et al., (2010), the probability that a definite factor detrimental to the overall project occurs is always present.

2.8.1 Categorization of Construction Risks

Risk affecting projects either positively or negatively are organized into risk categories. Different individuals and institutions organize risks differently as shown in table 2.4 below.

Table 2.4 Categorization of Construction Risks

Previous study	**Category of risks**
PMI (2013)	• Technical, quality performance risks • Project management risks. • Organization risks. • External risks
Caltran (2007)	• Design risks. • External risk. • Environmental risks. • Organization risks. • Project Management risks. • Right of way risks. • Construction risks. • Engineering services risks.
Ehsan et al., (2010),	• Technical risks • Logistical risks • Environmental risks • Financial risks • Socio- political risks
Mahendra et al., (2013)	• Technical risks • Construction risks • Physical risks • Organization risks • Financial risks • Social –political risks • Environmental risks
Baloi (2012)	• Technical • Construction • Legal • Natural • Logistic • Social • Economic • Financial • Commercial • Political

Source: Author, 2015

From this discussion it is apparent that risks in construction project are categorized differently. For the purpose of this study risks were classified into six categories. This was essentially to reflect on their impact on project objectives. These categories are:-

- Time
- Financial/ Economic
- Quality risks
- Construction/ project execution
- Political and environmental
- Act of God

2.8.2 An overview of the risks management process

Risks management process has been divided into various sub-processes by different authors and institutions as shown in table 2.5. According to Chapman and Ward (2003) organizations or individuals prefer a certain process because they are familiar with it. Some see advantages in following a risk management process promoted by certain professional organizations they belong to. Others may be required to employ a particular risk management plan framework. The different steps of risk management process are discussed below.

2.8.2.1 Risk management planning

This involves deciding how to approach and plan the risk management activities for a given project (PMI, 2013). According to Caltrans (2007) careful and precise planning enhances the possibility of success of the five other risk management steps.

Table 2.5 Risk management sub-processes

Previous study	**Risk Management sub-process**
PMI (2013)	• Risk planning • Risk identification • Qualitative risk analysis • Quantitative risk analysis • Risk response • Risk monitoring and control
Caltran (2007)	• Risks management planning • Risks identification • Qualitative risk analysis • Quantitative risk analysis • Risk response planning • Risks monitoring and control.
Chapman and Ward (2003)	• Define the project • Focus the process • Identify the issues • Structure the issues • Clarify ownership • Estimate variability • Evaluate implications • Harness the plans • Manage implementations
AS/ NZS 4360 (1999)	• Establish context • Identify the risks • Analyze the risks • Evaluate the risks • Treat the risks • Monitor and review • Communicate and consult
TSO (2009)	• Identify(context and risks) • Assess (Estimate and Evaluate) • Plan • Implement • Communicate
Baloi (2012)	• Planning • Identification • Classification • Analysis • Response • Monitoring and control
Tadayon, Jaafar and Nasri (2012)	• Identify risks • Asses risk either qualitatively or quantitatively • Choose appropriate method of handling risks • Monitoring and documenting risks

Source: Author, 2015

PMI (2013) gives the risk management planning inputs as:-

- Project charter – This is a document that formally authorizes a project.
- Organization's risk management policies –These are predefined approaches to risk analysis and response which have to be customized to a particular project.
- Refined roles and responsibilities – Involves defining roles, responsibilities and authorities levels for the purpose of making decisions.
- Stakeholder risk tolerance– The policy statement expressing the organization tolerances to risks.
- Templates for the organization risk management plan – involves developing templates for the use by the project team.
- Work break down structure (WBS) – This is a deliverable-oriented grouping of project components that organize and define the total scope of the project work.

PMI (2013) have provided that planning meetings should be held by project teams to develop a risk management plan as the tool and technique for risk management planning. The project manager, project team leader, risk manager, key stakeholders and any other necessary person attend these meetings. The outcome of risk management planning is a risk management plan. It identifies and establishes the activities of risk management for the project in the project plan (Caltrans, 2007). According PMI (2013) the risk management plan describes how risk identification, qualitative and quantitative analysis; response planning, monitoring and control will be ordered and implemented during the project lifecycle. The plan may include the implementation methodology, roles and responsibilities, budget time frame, scoring and interpretation, thresholds criteria for risks, reporting formats and tracking (PMI, 2013).

2.8.2.2 Risk Identification

Risk identification involves identifying potential project risks (Caltrans, 2007) and documenting their characteristics (PMI, 2013). Al Bahar and Crandal (1990) define risk identification as a process of systematically and continuously identifying, classifying and assessing the significance of risks associated with a particular construction project. Baattz (2003) observes risk identification as the first step towards the development of risk management strategies. He asserts that risk identification, allocation and management by any appropriate means are the best prospect of ensuring the closest approximation to the ideal. According to Tadayon et al. (2012) without having any perception and approach for risk identification, construction participants cannot make appropriate decisions in the other risk management processes. Further he notes that identifying risk at the early stages of the project planning and assessing their significance, the project managers can decide on the best methods to reduce them and allocate the best people to mitigate them.

Participants in risks identification may include the following, where appropriate: Project manager, risk management team, project team members, and subject matter experts from the project and from outside the project team, and risk management customers, end users, other project managers, stakeholders and risk management experts (PMI, 2013; Caltrans, 2007).

Inputs to risks identification for this stage includes the risk management plan developed in step one and the other project planning outputs which include project mission, scope and objectives of the client, sponsor or stakeholders, outputs of other process, the project charter, WBS, product description, schedule and cost estimates, resources plan, procurement plan, assumption and constraints (PMI, 2013).

Risk categories also form the input for this stage of project management process. The risk that may affect the project are identified and organized into categories. Historical information from past similar project files or published information also forms a source information risk identification process (PMI, 2013).

PMI (2013) propose the following tools and techniques for risk identification:-

- Documentation reviews – structured review of project plans and assumption.
- Information gathering techniques.

This includes:-

- Brainstorming – this technique is used to identify risks using a group of team members or subject-matter experts. Typically, a brainstorming session is structured so that each participant's ideas are recorded and analysed later.

- Delphi method - this is a process in which each team member individually and anonymously lists potential risks and their inputs.
- Interviewing - experienced project participants, stakeholders and subject matter experts are interviewed to identify risks.
- Strengths, weaknesses, opportunities, and threats (SWOT) analysis- involves the examination of project from each of the SWOT perspectives.
- Checklist – they are comprehensive, listing several types of risk that have been encountered on prior projects.
- Assumption Analysis – this explores the validity of assumptions, hypothesis or scenarios.
- Diagrammatic techniques –these may include course and effect diagrams system and process flow charts and influence diagrams.

According to PMI (2013) outputs from risk identification are:-

- Risk –uncertain event or condition which if it occurs, have positive or negative effect on project objectives.
- Triggers - risk symptoms or warring sign, indicators that a risk has occurred or is about to occur.
- Input to other process.

2.8.2.3 Qualitative Risk Analysis

According to Caltrans (2007), qualitative risk analysis includes methods for prioritizing the identified risks for further action, such as quantitative risk analysis or risk response planning. They believe that responding to the high priority risks can improve the organizations performance. According to Baloi (2012) the results of risk analysis determine the appropriate course of action to pursue. Qualitative risk analysis requires that the probability and consequences of risk to be evaluated using established qualitative analysis methods and tools.

PMI (2013) identifies the following inputs for this process:-

- Risk management plan
- Identified risks –Risk identified during risk identification.

- Project status – Project progress through the project life cycle
- Project type – Common or state -of –art project
- Data precision- extent the risk is known or understood.
- Scale of probability and impact
- Assumptions

Tools and techniques for qualitative risk analysis are risk probability and risk consequence/impact. Risk probability is the likelihood that a risk will occur while risk consequence/ impact are the effect on project objectives if the risk event occurs (PMI, 2004). Risk probability and risk impact on project objectives tools and techniques employed in this study. Respondents' opinions are converted into numerical values and analyzed to give the required results for the purposes of risk management and improving project delivery among contractors in Kenya.

2.8.2.3.1 Probability/Impact risk rating matrix

A matrix is constructed that assigns risk ratings. (Very low, low, moderate, high and very high to risk or conditions based on combining probability and impact (PMI, 2013). Risks with high probability and high impact are likely to require further analysis, including qualification and aggressive risk management.

According to Caltrans (2007), team members revisit qualitative risk analysis during the projects lifecycle for the purpose of re-evaluating the risks. By doing this trends in results may emerge that tell whether more or less risk management action is needed or whether a mitigation plan is working. PMI (2013) gives the output for qualitative risk analysis as:-

- Overall risk ranking for the project.
- List of prioritizes risks
- List of risks for additional analysis and management
- Trends in qualitative risk analysis results

2.8.2.4 Quantitative Risk Analysis

Quantitative risk analysis is a method of numerically estimating the probability of each risk and its consequences on project objectives as well as the extent of overall project risk (PMI, 2013). According to Caltrans (2007), this process is based on simultaneous evaluation of the impact of all identified and quantified risks. According to PMI (2013) this method of analysis uses techniques such as Monte Carlo simulation and decision analysis. The tools and techniques for quantitative risk analysis are interviews, sensitivity analysis, decision tree analysis and simulation.

PMI (2013) gives the output for Quantitative Risks analysis as:-

- Prioritized list of quantified risks-These are the risks that pose the greatest threat or present the greatest opportunity to the project together with a measure of their impact.
- Probabilistic analysis of the project – forecast of potential project schedule and cost results listing the possible completion dates or project duration and cost with their associated confidence levels.
- Probability of achieving the cost and time objectives
- Trends in quantitative risk analysis results.

The outputs of this particular study were a prioritized list of risks in relation to the different project objectives and the overall prioritized list of all the risks in the construction industry. Regression analysis helped us determine some important relationships between risks, trends and model for improving project delivery.

2.8.2.5 Risk response in planning

Risk response planning is defined by PMI (2013) as the process of developing option and establishes actions to enhance opportunities and reduce threats to the project objectives. According to Caltrans (2007) it focuses on the high-risk in qualitative and/or quantitative risk analysis and involves the identification and assignment of individuals or parties to take responsibility for each agreed risk response. This is by ensuring that each risk requiring a response has an owner monitoring the response, although a different party may be responsible for implementing the risk handling action itself. This process aims at ensuring that all identified risks are properly addressed. The effectiveness of risk response planning will directly determine whether there is a risk increase or decrease in the project (PMI, 2013).

PMI (2013) identifies the following inputs for this process:-

- Risk management plan
- List of prioritized risks –list from qualitative analysis
- Risk ranking for the project
- Prioritized list of quantified risks

- List of potential response
- Risks thresholds –the level of risks that is acceptable to the organization
- Risk owners – a list of project stakeholders able to act as owners of risks with a common cause.
- Common risk causes – A one generic response that may mitigate two or more risks.
- Trends in qualitative and quantitative risk analysis results.

2.8.2.5.1 Tools and Techniques for risk Response

According to PMI (2013), there are several risk response strategies available and the strategy that is most likely to be effective should be selected. Any risk response strategy selected should aim at removing as much as possible of the negative impacts and maximize the positive ones (Ghahramanzade, 2013). For each of the risks specific actions are built up to execute that strategy. TSO (2009) emphasize that the risk response strategy taken should be proportional to the risk and that it should offer value for money, risk response do not necessarily remove the inherent risk in its entirety, leaving residual risk which can be considerable (TSO, 2009) . The PMI (2013) framework has four risk response strategies which includes risk avoidance, transference, mitigation and acceptance.

Risk Avoidance

Risk avoidance is changing the project plan or some aspects of the project, that is, the scope, procurement route, supplier or sequence of activities so that the risk can no longer have impact on project objectives (TSO, 2009; Caltrans, 2007). It may not be possible for the project team to get rid of all risk events, some risks may be avoided (PMI, 2013).

Panthi, Ahmed and Azhar (2007) asserts that this risk technique should be applied when the likelihood of occurrence of risk and the impact associated with it are high and this means choosing not to do the activity. He however, provides that the risky items in the scope of work can also be omitted. Mahendra et al. (2013) also believes that project management plan can be changed to eliminate a threat, to isolate project objectives from the risk's impact, or to relax the project objective that is in danger, such as extending schedule or reducing the scope. PMI (2013) have given some example of avoidance like reducing scope to avoid high risk activities, adding resources or time, adopting a familiar approach instead of an innovative one, or avoiding an unfamiliar subcontractor.

In some situations risk avoidance can occur inappropriately because of an attitude of risk aversion, which is a tendency of many people. Inappropriate risk avoidance may result to an increased significance of other risks (AS/NZS 4360, 1999). According to PMI (2013) some risk events that arise early in the project can be dealt with by expounding requirements, obtaining information, improving communication, or acquiring expertise.

Transference

This involves another party bearing or sharing some part of risk (AS/NZS 4360, 1999). It seeks to shift the consequences of a risk to a third party together with ownership of its management responsibility (PMI, 2013). Panthi et al. (2007) have stressed that when risk impact is high, even though the probability of occurrence may be fairly low, risk transfer strategies are applied.

As attested by PMI (2013) transfer of liability for risk is the most effective way to deal with financial risks. There are basically two ways of transferring project risks, that is, by insuring the project against high impact risks or by transferring risks to contracting firm, client or other stake holders through contracts (Panthi et al., 2007). Risk transfer involves the use of insurance policies, performance bond, warranties and guarantees (PMI, 2013). As Mahendra et al. (2013) assert the aim of risk transfer is to ensure that the risk is owned and managed by the party best able to deal with it effectively.

Mitigation

TSO, (2009) defines mitigation (reduction) as a proactive action taken to: 1) reduce the probability of the adverse event occurring, by performing some control and 2) reduce the impact of the event to acceptable threshold should it occur. Panthi et al. (2007) claims that not all risks can be solved by risk avoidance and transfer. He notes that for majority of risks mitigation technique need to be embraced.

PMI (2013) asserts that taking early action to reduce probability of risk occurring or its impact on the project is more effective than trying to repair the consequences after it has occurred. They have observed risk mitigation as taking any of the following forms:-

- Implementing a new course of action that will reduce the threat, for example, adopting less complex processes, conducting more seismic or engineering tests, or choosing a more stable seller.
- Changing conditions so that the likelihood of risk occurring is reduced, for example, adding resource or time to the schedule.

- Undertaking a prototype development to reduce the risks of scaling up from a bench-scale model.
- Taking a mitigation response, where it is not possible to reduce probability, to address the risk impact by targeting connections that determine the severity.

Acceptance

After risks have been reduced or transferred, there may be residual risks which are retained (AS/NZS 4360, 1999) thus plans should be put in place to manage to manage the consequences of these risks should they occur, including identifying a means of financing them. A conscious and deliberate decision is taken to retain the risk, having determined that it is more economical to do so than to attempt a risk response action (TSO, 2009). The threat should continue to be monitored to ensure that it remains tolerable. According to Caltrans (2007) it is a strategy that is opted because it is either not possible to eliminate a risk or the cost in time or/and money of response is not warranted by the importance of the risk. According PMI (2013) this indicates that the project team has decided not to change the project plan to deal with a risk or is unable to identify any other suitable response strategy. They assert that the common risk acceptance response strategy is to establish a contingency allowance including amounts of time, money, or resources to account for known risks. This allowance should be determined by the impacts, computed at an acceptance level of risks exposure, for the risks that have been accepted.

2.8.2.6 Risk Monitoring and Control

PMI (2013) defines risk monitoring and control as the process of keeping track of the identified risks, residual risks and new risks. It also monitors the execution of risk plans, and evaluates their effectiveness in reducing risk. Risk monitoring and control continues throughout the project life cycle. As the project matures, new risks may emerge, or anticipated risks may disappear. Good risk monitoring and control processes ensure effective decisions are made in advance of the risks occurring. Communication to all project stakeholders is needed to assess periodically the acceptability of the level of risk on the project. According to Caltrans (2007) risk control involves choosing alternative responsive strategies, implementing a contingency plan, taking corrective actions, or re-planning the project as applicable. PMI (2013) risk management framework has the following inputs for risk monitoring and control**.**

1. Risk management plan.
2. Risk response plan.

3. Project communication. – provide information about project performance and risks. Reports generally used to monitor and control risks include: Issues Logs, Actions-item Lists, jeopardy warnings, or Escalation Notices
4. Additional risk identification and analysis. –As project performance is measured and reported, potential risks not previously identified may surface the cycle of the six risk processes should be implemented for these risks.
5. Scope changes. – Scope changes most of the times require a fresh risk analysis and response plans.

According to PMI (2013) the tools and techniques for risk monitoring and control includes project risk response audits, periodic project risk reviews, earned value analysis, technical performance measurement and additional risk response planning. They have provided the following as outputs of risk Motoring and Control:-

- Workaround plans
- Corrective action.
- Project change requests
- Updates to the risk response plan
- Risks database
- Updates to risk identification checklists.

2.9 Contractors in relation risk management

Construction industry is associated with a high degree of risk due to the complex nature of the of the construction process. The occurrence of risk event has a positive or negative effect on at least one project objective i.e. time, cost, scope or quality, (PMI, 2004). Gwaya et al. (2014) noted that projects have an element of risk and tasks leading to their completion may not be described with accuracy in advance.

Risk management is an important aspect construction project management in that it involves identifying major risks that influence contractor performance in terms of meeting project objectives (Wanyona, 2005) , that is, time, quality, safety and environmental sustainability (Zou et al., 2006). The difficult in achieving the main project objectives results to most of the problems militating against the achievement of desired effect on the construction industry of any country (Gwaya, et al., 2014). This ultimately results to dissatisfied clients. Risk management has been identified as one of the most important tools in determining any project success yet very few studies investigate the nature of this relationship (Fewings, 2005). Also Wanyona (2005) also notes that very few studies have been done in Kenya on risk management. Where the nature of risks is understood less is known about likelihood of occurrence and the potential impact (Chileshe & Yirenkyi-Fianko, 2011). According to Deviprasadh (2009) managing risk should be an integral part of a good management and fundamental to achieving business and project outcomes and effective procurement of goods and services. Therefore, there is a clear need for a strong risk management processes from the outset of a project and to be applied and continuously developed throughout the life of the project.

The function of project management is therefore to predict as many risks and problems as possible and plan, organize and control activities so that the project is completed successfully (Gwaya et al., 2014). Most research has focused on some aspects of construction risk management rather than using a systematic and holistic approach to identify risks and analyze their likelihood of occurrence and impact of these risks on project objectives (Zou et al., 2006). A study by Mousa (2005) in Palestine has shown that contractors and owners suffer from lack of innovative methods to prevent and mitigate risks. They fail to utilize risk analysis techniques but depend widely on direct judgment in estimating time and cost. Assessment of risk of cost overruns and delivery of project within budget is also a major challenge in Nigerian construction industry (Tipili & IIyasu, 2014). This has an increased project cost, time delays and lack of quality of projects.

Studies done in Kenya have shown that 73 percent of project assessed experienced time overruns and 38 percent suffered cost overruns (Mbatha, 1986). Another study by Gichunge (2000) showed that the most serious source of cost and time related risks in building projects during construction period is extra work (variations). According to him this occurs in 73per cent of building projects in the population whereas defective materials accounted for 38.2 percent for observed unacceptable quality work cases. Construction performance in Kenya is inadequate. Despite the fact that projects are supervised by very qualified human resources, they end up failing (Gwaya et al. 2014). There is the need to look into construction project performance with a view of identifying the right success measures for appropriate application. Risk management is one of the important measures to undertake to ensure improved construction performance. Al-Shibly, Lousi and Hiassat (2013), states that it is one of the performances that can positively affect working effectively inside the firm if it was practiced in the proper way.

Dawood (2001) and Wanyona (2005) have observed that in the current practices in the construction industry there is lack of structured methodologies and systematic cost escalation approach to achieve an appropriate cost analysis at the onset of construction process. Many projects fail because of choices made in the early stages of development. An inappropriately designed project-delivery approach or the wrong procurement method can lead to delays, higher costs, and administrative returns (Beckers et al., 2013). Assessing risk indicators associated with cost prior to the start of project enables better prediction of risk levels.

Effective use of project management techniques such as risk and value management is considered as key supporting processes and to add to them quality, cost, time and change control (Fewings, 2005) all together generate an integrated approach to the project success.

2.9.1 Important risk factors affecting construction

Aibinu and Jagboro (2002) surveyed major delays facing Nigerian construction industry. He defines delay as a situation when the contractor and project owner jointly or severally contribute to the non-completion of projects within the original or the situated period. The major client related delays were: variation orders; slow decision making process and cash flow. The contractor related risk factors were: financial difficulties; material management problems; planning and scheduling problems; inadequate site inspection; equipment shortage problems; and shortage of manpower. Extraneous problems, identified were ranked as: increment weather; acts of God; labour disputes and strikes. He concluded that cost overruns and time overrun were the two most frequent effects of delay in the Nigerian construction industry.

A similar study was carried out by Shebob, Dawood, and Xu (2011) in Libya. The survey showed that: low skills workers; rise in material prices; delay in material delivery; changes in scope of project were critical delay factors in the Libyan construction industry on contractor point of view. On owner's point of view the most critical delay factors were low skills of manpower; delay in delivery of site to contractor, modification (replacement or addition of new works); changes in material specification. On the consultant point of view: delay in making decision; slow supervision; poor planning; slowness in giving instructions; poor qualification of consultant engineer staff and waiting time for approval of drawing and tests samples of materials.

Tipili and IIyasu (2014) observed that risk of cost overruns and delivery of project within budget as major challenges in Nigerian construction industry. Factors affecting projects costs were ranked in order of significance as: design variation; variations by clients; price inflation; incomplete or inaccurate cost estimate; and inaccurate program scheduling. Risk factors related to time in order of significance were: Bureaucracy of government; design variations; quality performance; tight project schedule and variation of construction programme. Risk factors related to quality in order of significance were: Tight project schedule; design variation; lack of coordination between project participates; unsuitable contract programme planning and lack of skilled labour. Risks related to cost in order of significance were: incomplete or inaccurate cost estimate; in adequate program planning; variation by the client; design variation and price inflation.

Chilesh and Yirenkyi-Fianko (2012) identified 25 major risk factors associated with construction projects and have major impacts on issues related to project performance and delivery in relation to cost, time and quality. The five most likely risk factors agreed by clients, consultants and contractors in Ghana were: price fluctuations; delay in payment; inflation; quality and performance and poor financial markets. The important risks in terms of impact on construction objectives were: delay in payment; inflation; financial failure; price fluctuation and quality performance control.

Deviprasadh (2009) carried out a risk management study in India. He identified the most significant risk in the construction industry in India as:- shortage of skillful workers; time constraint; sub contractors related risks; delays in the project completion from other companies; Inflation rate political risk; legal risks and environmental risks.

Mousa (2005) investigated forty four (44) risk factors in Gaza Strip. Most important risk factors identified, on contractors' point of view, were: Financial failure by contractors; dangerous working condition; closure; defective design; delayed payment on contract; segmentation of Gaza Strip; unstable security circumstances; poor communication between involved parties; unmanaged cash flow and award of design to unqualified designers. On the owner point of view the major risks assessed were: Awarding the design to unqualified designers; defective design; occurrence of accidents; difficult access to site; inaccurate quantities; lack of consistency between Bill of Quantities, drawing and specifications; working at hot (dangerous) areas; financial failure of the contractors; closures and high competition bids.

Zou et al. (2006) in his paper identified and analyzed the risks associated with the development of construction projects from stakeholders and life cycle perceptions in China. Twenty major risks factors were identified and were mainly related contractors, clients and designer with few related to Government bodies, subcontractors/suppliers and external issues. Among them, in ranking, were: Tight project schedules; design variation; excessive approval procedure in administrative government departments; high performance; unsuitable contractors programme planning; variation of construction programme; low management competency of sub-contractors; variations by the client; incompletion approval and other documents; and incomplete and inaccurate estimates.

Wang, Dulaimi and Agura (2004) also carried a research in China on risk management on construction in developing countries. These included:- Approval and permit; change of law; justice reinforcement; local partner's credit worthless; political instability; cost overrun; corruption; inflation and interest rates; government policies and government influence on disputes.

Tang, Qiang, Duffield and Lu (2007) carried out a research on risk management in the Chinese construction industry. He compared criticality of the risks and evaluated the methods and risk responses used by project parties in construction industry. They ranked the five most important risks as poor quality of work, premature failure of the facility, safety, inadequate or incorrect design, and financial risk.

2.10 Discussion

From the literature it is noted that construction risk is the biggest fear among contractors around the world. From the foregoing literature review from different countries, construction risks have been identified as a key concern in project delivery within project objectives. Risk management process has been insisted by several authors as the appropriate step in identifying construction risks, analyzing them and taking best mitigation strategies to solve them. Tang et al. (2007) believed that the existing risk management systems are not sufficient for managing risks and the key barrier to proper risk management is lack of joint management mechanism. From the literature review, risk management has emerged to be very critical in the construction industry of any country if contractors are to deliver projects within objectives. Though substantial risk studies have been carried out in Kenya, none has attempted to relate risks with all the project objectives.

2.11 Research Gaps

A lot of researches on risk management have been carried out both in Kenya and globally. From the literature review it has emerged that very little has been done to relate construction risks and project delivery in terms of meeting all the critical project objectives. Where research has been carried out in this area it has not attempted to establish how construction risks influence all the performance variables in construction projects. Most of the studies carried out have concentrated on only two objectives, that is, cost and time. For example, Gichunge (2000) looked into how construction risk influence both project cost and project time. Wanyona (2005) has looked into risk Management in the cost planning and control of building projects by considering the Quantity Surveying profession in Kenya. Talukhaba (1988) has researched on project time and cost performance of construction projects.

This research has investigated five project objectives identified earlier in this chapter, that is, cost, time, quality, environment and health and safety. The likelihood of occurrence and the impact of construction risks on each of the objectives were assessed. This provided the much needed information where their order of significance in relation to project performance objectives was determined.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter presents various stages and phases that were followed in completing this study. Most decisions about how research was executed and how respondents were to be approached, as well as when, where and how the research was to be conducted are discussed. This chapter consists of research design, target population, sample design, data collection instruments and procedures and data analysis.

3.2 Research Design

The study has adopted a survey research design. The study aimed at collecting information from respondents on their attitudes and opinions in relation to the construction risks among contractors in Kenya. This study has attempted to identify key risks affecting construction projects delivery and to provide practical suggestions and recommendations pointing toward improving the risk management practices in construction and therefore improve the performance.

3.3 Population of the study

Population refers to the entire group of individuals, events or objects having common observable characteristics (Mugenda & Mugenda, 2003). This is a set of elements that the research focuses upon and to which the results obtained by testing the sample should be generalized and therefore it is absolutely essential to describe accurately the age population (Smith et al., 2006). The study targeted contractors registered with National Construction Authority (NCA). The choice of NCA is believed to be the representation of the entire construction industry since they operate under a formal organization and is a criterion for choosing a contractor for a project in Kenya.

Table 3.1 Population of the Study

CATEGORY	NUMBER
NCA 1	643
NCA 2	480
NCA 3	867
NCA 4	2,987
NCA 5	2,666
NCA 6	5,231
NCA 7	7,472
NCA 8	2,659
TOTAL	**23,005**

Source: NCA website (www.nca.go.ke), accessed on 17th February 2015

3.3.1 Exclusion criteria

All the contractors in the NCA contractors' register who are in category NCA 6 and below were excluded. This is because their limited expertise, they have handled very few projects and of small magnitude. The experience of their staff in the industry and their technical qualification may also be inadequate to understand much about construction risks. According to NCA (2015) the directors of these companies have technical qualification of below a diploma (See to appendix 4 and five on NCA registration requirements in terms of technical requirements and capability respectively) 2.) All the contractors not registered with NCA were also excluded in this research.

3.3.2 Inclusion criteria

The following were included in the study: 1.) All the contractors registered with NCA in category NCA 1, NCA 2, NCA 3, NCA 4 and NCA5. Contractors in these categories were chosen because of the number and size of projects they have handled, experience of their staff in the construction industry and their technical qualification. According to NCA (2015) these construction firms have at least one employee with a minimum of a diploma in a technical field (See to appendix 4 and five on NCA registration requirements in terms of technical requirements and capability respectively).

3.4 Sample size and sampling procedure

A sample from Cramer and Howitt (2005) view is a set of entities drawn from a population with the aim of estimating characteristics of the population. Cramer and Howitt (2005) further define a sample size as the number of cases or entities in the sample studied. They have asserted that the question of an appropriate sample size is a complex issue which depends on many factors. One important factor is the researcher's expectations of the trend of responses. The greater the trend the smaller the appropriate sample size and vice versa. In addition to the purpose of the study and population size, the level of precision, the level of confidence or risk and the degree of variability in attributes being measured need to be specified to determine the appropriate sample.

There are several methods of determining the sample size. According to Mugenda and Mugenda (2003), 10% of the accessible population is enough for sampling for descriptive study. Other methods include census for small population, imitating a sample size of similar studies, using published tables, and applying formulas to calculate the sample size.

For the purpose of this study a formula proposed by Fisher et al. (1972) was adopted in determining the sample size. Based on the NCA website (www.nca.go.ke), accessed on 17th February 2015, there are 23,005 registered members comprising of not only Building and Civil Engineering Contractors, but also Specialists Contractors and Sub-contractors. Contractors in categories NCA 1, NCA 2, NCA 3, NCA 4 and NCA 5 are chosen are included in this study while those in categories NCA 6, NCA 7 and NCA 8 are excluded. This translates to 7643 contractors which is 33% of the total population. Table 3.2 shows the proportionate distribution of these contractors in terms of their category of registration in the NCA register.

Formula for calculating the sample size as per Fisher *et al* (1972)*:*

$$N = \frac{Z^2 pq}{e^2}$$

Description:

N = required sample size (when population is more than 10,000)

Z^2 = standard normal deviation at 95% confidence level (=1.96)

P = expected prevalence or proportion. Sample size shall be based on the proportion of contractors who are in category NCA 5 and above (33%) according to NCA (2015).

q= 1- p

e^2 = degree of accuracy / level of precision (set at +/- 7% or 0.07)

Thus,

$$N = \frac{(1.96)^2 (0.33) (0.67)}{(0.07)^2}$$

$$= 173$$

This sample size formula provides the number of responses that need to be obtained assuming that there is no problem with non-response or missing values. The sample size was increased by 10% to compensate for this (Cochran, 1963).

Thus the number of administered questionnaires was:

$$= 173 + \frac{10}{100} \times 173$$

= 190

A sample design is a definite plan for obtaining a sample from the sampling frame. It refers to the techniques or procedures the researcher would adopt in selecting sampling units from which inference about the population are drawn (Kothari, 2004). For the purpose of this study, stratified proportionate random sampling was adopted. According to Kothari (2004), a stratified random sampling is used where the population embraces a number of distinct categories, the frame can be organized by these categories into separate "strata." Each stratum was then sampled as an independent sub-population, out of which individual elements can be randomly selected. In this study the population is stratified into eight (8) distinct strata and the sample was drawn from five (5) of these strata. This is as shown in table 3.2.

Selection of contractors from each stratum was based on simple random sampling. In assessing construction risk the researcher targeted senior managers, project managers, technical managers, architects, quantity surveyors and engineers employed by the respondent.

Table 3.2 Proportionate sample distribution

CATEGORY	**NUMBER**	**PERCENTAGE OF TOTAL**	**SAMPLE DISTRIRIBUTION**
NCA 1	643	8.40	16
NCA 2	480	6.30	12
NCA 3	867	11.30	22
NCA 4	2987	39.10	74
NCA 5	2666	34.90	66
TOTAL	7643	100.00	190

Source: Author, 2015

3.5 Data Collection Instrument

Axinn and Pearce (2006) explain that there are four data collection methods; questionnaires, interviews, observation and focus group discussion. Questionnaire is a series of written questions on a topic about which the respondents' opinion are sought (Chandran, 2004). Axinn and Pearce (2006) argue that questionnaires provide a high degree of data standardization and adoption of generalized information amongst any population. Cannoway and Powell (2010) add that questionnaires are advantageous since they are filled up by the respondents in their own comfort and facilitate the collection in large amount of data in a relatively short time.

To carry out this study a structured questionnaire was developed and pre-tested. It contained both open and close ended questions. The questionnaire consisted of three parts. Part one (1) and part two (2) contained close ended, structured and pre-determined questions while part three (3) contained one open ended question. The reason why close ended, structured and pre-determined questions were largely used was to allow for collecting information from respondents within the limited time and budget. It was also to ensure reliability by promoting consistency in responses and simplified data analysis. The shortcoming is that the respondents are given no room for their opinions. To take care of this an open ended question was introduced in part three (3) for the respondent to give their views on risk management practice in Kenya. A letter to the respondents requesting for information and explaining the purpose of this study and a research permit from National Commission for Science, Technology and Innovation (NACOSTI) accompanied the questionnaire.

In part two (2) of the questionnaire a Likert scale of 1-5 was used. A Likert scale is a type of psychometric response scale used in questionnaires, and is widely used scale in survey research. The scale is named after Rensis Likert, who published a report describing its use (Likert, 1932). When responding to a Likert questionnaire item, respondents indicated their attitude on risk likelihood of occurrence and impact on project objectives.

3.6 Pilot Study

A pilot study is a mini-version of a full-scale study or a trial run done in preparation of the complete study. The latter is also called a 'feasibility' study. It can also be a specific pre-testing of research instruments, including questionnaires or interview schedules. (Polit & Beck, 2002). The pilot study in the current research can be defined as mainly a try-out of research techniques and methods, and also questionnaires. This was done using ten (10) contractors who were not necessarily members of NCA. Twenty (20) questionnaires were prepared and self administered to senior managers and consultants in these construction firms. These questionnaires sought contractors' opinion on risks likelihood of occurrence and their impact on the five risk objectives. The respondents were not only supposed to complete the questionnaires but also give their comments about them. Twelve (12) of these contractors responded. The results showed that cost and time as the most vulnerable to risks. Contractors were also to give comments on the questionnaires. Comments were well noted to establish whether the questions were clear to them and whether they were comfortable with them. Responses to the questions and insight provided by these active and influential project participants provided additional guidance and assistance to the researcher for the purpose of finalizing the research tools. The pilot survey results also formed the basis of modifying the questionnaire for the subsequent full-scale survey. Several adjustments were made to the questionnaire.

3.7 Data collection Procedures

This is a set-up plan on how to introduce the study to project participants and how to follow-up to ensure that maximum response is received from the sample which is chosen. The data was gathered through the use of questionnaire survey, self-administered on consultants and senior managers in the one hundred and ninety (190) randomly selected contractors.

Questionnaires were distributed to the respondents and 21 days were given to the respondents to complete the questionnaires before collection. A follow up was conducted after the first week of distribution to respondents. All the questionnaires were picked after this period of time or within any other agreed date.

3.8 Data Analysis

Data analysis entailed examining and summarizing data with the aim of extracting useful information and develop conclusions. Data analysis involved cleaning, sorting, and coding of raw data collected from the field and processing for purposes of interpretation by use of statistical package for social science (SPSS) analysis software and Microsoft Office Excel. The data provided by the questionnaire was analyzed using both descriptive and inferential statistical methods. In descriptive method, some measures of distribution, central tendency and dispersion were used. Inferential method involved the use of principal component analysis where component and composite scores were used to rank risk factors and regression analysis where a project delivery model was developed. These methods were chosen because they could give the results which answer the research questions. Findings were presented using tools like pie charts, graphs, tables, radar diagram and statistical equations models.

The survey feedback mainly included two groups of data, the likelihood of occurrence of each risk and its level of impact on project objective in relation to cost, time, quality, environment and health and safety. With respect to the impact on a particular project objective, a significance score for each risk assessed by each respondent was calculated. Significance index score was then determined for every risk. This is the average score for each risk considering its significance on a project objective. These calculated averages also formed the basis for principal component analysis. The significant index developed by Shen et al. (2001) was used in this research. This can be described as the function of the two attributes, that is, the likelihood of occurrence of risk and its level of impact on project objective.

$$r = f(\alpha\ \beta) \quad \text{……………………………………………..………} \quad (1)$$

Where;

r = risk significance

α = risk probability

β = risk impact

Thus the study questionnaire was designed to collect data about these two attributes. In order to assess the importance of each risk factor in relation to the project objectives, a risk significance index will be established by calculating a significance score for each of the risk factor. The significance score for each risk assessed by each respondent was calculated as follows:-

$$r_{ij}^{k} = \alpha_{ij}\ \beta_{ij}^{k} \quad \text{……………………………………..…………………} \quad (2)$$

Where;

r_{ij}^{k} = significance score assessed by respondent "j" for risk "i" on project objective "k

i = ordinal number of risk = (1, 45)

k = ordinal number of project objective = (1, 5)

j = ordinal number of valid response = (1, n)

n = total number of valid response to risk "i"

α_{ij} = risk probability assessed by respondent "j" for risk "i"

β_{ij}^{k} = risk impact assessed by respondent "j" for risk "i" on project objective "k".

The average score (significance index score) for each risk in relation to the different project objectives was calculated. By averaging scores from all the responses, it is possible to get the risk index score for each risk and is used to rank among all risks. The model for the calculation of risk index score can be written as:-

$$R_j^k = \frac{\sum_{j=1}^{n} r_{ij}^k}{n} \qquad \text{…………………………………………… (3)}$$

Where;

R_j^k = significance index score for risk *"i"* on project objective *"k"*.

r_{ij}^k = significance score assessed by respondent *"j"* for risk *"i"* on project objective *"k*

n = total number of valid response to risk *"i"*

For the purpose of calculating significance score assessed by the various respondents for the various risks on different project objectives, a numerical conversion for the rating of the scale was applied. Five- point scale was applied for α (almost certain, highly likely, likely, unlikely and rare (remote)) and for β (very low impact, low impact, medium/ moderate impact, high impact and very high impact). These scales were converted into numerical scales as shown in the table 3.3 and 3.4. Conversion of risk probability was on the basis of level likelihood of occurrence "almost certain" risks were rated high one (1) while "rare/ remote" risks were rated low (0.2). This also applied with impact of risks on project objectives. Where the respondents opinion "very high" was rated as one (1) while "very low" risks were rated low (0.2).

Table 3.3 Numerical conversion table for scale (Risk probability)

α (Risk probability)		
Scale (Rating attributes)	**Meaning**	**Numerical conversion**
1	rare (remote)	0.2
2	unlikely	0.4
3	likely	0.6
4	highly likely	0.8
5	almost certain	1.0

Source: Author

Table 3.4 Numerical conversion table for scale (risk impact)

β (risk impact)		
Scale (Rating attributes)	**Meaning**	**Numerical conversion**
1	very low	0.2
2	low	0.4
3	medium/ moderate	0.6
4	high	0.8
5	very high	1.0

Source: Author

3.8.1 Probability/ Impact risk matrix

A risk matrix was constructed that was used for the calculation of the risk significance index by combining both the probability and impact numerical scales.

	RISK IMPACT (β)					
RISK PROBABILITY (α)		Very Low (0.20)	Low (0.40)	Moderate (0.60)	High (0.80)	Very High (1.00)
	Almost certain (1.00)	0.20 (M)	0.40 (H)	0.60 (E)	0.80 (E)	1.00 (E)
	Highly likely (0.80)	0.16(M)	0.32 (H)	0.48 (E)	0.64 (E)	0.80 (E)
	Likely (0.60)	0.12 (L)	0.24 (M)	0.36 (H)	0.48 (E)	0.60 (E)
	Unlikely (0.40)	0.08 (L)	0.16 (M)	0.24 (M)	0.32 (H)	0.40 (H)
	Rare (Remote) (0.20)	0.04 (L)	0.08 (L)	0.12 (L)	0.16 (M)	0.20 (M)

Key:

E (Red): Extreme risk; immediate action required	0.48 - 1.00
H (Orange): High risk; senior management attention needed	0.32 - 0.47
M (Yellow): Moderate risk; management responsibility must be specified	0.16 – 0.31
L (Green): Low risk; manage by routine procedures	0.00 – 0.15

Figure 3.1 Risk analysis matrix- risk significance index calculation and level of risk

Source: Based on AS/NZS4360, 2004

3.9 Conclusion

The index score calculated was used to rank risk factors in relation to project objectives. The significance index scores calculated for all the risks also formed the basis for inferential statistics. Underlying statistical relationships on how risks impact on the different objectives were investigated. To achieve this principal component analysis (PCA) technique was applied. Using SPSS statistical analysis software, factor score were determined for individual risk factor and the composite score. Principal component regression and factor score analysis methods were used to come up with the risk composite score (RCS) for all the 45 risks. Risks were subsequently ranked using the RCS. Ranking of risks using RCS did not only employ the level of significance of risks in relation to project objectives but also existing statistical relationships between a given risk and all the project objectives. This implied that an appropriate action taken to mitigate a particular risk in relation to a particular project objective, shall also impact on all other related objectives. This was necessary for the purpose of decision making in terms of coming up with appropriate strategies and measures to enhance risk management and consequently improved project delivery.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter focuses on presentation, data analysis together with its interpretation and presents discussions.

The data analysis is reported in six main sections.

- Introduction - Information about the respondents
- Likelihood of occurrence of construction risks among contactors.
- The impact of construction risks on construction objectives, that is, time, cost, quality, environment and health and safety.
- Risk significance index score in relation to project objectives and ranking of risks
- Principal component analysis (PCA) and Component composite score ranking of risks
- Extent of construction risk management in the Kenyan construction industry among contractors.

The reason for subdividing the data in six sections is because the questionnaire opinion survey was extensive and has been summarized to make it readily understandable. Statistics given refer to responses to individual questions and are used to indicate trends rather than absolute exactness.

Services in the construction industry are offered by the contractors and the consultants, who include architects, quantity surveyors, construction project managers and engineers. Contractors take a bigger portion of the risks in the construction industry compared to any other stakeholders apart from clients in the industry. The respondents were therefore drawn from the construction firms included in the random sample. It is therefore important that the nature of the respondent in-terms of level of education, professional background, experience in the construction industry and nature of firms they serve in are looked into.

Combination of two (2) aspects of risks, that is, likelihood of occurrence and its impacts on one more projects objectives if it happens to occur determines the performance in a project. The respondents' opinions on the two aspects indicate which risks should be emphasized on in risk management to improve their performance and the performance of the construction industry as a whole. Through a thorough risk analysis process key risks determining contractors' performance are identified.

Information on the extent of risk management in the construction industry is important in that it determines whether the contractors are conscious about risks and the priority they are given in their business organizations. Moreover, this information will largely influence the recommendations of this research.

4.1.1 Nature of respondents and their organization

In this section the researcher examines the nature of respondents and the nature of their construction firm in terms of NCA registration. The education background, professional background, position held in the construction firm and the experience of the respondents are attributes believed to determine their knowledge about construction risk thus high reliability of their response. Respondents who are literate; possess professional qualification related to construction; holding either managerial or technical position in the organization and have worked for long in the construction industry and are believed to provide more reliable information relating to construction risks. Company directors, senior managers and construction professionals, that is, construction project managers, technical managers, engineers, quantity surveyors, architects formed the respondent group. All these are assumed to have vast knowledge about construction risks that can be relied on at a reasonable precision.

Construction companies registered above category NCA 5 were included in this survey. These firms have experience with large construction projects and they have professional employees with extensive experience in the construction industry. The first registration and the current registration category with NCA were considered. This is an indicator of the size of the firm in terms of the magnitude of projects it has handled, the equipment if owns, the experience of its employees.

The questionnaire consisted of three sections. Section one (1) solicited general information about the respondents. Questions 1 to 5 of this section aimed at collecting information on respondents' education background, professional background, position held in the construction firm and the experience. Data from the ninety eight (98) valid questionnaires were analyzed to determine the nature of respondents. The results are discussed in section 4.3.1 and tabulated in tables 4.2 to table 4.7. Questions 6 and 7 are on construction firm category of registration in the NCA register. A summary of these two questions is given in section 4.3.2.

4.2 Response rate

Response rate is the number of people participating in a survey divided by the number of people who were invited to respond, in the form of a percentage (Rubin & Babbie, 2009).

Table 4.1 Response rate

	Frequency	**Percentage**
Valid Response	98	51.58
Invalid response	2	1.05
Did not respond	90	47.37
Total	190	100.00

Source: Field survey, 2015

The questionnaires were distributed to the one hundred and ninety (190) respondents in the construction companies. Out of this, one hundred feedbacks were received in which two (2) feedbacks were identified as invalid due to incomplete or invalid answers. This represents a valid response rate is 51.58% which according to Rubin and Babbie (2009) is considered adequate for analysis and reporting. Table 4.1 presents this response information.

4.3 General Information

The study sought to establish the profile of the respondents in terms of the highest level of education, professional qualification, position held in the Construction Company, experience in the construction industry. The study also sought information on respondents' employing construction company in terms of NCA registration. The characteristics of study subjects were described using frequencies and percentages.

4.3.1 Highest level of education of respondents

Table 4.2 Highest Level of Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Certificate	6	6.1	6.1	6.1
	Diploma	32	32.7	32.7	38.8
	Degree	49	50.0	50.0	88.8
	Post graduate	11	11.2	11.2	100.0
	Total	98	100.0	100.0	

Source: Field survey, 2015

Table 4.2 shows distribution of respondents according to the highest level of education attained. The table shows that approximately 6 percent of the respondents had certificates (artisans). Approximately 33 percent of the respondents were diploma holders and were the second majority respondents after degree holders with 50 percent of the respondents. The least were post graduates with approximately11 percent.

4.3.2 Professional qualification

Table 4.3 shows the percentage distribution of the respondents in terms of professional qualification. The table shows that approximately 14 percent were qualified project managers. Engineers were the majority at approximately 29 percent. These were mainly civil engineers, electrical engineers and mechanical engineers. Quantity surveyors and architects were approximately 9 percent and 14 percent respectively. Electrical engineers and mechanical engineers were either employed by the contractors or acted as directors and senior managers of construction companies registered by NCA under Electrical Engineering Services and Mechanical Engineering Services classes respectively. Being essential players in the industry, electrical engineers and mechanical engineers had valid opinions as far as construction risks are concerned thus their inclusion.

Table 4.3 Professional Qualification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Project manager	14	14.3	14.3	14.3
	Engineer	28	28.6	28.6	42.9
	Quantity surveyor	9	9.2	9.2	52.0
	Architect	14	14.3	14.3	66.3
	Others	33	33.7	33.7	100.0
	Total	98	100.0	100.0	

Source: Field survey, 2015

Majority of the respondents (approximately 34 percent) were from other professional groups. This included land surveyors, accountants, land economists and business administrators. This indicates that there are several proprietors who are in construction business though their training is not in construction field.

4.3.3 Position held in the construction company

4.3.3.1 Position held in first employment

Table 4.4 shows the frequency and the percentage distribution of the respondents according to the position they held in their first employment in construction. The table shows that about 9 percent and 5 percent of the respondents joined the industry as company directors and senior managers respectively. The table shows that technical managers and engineers had the major share of respondents, that is, approximately 22 percent and 20 percent respectively. Those who got their first jobs as Architects and Project managers were approximately 9 percent and 14 percent respectively. The findings presented in the 4.4 further illustrate that approximately 12 percent of the respondents were employed to do other jobs other than directors, senior manager, technical manager, engineer, quantity surveyor, and architect or project manager.

Table 4.4 Position Held in First Appointment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Director	9	9.2	9.2	9.2
	Senior manager	5	5.1	5.1	14.3
	Technical manager	22	22.4	22.4	36.7
	Engineer	20	20.4	20.4	57.1
	Quantity Surveyors	7	7.1	7.1	64.3
	Architect	9	9.2	9.2	73.5
	Project manager	14	14.3	14.3	87.8
	Others	12	12.2	12.2	100.0
	Total	98	100.0	100.0	

Source: Field survey, 2015

4.3.3.2 Position held in the current employment

Table 4.5 presents the frequency and the percentage distribution of the respondents according to their current position in their construction firms. The table shows that about 36 percent and 16 percent of the respondents currently are directors and senior managers respectively in their construction companies. These findings indicate these two as the majority groups. The table shows that both technical managers and engineers have a share of approximately 12 percent.

Table 4.5 Current Position Held

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Director	35	35.7	35.7	35.7
	Senior manager	16	16.3	16.3	52.0
	Technical manager	12	12.2	12.2	64.3
	Engineer	12	12.2	12.2	76.5
	Quantity surveyor	4	4.1	4.1	80.6
	Architect	8	8.2	8.2	88.8
	Project manager	8	8.2	8.2	96.9
	Others	3	3.1	3.1	100.0
	Total	98	100.0	100.0	

Source: Field survey, 2015

Those who responded to the questionnaire survey and currently practicing as quantity surveyors are approximately 4 percent. The findings presented in the table further point out that approximately 8 percent of the respondents are employed as project managers while approximately 3 percent do other jobs other than directors, senior manager, technical manager, engineer, quantity surveyor, architect and project manager.

4.3.4 Experience in the construction industry

Table 4.6 presents the frequency and the percentage distribution of the respondents according to their years of experience in the construction industry. This is further summarized in figure 4.1. Approximately 30 per cent of the respondents have more than fifteen (15) years of experience in the construction industry whereas about 23 percent and 28 percent had experience of ten (10) to fifteen (15) years and experience of five (5) to ten (10) years respectively.

Table 4.6 Years of Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 Year or less	1	1.0	1.0	1.0
	More than 1 year - 5 year	18	18.4	18.4	19.4
	More than 5 years - 10 years	27	27.6	27.6	46.9
	More than 10 years - 15 years	23	23.5	23.5	70.4
	More than 15 years	29	29.6	29.6	100.0
	Total	98	100.0	100.0	

Source: Field survey, 2015

The findings further illustrate approximately 18 percent of the respondents had experience of between one (1) and five (5) years. Only a minority of 1 percent had experience of less than one (1) year. The background and experience of the respondents supports the belief that they were involved with running of projects at both operational and strategic levels, therefore had some knowledge of issues related to awareness and likelihood and degree of impact of risk factors on construction projects.

4.3.5 NCA Registration of the respondents' construction company

Table 4.7 presents the frequency and the percentage distribution of the respondents according to their firms' first NCA registration. Approximately 6 per cent of the respondents had their construction firms first registered in category NCA 1 whereas about 11 percent and 15 percent were registered in category NCA 2 and category NCA 3 respectively.

The findings indicate majority of respondents (approximately 25 percent) were first registered in category NCA 4. Further the finding illustrate approximately 15 percent of the respondents had their construction firms first registered in category NCA 5 whereas about 13 percent and 12 percent were registered in category NCA 6 and category NCA 7 respectively. Only 2 percent of the respondents registered in category NCA 8 in their first registration with the statutory body. This is the least number of all the respondents interviewed.

Table 4.7 First NCA Registration

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NCA 1	6	6.1	6.1	6.1
	NCA 2	11	11.2	11.2	17.3
	NCA 3	15	15.3	15.3	32.7
	NCA 4	24	24.5	24.5	57.1
	NCA 5	15	15.3	15.3	72.4
	NCA 6	13	13.3	13.3	85.7
	NCA 7	12	12.2	12.2	98.0
	NCA 8	2	2.0	2.0	100.0
	Total	98	100.0	100.0	

Source: Field survey, 2015

Table 4.8 presents the frequency and the percentage distribution of the respondents according to their firms' current NCA registration. Approximately 7 per cent of the respondents had their construction firms first registered in category NCA 1 whereas about 11 percent and 19 percent are registered in categories NCA 2 and category NCA 3 respectively. The findings further indicate majority of respondents, approximately 28 percent and 35 percent, were registered in categories NCA 4 and NCA 5 respectively.

Table 4.8 Current NCA Registration

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NCA 1	7	7.1	7.1	7.1
	NCA 2	11	11.2	11.2	18.4
	NCA 3	19	19.4	19.4	37.8
	NCA 4	27	27.6	27.6	65.3
	NCA 5	34	34.7	34.7	100.0
	Total	98	100.0	100.0	

Source: Field survey, 2015

Table 4.9 compares the current registration of respondent firms with the sample distribution. The findings as presented on the table indicate that approximately 44 percent of the targeted respondents in category NCA 1 returned a completed and valid questionnaire. The response rate was highest in category NCA 2. This is approximately 92 percent. Another impressive response is noted in category NCA 3 where approximately 86 percent responded to the questionnaire. The table further indicates a response rate of approximately 36 percent and 52 percent with category NCA 4 and NCA 5 respectively.

Table 4.9 Current NCA Registration distribution compared to sample distribution

Current NCA registration	Total out (Sample distribution)	No. of responses	Percent of total sample size (%)
NCA 1	16	7	43.75
NCA 2	12	11	91.67
NCA 3	22	19	86.36
NCA 4	74	27	36.49
NCA 5	66	34	51.52
Total	190	98	51.58

Source: Field survey, 2015

Table 4.10 is a cross tabulation between first registration of respondents' construction companies and the current registration. Data presented illustrates how contractors have either upgraded or downgraded their registration in the NCA register. Upgrading is mainly based on contractor's performance in terms of magnitude of project completed, number and qualification of staff employed, financial strength and equipment owned.

Table 4.10 Current NCA Registration * First NCA Registration Cross tabulation

		First NCA Registration								Total
		NCA 1	NCA 2	NCA 3	NCA 4	NCA 5	NCA 6	NCA 7	NCA 8	
Current NCA Registration	NCA 1	5	2	0	0	0	0	0	0	7
	NCA 2	1	8	1	0	1	0	0	0	11
	NCA 3	0	1	14	1	1	0	1	1	19
	NCA 4	0	0	0	23	1	2	0	1	27
	NCA 5	0	0	0	0	12	11	11	0	34
Total		6	11	15	24	15	13	12	2	98

Source: Field survey, 2015

The table shows that two (2) out of the total seven (7) contractors in category NCA1 upgraded from NCA 2 while one of them was downgraded from category NCA 1 to category NCA 2. Two (2) contractors upgraded from category NCA 3 and NCA5 to category NCA 2 while one of them was downgraded from category NCA 2 to category NCA 3. Eight (8) contractors upgraded their registration in both category NCA 3 and NCA 4. Category NCA 5 had the highest number of upgrades where eleven (11) contractors upgraded from NCA 6 to NCA 5 and eleven (11) more from NCA 7 to NCA 5.

4.3.6 Summary of respondents information and their organizations

Majority of respondents are well educated with approximately 61 percent having a first degree and above and the rest with either a diploma or a certificate in a technical area. This indicates that these are people who understand the questions contained in the questionnaire and the construction industry.

It is apparent from the findings that majority of respondents were Engineers, Architects, Construction project managers or Architects whom constitute a total of approximately 66 percent. Professionals in other fields like accounting, Surveying, Economic and planning constitutes the rest of approximately 34 percent.

Most of the respondents joined the construction industry mainly in positions of their qualification with a few of them joining as directors and senior managers (14.30%). It appears that after gaining experience in the industry a good number of employees start their own construction companies. Thirty five percent (35%) of the respondents are currently directors compared to 9 percent at the point of entering the industry. Several others get promotion to senior management positions. At the point of entrance approximately 14 percent were senior managers compared to the current 52 percent.

Majority of respondents (over 80%) have experience of over five (5) years in the construction industry. The rest (less than 20%) have experience of less than five (5) years. Respondents with high experience in the construction understand construction procedures, challenges experienced and risks. This is indispensable to ensure reliable data is collected.

It appears that majority of the respondents' organizations are registered in category NCA 4 and NCA 5 but when compared with the sample distribution the response was highest with the respondents in category NCA 2 followed by NCA 3. Response in other categories, that is, NCA 1, NCA 4 and NCA 5 was average. The good response in these categories is a pointer that the information provided is reliable and a good representative of the population. A number of construction companies have upgraded their registration in the NCA register. This is a pointer that these companies are exceedingly active in the construction industry.

In conclusion information on respondent and the employing construction companies is imperative to investigate why despite of a strong construction industry and competent construction professionals the industry still experiences the dreadful effects of construction risks. There is need for adequate risk management procedures in construction projects among contractors and their professional consultants. This therefore calls for gathering information on these professionals and also understanding the nature of construction companies they serve. This is important to ensure reliable data on construction risks is collected and results are dependable. Recommendations provided in this research are believed that they shall improve project delivery among contractors.

4.4 Risk likelihood of occurrence

One of the objectives of this study is to investigate the likelihood of occurrence of construction risk. Table 4.11 illustrates analyses of the various construction risks using percentages, mean and standard deviation.

Table 4.11 Percentage frequency distribution, mean and standard deviation table for risk probability

	RISK FACTOR	Risk probability percentage distribution					Statistics		
		Rare/ remote (0.2)	**Unlikely (0.4)**	**Likely/ possible (0.6)**	**Highly likely (0.8)**	**Almost certain (1.0)**	**Average**	**Std deviation**	**Rank**
	Design/Technical								
1	Design variations required by clients	6.20	9.30	43.30	21.60	19.60	**0.6816**	**0.2203**	**4**
2	Defective designs(shoddy and/or erroneous)	15.30	24.50	40.80	11.20	8.20	**0.5449**	**0.2220**	**35**
3	Incomplete design	17.50	12.40	34.00	30.90	5.20	**0.5876**	**0.2324**	**29**
4	Inadequate or insufficient site information (site investigation report)	8.20	12.20	30.60	37.80	11.20	**0.6633**	**0.2180**	**8**
5	Inadequate/ defective specification	7.40	12.60	41.10	31.60	7.40	**0.6633**	**0.2180**	**9**
6	Information unavailability- details, drawings, sketches	8.20	10.20	28.60	28.60	24.50	**0.7020**	**0.2407**	**3**
7	Unclear scope of work	12.30	15.30	45.90	17.30	9.20	**0.5918**	**0.2186**	**26**
8	Lack of consistency between the BQs, drawings and specifications	3.10	14.30	42.90	28.60	11.20	**0.6612**	**0.1914**	**10**
	Time								
9	Delay in handing over the site	11.20	22.40	39.80	20.40	6.10	**0.5755**	**0.2116**	**31**
10	Inadequate project programme	9.40	17.70	41.70	25.00	6.30	**0.6021**	**0.2062**	**21**
11	Tight project schedule	9.20	14.30	38.80	30.60	7.10	**0.6245**	**0.2096**	**17**
12	Difficult to access the site	20.60	39.20	30.90	9.30	0.00	**0.4577**	**0.1809**	**42**
13	Delays in supply of Materials	5.10	23.50	48.00	17.30	6.10	**0.5918**	**0.1859**	**26**
14	Delays in supply of utilities i.e. electricity and water	3.10	17.30	48.00	24.50	7.50	**0.6306**	**0.1802**	**14**
	Financial/ Economic								
15	Delayed payment by the employer	6.10	5.10	30.60	42.90	15.30	**0.7122**	**0.2032**	**2**

	RISK FACTOR	Risk probability percentage distribution					Statistics		
		Rare/ remote (0.2)	Unlikely (0.4)	Likely/ possible (0.6)	Highly likely (0.8)	Almost certain (1.0)	Average	Std deviation	Rank
16	Financial failure of the contractor	9.20	15.30	46.90	24.50	4.10	**0.5980**	**0.1937**	**22**
17	Financial failure of the sub-contractor	5.10	19.40	45.90	25.50	4.10	**0.6082**	**0.1815**	**20**
18	Exchange rate fluctuations and inflation	13.30	21.40	18.40	32.70	14.30	**0.6265**	**0.2563**	**16**
19	Cost under estimation	4.10	14.40	38.10	28.90	14.40	**0.6701**	**0.2062**	**5**
	Quality risks								
20	Inadequate sub-contractor efficiency and competency	6.20	26.80	51.50	9.30	6.20	**0.5649**	**0.1826**	**33**
21	Defective work	6.10	31.60	40.80	11.20	10.20	**0.5755**	**0.2076**	**31**
22	Technical complexity and design innovations requiring new construction methods and materials	10.20	17.30	39.80	28.60	4.10	**0.5980**	**0.2041**	**22**
23	High performance or quality standard to meet	11.30	8.20	28.90	38.10	13.40	**0.6680**	**0.2325**	**6**
	Construction/ project execution								
24	Legal disputes during construction among the parties to contract	13.30	39.80	31.56	9.20	6.10	**0.5102**	**0.2073**	**41**
25	Industrial disputes during construction	8.30	19.80	51.00	17.70	3.10	**0.5796**	**0.1827**	**30**
26	Loss or damage of third parties property due to construction activities	31.60	32.70	24.50	7.10	4.10	**0.4388**	**0.2181**	**44**
27	Serious accidents on site	21.90	45.80	21.90	5.20	5.20	**0.4510**	**0.2037**	**43**
28	Wastage of materials on site by workers	3.10	21.60	34.00	33.00	8.20	**0.6449**	**0.1959**	**12**
29	Actual quantities different from contract quantities	4.10	13.40	37.10	37.10	8.20	**0.6653**	**0.1900**	**7**
30	Inadequate labour and equipment productivity	12.20	35.70	33.70	16.30	2.00	**0.5204**	**0.1942**	**40**
31	Equipment failure	8.20	31.60	43.90	12.20	4.10	**0.5449**	**0.1856**	**35**
32	Difficult site conditions	5.20	25.80	42.30	21.60	5.20	**0.5939**	**0.1893**	**25**
33	Inadequate supervision and supervision team	9.30	19.60	43.30	22.70	5.20	**0.5897**	**0.2008**	**28**
34	Poor communication between contract parties	11.30	23.70	41.20	20.60	3.10	**0.5608**	**0.1993**	**34**

	RISK FACTOR	Risk probability percentage distribution					Statistics		
		Rare/ remote (0.2)	**Unlikely (0.4)**	**Likely/ possible (0.6)**	**Highly likely (0.8)**	**Almost certain (1.0)**	**Average**	**Std deviation**	**Rank**
35	Lack of coordination between project participants	12.20	12.20	39.80	27.60	8.20	**0.6143**	**0.2210**	**18**
	Political and Environmental								
36	Excessive approval procedures in administrative government departments	6.10	13.30	25.50	27.60	27.60	**0.7143**	**0.2403**	**1**
37	Compliance with new government Acts and Legislations	13.30	11.20	32.70	33.70	9.20	**0.6286**	**0.2315**	**15**
38	Lack of support for the project by the local communities	9.20	40.80	33.70	12.20	4.10	**0.5224**	**0.1919**	**39**
39	Adverse weather conditions	3.10	15.10	41.20	34.00	6.20	**0.6510**	**0.1801**	**11**
40	Impact of construction project on surrounding environment	13.40	34.00	28.90	20.60	3.10	**0.5306**	**0.2093**	**37**
41	Unhealthy working condition for workers	12.20	16.30	37.80	27.60	6.10	**0.5980**	**0.2178**	**22**
42	Lack of compliance with environmental requirements	11.20	18.40	34.70	25.50	10.20	**0.6102**	**0.2286**	**19**
43	Lack of compliance with safety and health requirements on site	7.20	15.50	38.10	28.90	10.30	**0.6408**	**0.2110**	**13**
44	Unstable security circumstances	12.40	38.10	27.80	16.50	5.20	**0.5286**	**0.2115**	**38**
	Act of God								
45	Damage caused by wind, hurricanes, fire, landslides	50.00	19.40	18.40	4.10	8.20	**0.4020**	**0.2528**	**45**

Source: Field Survey, 2015

The table shows “Excessive approval procedures in administrative government departments” as the most likely risk in the construction industry with an average score of 0.7143 and a standard deviation of 0.2403. Approximately 28 percent of respondents viewed the risk as almost certain and 28 percent as highly likely while approximately 26 percent of respondents viewed this as a likely risk. “Delayed payment by the employer” is shown as the second likely risk in the construction industry with an average score of 0.7122 and a standard deviation of 0.2032. Approximately 43 percent of respondents viewed the risk as highly likely while about 31 percent of respondents viewed this as a likely risk and 15 percent were of the opinion that this is an almost certain risk.

Further, the table presents “Information unavailability-details, drawings, and sketches” as the third likely risk with an average score of 0.7020 and a standard deviation of 0.2407. Approximately 29 percent of respondents viewed the risk as highly likely and a similar proportion was of the opinion that this is just a likely risk. Approximately 25 percent of respondents were of the opinion that this is an almost certain risk.

Other probable risks in order of likelihood are: “Design variations required by clients” (0.687); “Cost under estimation” (0.6701); “High performance or quality standard to meet” (0.668); “Actual quantities different from contract quantities” (0.6653); “Inadequate or insufficient site information (site investigation report)” (0.6633); “Inadequate/ defective specification” (0.6633); and “Lack of consistency between the BQs, drawings and specifications” (0.661). The table indicates the least probable risk as “Damage caused by wind, hurricanes, fire, landslides”. This has an average of 0.4020 and a standard deviation of 0.2528. Fifty (50) percent of the responds believe that this is a rare (remote) risk in the construction industry.

“Loss or damage of third parties property due to construction activities” is the second least probable risk (from bottom) with a likelihood average of 0.4388 and a standard deviation of 0.2181. The table shows that approximately 32 percent and 33 percent of the respondents were of the opinion that this risk is remote and unlikely respectively.

The third least probable risk is “Serious accident on site” with likelihood average of 0.4510 and a standard deviation of 0.2037. The table shows that approximately 22 percent and 46 percent of the respondents were of the opinion that this risk is remote and unlikely respectively.

Other less probable risks in order of likelihood from bottom are: “Difficult to access the site” (0.4577); “Legal disputes during construction among the parties to contract” (0.5102); “High performance or quality standard to meet” (0.5204); “Inadequate labour and equipment productivity” (0.5224); “Unstable security circumstances” (0.5286); “Impact of construction project on surrounding environment” (0.5306); and “Equipment failure” (0.5449).

4.5 Risk impact on project objectives

The nature and effect of risk varies from one factor to the other. A risk factor may have a very high likelihood of occurrence with a negligible impact when it occurs consequently may require little if any risk response. Table 4.12 represents the impact of various risks on different project objectives, that is, cost, time, quality, environment, and health and safety.

Table 4.12 Average and standard deviation table for risk impact on project objectives

	RISK FACTOR	IMPACT ON PROJECT OBJECTIVES									
		COST		TIME		QUALITY		ENVIRONMENT		HEALTH AND SAFETY	
		Average	Std deviation	Average	Std deviation	Average	Std deviation	Average	Std deviation	Average	Std deviation
	Design/ Technical										
1	Design variations required by clients	0.7367	0.2308	0.7531	0.2330	0.5711	0.2345	0.4102	0.2058	0.4000	0.2298
2	Defective designs(shoddy and/or erroneous)	0.7423	0.2309	0.7347	0.2311	0.7000	0.2713	0.4990	0.2616	0.5020	0.2682
3	Incomplete design	0.7292	0.2210	0.7579	0.2421	0.6589	0.2607	0.3936	0.2262	0.4323	0.2802
4	Inadequate or insufficient site information (site investigation report)	0.6653	0.2257	0.6680	0.2215	0.6268	0.2339	0.5612	0.2414	0.5041	0.2572
5	Inadequate/ defective specification	0.7408	0.1973	0.6833	0.2004	0.7292	0.2462	0.5155	0.2288	0.5188	0.2438
6	Information unavailability-details, drawings, sketches	0.6939	0.2153	0.7531	0.2087	0.7143	0.2504	0.4449	0.2197	0.4429	0.2407
7	Unclear scope of work	0.7367	0.2198	0.7469	0.2198	0.6204	0.2215	0.4245	0.2373	0.4184	0.2538
8	Lack of consistency between the BQs, drawings and specifications	0.7612	0.2143	0.7061	0.2075	0.6694	0.2649	0.3959	0.2380	0.3755	0.2373
	Time										
9	Delay in handing over the site	0.5898	0.1956	0.7469	0.2325	0.4429	0.1867	0.3588	0.2738	0.3093	0.1684
10	Inadequate project programme	0.6144	0.1920	0.7546	0.2264	0.5188	0.1938	0.3625	0.1888	0.3729	0.1803
11	Tight project schedule	0.6286	0.2130	0.7041	0.2875	0.6227	0.2343	0.4510	0.2097	0.4694	0.2263
12	Difficult to access the site	0.5726	0.2075	0.7179	0.2432	0.4568	0.2253	0.3830	0.2188	0.3937	0.2342
13	Delays in supply of Materials	0.6521	0.1930	0.7875	0.2263	0.6082	0.2159	0.3649	0.1915	0.3485	0.1739
14	Delays in supply of utilities i.e. electricity and water	0.6327	0.1786	0.7612	0.2200	0.5755	0.2390	0.3959	0.2121	0.4521	0.2234

	RISK FACTOR	IMPACT ON PROJECT OBJECTIVES									
		COST		TIME		QUALITY		ENVIRONMENT		HEALTH AND SAFETY	
		Average	Std deviation	Average	Std deviation	Average	Std deviation	Average	Std deviation	Average	Std deviation
	Financial/ Economic										
15	Delayed payment by the employer	0.7449	0.2067	0.7918	0.2009	0.5837	0.2162	0.3510	0.1840	0.3408	0.1704
16	Financial failure of the contractor	0.7510	0.2112	0.7939	0.2158	0.6490	0.2369	0.3980	0.2234	0.4144	0.2278
17	Financial failure of the sub-contractor	0.7082	0.2190	0.7612	0.2181	0.6469	0.2312	0.3773	0.2018	0.3856	0.2184
18	Exchange rate fluctuations and inflation	0.7245	0.2671	0.6143	0.2211	0.5020	0.2192	0.3216	0.1622	0.3113	0.1607
19	Cost under estimation	0.7600	0.2271	0.6468	0.2336	0.6253	0.2497	0.3895	0.2322	0.3642	0.2083
	Quality risks										
20	Inadequate sub-contractor efficiency and competency	0.6474	0.2016	0.6866	0.2234	0.7333	0.2474	0.4542	0.2294	0.4779	0.2446
21	Defective work	0.7102	0.2353	0.7402	0.2258	0.7755	0.2407	0.5449	0.2433	0.5531	0.2582
22	Technical complexity and design innovations requiring new construction methods and materials	0.7204	0.2293	0.7082	0.2406	0.7052	0.2567	0.4776	0.2103	0.4837	0.2167
23	High performance or quality standard to meet	0.6959	0.2407	0.6898	0.2422	0.6928	0.2724	0.4309	0.1965	0.4429	0.2096
	Construction/ project execution										
24	Legal disputes during construction among the parties to contract	0.6755	0.2178	0.7633	0.2339	0.5216	0.2032	0.3237	0.1790	0.3271	0.1695
25	Industrial disputes during construction	0.6429	0.2015	0.7402	0.2276	0.5694	0.2175	0.3814	0.2103	0.4268	0.1929
26	Loss or damage of third parties property due to construction activities	0.5796	0.2359	0.5939	0.2270	0.3898	0.2018	0.4020	0.2120	0.4245	0.2284
27	Serious accidents on site	0.5546	0.2319	0.6000	0.2187	0.4479	0.2243	0.3835	0.2392	0.6227	0.2841
28	Wastage of materials on site by workers	0.7204	0.1984	0.6062	0.1989	0.6392	0.2409	0.4884	0.2401	0.4289	0.2363

	RISK FACTOR	IMPACT ON PROJECT OBJECTIVES									
		COST		TIME		QUALITY		ENVIRONMENT		HEALTH AND SAFETY	
		Average	Std deviation	Average	Std deviation	Average	Std deviation	Average	Std deviation	Average	Std deviation
29	Actual quantities different from contract quantities	0.7571	0.2096	0.6286	0.2225	0.6286	0.2487	0.3771	0.2227	0.3402	0.1961
30	Inadequate labour and equipment productivity	0.6816	0.1986	0.7041	0.2191	0.6680	0.2481	0.4124	0.2118	0.4392	0.2285
31	Equipment failure	0.6619	0.2089	0.7122	0.2244	0.6633	0.2413	0.4125	0.2089	0.4660	0.2358
32	Difficult site conditions	0.6598	0.1961	0.7320	0.2039	0.6186	0.2347	0.4611	0.2085	0.4708	0.2132
33	Inadequate supervision and supervision team	0.6633	0.2023	0.7265	0.2039	0.7490	0.2230	0.4660	0.2155	0.4878	0.2299
34	Poor communication between contract parties	0.6227	0.1977	0.6825	0.2175	0.6583	0.2030	0.4186	0.2329	0.4104	0.2159
35	Lack of coordination between project participants	0.6367	0.2117	0.7449	0.1922	0.6948	0.2311	0.4247	0.2184	0.4333	0.2185
	Political and Environmental										
36	Excessive approval procedures in administrative government departments	0.6694	0.2033	0.7429	0.2279	0.4701	0.2199	0.3670	0.2135	0.3449	0.2047
37	Compliance with new government Acts and Legislations	0.6265	0.2309	0.6816	0.2550	0.5155	0.2412	0.5155	0.2412	0.4268	0.2094
38	Lack of support for the project by the local communities	0.6122	0.2258	0.7204	0.2346	0.4816	0.2258	0.4184	0.2335	0.4878	0.2317
39	Adverse weather conditions	0.7072	0.2103	0.7837	0.2345	0.6309	0.2224	0.5714	0.2386	0.5735	0.2397
40	Impact of construction project on surrounding environment	0.4755	0.2289	0.4742	0.2386	0.4330	0.2211	0.6347	0.2740	0.4816	0.2383
41	Unhealthy working condition for workers	0.6163	0.2104	0.6143	0.2211	0.6188	0.2286	0.5443	0.2545	0.7072	0.2815
42	Lack of compliance with environmental requirements	0.5551	0.2159	0.5714	0.2315	0.5490	0.2212	0.6571	0.3012	0.6125	0.2781

	RISK FACTOR	IMPACT ON PROJECT OBJECTIVES									
		COST		TIME		QUALITY		ENVIRONMENT		HEALTH AND SAFETY	
		Average	Std deviation	Average	Std deviation	Average	Std deviation	Average	Std deviation	Average	Std deviation
43	Lack of compliance with safety and health requirements on site	0.5633	0.2078	0.5711	0.2254	0.5381	0.2148	0.5918	0.2691	0.7052	0.3203
44	Unstable security circumstances	0.6612	0.2176	0.7163	0.2367	0.5711	0.2291	0.4763	0.2474	0.6292	0.2828
	Act of God										
45	Damage caused by wind, hurricanes, fire, landslides	0.7898	0.2654	0.7939	0.2716	0.6875	0.2750	0.7083	0.2705	0.7113	0.2901

Source: Field Survey, 2015

4.5.1 Risk impact on cost

The survey results revealed that natural occurrences such as “Damage caused by wind, hurricanes, fire, landslides” as having the most significant impact on all project objectives. Table 4.12 shows this risk factor as having the highest impact on cost with an average impact of 0.7898 and a standard deviation of 0.2654. “Lack of consistency between the BQs, drawings and specifications” is second ranked in terms of severity on cost. It has an average impact of 0.7612 and a standard deviation of 0.2143.

Table 4.12 further shows other risk factors in their order of severity on cost as: “Cost under estimation” (Average impact of 0.7600 and Standard deviation of 0.2143), “Actual quantities different from contract quantities” (Average impact of 0.7571 and Standard deviation of 0.2096), “Financial failure of the contractor” (Average impact of 0.7510 and Standard deviation of 0.2112), “Delayed payment by the employer” (Average impact of 0.7449 and Standard deviation of 0.2067), “Defective designs(shoddy and/or erroneous)” (Average impact of 0.7423 and Standard deviation of 0.2309), “Inadequate/ defective specification” (Average impact of 0.7408 and Standard deviation of 0.1973), “Design variations required by clients” (Average impact of 0.7367 and Standard deviation of 0.2308) and “Unclear scope of work” (Average impact of 0.7367 and a Standard deviation of 0.2198).

Average impact represents the degree of potential loss on construction project cost in the construction industry while the standard deviation measures average deviation from the average impact.

4.5.2 Risk impact on time

As the case with cost "Damages caused by natural occurrences wind, hurricanes, fire, landslides" is the most impacting on project time. As shown in table 4.12, this risk factor has the highest impact on time at an average impact of 0.7939 and a standard deviation of 0.2716. "Financial failure of the contractor" has also has an average impact on time of 0.7939 and a standard deviation of 0.2158. The third ranked risk in terms of severity on time is "delayed payment by the employers" at an average impact of 0.7918 and a standard deviation of 0.20086.

Table 4.12 presents all the risk factors surveyed and their average impact on time. Some of the other severe risks affecting project time are: "Delays in supply of Materials" (Average impact of 0.7875 and Standard deviation of 0.2263), "Adverse weather conditions" (Average impact of 0.7837 and Standard deviation of 0.2345), "Legal disputes during construction among the parties to contract" (Average impact of 0.7633 and Standard deviation of 0.2339), "Delays in supply of utilities i.e. electricity and water" (Average impact of 0.7612 and Standard deviation of 0.2200), "Financial failure of the sub-contractor" (Average impact of 0.7612 and Standard deviation of 0.21810), "Incomplete design" (Average impact of 0.7579 and Standard deviation of 0.2421), "Design variations required by clients" (Average impact of 0.7531 and Standard deviation of 0.2330) and Information unavailability-details, drawings, sketches" (Average impact of 0.7531 and Standard deviation of 0.2087).

The average impact on time represents the degree of potential time loss on construction project time in the construction industry while the standard deviation measures average deviation from the average impact.

4.5.3 Risk impact on quality

As shown in table 4.12, "Defective work" has the highest impact on quality at an average impact of 0.7756 and a standard deviation of 0.2407. "Inadequate supervision and supervision team" is the second ranked in terms of severity on cost. It has an average impact of 0.7490 and a standard deviation of 0.2230.

Table 4.12 further shows other risk factors in their order of severity on quality are as follows: "Inadequate sub-contractor efficiency and competency" (Average impact of 0.7333 and Standard deviation of 0.2474), "Inadequate/ defective specification"

(Average impact of 0.7292 and Standard deviation of 0.2920), “Information unavailability-details, drawings, sketches” (Average impact of 0.7143 and Standard deviation of 0.2504), “Technical complexity” and “design innovations requiring new construction methods and materials” (Average impact of 0.7052 and Standard deviation of 0.2567), “Defective designs(shoddy and/or erroneous)” (Average impact of 0.7000 and Standard deviation of 0.2713), “Lack of coordination between project participants” (Average impact of 0.7490 and Standard deviation of 0.2230), “High performance or quality standards to meet” (Average impact of 0.6928 and Standard deviation of 0.2724) and “Damage caused by natural occurrences such as wind, hurricanes, fire, landslides” (Average impact of 0.6875 and Standard deviation of 0.2750).

Average impact on quality represents the degree of deviation from specifications and standards and the extent of repairs and redoing of certain activities in the project as a result of a risk factor. Standard deviation measures the average deviation from the average impact of risk on quality.

4.5.4 Risk impact on environment

Table 4.12 shows that “Losses caused by natural occurrences such as wind, hurricanes, fire, landslides” have the highest impact on environment at an average impact of 0.7083 and a standard deviation of 0.2705. “Lack of compliance with environmental requirements” is ranked second with an average impact on environment of 0.6571 and a standard deviation of 0.3012.

Other risk factors in order of severity on environment are as follows: “Impact of construction project on surrounding environment” (Average impact of 0.6347 and Standard deviation of 0.2740), “Lack of compliance with safety and health requirements on site” (Average impact of 0.5918 and Standard deviation of 0.2691), “Adverse weather conditions” (Average impact of 0.5714 and Standard deviation of 0.0.2386),” Inadequate or insufficient site information (site investigation report)” (Average impact of 0.5612 and Standard deviation of 0.2414), “Defective work” (Average impact of 0.5449 and Standard deviation of 0.2433), “Unhealthy working condition for workers” (Average impact of 0.5443 and Standard deviation of 0.2545), “Inadequate/ defective specification” (Average impact of 0.5155 and Standard deviation of 0.2288) and “Compliance with new government Acts and Legislations” (Average impact of 0.5155 and Standard deviation of 0.2412).

4.5.5 Risk impact on health and safety

Table 4.12 shows that "Losses caused by natural occurrences such as wind, hurricanes, fire, landslides" have been indicated as having most severe impact on health and safety on construction sites at an average impact of 0.7113 and a standard deviation of 0.2900. "Unhealthy working condition for workers" is ranked second with an average impact on environment of 0.7072 and a standard deviation of 0.2815. Findings show that "Lack of compliance with safety and health requirements on site" is the third most severe risk affecting health and safety on site. An average impact of 0.7052 was reported and a standard deviation of 0.3203.

Other risk factors affecting health and safety in order of severity are: "Unstable security circumstances" (Average impact of 0.6292 and Standard deviation of 0.2828), "Serious accidents on site" (Average impact of 0.6227 and Standard deviation of 0.2841), "Lack of compliance with environmental requirements" (Average impact of 0.6125 and Standard deviation of 0.0.27806), "Adverse weather conditions" (Average impact of 0.5735 and Standard deviation of 0.23965), "Defective work" (Average impact of 0.5531 and Standard deviation of 0.2586), "Inadequate/ defective specification" (Average impact of 0.5188 and Standard deviation of 0.2438), "Inadequate or insufficient site information (site investigation report)" (Average impact of 0.5041 and Standard deviation of 0.2572) and "Design variations required by clients" (Average impact of 0.5020 and Standard deviation of 0.2682).

4.6 Risk Significance Index Score (RSIS) and Ranking of risks

Table 4.13 Risk Significance Index Score of risks in relation to project objectives

	RISK FACTOR	SIGNIFICANCE INDEX SCORE ON PROJECT OBJECTIVES									
		COST	RANK	TIME	RANK	QUALITY	RANK	ENVIRONMENT	RANK	HEALTH AND SAFETY	RANK
	Design/ Technical										
1	Design variations required by clients	0.5322	**3**	0.5474	**4**	0.4004	**18**	0.2808	**18**	0.2698	**23**
2	Defective designs(shoddy and/or erroneous)	0.4231	**20**	0.4155	**28**	0.3837	**23**	0.2771	**19**	0.2849	**17**
3	Incomplete design	0.4633	**14**	0.4779	**11**	0.3988	**20**	0.2370	**33**	0.2680	**24**
4	Inadequate or insufficient site information (site investigation	0.4608	**15**	0.4619	**17**	0.4342	**10**	0.3820	**4**	0.3363	**6**

	RISK FACTOR	SIGNIFICANCE INDEX SCORE ON PROJECT OBJECTIVES									
		COST	RANK	TIME	RANK	QUALITY	RANK	ENVIRONMENT	RANK	HEALTH AND SAFETY	RANK
	report)										
5	Inadequate/ defective specification	0.4957	**10**	0.4611	**18**	0.4825	**3**	0.3363	**9**	0.3352	**8**
6	Information unavailability- details, drawings, sketches	0.5106	**6**	0.5527	**3**	0.5188	**1**	0.3078	**11**	0.3061	**11**
7	Unclear scope of work	0.4506	**18**	0.4620	**16**	0.3841	**22**	0.2567	**26**	0.2588	**28**
8	Lack of consistency between the BQs, drawings and specifications	0.5265	**4**	0.4857	**9**	0.4567	**6**	0.2610	**24**	0.2498	**31**
	Time										
9	Delay in handing over the site	0.3494	**39**	0.4482	**26**	0.2612	**40**	0.2058	**40**	0.1852	**44**
10	Inadequate project programme	0.3788	**31**	0.4679	**15**	0.3208	**36**	0.2173	**38**	0.2253	**38**
11	Tight project schedule	0.4110	**23**	0.4739	**13**	0.4091	**16**	0.2890	**15**	0.3090	**9**
12	Difficult to access the site	0.2703	**45**	0.3293	**41**	0.2223	**43**	0.1872	**43**	0.1962	**41**
13	Delays in supply of Materials	0.3929	**29**	0.4775	**12**	0.3645	**27**	0.2111	**39**	0.2037	**40**
14	Delays in supply of utilities i.e. electricity and water	0.4012	**26**	0.4898	**7**	0.3665	**26**	0.2507	**28**	0.2863	**16**
	Financial/ Economic										
15	Delayed payment by the employer	0.5514	**1**	0.5849	**1**	0.4269	**14**	0.2449	**31**	0.2408	**35**
16	Financial failure of the contractor	0.4645	**13**	0.4878	**8**	0.3992	**19**	0.2457	**30**	0.2516	**30**
17	Financial failure of the sub-contractor	0.4518	**17**	0.4833	**10**	0.4074	**17**	0.2351	**35**	0.2412	**34**
18	Exchange rate fluctuations and inflation	0.5037	**7**	0.4114	**29**	0.3282	**35**	0.1979	**41**	0.1901	**43**
19	Cost under estimation	0.5356	**2**	0.4562	**20**	0.4400	**9**	0.2585	**25**	0.2484	**32**

	RISK FACTOR	SIGNIFICANCE INDEX SCORE ON PROJECT OBJECTIVES									
		COST	**RANK**	**TIME**	**RANK**	**QUALITY**	**RANK**	**ENVIRONMENT**	**RANK**	**HEALTH AND SAFETY**	**RANK**
	Quality risks										
20	Inadequate sub-contractor efficiency and competency	0.3868	**30**	0.4083	**30**	0.4292	**12**	0.2671	**22**	0.2813	**19**
21	Defective work	0.4347	**19**	0.4507	**22**	0.4657	**4**	0.3371	**8**	0.3363	**6**
22	Technical complexity and design innovations requiring new construction methods and materials	0.4547	**16**	0.4489	**24**	0.4532	**7**	0.3025	**12**	0.3037	**12**
23	High performance or quality standard to meet	0.4981	**9**	0.4924	**6**	0.4983	**2**	0.3021	**13**	0.3072	**10**
	Construction/ project execution										
24	Legal disputes during construction among the parties to contract	0.3612	**38**	0.4008	**32**	0.2759	**39**	0.1720	**45**	0.1758	**45**
25	Industrial disputes during construction	0.3931	**28**	0.4520	**21**	0.3429	**32**	0.2326	**37**	0.2561	**29**
26	Loss or damage of third parties property due to construction activities	0.2800	**42**	0.2816	**44**	0.1886	**45**	0.1943	**42**	0.1943	**42**
27	Serious accidents on site	0.2767	**43**	0.2878	**43**	0.2167	**44**	0.1860	**44**	0.2878	**15**
28	Wastage of materials on site by workers	0.4861	**11**	0.4050	**31**	0.4276	**13**	0.3255	**10**	0.2792	**20**
29	Actual quantities different from contract quantities	0.5245	**5**	0.4351	**27**	0.4314	**11**	0.2488	**29**	0.2227	**39**
30	Inadequate labour and equipment productivity	0.3682	**34**	0.3714	**40**	0.3637	**28**	0.3637	**5**	0.2309	**37**
31	Equipment failure	0.3749	**33**	0.3918	**35**	0.3625	**29**	0.2346	**36**	0.2623	**27**

	RISK FACTOR	SIGNIFICANCE INDEX SCORE ON PROJECT OBJECTIVES									
		COST	**RANK**	**TIME**	**RANK**	**QUALITY**	**RANK**	**ENVIRONMENT**	**RANK**	**HEALTH AND SAFETY**	**RANK**
32	Difficult site conditions	0.4012	**25**	0.4483	**25**	0.3703	**25**	0.2842	**16**	0.2833	**18**
33	Inadequate supervision and supervision team	0.4087	**24**	0.4491	**23**	0.4631	**5**	0.2817	**17**	0.2911	**14**
34	Poor communication between contract parties	0.3674	**35**	0.3934	**34**	0.3779	**24**	0.2433	**32**	0.2425	**33**
35	Lack of coordination between project participants	0.4131	**22**	0.4731	**14**	0.4474	**8**	0.2751	**21**	0.2775	**22**
	Political and Environmental										
36	Excessive approval procedures in administrative government departments	0.5000	**8**	0.5641	**2**	0.3394	**33**	0.2561	**27**	0.2367	**36**
37	Compliance with new government Acts and Legislations	0.4192	**21**	0.4571	**19**	0.3394	**33**	0.2755	**20**	0.2656	**26**
38	Lack of support for the project by the local communities	0.3314	**40**	0.3869	**37**	0.2592	**41**	0.2355	**34**	0.2669	**25**
39	Adverse weather conditions	0.4837	**12**	0.5347	**5**	0.4256	**15**	0.3849	**3**	0.3902	**3**
40	Impact of construction project on surrounding environment	0.2755	**44**	0.2784	**45**	0.2454	**42**	0.3514	**6**	0.2788	**21**
41	Unhealthy working condition for workers	0.4000	**27**	0.3955	**33**	0.3904	**21**	0.3439	**7**	0.4499	**2**
42	Lack of compliance with environmental requirements	0.3641	**36**	0.3739	**39**	0.3531	**31**	0.4208	**1**	0.3858	**4**
43	Lack of compliance with safety and health	0.3771	**32**	0.3806	**38**	0.3559	**30**	0.3984	**2**	0.4746	**1**

	RISK FACTOR	SIGNIFICANCE INDEX SCORE ON PROJECT OBJECTIVES									
		COST	RANK	TIME	RANK	QUALITY	RANK	ENVIRONMENT	RANK	HEALTH AND SAFETY	RANK
	requirements on site										
44	Unstable security circumstances	0.3625	**37**	0.3886	**36**	0.3109	**37**	0.2656	**23**	0.3383	**5**
	Act of God										
45	Damage caused by wind, hurricanes, fire, landslides	0.3220	**41**	0.3253	**42**	0.2829	**38**	0.2954	**14**	0.2977	**13**

Source: Field Survey, 2015

Essentially all the risks observed in the questionnaire can happen to any construction project. The main purpose of this investigation is not only to identify a list of risks but to ascertain the key risks that can significantly influence the delivery of construction projects among contractors in Kenyan. RSIS represent the relative importance of risk factors among contractors in Kenya. The relative importance between one factor and the other is expressed through their relative score. Table 4.13 shows the RSIS of all the risks surveyed in relation to project objectives. Based on RSIS risks are then ranked. To determine the key risks affecting the different project objectives, only the top ten ranked ones are chosen as key risks. Disregarding the risk category, all risks are ranked in accordance with the RSIS on the project cost, time, quality, environment and health and safety. The results of this analysis are shown in table 4.14.

Table 4.14 Top 10 ranked risks as per their significance in relation to project objectives

	RISK FACTOR	**SIGNIFICANCE INDEX SCORE**	**STANDARD DEVIATION**	**RANK**
COST RELATED				
15	Delayed payment by the employer	0.5514	0.2457	1
19	Cost under estimation	0.5356	0.2643	2
1	Design variations required by clients	0.5322	0.27560	3
8	Lack of consistency between the BQs, drawings and specifications	0.5265	0.2461	4
29	Actual quantities different from contract quantities	0.5245	0.2388	5

	RISK FACTOR	SIGNIFICANCE INDEX SCORE	STANDARD DEVIATION	RANK
6	Information unavailability-details, drawings, sketches	0.5106	0.2559	6
18	Exchange rate fluctuations and inflation	0.5037	0.3116	7
36	Excessive approval procedures in administrative government departments	0.5000	0.24560	8
23	High performance or quality standard to meet	0.4981	0.2621	9
5	Inadequate/ defective specification	0.4957	0.2164	10
TIME RELATED				
15	Delayed payment by the employer	0.5849	0.2505	1
36	Excessive approval procedures in administrative government departments	0.5641	0.2832	2
6	Information unavailability-details, drawings, sketches	0.5527	0.2703	3
1	Design variations required by clients	0.5474	0.2851	4
39	Adverse weather conditions	0.5347	0.2454	5
23	High performance or quality standard to meet	0.4924	0.2645	6
14	Delays in supply of utilities i.e. electricity and water	0.4898	0.21766	7
16	Financial failure of the contractor	0.4878	0.2193	8
8	Lack of consistency between the BQs, drawings and specifications	0.4857	0.2291	9
17	Financial failure of the sub-contractor	0.4833	0.2281	10
QUALITY RELATED				
6	Information unavailability-details, drawings, sketches	0.5188	0.2817	1
23	High performance or quality standard to meet	0.4983	0.2792	2
5	Inadequate/ defective specification	0.4825	0.2318	3
21	Defective work	0.4657	0.2483	4
33	Inadequate supervision and supervision team	0.4631	0.2294	5

	RISK FACTOR	SIGNIFICANCE INDEX SCORE	STANDARD DEVIATION	RANK
8	Lack of consistency between the BQs, drawings and specifications	0.4567	0.2475	6
22	Technical complexity and design innovations requiring new construction methods and materials	0.4532	0.2519	7
35	Lack of coordination between project participants	0.4474	0.2391	8
19	Cost under estimation	0.4400	0.2594	9
4	Inadequate or insufficient site information (site investigation report)	0.4342	0.2350	10
ENVIRONMENT RELATED				
42	Lack of compliance with environmental requirements	0.4208	0.2536	1
43	Lack of compliance with safety and health requirements on site	0.3984	0.2457	2
39	Adverse weather conditions	0.3849	0.2136	3
4	Inadequate or insufficient site information (site investigation report)	0.3820	0.2081	4
30	Inadequate labour and equipment productivity	0.3637	0.2059	5
40	Impact of construction project on surrounding environment	0.3514	0.22230	6
41	Unhealthy working condition for workers	0.3439	0.2237	7
21	Defective work	0.3371	0.2394	8
5	Inadequate/ defective specification	0.3363	0.1844	9
28	Wastage of materials on site by workers	0.3255	0.20623	10
HEALTH AND SAFETY RELATED				
43	Lack of compliance with safety and health requirements on site	0.4746	0.28240	1
41	Unhealthy working condition for workers	0.4499	0.2592	2
39	Adverse weather conditions	0.3902	0.2228	3
42	Lack of compliance with environmental requirements	0.3858	0.2205	4

	RISK FACTOR	SIGNIFICANCE INDEX SCORE	STANDARD DEVIATION	RANK
44	Unstable security circumstances	0.3383	0.2233	5
4	Inadequate or insufficient site information (site investigation report)	0.3363	0.2034	6
21	Defective work	0.3363	0.2367	7
5	Inadequate/ defective specification	0.3352	0.1907	8
11	Tight project schedule	0.3090	0.2164	9
23	High performance or quality standard to meet	0.3072	0.1801	10

Source: Field Survey, 2015

4.6.1 Risk Significance Index Score (RSIS) for risk (Cost related)

Table 4.14 shows that under the cost related factors, “Delayed payment by the employer” has the highest RSIS of 0.5514 and a standard deviation of 0.2457. This is followed by “Cost under estimation” with RSIS of 0.5356 and a standard deviation of 0.2643.

RSIS for other cost related risks in order of significance as presented in table 4.14 are: “Design variations required by clients” (RSIS of 0.5322 and Standard deviation of 0.2760), “Lack of consistency between the BQs, drawings and specifications” (RSIS of 0.5265 and Standard deviation of 0.2461), “Actual quantities different from contract quantities” (RSIS of 0.5245and Standard deviation of 0.2388), “Information unavailability-details, drawings, sketches” (RSIS of 0.5106 and Standard deviation of 0.2559), “Exchange rate fluctuations and inflation” (RSIS of 0.5037and Standard deviation of 0.3115) , “Excessive approval procedures in administrative government departments” (RSIS of 0.5000 and Standard deviation of 0.2456), “High performance or quality standard to meet” (RSIS of 0.4981and Standard deviation of 0.2621) and “Inadequate/ defective specification” (RSIS of 0.4957 and Standard deviation of 0.2164).

4.6.2 Risk Significance Index Score (RSIS) for risk (Time related)

Table 4.14 shows that under the time related factor, “Delayed payment by the employer” has the highest RSIS of 0.5849 and a standard deviation of 0.2505. This is followed by "Excessive approval procedures in administrative government departments" with RSIS of 0.5641 and a standard deviation of 0.2832.

RSIS for other time related risks in order of significance as presented in table 4.14 are: "Information unavailability-details, drawings, sketches" (RSIS of 0.5527 and Standard deviation of 0.2703), "Design variations required by clients" (RSIS of 0.5474 and Standard deviation of 0.2851), "Adverse weather conditions" (RSIS of 0.5347 and Standard deviation of 0.2454), "High performance or quality standard to meet" (RSIS of 0.4924 and Standard deviation of 0.2645), "Delays in supply of utilities i.e. electricity and water" (RSIS of 0.4898 and Standard deviation of 0.2177), "Financial failure of the contractor" (RSIS of 0.4878 and Standard deviation of 0.2193), "Lack of consistency between the BQs, drawings and specifications" (RSIS of 0.4857 and Standard deviation of 0.2291) and "Financial failure of the sub-contractor" (RSIS of 0.4833 and Standard deviation of 0.228.

4.6.3 Risk Significance Index Score (RSIS) for risk (Quality related)

Table 4.14 shows that under the quality related factors, "Information unavailability-details, drawings, sketches" has the highest RSIS of 0.5188 and a standard deviation of 0.2817. This is followed by "High performance or quality standard to meet" with RSIS of 0.4983 and a standard deviation of 0.2792.

RSIS for other quality related risks as presented in table 4.14 are: "Inadequate/ defective specification" (RSIS of 0.4825 and Standard deviation of 0.2318), "Defective work" (RSIS of 0.4657 and Standard deviation of 0.2483), "Inadequate supervision and supervision team" (RSIS of 0.4631 and Standard deviation of 0.2294), "Lack of consistency between the BQs, drawings and specifications"(RSIS of 0.4567 and Standard deviation of 0.2475), "Technical complexity and design innovations requiring new construction methods and materials" (RSIS of 0.4532 and Standard deviation of 0.2519), "Lack of coordination between project participants (RSIS of 0.4474 and Standard deviation of 0.2391 "Cost under estimation" (RSIS of 0.4400 and Standard deviation of 0.2594) and "Inadequate or insufficient site information (site investigation report)" (RSIS of 0.4342 and Standard deviation of 0.2350).

4.6.4 Risk Significance Index Score (RSIS) for risk (Environment related)

Table 4.14 shows that under the environment related factors, "Lack of compliance with environmental requirements" has the highest RSIS of 0.4208 and a standard deviation of 0.2536. This is followed by "Lack of compliance with safety and health requirements on site" with RSIS of 0.3984 and a standard deviation of 0.2457.

RSIS for other environment related risks as presented in table 4.14 are: “Adverse weather conditions” (RSIS of 0.3849 and Standard deviation of 0.2136), “Inadequate or insufficient site information (site investigation report)” (RSIS of 0.3820 and Standard deviation of 0.208), “Inadequate labour and equipment productivity” (RSIS of 0.3637 and Standard deviation of 0.2059), “Impact of construction project on surrounding environment” (RSIS of 0.3514 and Standard deviation of 0.2230), “Unhealthy working condition for workers” (RSIS of 0.3439 and Standard deviation of 0.2237), “Defective work” (RSIS of 0.3371 and Standard deviation of 0.2394),” Inadequate/ defective specification” (RSIS of 0.3363 and Standard deviation of 0.1844) and “Wastage of materials on site by workers” (RSIS of 0.3255 and Standard deviation of 0.2063).

4.6.5 Risk Significance Index Score (RSIS) for risk (Health and safety related)

Table 4.14 shows that under the health and safety related factors, “Lack of compliance with safety and health requirements on site” has the highest with RSIS of 0.4746 and a standard deviation of 0.2824. This is followed by “Unhealthy working condition for workers” with RSIS of 0.4499 and Standard deviation of 0.2592.

RSIS for other health and safety related risks as presented in table 4.14 are: “Adverse weather conditions” (RSIS of 0.3902 and Standard deviation of 0.2228), “Lack of compliance with environmental requirements” (RSIS of 0.3858 and Standard deviation of 0.2205), “Unstable security circumstances” (RSIS of 0.3383 and Standard deviation of 0.2233), “Inadequate or insufficient site information” (site investigation report) (RSIS of 0.3363 and Standard deviation of 0.203), “Defective work” (RSIS of 0.3363 and Standard deviation of 0.2367, “Inadequate/ defective specification” (RSIS of 0.3352 and Standard deviation of 0.1907), “Tight project schedule” (RSIS of 0.3090 and Standard deviation of 0.2164) and “High performance or quality standard to meet” (RSIS of 0.3021 and Standard deviation of 0.3072).

Figure 4.2 is a graphical presentation of key risks in relation to the different project objectives. This does not only help to understand how many project objectives each risk can influence but also help to visualize the magnitude of the significance of different risks on a particular project objectives. From figure 4.2 it is apparent that both cost and time are objectives most vulnerable to risk with slightly higher impact to time than cost. It is evident that RSIS for all the risks influencing both the objectives are between 0.48 and 1.00 indicating they can be regarded as extreme risks as per risk analysis matrix

(Figure 3.1). They are risks that require immediate management intervention. Project quality is also not safe from risks; half of the ten key risks influencing it are extreme and the other half being high. Risks impacting on project environment range between 0.32 and 0.48 meaning they are high and require the attention of senior management.

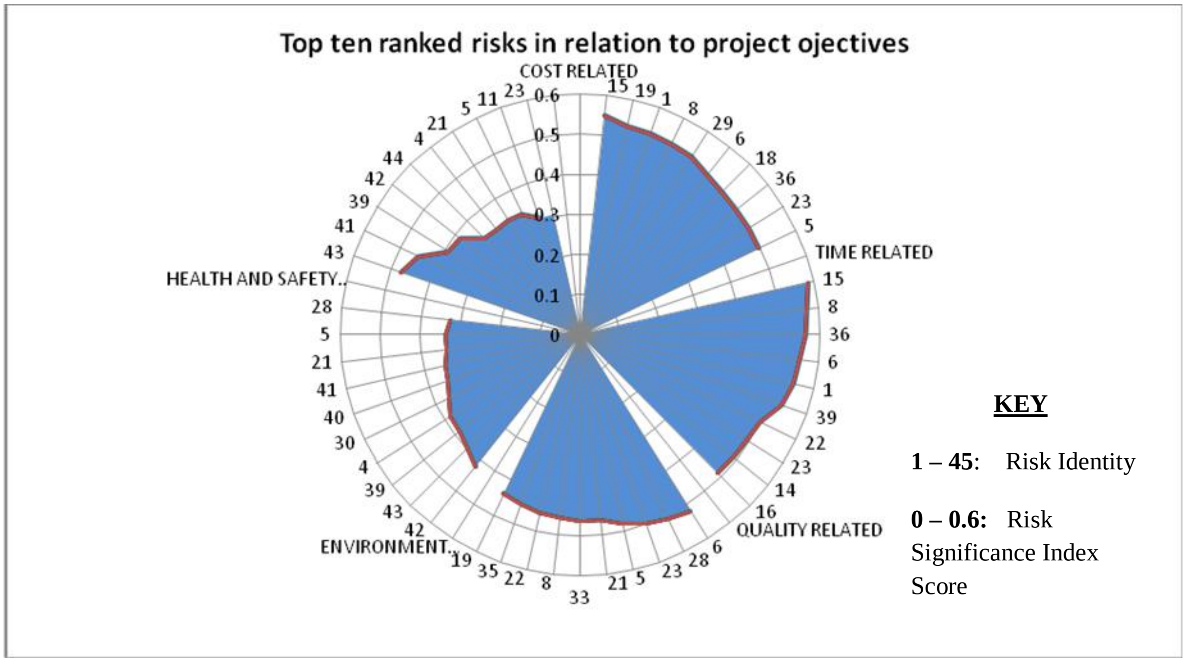

Figure 4.1 Key risks and their influence project objectives

Source: Field Survey, 2015

4.7 Collapsed list of risks affecting project objectives

Table 4.14 shows the RSIS for various risk factors in order of importance in relation to the different risk objectives. To come up with a comprehensive list of the main risks affecting all the project objectives, risks were ranked according to each risk's significance score on individual project objective. SPSS statistical analysis software was applied to filter repeated risks and to rank the risks in order of their significance score. In total fifty (50) risks were believed to be able to influence the project objectives, with ten (10) factors related to each of the project objectives. It is apparent that a number of the fifty (50) risks are repeated among the five grouping (see that in table 4.14). For example, "Delayed payment by the employer" can influence both cost and time; "Lack of consistency between BQs, drawings and specifications" can influence cost, time and quality. With the repeated risks filtered, a comprehensive list of twenty seven (27) highlighted risks was achieved.

Table 4.15 shows these risks together with their RSIS. “Delayed payment by the employer” had the highest level impact on time and cost at RSIS of 0.5849 and 0.5514 respectively. This risk can influence all the project objectives but significantly the project cost and time. “Excessive approval procedures in administrative government departments” has dominant influence on both time and cost at RSIS of 0.5641 and 0.5000 respectively. “Information unavailability-details, drawings, sketches” has a significant impact on all the project objectives. It emerges to be the risk affecting the project quality most having RSIS of 0.5188. The risk has its highest impact on project time (RSIS of 0.5527) where is ranked third and also a significant impact on cost where it is ranked sixth. “Design variations required by clients” comes out as being a very influential risk on both time and cost having RSIS of 0.5474 and 0.5322 respectively. The risk is ranked third impacting on cost and forth on time.

Table 4.15 Risks ranked in order of their significance index score

	RISK FACTOR	**SIGNIFICANCE INDEX SCORE**
15	Delayed payment by the employer	0.5849
36	Excessive approval procedures in administrative government departments	0.5641
6	Information unavailability-details, drawings, sketches	0.5527
1	Design variations required by clients	0.5474
39	Adverse weather conditions	0.5347
19	Cost under estimation	0.5356
8	Lack of consistency between the BQs, drawings and specifications	0.5265
29	Actual quantities different from contract quantities	0.5245
18	Exchange rate fluctuations and inflation	0.5037
23	High performance or quality standard to meet	0.4983
5	Inadequate/ defective specification	0.4957
14	Delays in supply of utilities i.e. electricity and water	0.4898
16	Financial failure of the contractor	0.4878
17	Financial failure of the sub-contractor	0.4833

	RISK FACTOR	SIGNIFICANCE INDEX SCORE
43	Lack of compliance with safety and health requirements on site	0.4746
21	Defective work	0.4657
33	Inadequate supervision and supervision team	0.4631
41	Unhealthy working condition for workers	0.4499
22	Technical complexity and design innovations requiring new construction methods and materials	0.4532
35	Lack of coordination between project participants	0.4474
4	Inadequate or insufficient site information (site investigation report)	0.4342
42	Lack of compliance with environmental requirements	0.4208
30	Inadequate labour and equipment productivity	0.3637
40	Impact of construction project on surrounding environment	0.3514
44	Unstable security circumstances	0.3383
28	Wastage of materials on site by workers	0.3255
11	Tight project schedule	0.3090

Source: Field Survey, 2015

Table 4.14 and Table 4.15 show “Adverse weather conditions” as a very dominant risk among contractors in Kenya. It has its highest impact on time having RSIS of 0.5347 and ranked fifth. The risk is also a significant risk in both environment and health and safety where it is ranked third and fourth respectively. “Cost under estimation” emerges as another important risk factor with dominant impact on cost and quality. It is ranked as second in relation to cost and ninth in relation to quality having RSIS of 0.5356 and 0.4400 respectively. “Lack of consistency between the BQs, drawings and specifications” has a significant impact on cost, time and quality. It emerges to be the forth influential on cost with RSIS of 0.5265 and sixth and ninth on quality and cost respectively.

Another significant risk in the list is "Actual quantities different from contract quantities" with a dominant impact on cost and ranked fifth having RSIS of 0.5245. "Exchange rate fluctuations and inflation" has also a notable impact on project cost with RSIS at 0.5037 and ranked as seventh factor influencing this project objective. "Lack of compliance with safety and health requirements on site" has the highest impact on health and safety with a RSIS of 0.4746.

Generally most index scores are located between 0.32 and 1.00 with only two risks with RSIS below 0.32. This implies out of the identified twenty seven (27) risks twenty five (25) of them range from high to extremely high with only two risks with medium impact. This indicates that they are very important in project management.

Though this process identified important risks influencing individual project objectives, it failed to look into underlying relationships between the risk factors and their significance in relation to all the project objectives. Risks had varying impact on different project objectives and to come up with an accurate ranking of risks it was important to look comprehensively how a particular risk influences all the project objectives. Principal component analysis (PCA) was the technique applied to determine the statistical inter-relationships between the impact of risks and the project objectives. Risks were therefore ranked and the overall key risks identified.

4.8 rincipal Components Analysis

Principal component analysis (PCA) is a variable reduction technique which maximizes the amount of variance accounted for in the observed variables by a smaller group of variables called components. This technique uses an orthogonal transformation to convert a set of observations possibly correlated variables into a set of values of uncorrelated variables (Jolliffe, 2002). This technique was necessary to determine the statistical relationships between the different variables impacting on project objectives. Factor loadings were determined, principal components extracted and relationships between risks and these components established. There were four variables under investigation, that is, risk significance in relation to project cost, risk significance in relation to project time, risk significance in relation to project quality, risk significance in relation to environment conservation and risk significance in relation to health and safety. Risk significance score indices determined earlier in this chapter were used as the measure of risk impact in relation to the different project objectives. Using SPSS statistical analysis software, these variables were analyzed to determine the factor score for individual risk factor and the composite score. Principal component regression and factor score analysis methods were used and finally culminating in risk composite score (RCS) for all the 45 risks. Risks were subsequently ranked using the RCS. Ranking of risks using RCS did not only employ the level of significance of risks in relation to project objectives but also existing statistical relationships between a given risk and all the project objectives. This implies that an appropriate action taken to mitigate a particular risk shall impact on all correlated risk objectives. This was necessary for the purpose of decision making in terms of coming up with appropriate strategies and measures to enhance risk management and consequently improved project delivery.

4.8.1 Measure of appropriateness of factor analysis

The Kaiser-Meyer-Olkin (KMO) was used to measure the sampling adequacy of data. The data was interpreted as marvelous (0.90’s) meritorious (0.80’s), middling (0.70’s), mediocre (0.60’s), miserable (0.50’s) and unacceptable when below 0.50 (Kaiser, 1974). Table 4.16 shows the value of KMO for this set of variable is 0.664 which would be labeled as mediocre therefore meet the minimum criteria of sampling adequacy.

Bartlett’s test tests whether there are some relationships between variables we hope to include in the analysis. Principal component analysis requires that the probability associated with Bartlett’s test of sphericity be less than the level of significance. For this study, the probability associated with the Bartlett’s test is 0.000 which is less than 0.001. This satisfies the requirement and factor analysis is appropriate.

Table 4.16 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.664
Bartlett's Test of Sphericity	Approx. Chi-Square	143.549
	df	10
	Sig.	0.000

Source: Field Survey, 2015

Principal component analysis also requires that the Kaiser-Meyer-Olkim measure of sampling adequacy (MSA) be greater than 0.50 for each individual variable. Table 4.17 below, in the anti- image correlation matrix, shows that MSA for all the variables included in the analysis was greater than 0.50, supporting their retention in the analysis (Kaiser & Rice, 1974).

Table 4.17 Anti-image Matrices

		Risk significance in relation to Cost	Risk significance in relation to Time	Risk significance in relation to Quality	Risk significance in relation to Environment	Risk significance in relation to Health and Safety
Anti-image Covariance	Risk significance in relation to Cost	.223	-.151	-.134	-.019	.057
	Risk significance in relation to Time	-.151	.321	-.057	.065	-.019
	Risk significance in relation to Quality	-.134	-.057	.268	-.072	-.043
	Risk significance in relation to Environment	-.019	.065	-.072	.322	-.246
	Risk significance in relation to Health and Safety	.057	-.019	-.043	-.246	.352
Anti-image Correlation	Risk significance in relation to Cost	.663[a]	-.562	-.550	-.070	.203
	Risk significance in relation to Time	-.562	.737[a]	-.193	.203	-.058
	Risk significance in relation to Quality	-.550	-.193	.766[a]	-.246	-.141
	Risk significance in relation to Environment	-.070	.203	-.246	.569[a]	-.732
	Risk significance in relation to Health and Safety	.203	-.058	-.141	-.732	.553[a]

a. Measures of Sampling Adequacy(MSA)

Source: Field Survey, 2015

Anti-image correlation matrix contains the negatives of the partial correlation coefficients and the anti-image covariance matrix contains the negatives of the partial covariances. Most of the off diagonal elements should be small in a good factor model. Table 4.16 shows this requirement was satisfied.

4.8.2 Correlations

Correlation refers to a statistical relationship involving dependence between variables or a set of data. Table 4.18 shows a high correlation of 0.81 between the risk significance in relation to cost and risk significance in relation to time. This indicates a change of risk impact on project cost has a high impact on project time and vise versa. There is also a high correlation of 0.789 between risk significance in relation to cost and risk significance in relation to quality. A change in the impact of risks on cost has a significant impact on project quality and vise versa. This also applies to risk significance in relation to time and risk significance in relation to quality where correlation is 0.674. Another strong correlation, of 0.794, is between risk significance in relation to environment and risk significance in relation to health and safety.

Table 4.18 Correlation Matrix

		Risk significance in relation to Cost	Risk significance in relation to Time	Risk significance in relation to Quality	Risk significance in relation to Environment	Risk significance in relation to Health and Safety
Correlation	Risk significance in relation to Cost	1.000	.810	.789	.168	.049
	Risk significance in relation to Time	.810	1.000	.674	.046	-.002
	Risk significance in relation to Quality	.789	.674	1.000	.431	.330
	Risk significance in relation to Environment	.168	.046	.431	1.000	.794
	Risk significance in relation to Health and Safety	.049	-.002	.330	.794	1.000
Sig. (1-tailed)	Risk significance in relation to Cost		.000	.000	.136	.374
	Risk significance in relation to Time	.000		.000	.383	.494
	Risk significance in relation to Quality	.000	.000		.002	.013
	Risk significance in relation to Environment	.136	.383	.002		.000
	Risk significance in relation to Health and Safety	.374	.494	.013	.000	

Determinant = .031

Source: Field Survey, 2015

This indicates that a change in project environment as a result of construction activities results to a corresponding change in health and safety. A negligible inverse correlation of -0.002 was noted between risk significance in relation to time and risk significance in relation to health and safety. An increased time risks in construction project has a negligible impact on project health and safety and the opposite is true. Table 4.18 shows a determinant of correlation matrix of 0.031 which is greater than 0.00001 which implies there is no multicollinearity.

4.8.3 Extracting principal components

The initial number of components is the same as the number of variables used in the component analysis. However, not all the five components will be retained. Using the output as shown in table 4.19, there are two eigenvalues greater than 1.0. The latent root criterion for number of factors to derive would indicate that there were 2 components to be extracted for these variables. The second row shows a value of 88.248. This means that a two components solution would explain approximately 88.25% of the total variance.

Table 4.19 Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.719	54.375	54.375	2.719	54.375	54.375	1.538	30.754	30.754
2	1.694	33.873	88.248	1.694	33.873	88.248	1.450	29.004	59.758
3	.261	5.214	93.463	.261	5.214	93.463	.992	19.841	79.599
4	.186	3.718	97.181	.186	3.718	97.181	.580	11.607	91.206
5	.141	2.819	100.000	.141	2.819	100.000	.440	8.794	100.000

Extraction Method: Principal Component Analysis.

Source: Field Survey, 2015

4.8.4 Evaluation of communalities

This represents the proportion of the variance in original variables that is accounted for by the factor solution. The factor solution should explain at least each original variable's variance, so the communality value for each variable for each variable should be 0.5 or higher. Table 4.20 represents the percentage variability attributed to the model. It shows that the risk significance in relation to cost accounted for 90.6% of the variance of the extracted factors. Risks significance in relation to environment accounted for 89.8% while risk significance in relation to health and safety rated at 88.9%. Significance in relation to quality and significance in relation time rated at 86.4% and 85.6% respectively. All the five factors have communality value of over 50%.

Table 4.20 Communalities

	Initial	Extraction
Risk significance in relation to Cost	1.000	.906
Risk significance in relation to Time	1.000	.856
Risk significance in relation to Quality	1.000	.864
Risk significance in relation to Environment	1.000	.898
Risk significance in relation to Health and Safety	1.000	.889

Extraction Method: Principal Component Analysis.

Source: Field Survey, 2015

4.8.5 Scree plot

A scree plot has also been generated to justify the retention of the two factors. This is shown in Figure 4.3 below. Scree plot plots eigenvalues on Y-axis and component number on X-axis. At the point of inflexion on the curve, the curve begins to tail-off after the first two components. Both the components have eigenvalues above 1.0. The two components are therefore retained as the principal components.

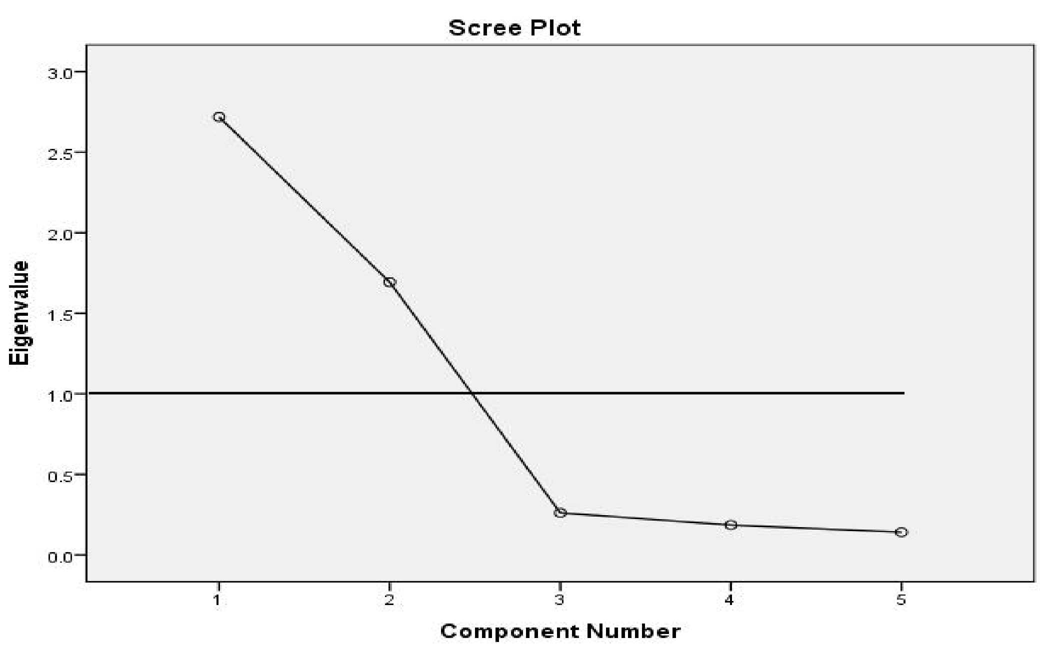

Figure 4.2 Scree plot

Source: Field Survey, 2015

4.8.6 Factor loadings

This is the expression of correlation between specific observed variables and specific factors or components. That is, factor loadings have given us an idea about how much the variable has contributed to the factor; the larger the factor loading the more the variable has contributed to the factor.

Table 4.21 Component Matrix (Unrotated)

	Component	
	1	2
Risk significance in relation to Quality	.927	-.068
Risk significance in relation to Cost	.861	-.407
Risk significance in relation to Time	.783	-.493
Risk significance in relation to Health and Safety	.455	.826
Risk significance in relation to Environment	.547	.773

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

Source: Field Survey, 2015

Table 4.22 Rotated Component Matrix

	Component	
	1	2
Risk significance in relation to Cost	.951	.040
Risk significance in relation to Time	.922	-.073
Risk significance in relation to Quality	.852	.371
Risk significance in relation to Health and Safety	.019	.943
Risk significance in relation to Environment	.125	.939

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Source: Field Survey, 2015

Component matrix shows the structure coefficients, or the correlation between the variables and the components created. Rotating the factors is a way to distribute the factor loadings in such a way as to make job of interpreting the meaning of the factors easier. The main aim is to ensure that each variable loads highly on only one factor, thus ensuring a simple structure.

Table 4.22 is a rotated component matrix while figure 4.4 below is its graphical representation. The first three variables load well on the first component, while the other two variables load well on component 2. High loadings have been highlighted for each component. A positive loading, for example, 0.951 indicate a positive relationship with the component whereas a negative sign in a loading suggests an inverse relationship. The pattern of component loading show that variables, “risk significance in relation in relation to cost”, “risk significance in relation in relation to time” and “risk significance in relation in relation to quality”, load on the first component. This component was therefore labeled as *primary variable*. “Risk significance in relation in relation to environment” and “risk significance in relation in relation to health and safety”, load on the second component. This component was therefore labeled as *secondary variable*.

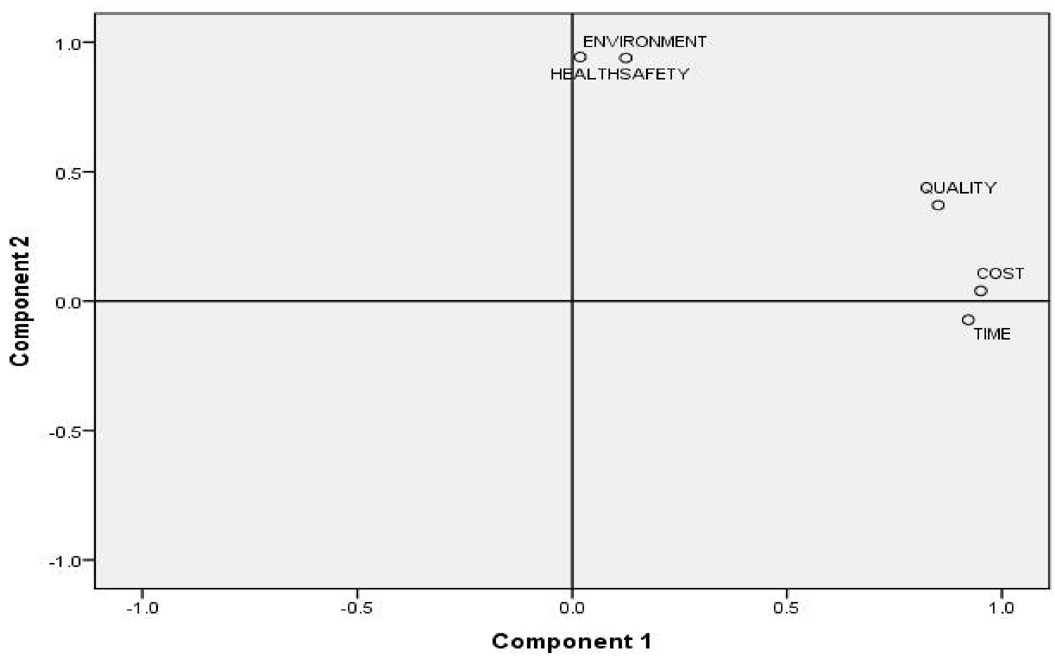

Figure 4.3 Component Plot in Rotated Space

Source: Field Survey, 2015

4.8.7 Factor scores analysis

Factors scores for each individual case (risk) were obtained and compared. SPSS software provides a user friendly way to compute regression factor scores. Factor scores are automatically generated using SPSS software and are presented in table 4.23, column 3 (FAC1_1) and column 4 (FAC2_1). An equation can also be used to calculate these factor score. Factor score analysis aims to describe P variables, $x_1,x_2,\ldots\ldots\ldots,x_p$. Where: x_i $(i=1,\ldots\ldots,p)$ represent the original variables but standardized with zero mean and unit variance. They are described in terms of smaller number of m factors and highlights relationships between these variables.

$$X=(x_1,x_2,x_3,\ldots\ldots\ldots,x_p)$$

$$F=(f_1,f_2,f_3,\ldots\ldots\ldots,f_p)$$

X is random variables

F is the common factor

Then we can see factor analysis model as:

$$X_1=a_{11}F_1+ a_{12}F_2+\ldots, +a_{1m}F_m) + \varepsilon_1$$

$$X_2=a_{21}F_1+ a_{22}F_2+\ldots, +a_{2m}F_m) + \varepsilon_2$$

$$\ldots X_p = a_{p1}F_1+ a_{p2}F_2+\ldots, +a_{pm}F_m) + \varepsilon_p$$

Where: x_i $(i=1,\ldots\ldots,p)$ represent the original variables but standardized with zero mean and unit variance.

$a_{i1}, a_{i2}\ldots\ldots, a_{im}$ are the factors loadings related to variables x_i

$F_1,F_2,\ldots\ldots,F_m$ are m uncorrelated common factors each with zero mean and unit variance

ε is the special influence factors outside the factor (in actual analysis is negligible).

We can use regression estimation method to compute mathematical model of factor scores after calculating the common factor, and then evaluate the case by further calculating the factor scores. The formula for factor score can be written as:

$$F=b_{i1}X_1+ b_{i2}F_2+\ldots, +b_{in}X_n) \ (i= 1,2,3\ldots m)$$

F= the subject's score on principal component

b_{in} =the regression coefficient (or weight) for observed variable n

X_p=the subject's score on observed variable p

Table 4.23 Factor score and Composite/ Comprehensive scores analysis

ID	RISK FACTOR	FAC1_1	FAC1_2
R1	Design variations required by clients	1.32362	-0.26621
R2	Defective designs(shoddy and/or erroneous)	-0.06323	0.12637
R3	Incomplete design	0.59883	-0.46668
R4	Inadequate or insufficient site information (site investigation report)	0.47491	1.38468
R5	Inadequate/ defective specification	0.87941	1.04117
R6	Information unavailability-details, drawings, sketches	1.66673	0.45049
R7	Unclear scope of work	0.38408	-0.36086
R8	Lack of consistency between the BQs, drawings and specifications	1.22028	-0.3913
R9	Delay in handing over the site	-0.60696	-1.46416
R10	Inadequate project programme	-0.1553	-1.00913
R11	Tight project schedule	0.26451	0.3693
R12	Difficult to access the site	-1.84265	-1.31355
R13	Delays in supply of Materials	0.18215	-1.19618
R14	Delays in supply of utilities i.e. electricity and water	0.17605	-0.22141
R15	Delayed payment by the employer	1.7976	-0.84208
R16	Financial failure of the contractor	0.67714	-0.54479
R17	Financial failure of the sub-contractor	0.63857	-0.68565
R18	Exchange rate fluctuations and inflation	0.27098	-1.45507
R19	Cost under estimation	1.03895	-0.40607
R20	Inadequate sub-contractor efficiency and competency	-0.09549	0.13007
R21	Defective work	0.4316	1.10196
R22	Technical complexity and design innovations requiring new construction methods and materials	0.5353	0.51447
R23	High performance or quality standard to meet	1.18486	0.49632
R24	Legal disputes during construction among the parties to contract	-0.71614	-1.72652
R25	Industrial disputes during construction	-0.12475	-0.58125
R26	Loss or damage of third parties property due to construction activities	-2.19647	-1.24759
R27	Serious accidents on site	-2.17593	-0.52244
R28	Wastage of materials on site by workers	0.36865	0.51713
R29	Actual quantities different from contract quantities	0.86628	-0.66225
R30	Inadequate labour and equipment productivity	-0.65884	0.50603
R31	Equipment failure	-0.48153	-0.36151
R32	Difficult site conditions	-0.05343	0.11307
R33	Inadequate supervision and supervision team	0.36407	0.29419
R34	Poor communication between contract parties	-0.42868	-0.42125

ID	RISK FACTOR	FAC1_1	FAC1_2
R35	Lack of coordination between project participants	0.47611	0.05792
R36	Excessive approval procedures in administrative government departments	1.05187	-0.8385
R37	Compliance with new government Acts and Legislations	-0.01066	-0.18322
R38	Lack of support for the project by the local communities	-1.16796	-0.4333
R39	Adverse weather conditions	0.89337	1.68427
R40	Impact of construction project on surrounding environment	-2.199	0.84929
R41	Unhealthy working condition for workers	-0.51174	2.08816
R42	Lack of compliance with environmental requirements	-0.93641	2.22134
R43	Lack of compliance with safety and health requirements on site	-0.91809	2.73542
R44	Unstable security circumstances	-0.88936	0.44853
R45	Damage caused by wind, hurricanes, fire, landslides	-1.53329	0.4708

Source: Field Survey, 2015

The reason why the factor score of given risk factors were negative was that the original data were standardized and the average impacts of the risk factors was addressed as zero. Therefore the negative impact scores just indicated that the impact was lower than the average.

From table 4.23 it is apparent that “delayed payment by the employer” was the most significant risk impacting on *primary variable*. that is, cost, time and quality. This is followed by “information unavailability-details, drawings, sketches”. “Design variations required by clients” and “lack of consistency between the BQs, drawings and specifications” are second and third in significance respectively. Other significant risks influencing project cost and time are “high performance or quality standard to meet”, “excessive approval procedures in administrative government departments”, and “cost under estimation” ranked in that order.

Secondary variable, was significantly influenced by “lack of compliance with safety and health requirements on site”, “lack of compliance with environmental requirements”, “unhealthy working condition for workers”, “lack of support for the project by the local communities”, “inadequate or insufficient site information (site investigation report)”, “defective works” and “inadequate/ defective specification” in order of significance.

4.8.8 Composite/ Comprehensive score and ranking of risks

In addition to factor scores for each individual case table 4.24 also shows the comprehensive scores for all the risk factors. These scores were automatically generated and ranked using SPSS software. The formula for calculating the same is:

Comprehensive score (R) = principal components variance contribution rate * principal components coefficients.

Principal components coefficients were obtained from total variance table 4.19.

$$R_1=0.54375 * FAC1\_1 + 0.33873 * FAC1\_2$$

Table 4.24 Risks ranked on bases composite/ comprehensive scores analysis

ID	RISK FACTOR	FAC1_1	FAC1_2	RISK COMP. SCORE	RANK
R6	Information unavailability-details, drawings, sketches	1.66673	0.45049	1.05888	1
R39	Adverse weather conditions	0.89337	1.68427	1.05628	2
R5	Inadequate/ defective specification	0.87941	1.04117	0.83085	3
R23	High performance or quality standard to meet	1.18486	0.49632	0.81239	4
R4	Inadequate or insufficient site information (site investigation report)	0.47491	1.38468	0.72726	5
R15	Delayed payment by the employer	1.7976	-0.84208	0.69221	6
R1	Design variations required by clients	1.32362	-0.26621	0.62954	7
R21	Defective work	0.4316	1.10196	0.60795	8
R8	Lack of consistency between the BQs, drawings and specifications	1.22028	-0.3913	0.53098	9
R22	Technical complexity and design innovations requiring new construction methods and materials	0.5353	0.51447	0.46534	10
R41	Unhealthy working condition for workers	-0.51174	2.08816	0.42907	11
R19	Cost under estimation	1.03895	-0.40607	0.42738	12
R43	Lack of compliance with safety and health requirements on site	-0.91809	2.73542	0.42736	13
R28	Wastage of materials on site by workers	0.36865	0.51713	0.37562	14
R33	Inadequate supervision and supervision team	0.36407	0.29419	0.29761	15
R36	Excessive approval procedures in administrative government departments	1.05187	-0.8385	0.28793	16
R35	Lack of coordination between project participants	0.47611	0.05792	0.2785	17
R11	Tight project schedule	0.26451	0.3693	0.26892	18
R29	Actual quantities different from contract quantities	0.86628	-0.66225	0.24672	19
R42	Lack of compliance with environmental requirements	-0.93641	2.22134	0.24326	20
R16	Financial failure of the contractor	0.67714	-0.54479	0.18366	21
R3*	Incomplete design	0.59883	-0.46668	0.16753	22

ID	RISK FACTOR	FAC1_1	FAC1_2	RISK COMP. SCORE	RANK
R17	Financial failure of the sub-contractor	0.63857	-0.68565	0.11498	23
R7*	Unclear scope of work	0.38408	-0.36086	0.08661	24
R14	Delays in supply of utilities i.e. electricity and water	0.17605	-0.22141	0.02073	25
R32*	Difficult site conditions	-0.05343	0.11307	0.00925	26
R2*	Defective designs(shoddy and/or erroneous)	-0.06323	0.12637	0.00842	27
R20	Inadequate sub-contractor efficiency and competency	-0.09549	0.13007	-0.00786	28
R37	Compliance with new government Acts and Legislations	-0.01066	-0.18322	-0.06786	29
R30**	Inadequate labour and equipment productivity	-0.65884	0.50603	-0.18684	30
R25	Industrial disputes during construction	-0.12475	-0.58125	-0.26472	31
R13	Delays in supply of Materials	0.18215	-1.19618	-0.30614	32
R44**	Unstable security circumstances	-0.88936	0.44853	-0.33166	33
R18**	Exchange rate fluctuations and inflation	0.27098	-1.45507	-0.34553	34
R34	Poor communication between contract parties	-0.42868	-0.42125	-0.37578	35
R31	Equipment failure	-0.48153	-0.36151	-0.38429	36
R10	Inadequate project programme	-0.1553	-1.00913	-0.42627	37
R45	Damage caused by wind, hurricanes, fire, landslides	-1.53329	0.4708	-0.67425	38
R38	Lack of support for the project by the local communities	-1.16796	-0.4333	-0.78185	39
R9	Delay in handing over the site	-0.60696	-1.46416	-0.82599	40
R40**	Impact of construction project on surrounding environment	-2.199	0.84929	-0.90803	41
R24	Legal disputes during construction among the parties to contract	-0.71614	-1.72652	-0.97423	42
R27	Serious accidents on site	-2.17593	-0.52244	-1.36013	43
R12	Difficult to access the site	-1.84265	-1.31355	-1.44688	44
R26	Loss or damage of third parties property due to construction activities	-2.19647	-1.24759	-1.61692	45

* New risks in the 27 key risks influencing individual objectives (See table 4.15)

** Dropped from the 27 Key risks list influencing individual objectives (See table 4.15)

Source: Field Survey, 2015

Risks were ranked based on the comprehensive score so generated. This is very useful in decision making. “Information unavailability-details, drawings, sketches” was the highly ranked risks impacting on both the components. However, it has loaded more on *primary variable* than on *secondary variable*. “Adverse weather conditions” and “inadequate/ defective specification” though loading highly on both the components, their impact is more on *secondary variable*. “High performance or quality standard to meet" is the fourth ranked risk. It is highly impacting on both the components though it has loaded more *primary variable* than on *secondary variable*.

Other risks ranked high are "delayed payment by the employer", "design variations required by clients" and "lack of consistency between the BQs, drawings and specifications". These risks are noted to have very high significance in relation to *primary variable* and low impact in relation to *secondary variable*. "Inadequate or insufficient site information (site investigation report)" and "Defective work" impact very high on *secondary variable* but also there is a significant impact on component *primary variable*.

Risks like "legal disputes during construction among the parties to contract", "serious accidents on site", "difficult to access the site" and "loss or damage of third parties property due to construction activities" are ranked insignificant in terms of both components.

4.9 Key risk affecting project delivery among contractors in Kenya

Key risk affecting project delivery are those risks are those risks that significantly influence the delivery of construction projects. These risks require a serious among contractors in Kenya and require management immediate action if the projects have to be delivered within budget, schedule, quality, environmental requirements, and healthy and safety requirements. These risks were determined through ranking of risks according to their comprehensive scores. Table 4.24 shows the comprehensive scores for the various risk factors in order of importance in relation to the components. A total of twenty seven (27) risks are highlighted as significant risks to influence the achievement of the project objectives.

This list of risks is then compared with the earlier list arrived at through descriptive statistics in section 4.7 and presented in table 4.5. In total there were twenty seven (27) risk influencing project objectives based on Risk Significance Index Score (RSIS). Through inferential statistics using the comprehensive score analysis, risks were ranked and twenty seven (27) key risks highlighted. Twenty three (23) of the significant risks were in both these lists and were identified as the key risks that influence project delivery among contractors in Kenya. Table 4.25 shows these risks with their significance index score, their comprehensive score and ranking. Composite score was preferred in ranking of risks as it does not only look into the highest scores in terms of the project objectives, as the case with risk significance score ranking, but it also looks into the underlying relationships between these risks and their effect on project objectives.

Table 4.25 shows that “Information unavailability-details, drawings, sketches” appears to be the most influential risk affecting all the project objectives. It has its highest level effect on project objectives at a comprehensive score of 1.05888. The second and third ranked risks are “adverse weather conditions” and “inadequate/ defective specification” having comprehensive scores of 1.05628 and 0.83085 respectively.

Table 4.25 Key risks among contractors in Kenya

ID	RISK FACTOR	RSIS	RISK COMP. SCORE	RANK
R6	Information unavailability-details, drawings, sketches	0.5527	1.05888	1
R39	Adverse weather conditions	0.5347	1.05628	2
R5	Inadequate/ defective specification	0.4957	0.83085	3
R23	High performance or quality standards to meet	0.4983	0.81239	4
R4	Inadequate or insufficient site information (site investigation report)	0.4342	0.72726	5
R15	Delayed payment by the employer	0.5849	0.69221	6
R1	Design variations required by clients	0.5474	0.62954	7
R21	Defective work	0.4657	0.60795	8
R8	Lack of consistency between the BQs, drawings and specifications	0.5265	0.53098	9
R22	Technical complexity and design innovations requiring new construction methods and materials	0.4532	0.46534	10
R41	Unhealthy working condition for workers	0.4499	0.42907	11
R19	Cost under estimation	0.5356	0.42738	12
R43	Lack of compliance with safety and health requirements on site	0.4746	0.42736	13
R28	Wastage of materials on site by workers	0.3255	0.37562	14
R33	Inadequate supervision and supervision team	0.4631	0.29761	15
R36	Excessive approval procedures in administrative government departments	0.5641	0.28793	16
R35	Lack of coordination between project participants	0.4474	0.2785	17
R11	Tight project schedule	0.3090	0.26892	18
R29	Actual quantities different from contract quantities	0.5245	0.24672	19
R42	Lack of compliance with environmental requirements	0.4208	0.24326	20
R16	Financial failure of the contractor	0.4878	0.18366	21
R17	Financial failure of the sub-contractor	0.4833	0.11498	22
R14	Delays in supply of utilities i.e. electricity and water	0.4898	0.02073	23

Source: Field Survey, 2015

“High performance or quality standards to meet” is the fourth ranked risk. The risk has a comprehensive score of 0.8123. “Inadequate or insufficient site information (site investigation report)” is the fifth ranked risk. The risk has a significant has a comprehensive score of 0.72726. “Delayed payment by the employer” and “design variations required by the clients” emerged as being very influential risks on time, cost and quality. However, they have minimal impact on environment and health and safety. They were ranked sixth and seventh with comprehensive score of 0.69221 and 0.62954 respectively.

Other significant risks in the list are “Defective works” with a comprehensive score of 0.60795 and ranked eighth. “Lack of consistency between the BQs, drawings and specifications” has also a notable impact having a comprehensive score of 0.53098 and ranked as the ninth risk influencing project objective objectives. “Technical complexity and design innovations requiring new construction methods and materials” ranked tenth in the list having a composite score of 0.46534.

4.10 Extent of construction risk management among contractors in Kenya

The study sought for opinion on the current scope of risk management among contractors in Kenya. Out of the total ninety eight (98) respondents, ninety two (92) of them responded to the open question with valid answers. Some of the respondents have provided more than one response thus the one hundred and fifty seven (157) responses. The responses are represented in table 4.26 and Figure 4.5.

Table 4.26 shows that contractors are faced with many risks (13 percent). Despite this, 15 percent of the responses indicate that contractors do not consider risk management in construction project management with 13 percent feeling that risks are handled in an arbitrary way. 10 percent of the responses indicate that contractors lack in knowledge on risks and their mitigation while 9 percent of the responses point out that lack of risk management in construction project has resulted to time and cost overruns, reduced profitability and even losses.

Table 4.26 Opinion on construction risk management in Kenya- response frequency table

Response	**No. of responses**	**Percentage**
There is lack of risk management among contractors	24	15%
Risk are arbitrary handled	21	13%
Construction industry faced with several risks	20	13%
Contractors lack knowledge in risk management	16	10%
Lack of risk management has resulted to time and cost overruns, losses and reduced profitability	14	9%
There is need to train and sensitize contractors in risk management	12	8%
Contractors respond to risks by taking insurance cover	12	8%
There is lack of human recourses trained in risk management in the construction companies	10	6%
There is need to use construction management tools and techniques to reduce construction risks	10	6%
Contractors respond to risks through subcontracting, contingency and guarantees	8	5%
There is need to employ professionals and skilled labour in construction	6	4%
There is inequality in risk allocation with most risk going to contractors	4	3%
Total	**157**	**100%**

Source: Field Survey, 2015

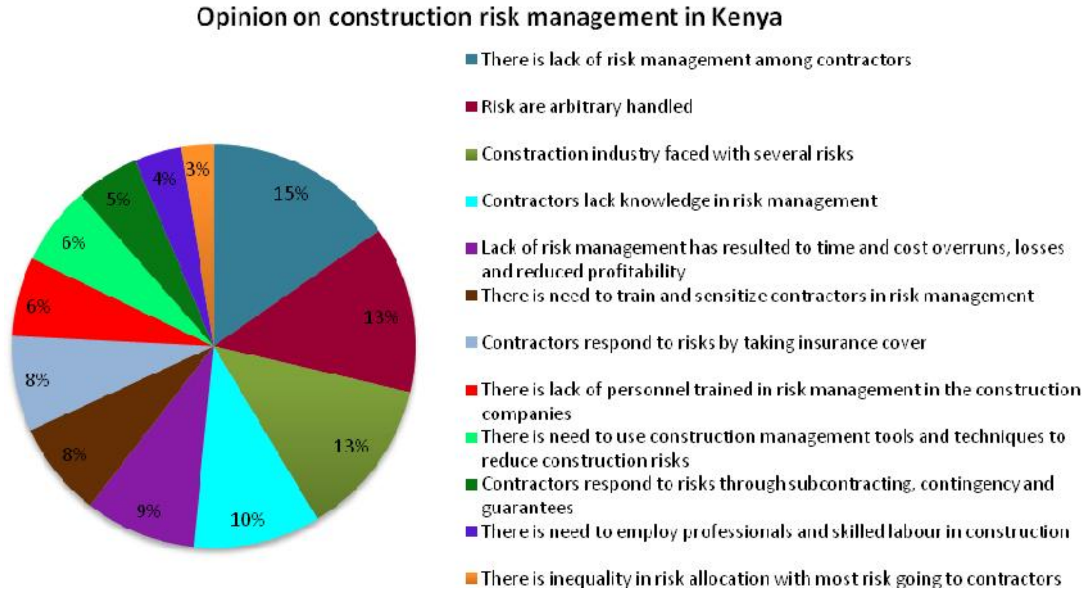

Figure 4.4 Opinion of contractors on construction risk management in Kenya

Source: Field survey, 2015

Eight (8) percent of the responses represented in Table 4.26 further shows there is need to train and sensitize contractors in risk management through seminars and workshops. Six (6) percent point out that employing risk management experts can ensure risks are identified, analyzed and responded to in construction projects with minimal impacts. Failure by contractors to employ professionals and people skilled construction has also contributed to construction risk. Four (4) percent and 6 percent of the responses show that if contractors employ qualified people in their businesses and apply project management tools and techniques risks can be reduced or even eliminated.

Some respondents also indicated that contractors have transferred risks to third parties like insurance companies (8 percent) while some contractors subcontracts some or all the works, use performance bonds to guarantee performance and contingency funds (5 percent). Further, some responses (3 percent) present that contractors are unfairly treated in risk allocation with most of risks allocated to them.

In conclusion the response confirms that construction industry is prone to several risks with contractors unaware of them and thus there isn't any risk management procedure in place and where responded to it is in a random way. Risk has resulted to project being uncompleted or completed with cost and time overruns. Contractors have also suffered from reduced profits or even losses.

Insurance has emerged as the risk response method most contractors are familiar with while a big number of them understand risk to mean accidents on site only. There is need to train contractors through seminars and workshops on risk management and even develop a curriculum for risk managers in universities and colleges.

4.11 Discussion

Using RSIS risks were ranked and key risks impacting on the different project objectives were identified. Though this process gave important information for risk management, it failed to look into underlying relationships between the risk factors and their significance in relation to the different project objectives. This was necessary to arrive at concrete decisions on risk management. Principal component analysis was applied to analyze identified construction risks.

Measure of appropriateness for principal component analysis showed that this technique was appropriate for analysis of the risk data collected. This was used to determine correlations between risk significance in relation to the different project objectives. High correlation was observed between risk significance in relation to cost, risk significance in relation time and risk significance in relation quality. Further strong correlation was noted between risk significance in relation to environment and risk significance in relation health and safety. This indicated that mitigation actions taken to respond to risk impacting on cost was to have a corresponding reduction of time related risks and vise versa. The same applies between quality related risks and cost and time related risks. Response to quality related risks would result to reduction in impact of risks on time and cost and vise versa. Response to risks impacting on environment would result to improved health and safety performance while response to risks related to health and safety would result to improved environment conservation.

Two principal components were extracted. The first principal component (PC-1) has the largest possible variance of 54.375. The second principal component (PC-2) accounts for the most of the remaining variance, that is, 33.873. The two principal components were labeled as *primary variable* and *secondary variable* respectively. Cumulatively the two components explained approximately 88.25% of the total variance. Risk significance in relation to cost, risk significance in relation to time and risk significance in relation quality were found to load well on the *primary variable* while risk significance in relation to environment and risk significance in relation health and safety loaded well on the *secondary variable*.

Factor score analysis was carried out using SPSS software and two sets of variables generated (FAC1-1 and FAC2-1). These indicate the loadings (weight) of the different factors on the individual component. “Delayed payment by the employer” was the most significant risk impacting on *primary variable*, that is, cost and time. This was followed by “information unavailability-details, drawings, sketches”, “design variation required by client” and “lack of consistency between the bill of quantity, drawing and specifications”. *Secondary variable* was significantly influenced by “lack of compliance with safety and health requirement on site”, “lack of compliance with environment requirements”, “unhealthy working conditions for workers” and “lack of support for the project by local communities”, “inadequate or insufficient site information (site investigation report)”, “defective works” and “inadequate/ defective specification” in that order.

The study further determined the composite score in relation to all the risk factors. This was for the purpose of ranking the risks in terms of their loading on both the components. “Information unavailability-details drawings, sketches” was the top ranked risk. The risk has significant impact on both the components. “Adverse weather conditions” and “inadequate/ defective specification” were ranked second and third respectively. “High performance or high quality standard to meet” was ranked fourth. Other top ranked factors in order of significance were: “inadequate or insufficient site information (site investigation report)”; “delayed payment by the employer”; “design variation required by client”; “defective works”; “lack of consistency between the BQs, drawings and specifications”; technical complexity and design innovations requiring new construction methods and materials” and; “unhealthy working conditions”.

These results are valid as they match well with the results with significance index score in relation to the individual objectives. Of the 27 risks identified as significantly influencing the different project objectives using descriptive statistics, 23 risks were still identified to be among the 27 top ranked in the composite score list. These risks are recognized as the key risks influencing project objectives and hindering project delivery among contractors in Kenya. Immediate response to these risks by management is imperative and a definite way of improving project delivery.

These observations are very important in making decisions in regard to risk management and the promotion of project production in terms of timely completion, with no cost overruns and to the client satisfaction in terms of meeting the intended specifications and requirements. Also decisions regarding work environment in terms of environment conservation and meeting the site health and safety. In order to promote project performance in a particular dimension, the contractors should embrace risk management.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The study evaluates the construction risks that hamper contractors from achieving project objectives. This has been done by collecting respondents' opinions in relation to risk management among construction contractors in Kenya. The study has documented the likelihood of occurrence of the risks and their impact to project objectives, that is, cost, time, quality, environment and safety and health. The study generally aims at determining the key risks in the construction industry which when responded to can result to improved project delivery.

The research problem was stated (Chapter 1) as:-

> *"Contractors are faced with several risks in their construction business and fail to meet the principal project objectives of budget, time, quality, environmental conservation and health and safety. This has been attributed to lack of knowledge of key risks influencing each of the objectives and how best to manage them"*

Chapter 2, 3, and 4 provided focus for the investigation of the research questions, namely:-

i) What is the likelihood of occurrence of construction risks among contractors in Kenya?

ii) What is the impact of construction risks on project objectives among contractors in Kenya?

iii) What is the order of significance of construction risk in relation to the different project objectives?

iv) What are the key risks related to project delivery among contractors in Kenya?

In this chapter, the findings of the research questions are presented. Conclusions are drawn from the research findings and recommendations made for practice and future research. Finally, the attainment of the research objectives is discussed.

5.2 Validation of the research problem

The research problem has been validated by questionnaire survey more specifically it has shown that:-

- Construction is susceptible to several risks where contractors lack risk management skills with risks being either ignored or handled in arbitrary way with no formal procedure in place. This is discussed earlier in Chapter 4, pages 129 to 131.

- Construction risks have high impact on construction project objectives of cost, time, quality, environment, and health and safety. Out of the twenty seven (27) highlighted key risks, twenty five (25) of them range from high to extremely high with only two risk with medium impact. This was ealier discussed in Chapter 4, pages 107 to 111.

5.3 Findings of the research questions

This section provides the findings of the research questions.

i) What is the likelihood of occurrence of construction risks among contractors in Kenya?

Risk likelihood of occurrence or risk probability has been defined in Chapter 2 as the estimate of the likelihood that a risk event will occur. This is obtained through data collection among sampled respondents. Table 4.11 in chapter 4 shows all the risks surveyed together with their percentage frequency distribution of respondents in term of their opinion. The table also presents the ranking of these risks in term of their average likelihood of occurrence. The following ten (10) risks were identified as the most probable risks in order of their likelihood.

1) Excessive approval procedures in administrative government departments
2) Delayed payment by the employer
3) Information unavailability-details, drawings, sketches
4) Design variations required by clients
5) Cost under estimation
6) High performance or quality standard to meet
7) Actual quantities different from contract quantities

8) Inadequate or insufficient site information (site investigation report)
9) Inadequate/ defective specification
10) Lack of consistency between the BQs, drawings and specifications

ii) What is the impact of construction risks on project objectives among contractors in Kenya?

Risk impact has been defined in Chapter 2 as the effect on project objectives if the risk event occurs. Table 4.12 in Chapter 4 shows all the risks and their average impact on project objectives.

- Impact on cost

Construction risks were ranked depending on their impact on cost. Below are the ten risks with the highest impact on cost.

1) Damage caused wind, hurricanes, fire, landslides,
2) Lack of consistency between the BQs, drawings and specifications
3) Cost under estimation
4) Actual quantities different from contract quantities
5) Financial failure of the contractor
6) Delayed payment by the employer
7) Defective designs (shoddy and/or erroneous)
8) Inadequate/ defective specification
9) Design variations required by clients
10) Unclear scope of work

- Risk impact on time

Construction risks were ranked depending on their impact on time. Below are the ten ranked risks with the most impact on construction cost. "Design variations required by clients" and "Information unavailability-details, drawings, sketches" had the same average impact on time hence the list has eleven risks.

1) Damage caused wind, hurricanes, fire, landslides,
2) Financial failure of the contractor
3) delayed payment by the employers
4) Delays in supply of Materials

5) Adverse weather conditions
6) Legal disputes during construction among the parties to contract
7) Delays in supply of utilities, for example, electricity and water
8) Financial failure of the sub-contractor
9) Incomplete design
10) Design variations required by clients
11) Information unavailability-details, drawings, sketches

- Risk impact on quality

Construction risks were ranked depending on their impact on quality. Below are the ten ranked risks with the most impact on construction quality.

1) Defective work
2) Inadequate supervision and supervision team
3) Inadequate sub-contractor efficiency and competency
4) Inadequate/ defective specification
5) Information unavailability-details, drawings, sketches
6) Technical complexity and design innovations requiring new construction methods and materials
7) Defective designs(shoddy and/or erroneous)
8) Lack of coordination between project participants.
9) High performance or quality standards to meet
10) Damage caused by natural occurrences such as wind, hurricanes, fire, landslides

- Risk impact on environment

Construction risks were ranked depending on their impact on environment. Below are the ten ranked risks with the most impact on construction project environment.

1) Damage caused by natural occurrences such as wind, hurricanes, fire, landslides
2) Lack of compliance with environmental requirements
3) Impact of construction project on surrounding environment
4) Lack of compliance with safety and health requirements on site
5) Adverse weather conditions
6) Inadequate or insufficient site information (site investigation report)

7) Defective work
8) Unhealthy working condition for workers
9) Inadequate/ defective specification
10) Compliance with new government Acts and Legislations

- Risk impact on health and safety

Construction risks were ranked depending on their impact on health and safety of site. Below are the ten ranked risks with the most impact on health and safety on construction sites.

1) Damage caused by natural occurrences such as wind, hurricanes, fire, landslides
2) Unhealthy working condition for workers
3) Lack of compliance with safety and health requirements on site
4) Unstable security circumstances
5) Serious accidents on site
6) Lack of compliance with environmental requirements
7) Adverse weather conditions
8) Defective work
9) Inadequate/ defective specification
10) Inadequate or insufficient site information

iii) What is the order of significance of construction risk in relation to the different project objectives?

In Chapter 4 risks were ranked in order of their significance in relation to project objectives. These are key risks believed to influence the delivery of projects among contractors on Kenya. Table 4.14 presents the summary of the top ranked risk factors influencing each of the project objectives.

- Cost objective
  1) Delayed payment by the employer
  2) Cost under estimation
  3) Design variations required by clients
  4) Lack of consistency between the BQs, drawings and specifications
  5) Actual quantities different from contract quantities

6) Information unavailability-details, drawings, sketches
7) Exchange rate fluctuations and inflation
8) Excessive approval procedures in administrative government departments
9) High performance or quality standard to meet
10) Inadequate/ defective specification

- Time objective
    1) Delayed payment by the employer
    2) Excessive approval procedures in administrative government departments
    3) Information unavailability-details, drawings, sketches
    4) Design variations required by clients
    5) Adverse weather conditions
    6) High performance or quality standard to meet
    7) Delays in supply of utilities, for example, electricity and water
    8) Financial failure of the contractor
    9) Lack of consistency between the BQs, drawings and specifications
    10) Financial failure of the sub-contractor

- Quality objective
    1) Inadequate or insufficient site information (site investigation report)
    2) Information unavailability-details, drawings, sketches
    3) High performance or quality standard to meet
    4) Inadequate/ defective specification
    5) Defective work
    6) Inadequate supervision and supervision team
    7) Lack of consistency between the BQs, drawings and specifications
    8) Technical complexity and design innovations requiring new construction methods and materials
    9) Lack of coordination between project participants
    10) Cost under estimation

- Environment objective
    1) Lack of compliance with environmental requirements
    2) Lack of compliance with safety and health requirements on site
    3) Adverse weather conditions
    4) Inadequate or insufficient site information (site investigation report)
    5) Inadequate labour and equipment productivity
    6) Impact of construction project on surrounding environment
    7) Unhealthy working condition for workers
    8) Defective work
    9) Inadequate/ defective specification
    10) Wastage of materials on site by workers

- Health and safety objective
    1) Lack of compliance with safety and health requirements on site
    2) Unhealthy working condition for workers
    3) Adverse weather conditions
    4) Lack of compliance with environmental requirements
    5) Unstable security circumstances
    6) Inadequate or insufficient site information (site investigation report)
    7) Defective work
    8) Inadequate/ defective specification
    9) Tight project schedule
    10) High performance or quality standard to meet

iv) What are the key risks related to project delivery among contractors in Kenya?

Chapter 3 defines key risks as those risks that significantly influence the delivery of construction projects. This was achieved through ranking of risk factors according to their composite/ comprehensive scores. After a comprehensive score analysis, risks were ranked and twenty seven (27) key risks highlighted. Of the (27) key risks highlighted, twenty three (23) of them were identified as key risks impacting on individual project objectives. The identification of the 23 risks as key risks using both descriptive statistics and inferential statistics indicate that the method is valid. Table 4.25 in chapter 4 shows the comprehensive scores for the various risk factors in order of importance. Below is a list of key construction risks in order of significance in delivery of projects among contractors in Kenya.

1) Information unavailability-details, drawings, sketches
2) Adverse weather conditions
3) Inadequate/ defective specification
4) High performance or quality standards to meet
5) Inadequate or insufficient site information (site investigation report)
6) Delayed payment by the employer
7) Design variations required by the clients
8) Defective works
9) Lack of consistency between the BQs, drawings and specifications
10) Technical complexity and design innovations requiring new construction methods and materials
11) Unhealthy working condition for workers
12) Cost under estimation
13) Lack of compliance with safety and health requirements on site
14) Wastage of materials on site by workers
15) Inadequate supervision and supervision team
16) Excessive approval procedures in administrative government departments
17) Lack of coordination between project participants
18) Tight project schedule
19) Actual quantities different from contract quantities
20) Lack of compliance with environmental requirements
21) Financial failure of the contractor
22) Financial failure of the sub-contractor
23) Delays in supply of utilities i.e. electricity and water

5.4 Conclusions

This research endeavored to identify key risks associated with the achievement of all project objectives in terms of cost, time, quality, environment and health and safety. This was based on collecting information about construction risks from practitioners in the construction industry owing to their robust experience and knowledge in construction projects and their threats. Using questionnaires, opinions of contractors on risk likelihood and impact on the project objectives was obtained. After a comprehensive analysis of the data collected key risks influencing project delivery were determined. Key risks are those risks that significantly influence the delivery of construction projects by impacting on these performance objectives.

Key risks influencing the achievement of each of the project objectives were identified. Table 4.14 gives these risks together with their RSIS and their rank. Using composite score analysis risks were ranked and the key risks identified. By applying inferential statistics composite scores for all the risk were determined and risks ranked. The results of the two methods of analysis were compared and 23 risks were identified as key risks requiring attention of management as they hold back project delivery among contractors in Kenya. The identification of the key risks was established to be valid because most of them had either high or extremely high impact on the project objectives.

The research has also shown that construction risks have their highest impact on cost and time. All the key risks impacting on these two objectives are extremely high. Project quality had risks influencing it between extreme and high impact. Environment and health and safety are established to be the project objective least vulnerable to risks. However, eight of the key risks have high impact on them with only one risk which is medium in impact.

Further this research has shown that construction industry is prone to several risks with contractors lacking knowledge about them and thus there isn’t any risk management procedure in place and where responded to it is in a haphazard way. This research thus has established the need for appropriate suggestions and recommendations for adequate risk management and consequent improved project delivery.

5.5 Recommendations

5.5.1 Recommended risk mitigation strategies among contractors

This research showed that Contractors in the Kenyan lack knowledge of risks and rarely do they employ formal risk management procedures in construction project management. Risk management is more often than not based on intuition and experience. In light of this finding it is important to enlighten the contractors on risk management procedures and strategies to improve their capacity. The researcher makes the below recommendations based on the research findings.

i) Table 4.26 in chapter 4 indicates that 10% of the respondents felt that contractors lack knowledge in risk management. 8% were of the opinion that there is need to train and sensitize contractors on risk management .

- Professionals in the construction field should be educated in risk management and thus both formal and informal system of risk management training needs to be developed. In the graduate level of education in construction project management, formal education on risk management should be provided. In the training curricula for building professionals i.e. Architecture, Quantity Surveying and Engineering students should be exposed to risk management concepts and practices. Informal education on risk management can be provided by career development programmes, trainings through workshops and seminars on risk-awareness, risk assessments, safety and legislative requirement. Such trainings can be organized by academic institutions or professional organizations such as Architectural Association of Kenya (AAK); Institute of Quantity Surveyors of Kenya (IQSK); Institute of Engineer Kenya (IEK), Engineers registration Board (ERB); Board of Registration of Architects and Quantity Surveyors (BORAQS) and universities offering building and engineering courses. Organizations like National Construction Authority (NCA), National Environment Management (NEMA), Kenya Federation of Master Builders (KFMB), Kenya Association Building and Civil Engineering Contractors (KABCEC) and Financial Institutions can also organize regional seminars and workshop to train contractors in project management practices. This can improve their managerial competency and reduce construction risks.

ii) Literature reviewed showed that there is increased ignorance of construction risks among contractors. This was supported by the findings of this research as presented in table 4.26. 15% of the repondents were of the opinion that there is lack of risk management among contractors in Kenya while 13% felt that risks are arbitrary handled.

- Risk management should be integrated in the Project Management Plan (PMP). PMP can ensure that construction risk management/ process produces worthwhile outcomes as efficiency and effectively as possible.

  The PMP shall provide:-

    - The project definition giving the aim, objectives, scope and authority, stakeholders, relationship of other projects.
    - Project planning- tasks, responsibilities, timetable, resources
    - Project implementation- communication, consultation, performance, monitoring and review.

- Management of risks should be embedded in the management philosophy and be integrated in the organizations' culture in which everybody is a risk manager. This is more important than developing and issuing extensive policies and procedures.
- There is need to initiate communication, consultation and participation among stakeholders. Open communication is necessary for risk management to succeed. This ensures risk management is "everybody's business". Managers require direct communication channels up, down and across their business to help identify risks and to take appropriate actions information must be shared. Stakeholders should be given the opportunity to contribute to the decision making process thus making available a large pool of information and expertise to enable valid solutions to be developed. To ensure successful implementation of any decision arrived at, it requires ownership and commitment from all parties influenced by it.
- **C**ontractors need to establish a highly co-operative construction team in which competent specialist contractors and skilled labourers are staffed. Communication, trust, commitment and integration are expected to bridge the physical and knowledge gap between different project participants. With maximum team efforts, construction programmes can be well executed and negative issue associated with construction such as friction, inefficiency, duplication of effort and pollution can be significantly minimized.
- Contractors should set up a responsibility centre for risk management. A Chief Risk Officer (CRO) who defines consistent approaches to managing risks should head it. The CRO should be the organization's risk champion and responsible for providing leadership, establishing and maintaining risk awareness across the organization, monitoring and continuous improvement of the risk management process at periodic intervals. He should regularly communicate the risk performance to the top management and stakeholders/stakeholder. The report should outline the major risks and how they have been managed.

- Implementing risk management requires resources. Investments will be required in: training, developing processes and techniques, management systems, specialist groups. Senior management must be committed to support the initiative with the required resources.

iii) In chapter 4, table 4.26, 4% of the responses showed that contractors were required to employ professionals and skilled in construction.

- The project management team is responsible for carrying out project management obligations. It is responsible and best suited to handle risks. Contractors should ensure positions in the team are held by professional in the construction industry. These professional are experts in project planning, contracts, environmental obligations, and health and safety issues. When these obligations are adequately implemented most of project risks in construction are eliminated. The performance of the team thus highly influences the success of a construction project. Several risks which can be mitigated through efficient and effective project management team includes: Inadequate project planning, cost under estimation, defective works, delays in supply of materials and services, Constructional and labour disputes.

iv) Findings in this reseach have presented the risks significantly influencing project ojectives hence the contractors' performance. Table 4.15 in chapter 4 presents the 27 key risks influencing project objectives. Contractors should come up with appropriate respose measures to mitigate against these risks. Appendix 6 presents the key risks influencing the five (5) project objectives and responding suggested response measures. Mitigation of these risks will lead to an improved contractors' performance in construction projects delivery.

5.5.2 Proposed future studies

- This study has looked into risk management in contractors' perspective. Future research should focus on risk management in perspective of other construction stakeholders who includes the client and the consultants.
- It is necessary to investigate risk management in terms of project lifecycle. Different risk factors influence construction projects at different development stages with varying probability and consequences.
- This research has established that most contractors in Kenya have no formal risk management procedures in construction project management. Therefore the

researcher recommends further research to be carried out to establish why contractors have not integrated risk management in project management.

- While this research has identified the key risks influencing the delivery of projects in Kenya it is necessary to establish how best the contractors should respond to these risks and how best to allocate or share them among the project stakeholders.

REFERENCES

Ahadzie, D. K., Proverbs, D. G., Olomolaiye, P., & Gameson, R. (2006). A conceptual predictive model for evaluating the performance of project managers in MHBPs. Cited in: BEAR. (2006). Construction Sustainability and Innovation/CIB W 89 *International Conference on Building Conclusions and recommendations Education and Research,* Hong Kong.

Aibinu, A.A., & Jagboro, G.O. (2002). The Effects of Construction Delays on Project Delivery in Nigeria Construction Industry. *International Journal of Project Management,* 20(4), 593-599.

Al-Bahar, J., & Crandall, K. (1990). Systematic Risk Management Approach for Construction Projects. *ASCE Journal of Construction Engineering and Management*, 116(3), 533-546.

Al-Shibly, H. H, Lousi B. M., & Hiassat, M.A. (2013). The impact of risk management on construction projects success from the employees' perspective. *Interdisciplinary Journal of Contemporary Research in Business*, 5(4), 12- 43

Andi (2006). The importance and allocation of risks in Indonesian construction projects. *Construction Management and Economics*, 24 (1), 69–80.

AS/NZS 4360 (1999). Risk management, Sydney, Australia/ Wellington, New Zealand: Standards Australia/ Standards New Zealand.

Axinn, W., & Pearce, L.D. (2006). *Mixed Method Data Collection Strategies.* New York: Cambridge University Press

Baartz, J., & Longley, N. (2003). Construction and infrastructure projects- risk management through insurance, *Allens Arthur Robinson*. Retrieved from https://www.allens.com.au/pubs/pdf/insur/ins6augs.pdf**.**

Baloi, D. (2012). Risk Analysis Techniques in Construction Engineering Projects. *Journal of risk analysis and Crises Response* 2(2), 115-123.

Beckers, F., Chiara, N., FLesch, A., Maly, J., Silva, E. &, Stegemann, U. (2013). A risk-management approach to a successful infrastructure project: Initiation, financing and execution. *Mckinsey Working papers on Risk*, Number 52.

Buerty, J.I.T., Abeere-Inga E., & Kumi T. A. (2012). Estimating Cost Contigency for Construction Projects: The challenge of systematic and project specific risk . *Journal of Construction Project Management and Innovation* , 2(1), 166 – 189

Caltrans Office of Statewide Project Management Improvement (2007). *Project Risk Management Handbook*: Threats and Opportunities, 2nd ed. Sacramento, CA. Retrieved from http://www.dot.ca.gov/hq/projmgmt/documents/prmhb/archive/caltrans_project_risk_management_handbook_20070502.pdf

Camp, W. G. (2001). Formulating and evaluating theoretical framework for career and technical education research. *Journal of Vocational Education Research, 21(1).* Retrieved from: https://scholar.lib.vt.edu/ejournals/JVER/v26n1/camp.html

Chan, A. (2001). Framework for Measuring Success of Construction Projects, *Report* 2001- 003-C-01.

Chan, A. P. C., & Chan, A. P. L. (2004). Key performance indicators for measuring construction success . *Benchmarking: An intenational journal*, 11(2), 203-221

Chan, A., Chan, D., & Yeung, J. (2009). Overview of the Application of “Fuzzy Techniques” in Construction Management Research. *Journal of Construction Engineering and Management, ASCE*, 135(11),1241-1252

Chandran, E. (2004). *Research methods: A quantitative approach*. Nairobi: Daystar University.

Chapman, C., & Ward, S. (1997). Project Risk Management—Processes, Techniques and Insights. Chichester, UK: John Wiley & Sons.

Chen, P., & Wang, J. (2009). Application of a fuzzy AHP method to risk assessment of international construction projects. *International Conference on Electronic Commerce and Business Intelligence*, 459–462.

Chia, S.E. (2006). Risk Assessment Framework for Project Management. *IEEE*, 376-379.

Chileshe, N., & Yirenki-Fianko, A. B. (2012). An evaluation of risk factors impacting construction projects in Ghana. *Journal of Engineering, Design and Technology* 3, 306 - 329.

Chileshe, N., & Yirenki-Fianko, A. B. (2011). Perceptions of Threat Risk Frequency and Impact on Construction Projects in Ghana: Opinion Survey Findings. *Journal of Construction in Developing Countries* 16(2), 115-149.

Chinn, P.L., & Kramer, M.K. (1999). Theory and nursing: a systematic approach, ed 5, Mosby: St Louis.

Chris, S.(2012). Global construction trends & forecasts. *International Tower cranes conference and reception.* Berlin Germany: International Construction.

Cochran, W. G. (1963). Sampling Techniques, 2nd ed. New York: John Wiley and Sons, Inc.

Connaway, L. S., & Powell, R. R. (2010). *Basic research methods for librarians* (5th ed.). Littleton, CO: Libraries Unlimited.

Dalcher, D. (1993). *The new project management mindset for the 21st century.* Proc. 1st British Project Management Colloquium, Henley-on-Thames, UK: British Project Management Colloquium

Dawood, N. N., Yasuhara, T., Usuda, Y., Matsuda, C., & Sawada, A. (2001). Analysis of cost escalation and risk assessment of infrastructure projects: An application in Japanese civil engineering projects. *In*: Akitonye A (Ed.) 17*th* *Annual ARCOM Conference*, 5-7 September 2001, University of Salford: Association of Researchers in Construction Management.

Deviprasadh, A. (2007). Risk Assessment and Management in construction projects. M.E. Construction Engineering and Management Thesis report. Chennai: Anna University,

Dikmen, I., Birgonul, M. T., & Arikan, A. E. (2004). A critical review of risk management support tools. In: Khosrowshahi, F (Ed.), *20th Annual ARCOM Conference*, 1-3 September 2004, Heriot Watt University. Association of Researchers in Construction Management, 2, 1145-54.

Ehsan, N., Mirza, E., Alam, M., & Ishaque, A. (2010). Risk management in construction industry. In *Computer Science and Information Technology (ICCSIT), 2010 3rd IEEE International Conference on* 9, 16-21.

Fewings, P. (2005). *Construction Project Management: An Integrated Approach.* Abingdon: Taylor and Francis.

Fisher, A. A., Laing, J. E., & Strocker, J.E. (1998). Handbook for Family Planning, Operation Research Design in Sampling. Population Council, 40-45

Fisk, E. R. (2003). *Construction Project Administration*. 7th ed. New Jersey Colombus, Ohio: Prentice Hall Upper Saddle River.

Ghahramanzadeh, M. (2013). Managing Risk of Construction Projects: A case study of Iran. Unpublished PHD thesis. London: University of East London.

Gichunge, H. (2000). *Risk Management in the Building Industry in Kenya*. Unpublished PhD. Thesis. Nairobi: University of Nairobi.

Gong, M. Z., & Tse, M. S. C. (2009). Pick, mix or match? A discussion of theories for management accounting research, *JABM: Journal of accounting business and management,* 16(2), 54-66.

Gravetter, F.J., & Forzano, L.A. (2011). *Research methods for the Behavioral Science*, 4th ed. Linda: Linnda Schreiber-Ganster Acquisitions.

Gwaya, A.O. Wanyona, G., & Masu, S. M. (2014). The Contingency Allowance In Project Budgeting. *International Journal of Soft Computing and Engineering* (IJSCE). 3(6), 17-23

Gwaya, A. O. Wanyona, G., & Masu, S. M. (2014). The need for Change in the Practice of Project Management in Kenya. *International Journal of Soft Computing and Engineering* (IJSCE). 3(6), 24-29

Gwaya, A. O., Masu, S. M., & Wanyona, G. (2014). Development of Appropriate project Managenemt Factors for the Construction Industry in Kenya. *International Journal of Soft Computing and Engineering* (IJSCE) 4(1), 70-76.

Gwaya, A.O., Masu, S. M., & Wanyona, G. (2014). A Critical Analysis of the Causes of Project Management Failures in Kenya. *International Journal of Soft Computing and Engineering* (IJSCE) 4(1), 64-69.

Haponava, T., & Al-Jibouri, S. (2010). Establishing influence of Design process performance on end-project goals in construction using process-based model. *Benchmarking: An intenational journal*, 17(5), 657-676.

Hayes, R.W., Perry, J. G. Thompson. P.A., & Wilmer. G. (1986). *Risk Management in Engineering Construction: A guide to project risk analysis and risk management.* SERC Report. London: Thomas Telford.

Hornby, A. S., Ashby, M., & Wehmeier, S. (2005). *Oxford advanced learner's dictionary of current English*. Oxford: Oxford University Press.

Howitt, D., & Cramer, D. (2005). *Introduction to Research Methods in Psychology*. Harlow : Pearson Education Limited.

Idrus, A., Sodangi, M., & Husin, M. (2011). Prioritizing Project Performance Criteria within Client Perspective. *Research Journal of Applied Sciences, Engineering and Technology*, 3(10), 1142–1151.

International Labour Organization (2001). The construction industry in the 21st century: Its image, employment prospects and skill requirements, Geneva: ILO.

Jollife, I. T. (2002). *Principal Component Analysis* Series: Springer Series in statistics 2nd Ed., Springer NY

Jomaah, I., Bafail, A., & Abdulaal, R. (2010). Identifying, assessing, and managing risks affecting the construction projects in King Abdulaziz University.

Vice Presidency of KAU for Projects, Research project No.: 429/88. KAU: King Abdulaziz University.

Kaiser, H. F. (1974). An index of Factorial Simplicity. *Psychometrika, 29*(1), 31-36.

Kaiser, H. F., & Rice, J. (1974). Little Jiffy, Mark IV. *Educational and Psychological measurement, 34*, 111-117.

KarimiAzari, A., Mousavi, N., Mousavi, S. F., & Hosseini, S. (2011). "Risk assessment model selection in construction industry", *Expert Systems with Applications, 38* (8), 9105-11.

Khosravi S., & Afshari H. (2011). A success Measurement Model for Construction Projects. *International conference on financial management and economics,* 11, 186-190.

Kishk, M., & Ukaga, C. (2008). The impact of effective Risk Management on project success. *In*: A. DAITY, ed. *Proceedings of the 24th Annual ARCON Conference* 1-3 September 2008 London: ARCON.

Kothari, C. R. (2004). *Research Methodology; Methods & Techniques*, , New Delhi, India: New Age International Publishers.

Likert, R. (1932). A Technique for the Measurement of Attitudes. *Archives of Psychology* 140, 55.

Lim, C. S., & Mohamed, M. Z. (1999). Criteria of project success: An exploratory re examination. *International Journal of Project Management*, 17(4), 243 – 248.

Liu, L., & Zhu, K. (2007). Improving cost estimates of construction projects using phased cost factors, *Journal of Construction, Engineering and Management,* 133(1), 91-95.

Love, E. D., & Holt D. G. (2000). Construction business performance measurement: The SPM alternative. *Journal of Business Process Management*, 6(5), 408-416

Lui, J., Li, B., & Zhang, J. (2004). Insurance and construction project risks: a review and research agenda

Madsen, P., & Desai, V. (2010). Failing to learn? The effects of failure and success on organizational learning in the global orbital launch vehicle industry, *Academy of management journal*, 53 (3). 451-476.

Mahendra, P.A., Jayeshkumar R.P., & Bhavsar J. J. (2013). A Study of Risk Management Techniques for Construction Projects in Developing Countries, *International Journal of Innovative Technology and Exploring Engineering (IJITEE)* 3, 5.

Mark, W., Cohen, P.E., & Glen, R.P. (2004). Project Risk Identification and Management, *AACE International Transactions,* INT. 01, 1-5.

Mbatha, C. M. (1986). *Building contract performance, A case study of Government Projects in Kenya*. Unpublished M.A. Thesis. Nairobi: University of Nairobi.

Mbeche, I. M. & Mwandali, D. N. (1996). Management by Projects. *A paper presented at the regional Conference on Construction Management,* 3-6 November, Garden Hotel, Machakos.

Mousa J. H. A. (2005). *Risk Management in Construction Projects from Contractors and Owners' perspectives.* Unpublished MSc. Thesis. Palestine: The Islamic University of Gaza-Palestine.

Mugenda, O. M., & Mugenda, A.G. (2003). Research Methods. Qualitative and Quantitative Approach. Nairobi: Acts Press.

Muiruri, G., & Mulinge, C. (2014). Health and Safety Management on Construction Projects Sites in Kenya. *FIG Congress, Engaging Challenges-Enhancing the Relevance* Kuala Lumpar, Mallaysia.

Mutema, J.K., & Muturi, W.M. (2013). Factors influencing risk management in construction projects in the petroleum industry in Kenya. *International Journal of Social Sciences and Entrepreneurship,* 1 (5), 668-678.

Nieto-Morote, A., & Ruz-Vila, F. (2011). A Fuzzy Approach to Construction Project Risk Assessment. *International. Journal of Project Management*. 29, 220-231.

Osipova, E., & Eriksson, P. E. (2009). The effects of procurement procedures on joint risk management. *In*: Daity, A. (Ed) *Procs 25th Annual ARCON Conference*, 7-9 September 2009, Nottingham, UK, Association of Researchers in Construction Management, 1305-14.

Panthi, K., Ahmed, S. M., & Azhar, S. (2007). Risk Matrix as a Guide to Develop Risk Response Strategies, *ASC Proceedings of the 43rd Annual Conference*, Northern Arizona University, Flagstaff, Arizona, April 12-14.

Piney, C. (2002). Risk Response Planning: Selecting the Right Strategy. *Fifth European Project Management Conference*, PMI, Europe.

Pinto, M. B., & Pinto, J. K. (1991). Determinants of cross-functional cooperation in the project implementation process. *Project Management Journal*, 9(3), 243-249.

Polit, D.F., & Beck, C.T. (2012). Nursing Research. Principles and Methods. 8th ed. London: Lippincott William and Wilkins.

Pourrostam, T., & Ismail, A. (2011). Significant factors causing and effects of delay in Iranian construction projects, *Australian Journal of Basic and Applied Sciences*, 5(7), 450-456.

Project Management Institute (PMI) (2013). *Project Management Body of Knowledge (PMBOK)*, 5th ed. USA: Project Management Institute, Inc.

Republic of Kenya (2014). *Economic Survey 2014*, Nairobi, Central Bureau of Statistics, Ministry of Finance, Nairobi: Government Printer.

Rubin, A., & Babbie, E. (2009). Essential research methods for social work, (2nd ed.). Belmont, CA: Brooks/Cole Publishing Co.

Shebob, A., Dawood, N., & Xu, Q. (2011). Analyzing construction delay factors: A srudy of building construction project in Libya in: Egbu,C, and Lou, E,C,W, (Eds) *Procs 27th Annual ARCOM Conference*, 5-7 September 2011, Bristol,UK, Association of Researchers in Construction Management, 1005-1012.

Shen, L. Y., Wu, G.W.C., & Ng, C.S.K. (2001). Risk assessment for Construction Joint Ventures in China, *Journal of Construction Engineering and Management*, 127(1), 76-81

Smith, N.J., & Merna, T. and Jobling, P. (2006). Managing risk in construction projects. Oxford: Blackwell Science Ltd.

Tadayon, M., Jaafar, M., & Nasri, E. (2012). An Assessment of Risk Identification in Large Construction Projects in Iran, *Journal of Construction in Developing Countries*, 1, 57–69.

Takim, R., Akintoye, A., & Kelly, J. (2003). Performance Measurement Systems in Construction. *19th Annual ARCOM Conference*, University of Brighton (Association of Researchers in Construction Management, University of Brighton), 1, 423-32.

Talukhaba, A. A. (1988). *Time and Cost performance of Construction Projects*. Unpublished M.A. Thesis. Nairobi: University of Nairobi.

Tang, W., Qiang, M., Duffield, C., Young, M., & Lu, Y. (2007). Risk management in the Chinese construction industry. *Journal of construction engineering and management*. 133(12), 944-955.

The National Environment Management Authority (NEMA).(2014). Retrieved from: http://www.nema.go.ke/index.php?option=com_content&view=article&id=267.

The Stationery Office (TSO) (2009). *Managing successful projects with PRINCE2* - PRINCE2, 5th ed. Nantwitch, U.K: TSO.

Tipili, G.L., & IIyasu, M.S. (2014). Evaluating the impact of risk factors on construction projects cost in Nigeria. *The Internationaljournal of Engineering and Science (IJES).* 3(6), 10-15.

Wang, S. Q., Dulaimi, M. F., & Agura, M.Y. (2004). Risk management framework for construction projects in developing countries. *Construction Management and Economic* 22, 237-252.

Wanyona, G. (2005). *Risk Management in the cost planning and control of building projects. The case of Quantity Surveying profession in Kenya*. Unpublished PhD Thesis.Cape Town: University of Cape Town.

Wibowo, M.A. (2009). *The Contribution of the Construction Industry to the Economy of Indonesia: A Systemic Approach*. Construction Management, Civil Engineering, Department, Diponegoro University, Indonesia. Retrieved from: http://eprints.undip.ac.id/387/1/Agung_Wibowo.pdf.

World Trade Organisation (2011). Construction and related engineering services. Retrieved from: http://www.wto.org/english/tratop-e/constructin-e/construction-e/htm.

Zayed T., Amer M., & Pan J. (2008). Assessing Risk and Uncertainty Inherent in Chinese Highway Projects Using AHP. *The international Journal of Project Management* 26(4), 408 – 419.

Zeithaml, V.A.P., Varadarajan, R., & Zeithaml, C.P. (1988). The Contingency Approach- Its Foundations and Relevance to Theory Building and Research in Marketing, *European Journal of Marketing*, 22(7), 37-64.

Zou, P., Zhang, G., & Wang, J.Y. (2006). Identifying key risks in construction projects: Life cycle and stakeholder perspectives, Proc. *12th Pacific real estate society conference*. Auckland, New Zealand, 22-25 January.

APPENDICES

1. Research Permit from National Commission for Science, Technology and Innovation (NACOSTI)
2. Sample introduction letter to respondents
3. Research questionnaire
4. Contractors' mandatory technical requirements for various classes
5. Categories of contractor registration according to capability
6. Appendix 1: Key risks suggested responses

Appendix 2: Research permit from National Commission for Science, Technology and Innovation (NACOSTI)

NACOSTI

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471, 2241349, 310571, 2219420
Fax: +254-20-318245, 318249
Email: secretary@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

9th Floor, Utalii House
Uhuru Highway
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No.

Date:

8th May, 2015

NACOSTI/P/15/8383/5371

Peter Mwangi Njogu
Jomo Kenyatta University of
Agriculture and Technology
P.O.Box 62000-00200
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Assessment of construction risk on project delivery among construction companies in Kenya''*** I am pleased to inform you that you have been authorized to undertake research in **all Counties** for a period ending **30th October, 2015.**

You are advised to report to **the County Commissioners and the County Directors of Education, all Counties** before embarking on the research project.

On completion of the research, you are required to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

DR. S. K. LANGAT, OGW
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioners
All Counties.

The County Directors of Education
All Counties.

National Commission for Science, Technology and Innovation is ISO 9001: 2008 Certified

Appendix 3: Introduction letter to respondents

QS. PETER M. NJOGU

P.O BOX 181-10205 Cell Phone: 0723 607 465

MARAGUA qsnjogu@yahoo.com

October 2014

To whom it may concern,

RE: INTRODUCTION TO INTERVIEW RESPONDENTS

I am a student at the Jomo Kenyatta University of Agriculture and technology undertaking a Masters Degree course in Construction Project Management. I am carrying out a research on "**Assessment of effects of construction risk on project delivery among contractors in Kenya**".

This is to therefore to introduce myself to you for the purpose of carrying out an interview towards my research thesis. Attached is a Questionnaire to be filled. All information will be strictly kept confidential and will be used for purposes of this research study only.

Your participation and assistance shall be highly appreciated.

Yours Faithfully,

Qs. Peter M. Njogu
Reg. No: AB343-0716/2013
Department of Construction Project Management

Appendix 4: Sample questionnaire

PART I: INTRODUCTION

Please tick appropriately

1. Please indicate your highest level of education.

   i) Certificate [ ] ii) Diploma [ ]

   iii) Degree [ ] iv) Post graduate [ ]

   v) Others [ ] (Please specify………………….……………)

2. Please indicate your professional qualification.

   i) Project manager [ ] ii) Engineer [ ]

   iii) Quantity surveyor [ ] iv) Architect [ ]

   v) Others [ ] (Please specify………..………..…………)

3. Please indicate the position you held in your first employment.

   i) Director [ ] ii) Senior manager [ ]

   iii) Technical manager [ ] iv) Engineer [ ]

   v) Quantity surveyor [ ] vi) Architect [ ]

   vii) Project manager [ ] viii) Others [ ] (Please specify…...…)

4. Please indicate your current position in this company.

   i) Director [ ] ii) Senior manager [ ]

   iii) Technical manager [ ] iv) Engineer [ ]

   v) Quantity surveyor [ ] vi) Architect [ ]

   vii) Project manager [ ] viii) Others [ ] (Please specify..………)

5. Please indicate your number of years of working experience in the construction industry.

   i) 1 year or less [ ] ii) More than 1 year -5 year [ ]

   iii) More than 5 years -10 years [ ] iv) More than 10 years – 15 years [ ]

   v) More than 15 years [ ]

6. Please indicate the current National Construction Authority (NCA) registration category of the construction company.

   i) NCA 1 [ ] ii) NCA 2 [ ]

   iii) NCA 3 [ ] iv) NCA 4 [ ]

   v) NCA 5 [ ]

7. Please indicate the first class of registration of the construction company.

   i) NCA 1 [ ] ii) NCA 2 [ ]

iii)	NCA 3	[ ]	iv)	NCA 4	[ ]
v)	NCA 5	[ ]	vi)	NCA 6	[ ]
vii)	NCA 7	[ ]	viii)	NCA 8	[ ]

PART II: CONSTRUCTION RISKS LIKELIHOOD (PROBABILITY) OF OCCURRENCE AND IMPACT ON PROJECT OBJECTIVES

Below is a table which contains the risk factors. Please assign (tick as appropriate) the likelihood of occurrence of each of risks and the impact on each of the project delivery objectives.

Risks Likelihood (Probability) of Occurrence

Symbol	Meaning
1	Rare (remote)
2	Unlikely
3	Likely (possible)
4	Highly likely
5	Almost certain

Impact of risk on Construction Project Delivery Objectives

Symbol	Meaning
1	Very low
2	Low
3	Moderate
4	High
5	Very high

	RISK FACTOR	**Risk likelihood of occurrence**					**Impact on Project Cost**					**Impact on Project Time**					**Impact on Quality**					**Impact on Environment**					**Impact on Health and Safety**				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Design/ Technical																														
1	Design variations required by clients																														
2	Defective designs(shoddy and/or erroneous)																														
3	Incomplete design																														
4	Inadequate or insufficient site information (site investigation report)																														
5	Inadequate/ defective specification																														
6	Information unavailability-details, drawings, sketches																														
7	Unclear scope of work																														
8	Lack of consistency between the BQs, drawings and specifications																														

	RISK FACTOR	Risk likelihood of occurrence					Impact on Project Cost					Impact on Project Time					Impact on Quality					Impact on Environment					Impact on Health and Safety				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Time																														
9	Delay in handing over the site																														
10	Inadequate project programme																														
11	Tight project schedule																														
12	Difficult to access the site																														
13	Delays in supply of Materials																														
14	Delays in supply of utilities i.e. electricity and water																														
	Financial/ Economic																														
15	Delayed payment by the employer																														
16	Financial failure of the contractor																														
17	Financial failure of the sub-contractor																														
18	Exchange rate fluctuations and inflation																														
19	Cost under estimation																														
	Quality risks																														
20	Inadequate sub-contractor efficiency and competency																														
21	Defective work																														
22	Technical complexity and design innovations requiring new construction methods and materials																														
23	High performance or quality standard to meet																														

	RISK FACTOR	**Risk likelihood of occurrence**					**Impact on Project Cost**					**Impact on Project Time**					**Impact on Quality**					**Impact on Environment**					**Impact on Health and Safety**				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Construction/ project execution																														
24	Legal disputes during construction among the parties to contract																														
25	Industrial disputes during construction																														
26	Loss or damage of third parties property due to construction activities																														
27	Serious accidents on site																														
28	Wastage of materials on site by workers																														
29	Actual quantities different from contract quantities																														
30	Inadequate labour and equipment productivity																														
31	Equipment failure																														
32	Difficult site conditions																														
33	Inadequate supervision and supervision team																														
34	Poor communication between contract parties																														
35	Lack of coordination between project participants																														

	RISK FACTOR	Risk likelihood of occurrence					Impact on Project Cost					Impact on Project Time					Impact on Quality					Impact on Environment					Impact on Health and Safety				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Political and Environmental																														
36	Excessive approval procedures in administrative government departments																														
37	Compliance with new government Acts and Legislations																														
38	Lack of support for the project by the local communities																														
39	Adverse weather conditions																														
40	Impact of construction project on surrounding environment																														
41	Unhealthy working condition for workers																														
42	Compliance with environmental requirements																														
43	Compliance with safety and health requirements on site																														
44	Unstable security circumstances																														
	Act of God																														
45	Damage caused by wind, hurricanes, fire, landslides																														

PART III: RESPONDENT'S OPINION ON CONSTRUCTION RISK MANAGEMENT IN CONSTRUCTION PROJECT DELIVERY

1. Please give your views on the extent of risk management by contractors in the project delivery arrangements in Kenya.

………
………
………
………
………
………
………
………
…………………………………………………………………………………….

Thanks a lot for your participation and cooperation in this study.

Appendix 5: Contractors' mandatory technical requirements for various categories

CATEGORY	TECHNICAL REQUIREMENTS
NCA 1	At least 1 Director with a minimum of Bachelors Degree in construction related field
NCA 2	At least 1 Director with a minimum of Bachelors Degree in construction related field
NCA 3	At least 1 Director with a minimum of Higher Diploma in construction related field
NCA 4	At least 1 Director with a minimum of Higher Diploma in construction related field
NCA 5	Diploma
NCA 6	Certificate
NCA 7	Trade Test

Source: NCA website (www.nca.go.ke), accessed on 17th February 2015

Appendix 6: Categories of contractors registration according to capability

1	**Contractors (Buildings)**	**Value Limit according to Category (Ksh.)**
	NCA 1	Unlimited
	NCA 2	500,000,000.00
	NCA 3	300,000,000.00
	NCA 4	200,000,000.00
	NCA 5	100,000,000.00
	NCA 6	50,000,000.00
	NCA 7	20,000,000.00
	NCA 8	10,000,000.00
2	**Specialist Contractors**	
	NCA 1	Unlimited
	NCA 2	250,000,000.00
	NCA 3	150,000,000.00
	NCA 4	100,000,000.00
	NCA 5	50,000,000.00
	NCA 6	20,000,000.00
	NCA 7	10,000,000.00
	NCA 8	5,000,000.00
3	**Roads and other Civil Works**	
	NCA 1	Unlimited
	NCA 2	750,000,000.00
	NCA 3	500,000,000.00
	NCA 4	300,000,000.00
	NCA 5	200,000,000.00
	NCA 6	100,000,000.00
	NCA 7	50,000,000.00
	NCA 8	20,000,000.00

Source: NCA website (www.nca.go.ke), accessed on 17th February 2015

Appendix 7: Key risks suggested responses

RISK FACTOR	SUGGESTED RESPONSE MEASURES
Delayed payment by the employer	• Transfer this risk to the clients through contract by ensuring there is a clause providing for the contractor to be paid interest on delayed payments. • The best strategy is to work with clients who have clean past records regarding the financial stability and timely payments. It is best to avoid those clients who do not pay on timely manner and have poor financial status.
Excessive approval procedures in administrative government departments	• This risk should be transferred to the owner. • The contractor should, where possible, only embark on a construction project when the client has obtained all the necessary approvals
Information unavailability-details, drawings, sketches	• The response strategy should be reduce both the likelihood and the impact of this risk. Reducing likelihood can be by ensuring all information is available at the start of the project. Ensure all designs are complete, details are available, drawings and sketches are complete, clear and available. • The contractor should also ensure that a schedules of site inspections and site meetings are issued by the project supervision team at the start of the project where issues of designs, details, sketches during constructions are discussed and instructions issued where necessary.
Design variations required by clients	• The cost associated with defective design should not be borne by the contractor and should be transferred to the owner.
Adverse weather conditions	• Delays resulting from adverse weather conditions are uncontrollable and therefore cannot be avoided. The best response strategy would therefore be to lessen the impact due to adverse weather. This risk should be retained by the contractor by allocating sufficient contingency in the schedule for such resulting delays.
Cost under estimation	• The best strategy is to reduce the likelihood of occurrence of this risk • This can be achieved by employing professionals qualified in cost estimating, pricing of bills and determining the cost of tender.
Lack of consistency between the BQs, drawings and specifications	• The response strategy should be to transfer the risk to the client in the conditions of contract. • The impact of this risk can also be reduced by ensuring through contract that incase of a descripancy, the Bill of Quantity prevails.

RISK FACTOR	SUGGESTED RESPONSE MEASURES
	This ensures there is t o change in contract sum.
Actual quantities different from contract quantities	• This can result from errors in documentation or from re-measurements resulting to variation orders. It the responsibility of the consultants and client team to ensure this is accurate as possible. • This risk can be mitigated by establishing an adequate contingency .in the contract. This will act as cushion against the impact of this risk on project objectives.
Exchange rate fluctuations and inflation	• This risk should be retained by the contractor. During cost estimation or during the pricing of tender documents cost related with the exchange rate fluctuation should be included in the rates. • Where the project is big and duration is long the inflation can be unpredictale and therefore it is transferred to the client. To ensure this has no impact on contract sum, a provisional allowance is usually made to cushion the project against the impact of this cost.
High performance or quality standard to meet	• It is the duty of the contractor to ensure the project is completed to the clients requirements and to his satisfaction in terms of performace and aesthetics. • This risk can be retained by the contractor or transferred to sub – contractor through sub-contracts. But ultimately he main contractor is responsible of project quality through proper workmanship, proper equipment choice and adherence to designs.
Inadequate/ defective specification	• Cost related to defective specification and design should be transferred to the client in the condition of contract. The contractor can also reduce the likelihood of this risk by raising an alarm in good time where his team establish the material, or method of construction specified is not working.
Delays in supply of utilities i.e. electricity and water	• In full contract, (contractor supply both labour and materials) the contractor is fully responsible for the supply of entities. The contractor is given an apportunity to price in for this cost in the preliminaries or also in should be included in the Bill quantity rates.
Financial failure of the contractor	• The response strategy should be geared towards reducing the likelihood and the impact of this risk on the project objectives. • The contractor can achieve this by demanding performance bond from the sub-contractors. • The likelihood of this risk can also be largely reduced by ensuring monies paid in the project by the client is used to run the project

RISK FACTOR	SUGGESTED RESPONSE MEASURES
	without being diverted to other projects.
Financial failure of the sub-contractor	• To reduce impacts related to this risk contractors should demand performance bonds from the subcotractors. • To reduce the likelihood of the risk, the contractors should ensure the subcontractors nominated in a project are financially stable and monies paid to them are strictly used in the particular project without diversion.
Lack of compliance with safety and health requirements on site	• It is the role of the contractor to ensure that workers comply with safety and health requirements on site. • The contractor should reduce the likelihood of this risk by complying with all safety and health requirements by doing the following:- o Safety signs o Supplying of safety gear, for example, helmets, aprons, gloves and boots and ensuring workers wear them at all times o Training on health and safety measures o Proper site organization o First Aid Kit on site o Provision of sanitation facility o Clean water supply
Defective work	• This is the responsibility of the contractor and should be retrained by the contractor • To mitigate against this risk the contractor should give emphasis to quality control and quality assurance.
Inadequate supervision and supervision team	• It is the responsibility of the client to appoint consultants to be involved in the supervision of works in a project. Risk related to inadequate supervision and supervision team should be transferred to the client. • The contractor can reduce the likelihood of this risk by ensuring he works closely with the supervision team ensuring inspections at all stages of work and complementing their effot
Unhealthy working condition for workers	• It is the role of the contractor to ensure that working condition in the construction sites are conducive. This risk should be retained by the contractor. • The best strategy by the contractor is to lessen the likelihood of occurrence of this risk by adhering to existing Health and safety regulations and provisions of National Construction Authority.

RISK FACTOR	SUGGESTED RESPONSE MEASURES
Technical complexity and design innovations requiring new construction methods and materials	• The contractor is responsible of providing the completed project to standards required by the clients as provided in the drawings, specifications and bills of quantities. • This risk can be retained by the contractor where he has the capacity. To reduce the impact of this risk the contractor should employ qualified personnel, emphasise on quality control and quality assurance and ensure his rates for items of work take care of the extra project requirements. • Where the contractor lacks the capacity the risk can be transferred to subcontractors.
Lack of co-ordination between project participants	• Project participants include the clients, the consultants and contractors. • This risk should be retrained by the contractor and take necessary measures to reduce its likelihood of occurance. This by ensuring all other participants are brought on board and there is adquate communication during construction. Also by ensuring site meeting and inspection schedules are in place and are adhered to.
Inadequate or insufficient site information (site investigation report)	• The client should provide adequate site information to the contractor to allow him to assign the right rate for items in the Bills of Quantities. • This risk be borne by the client and the best strategy is to transfer it to the client through contract. • To reduce the likelihood of this risk the contractor can insist on pre-contract site visit and insist on access to site investigation reports before the commencement of the project.
Lack of compliance with environmental requirements	• Construction projects in Kenya must comply with the National Environment Management Authority (NEMA) regulations. Risk associated to obtaining Environmental impact assessments and related permits for major projects should be transferred to the client. • For small projects with minor impact to the environment the risk can be retained by the contractor or transferred to the subcontractors. During construction Environmental impact assessments provisions must be adhered to. This shall unlimately reduce the likelihood of occurrence andconsequent impacts on project objectives.
Inadequate labour and equipment productivity	This risk is also seen as a risk with a high impact on project delivery objectives. Risk related to low labour and equipment productivity should be transferred to the subcontractors through subcontracts.

RISK FACTOR	**SUGGESTED RESPONSE MEASURES**
Impact of construction project on surrounding environment	Where the constructed facility have a major negative impact on the surrounding environment it should be avoided. However, with minor impact and adequate mitigation measures the project can proceed. This risk should be transferred to the client in the contract. The contractor should ensure subcontractors adherence to the environmental requirements as laid down in the environmental impact assessment report approved by NEMA. This will reduce the likelihood of this risk and its impact on environment of it occurs.
Unstable security circumstances	Through this risk has a major impact on project safety, the risk is not highly in the Kenyan construction industry. This risk can be accepted by the contractor. In areas known for various security issues-Al-shabab attacks and tribal clashes this risk can be transferred to an insurance company. Where the risk is accepted by the contractors, mitigation measures should be taken. This can be by encouraging ownership of the project by locals by employing them to provide labour and security in the project.
Tight project schedule	This is a medium risk among contractors in Kenya. Risk pertaining to tight project schedule should be transferred to sub contractors.