THE EFFECTS OF RISK MANAGEMENT AT PROJECT PLANNING PHASE ON PERFORMANCE OF CONSTRUCTION PROJECTS IN RWANDA

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DECLARATION

This research project is my original work and has not been presented for a degree in any other University.

Sign:_____________ Date__________________________

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This research project has been submitted for examination with my approval as University supervisors.

Dr. Jaya Shukla

Sign: ___________________________ Date: ________________________

DEDICATIONS

I dedicate this research Project to my Mother for showing me the importance of education, and to my children, Wanjiku, Gitau, Wambui and Njoki.

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ABSTRACT

Risk management is recognized as an important exercise in order to achieve better performance of construction projects. Success in construction project is indicated by its performance in the achievement of project time, cost, quality, safety and environmental sustainability objectives. Construction projects in Rwanda and generally in the region and the world run a high risk of being well over budget and significantly late. While some degree of cost and time schedule risks is inevitable in construction projects, it is possible to improve risk management strategies to minimize their negative impact.

Rwanda’s construction industry poor construction budget and schedule performance informed the need for this study. The objective of the study was to investigate the extent of the risk management practices at planning phase and the affect of these practices on project cost and schedule performance. The risk management practices at construction project planning phase include: risk identification and profiling, architect/engineer selection; site selection and validation, needs identification and validation and cost and schedule development. The study targeted architects, engineers, project managers, quantity surveyors, contractors, and, regulatory authorities in operation in Rwanda and key clients with major investments in the construction industry. The study used both qualitative and quantitative methods of data collection. Literature review, physical and email delivered questionnaires and structured interviews was used to collect data. The data was processed using SPSS. Correlation analysis was used to analyze the relationships between the independent and dependent variables.

The research project indicated that risk management practices at planning stage had an effect on project performance. The research project indicated that most projects in Rwanda had some input from a qualified engineer and architect. However most respondents had not studied risk management. While the study indicated that risk management was widely practiced at 92%, the process was mainly informal. The process of risk management was not adequate and no measures were put in place to mitigate the risks. Various project team members had different chances in managing the various risks with the client having the best chance of managing most risks at the planning stage by involving skilled professionals in decision making.

The research project found out that the consulting engineers and architects were often selected before the design phase of a project. This meant that many projects did not benefit from professional input at planning stage. The most used method of selection used for consultants was the quality and cost based selection method. 45.2% of the projects surveyed had poor time performance while 35.7 % of the projects had poor cost performance. The project site selection and needs identification happened during planning stage in majority of the projects surveyed and often without the involvement of construction professionals. The

site works contribution variations was found to be over 10% of the estimated cost in 45% of the projects surveyed.

Projects were conceived for various reasons customer request, business need and social need ranking high.
Compliance with external politics and organization strategies were key criteria used in project needs validation. The research project found out that expected income, and, return on investment as criteria for project validation, was not used 52.4% of the projects. This was surprising and contrary to expectations. This could be a result of external political strategies being key criteria in project needs validation. There were change orders in 80.5 % of the projects and their effect was fairly large.

The preliminary budget development process in most projects was done without the involvement of professionals. There were some projects that were closed before construction works, as the initially anticipated budget was not feasible. In many projects, contractors and consultants were forced to work within unfavorable client financial schedules resulting in incomplete and poor design and delay in construction works. There was strong relationship between designs done in less than two months and the occurrence of variations, change orders and design changes during construction.

This research project recommends a formal and structured risk management practice during project planning and with the involvement of construction professionals and end users. The researcher recommends that risk management be included in the curriculum as an examinable subject for all students undertaking construction related studies. There is need for continuous development seminars in risk management for all construction professionals in Rwanda and especially those in construction projects planning and procurement departments of both private and government developers. This research further recommends that qualified project managers who are either architects or engineers be included in all construction projects site selection, needs identification, and, in preliminary budget and schedule development. End users and beneficiaries should be involved in needs identification at the early stages of a project.

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ACRONYMS AND ABBREVIATIONS

ACWP	Actual Cost For Work Performed
BCWP	Budgeted Cost For Work Scheduled
BCWS	Budgeted Cost For Work Scheduled
EVM	Earned value management
GDP	Gross domestic Product
GSA	US General Services Administration Public Building Service
ICE	Institution of Civil Engineers
ISO	International Organization for Standardization
MINECOFIN	Ministry of Commerce and Finance
OAG	Office of the Auditor General of Public Finances
PMI	Project Management Institute
PMBOK	Project Management Body of Knowledge
QBS	Quality Based Selection
QCBS	Quality and Cost Based Selection
RDB	Rwanda development board
SPI	Schedule Performance Index
SV	Schedule Variance
UMIST	University of Manchester Institute of Science and technology
WBDG	The Whole Building Design Guide

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CHAPTER 1

INTRODUCTION

1.1 Background of the study

Cost and schedule performance are the primary measures of a project's success. A project is said to be successful if it is completed within the planned cost and time. Developing countries are faced with the problem of scarce project financial resources. Construction has an important role in the economy of many countries and especially developing countries. The construction industry contributes to the GDP and employment rate of many nations and for this reason it is considered vital for the economic development of any nation (Olwale & Sung, 2010). The role the construction industry plays in socio-economic development has a significant multiplier effect (Morris & Hough, 1988). It provides the infrastructure by constructing the physical facilities required for the production and distribution of goods and services.

Construction projects comprise of five major phases namely planning, programming and design, procurement, construction and project close out. Each phase has its own typical risks. The risks at planning phase include poor scope definition, poor estimates and budget based on incomplete data. The programming and design may have risks such as over-design, poor constructability, poor estimating and scope creep. The procurement phase is often plagued by risks of incomplete documents, poor contracting strategy, insufficient competition and fraud in the bidding process. The construction phase is faced with risks of change orders, delays and quality concerns. The risks at project close out include snag/punch lists issues, insufficient time for testing and commissioning and claims.

The construction industry is one of the major industries contributing significantly to the socio-economic development growth (Choge & Muturi, 2014). The construction sector in Rwanda is a key potential driver of economic growth (RDB 2014). The expenditure on development projects in Rwanda for year 2014-2015 is projected at 784.1billion Rwanda Francs, which is equivalent to 44.7% of total budget (Ministry of Finance and Economic planning [MINECOFIN], 2014,). Part of this expenditure is on construction projects as the country rebuilds its basic infrastructure after many years of underdevelopment and the 1994 Genocide. The construction industry is plagued by project expenditure exceeding the budget, delays in completing the projects in time and lack of acceptance by the stakeholders or end users at project completion.

Most construction projects in Rwanda experience cost variations and completion delay problem. The Kigali convention Centre has been under construction for 6 years while the contract period was less than three years. The Auditor General's annual report highlights delays and cost overruns in Bushenge hospital and wasteful expenditure in the proposed King Faycal expansion project (Office of the Auditor General of State Finances [OAG], 2013). King Faisal Hospital initiated a project for rehabilitation, upgrading and expansion of the existing facilities to include a Physicians' Plaza, a new services extension building and Biomedical Centre. The studies and design for the proposed project were done at the cost of 1.8 billion Rwnda Francs. The studies indicated an estimated construction cost of 191.5 Million Dollars. The above state of affairs is an indicator that King Faycal hospital expansion and rehabilitation project was launched prior to confirming availability of necessary funds for full implementation of the project. It appears like the hospital started the designs without a clear financing plan. This is an indicator of poor project conception. Consequently, the expenditure incurred on the design may become wasteful, especially if the designs developed for this project are not put to use by Government (OAG, 2013).

An earthquake destroyed Bushenge Hospital in 2008. The reconstruction of the hospital has been under construction for the past six years while the initial construction period was 12 months. The initial contract amount was 2.4 billion Rwanda Francs. The construction team later realized that some key works were not included in the initial tender document and an addendum contract of 463 million Rwanda francs was negotiated and signed. The Auditor General in the 2013 report recommended the termination of the contract and the appointment of another contractor. The Auditor General's report however does not investigate the sources the problem in the project. Bushenge hospital project was marred by poor needs identification and validation process and by poor architect and engineer selection process.

In Karongi District, construction works worth two billion Rwanda Francs for Kibuye Hospital had been significantly delayed. The works were expected] to be completed by December 2012 but by the time of audit in October 2012, work was still in the early stages and only 17.9% of the construction works had been completed (OAG, 2013). When the project was finally completed in 2014, the beneficiaries refused to move in, as the project did not meet their requirements.

All the six district branches and the Grand pension plaza done by the Rwanda social security board were constructed experienced delays and cost overruns. The studies for the buildings were typical and had not been adjusted to fit the different sites. The client's requirements were also enhanced during the project. The projects experienced costs and schedule overruns. The Grand Pension Plaza project, which was the largest of the seven projects, ended in a fierce dispute that saw the contractor go bankrupt and leave the country. These projects were marred by poor site selection, poor architect and engineer selection process and inadequate needs identification and validation process.

The four district Branches of Huye, Rwamagana, Rusizi and Musanze by the National banks have experienced some time delays and cost overruns. The largest housing project in Kigali to date is well behind schedule and the selling price of the units give a strong indication of serious cost overruns.

The school of finance and banking learning complex project started in 2006 but was only completed in the year 2013. The project was tendered for construction in the 2007 but the contract was not awarded, as the client had not secured enough funding for the project. The construction works started in 2009. The project time was extended by one year and the construction cost went up by 20% due to unforeseen ground conditions. The challenges in the project were mainly related to site selection and validation and the preliminary budget and schedule development processes.

Risk and uncertainty can potentially have damaging consequences for the construction projects (Flanagan, Norman, & Chapman, 2006). Therefore, risk analysis and management continue to be a major feature of the project management of construction projects in an attempt to deal effectively with uncertainty and unexpected events and to achieve project success. Project Management Institute defines project risk as an uncertain event or condition and that the occurrence has positive or negative effect on at least one project objective, such as time, cost, scope, or quality (PMI, 2008).

Risk management is one of the nine knowledge areas propagated by the Project Management Institute (PMI, 2008). Risk management in the construction project management context is a comprehensive and systematic way of risk identification, risk analysis and risk response with a view to achieving the project objectives (ICE, 2005). In the construction industry, risk is often referred to as the presence of potential or actual threats or opportunities that influence the objectives of a project during construction, commissioning, or at time of use (ICE, 2005).

Mitigating risk by lessening their impact is a critical component of risk management. Implemented correctly, a successful risk mitigation strategy should reduce adverse impacts. In essence a well-planned and properly administered risk mitigation strategy is a replacement of uncertain and volatile events with a more predictable or controlled response (Chapman & Ward, 2007). The ability to govern or to set up control mechanisms for costs, schedule and quality in a construction project reduces rapidly as you move through the project lifecycle (Wallace & Blumkin, 2007). The control activities at the planning stage are risk profiling, architect and engineer selection process, architect and engineer contract review, site selection and validation, need identification and validation and preliminary budget and schedule development (Wallace & Blumkin, 2007). My research builds on these variables as identified by Blumkin.

ISO 31000 is a family of standards relating to risk management codified by the International Organization for Standardization. ISO 31000:2009, Risk management – Principles and guidelines, provides principles, framework and a process for managing risk. It can be used by any organization regardless of its size, activity or sector. Using ISO 31000 can help organizations increase the likelihood of achieving objectives, improve the identification of opportunities and threats and effectively allocate and use resources for risk treatment ("ISO 3100:2009," 2009). ISO 31000 defines risk as the effect of uncertainty on objectives, which means that the effect may be either positive or negative.

1.2 Statement of the problem

Success in construction project is indicated by its performance in the achievement of project time, cost, quality, safety and environmental sustainability objectives (Zhou, Zhang, & Wang, 2007). Despite the efforts by all players in the construction industry, many construction projects in Rwanda and generally in the region and the world run a high risk poor performance by being well over budget and significantly late. The construction industry generally has poor cost and schedule performance. The industry has a reputation for time and cost overruns. One of the reasons of the bad performance is that the construction industry is one of riskiest of all business types (Clough, Sears, & Sears, 2005). While some degree of poor cost and time schedule performance is inevitable in construction projects, it is possible to improve risk management strategies to minimize their negative impact and thus improve the project performance. This study aims at determining the effects of risk management practices at the planning stage to the construction project performance.

The risks at construction project planning stage include poor scope definition, poor estimating and development of a budget based on incomplete data. The risk management practices required at this stage include risk profiling and identification, the architect and engineer selection process, construction site review and validation, needs identification and validation and preliminary budget and schedule development (Wallace & Blumkin, 2007, p. 4). Risk profiling involves finding an optimal investment risk by considering the risk required, risk capacity and risk tolerance of the client.

1.3 Objectives

1.3.1 General Objectives

The general objective is to determine the effect of project planning risk management practices on construction project performance in Rwanda.

1.3.2 Specific Objectives

The specific objectives are:

I. To identify the level of importance attached to risk identification practices during planning stage in construction projects in Rwanda.

II. To establish the effect of the architect and engineer selection process on the project performance.

III. To determine the effect of the site selection and validation process on the project performance.

IV. To determine the effect of the needs identification and validation process on the project performance.

V. To identify the effect of preliminary budget and schedule on project performance.

1.4 Research Questions

I. What is the level of importance attached to the process of risk identification practice during construction projects planning in Rwanda?

II. How does the architect and engineer selection process influence a construction project performance?

III. What is the effect of the site selection and validation process on the project performance?

IV. What is the effect of the needs identification and validation process on the project performance?

V. How does the preliminary budget and schedule affect the perception of project cost and schedule performance?

1.5 Justification

The results of this research are expected to indicate the correlation between risk management practices during the planning stage and the construction project performance. The planning stage provides the greatest opportunity in the project life cycle to govern and control scope, costs and schedule through sound risk management practices (Wallace & Blumkin, 2007). This ability decreases rapidly as you move through the project life cycle. It is expected that these results will inform construction industry professional and clients in Rwanda on the benefits of risk management at the planning stage on the projects performance. Initial cost and schedule estimates highlight potential bottlenecks and high cost items. However these estimates are often established on the basis of incomplete information. Poor scope definition leads to overdesign, scope creep, and cost and schedule variations. Risk identification can inform contracting decisions and provide input into creating risk-adjusted or “probabilistic” cost and schedule estimates. It is expected that the results of this study will inform policy makers and property developers on the benefits of the architect/engineer selection process and the site selection and validation process at the project planning stage. It is expected that this study will lead to the development of a policy to involve qualified project managers who are either architects or engineers on the needs identification and validation process and in the preparation of the preliminary budget and schedule that is submitted to the Ministry of Finance for budgetary allocation.

1.6 Scope

The scope of this research is the construction industry in Rwanda. The research only investigated risk management at the planning stage and not during the other construction phases. The research measured cost and schedule performance in construction projects. The respondents were the professionals in the construction industry working in Rwanda, selected major developers and the industry regulators. The research targeted ongoing and complete projects.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Risk management has become an important part of the management process for any project. Various theories and models have been advanced on the subject of risk and decision making under uncertainty. Risk in construction has been the object of attention because of time and cost overruns associated with construction projects. This chapter reviews the literature concerning theories of decision making under uncertainty, some of the risks faced in the construction industry, some risk analysis techniques and risk response practices. The chapter further reviews literature related to the independent and dependent variables in the research.

2.2 Theoretical review

Decisions should ideally be made under conditions in which all factors of influence, and, the decision-making methods result in predictable outcomes. However, decision-making often happens under conditions of risk and uncertainty. Construction projects never run under the ideal conditions of certainty. A decision is made under conditions of risk if the decision-maker is able to assess rationally or intuitively, with a degree of certainty, the probability that a particular event will take place, using as a basis his information about similar past events or his personal experience (Ceric, 2003, p. 11).

Expected Value was one of the first theories of decision-making under risk. The expected value model did not consider the fact that the value that a particular payoff held for one person was not directly related to its precise monetary worth (Tversky & Kahneman, 1979). Bernoulli introduced the concept of systematic bias in decision-making. Bernoulli assumed that people tried to maximize their utility and not their expected value(Tversky & Kahneman, 1979). In Von Neumann and Morgenstern's model of subjective utility, one person may not share the same utility curve as another, but each follows the same normative axiom in striving toward their individually defined maximum subjective utility (Neumann & Morgenstern, 1953).

Prospect theory is a theory of decision-making under conditions of risk (Tversky & Kahneman, 1979). Decisions involve internal conflict over value trade-offs. This theory is designed to better describe, explain, and predict the choices that typical person makes in a world of uncertainty. The theory addresses how these choices are framed and evaluated in the decision making process. Prospect theory advances the notion that utility curves differ in domains of gain from those in domains of loss.

Prospect theory is designed to explain a common pattern of choice. It is descriptive and empirical in nature. Prospect Theory looks at two parts of decision making: the editing, or framing, phase, and the evaluation phase (Tversky, 1967). Framing refers to the way in which a choice, or an option can be affected by the order or manner in which it is presented to a decision maker. The evaluation phase of a prospect theory encompasses two parts, the value function and the weighting function. The value function is defined in terms of gains and losses relative to the reference point not in terms of absolute wealth. In prospect theory, value is a function of change with a focus on the starting point so that the change is either negative or positive.

Prospect theory predicts that domain affects risk propensity. Losses have more emotional impact than an equivalent amount of gains and therefore weighted more heavily in our decision- making (Tversky & Kahneman, 1975). In making a decision, a decision maker multiplies the value of each outcome by its decision weight. Decision weights do not serve solely as measures of perceived likelihood of an outcome but also represent an empirically derived assessment of how people actually arrive at their sense of likelihood. An important function of weighting function is that low probabilities are overweighed while high and medium probabilities are subjectively underweighted (Tversky & Kahneman, 1979).

Risk is an exposure to the possibility of economic or financial loss or gains, physical damage or injury or delay as a consequence of the uncertainty associated with pursuing a certain cause of action (Chapman C.B., 1983). Many scholars have defined risk: Wideman (1986), Godfrey (1996) Kliem and Ludin (1997) and Smith (1999). Most definitions include the factors of chance or probability of events and the negative impact on the objectives or project. In mathematics, probability of an event is expressed statistically using the mean, dispersion, confidence interval and other statistical parameters. Relevant data must be available for a statistical analysis. When no data exists, the experience and knowledge of the decision maker is important in assessing the probability of an adverse event.

Risk impacts construction projects by adversely affecting the planned expenses, project schedule and quality of works. Both increased project duration and poor quality can be expressed in increased expenses. Risk impact is often calculated both quantitatively and qualitatively. Risk exposure is the product of risk probability and risk impact. Risk management is the process that, when carried out, ensures that all that can be done will be done to achieve the objective of the project, within the constraints of the project (Clark, Pledger and Needler, 1990). Risk management includes planning for risk, identifying risks, analyzing risks, developing risk response strategies, and monitoring and controlling risks to determine how they have changed (Kerzner, 2009). Since risk affects the achievement of project objectives, risk management is one aspect of sound project management.

According to Perry and Hayes (1985), the risk management process is linear and consists of risk identification, risk analysis and risk response. This linear process however does not appreciate that most risk management activities are themselves sources of new risks. Many scholars such as Carter et al (1994), Kliem and Ludiem (1997), Baker, Ponnier and Smith (1998), Chapman (1997), Grammer and Trollope (1993); view risk management as a cyclical process with a number of different phases. The cyclical process appreciates that a risk response may produce new events that may adversely affect the project and which it is necessary to identify, analyse and anticipate the appropriate response (Ceric, 2003).

The contingency amount has for a long time been added to the estimated construction cost and time to cover for all risk events and uncertainties. This amount is often an arbitrary figure of 10% to 20% of the estimated contract amount or project duration. This approach however does not take into consideration the specific features of each project and can thus not be said to be risk management. Hamburger (1990) and Murray et al (1983) have discussed the use of project reserves and contingency amounts as risk management strategies in construction projects. Jackson and Flanagan (2002) developed a systematic approach to managing project budget risks during project appraisal.

2.3 Conceptual Framework

The conceptual framework for this study is derived from the literature review that has identified the key risks at planning stage and suggested risk management practices. According to the UMIST report on risk management in Engineering Construction (Hayes et al, 1986) the greatest uncertainties and risks appear in the earliest phases of the project life cycle. The UMIST report recommends that project management should be a continuous activity throughout the project life cycle. The planning stage provides the greatest opportunity in the project life cycle to govern and control scope, costs and schedule through sound risk management practices (Wallace & Blumkin, 2007).

The risks at construction project planning Stage include poor scope definition, poor estimating and a project budget based on incomplete data. The risk management practices required at this stage include risk profiling and identification, the architect and engineer selection process, the site selection and validation process, the needs identification and validation, and, the preliminary budget and schedule development. Risk profiling involves finding an optimal investment risk by considering the risk required, risk capacity and risk tolerance of the client. The research aims to study the correlations between the risk management practices and the project performance. This research aims to describe, explain, and predict the choices made at construction project planning under conditions of uncertainty. The research addresses how these choices are framed and evaluated in the decision making process.

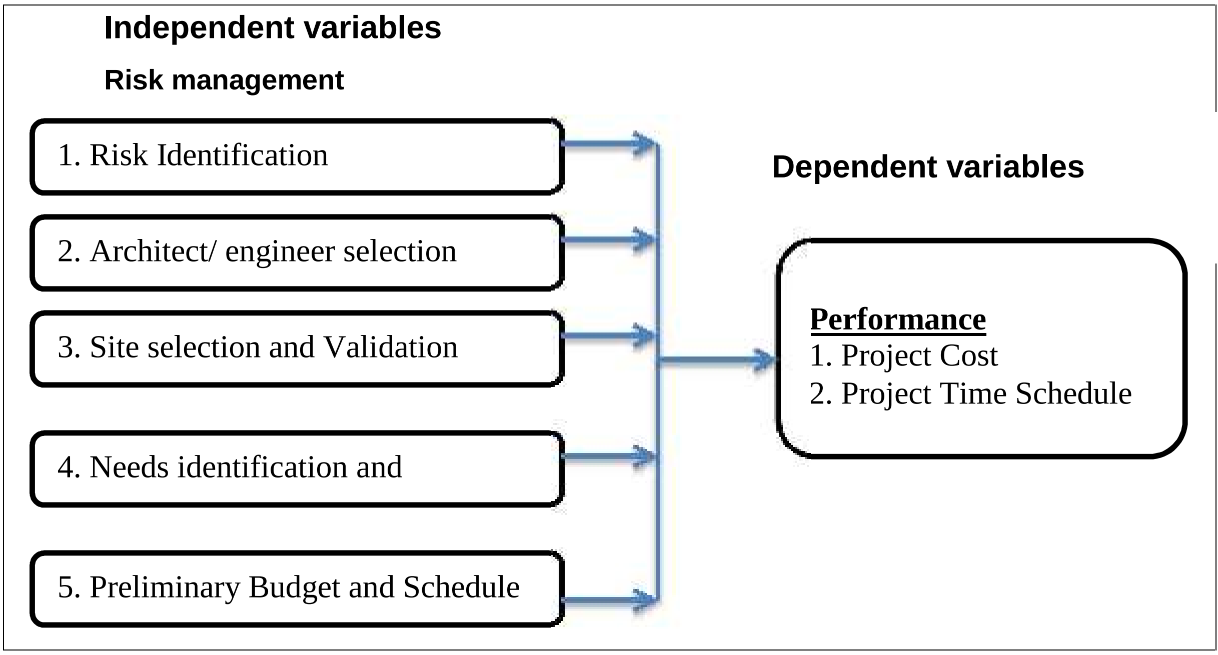

Figure 1 .Conceptual framework (Source: Gitau LM, 2015)

2.4 Empirical review

In this section we review literature related to the research problem and both the independent and dependent variables.

2.4.1 Risk Identification and management

Risk management is one of the nine knowledge areas propagated by the Project Management Institute (PMI). The PMBOK® Guide recognizes nine knowledge areas typical of almost all projects. Each PMI knowledge area in itself contains some or all of the project management processes. Risk management is a difficult aspect of project management. The project manager must be able to recognize and identify the root causes of risks and correlate them to their effects on project performance. Risk management in the construction project management context is a comprehensive and systematic way of identifying, analyzing and responding to risks to achieve the project objectives (PMI, 2008; ICE, 2005). Major decisions and influence on the choice of alignment and selection of construction methods are made at the early stages of a project, making risk management at this stage very essential (Eskesen, Tengborg, Kampmann, & Veicherts, 2004).

The construction industry involves many players and is inherently complex. The major classifications of construction works are: housing, non- residential building, heavy, highway, utility, and industrial (Clough et al., 2005). Construction projects may be new construction or renovation and rehabilitation of existing infrastructure facilities. Most construction work in Rwanda involves new public and private infrastructure projects. Large construction projects are exposed to risks arising from planning, design and construction complexity, many players, use of many resources and their availability, unpredictable environmental factors, the continuously changing economic and political environment, and statutory regulations.

The risk analysis and management techniques have been described in detail by many authors (Ahmed, 2007, Cretu, 2011; Chapman C, 2003; Klemetti, 2006; Smith NJ, 2006). A typical risk management process includes risk identification; risk assessment; risk mitigation; and risk monitoring. Risk identification process attempts to identify the source and type of risks. Risk identification involves the recognition of potential risk event conditions in the construction project and the clarification of risk responsibilities (Wang, Dulaimi, & Aguria, 2004). Risk identification is the basis for analysis and control of risk management and ensures risk management effectiveness. The identification and mitigation of project risks are crucial steps in managing successful projects (Carbone & Tippet, 2004, para. 1).

2.4.2 Architect/Engineer selection process

The selection of the architect and Engineer in Rwanda is done in accordance with the Law on public procurement no 12/2007 of 29/03/2007. This law does not differentiate between the selection of architects and engineers from the selection process of other consultants. Quality and cost-based selection (QCBS) is the default method of selection. Quality based selection (QBS) is only applicable where quality is the paramount factor. The law does not recognize construction as one such area; or rather it is silent on such consideration. Selection under a fixed budget may be applied when the assignment is simple and can be precisely defined and when the budget is fixed. Least cost selection may be applied when selecting consultants for assignments of a standard and routine nature and where well-established practices and standards exist and in which the contract amount is small. The law also provides for selection based on consultant's specific qualifications. The annual procurement plan should ensure there is sufficient budget allocation (GOR, 2007).

The Quality and Cost-Based Selection (QCBS) procurement method is a competitive process among short listed firms that considers both the quality of the project and cost of the services in the selection of the successful firm. The relative weight to be given to the quality and cost is to be determined for each case depending on the nature of the assignment. The technical and the financial scores are determined according to the complexity and nature of the assignment. The coefficient for quality and cost score to be used in determining the winning project is specified in the request for projects. The coefficient ranges from 0.7 to 0.8 for quality and 0.2 to 0.3 for cost. The overall score is obtained by adding the technical and financial scores after the weighting.

Quality Based Selection (QBS) may be appropriate for complex or highly specialized assignments, or those, which invite innovations. The selection is based solely on the quality of the project without consideration of the cost. The Public procurement guide (2000) stipulates that QBS will be used for assignments that are complex or highly specialized, have a long term impact and in which the objective is to have the best experts available; assignments that can be carried out in very different ways such as management advice, and therefore projects may not be directly comparable. The guide gives and an example of engineering designs for major infrastructure such as dams as a long-term impact project.

The selection of the Architect or engineer happens long after the project has been conceived and the budget has been approved. The procurement law and the users guide (2000) do not anticipate the need for the services of an engineer and architect at project planning stage but rather at the design stage. This therefore means that the needs assessment, the scope definition and the budget estimate are done without the advice of the architect or engineer. The failure to recognize the services of the architect or engineer as innovative and special management consultancies leaves clients at the mercy of the lowest qualified bidder.

2.4.3 Site selection and validation

Critical decisions made at the very beginning of every capital development project have major consequences for the overall success of the project. The site affects the organization, massing; functionality; sustainability; operation and economic efficiency; security; and lastly the aesthetic qualities of a building (GSA, 2001). The decision-making about the location of a construction site is an important risk management practice at planning stage. Buildings are inseparable from the location. The location has a strong influence of building design and structural characteristics and thus the execution of the project. The decision-making about location of investment is complex, low structured and multi-criteria problem (Jajac, Bilic, & Adjuk, 2013).

The site selection is a lifecycle decision that recognizes the balance among the initial cost of the real estate, the overall cost of executing the project, and the cost of operating the facility. All factors must be considered, in addition to the key factor of cost, in order to make the right decision. Making the right decision in site selection ensures that the selected site is suitable for the intended use; reduces the risk of unanticipated difficulties and their impact on time schedule and budget; manage expectations of stakeholders and encourage innovation and creativity in the selection process while incorporation existing precedents and best practices.

Rwanda's topography is generally hilly and mountainous with an altitude ranging between 900 m and 4.507 m (average 1700m), and has a tropical temperate climate due to this high altitude. Rwanda has volcanic mountains at the northern fringe and has rolling hills in most of the central plateau. The eastern part of the country is relatively flat with altitudes well below 1500metres. Rwanda’s hilly terrain and the proximity to the active volcanoes around the Kivu Basin makes most sites in Rwanda challenging for construction.

2.4.4 Needs identification and validation

Projects are authorized as a result of a market demand, a business need, a customer request, a legal requirement or a social need. One of the approaches in developing the project idea is the top-down when decision makers, politicians or senior civil servants identify situations that need improvement and try to find opportunities. The bottom-up approach starts by the general public coming up with requests to the decision makers, politicians or civil servants to act to solve a problem through a project. A full and accurate analysis of the existing problems, needs and opportunities is key to the achievement of a properly planned project addressing the real needs of specific target groups.

Problem analysis identifies the negative aspects of an existing situation and establishes the "cause and effect" relationships between the identified problems. The problem analysis involves the definition of the framework and subject of analysis and the identification of the major problems faced by target groups and beneficiaries; and the visualization of the problems in form of a diagram, called a problem tree to help analyse and clarify cause–effect relationships. The analysis is aimed at identifying the real bottlenecks which stakeholders attach high priority and which they wish to overcome. The problem analysis provides a sound foundation on which to develop a set of relevant and focused project objectives. Involving stakeholder representatives with appropriate knowledge and skills is critical to the quality of the output.

A well-defined project can reduce the risk of changes and delays during Project scope definition. Effective needs identification leads to clear project scope definition which can alleviate the risks of inadequate project planning and inadequate design that can lead to expensive changes during construction, delays, rework, cost overruns, schedule overruns, and project failure (Fageha & Aibinu, 2014). Variations during project execution most of the time are a reflection of the unmanaged risks that occur during the early stages of the project (Assaf & Al-Hejji, 2006). The change requests during the construction stage are often as a result of a stakeholder's differing appreciation and view of the project. The reason for such change orders may be poor project definition, or poor idea of how the work has to be handled. In turn, stakeholders would then refer to the different parties who can influence the project and those who will be affected by the project. A project has many stakeholders beyond the project team boundaries and whose interest could be related or in conflict (Wang & Huang, 2006) The needs identification process at the early stage with the input from all stakeholders is vital to the project success.

Validation is the assurance that a product, service, or system meets the needs of the customer and other identified stakeholders and often involves acceptance and suitability with external customers (PMI, 2008). The project needs validation process involves a set of criteria against which the project will be validated. They may include compliance with organizations' strategy, anticipated project impact, technology, risk, expected income (return on investment, profitability index, payback period) and safety. The organization must have the necessary resources and funding to undertake the project. The project scope and goals should comply with the organizations business strategy. The validation process investigates the feasibility of a project by reviewing the level of project risk, approving the value of the project risk and by verifying the proposed project methodology.

2.4.5 Preliminary schedule and budget development

The establishment of an appropriate budget and time schedule is critical to the success of a construction project. The client and the design consultants must agree on the anticipated cost early during the planning stage. This is a critical stage in the cost management process since an inaccurate budget can lead to poor project performance. Inaccurate budget may lead to quality compromise and variations with neither the client, end-user, nor design team being completely satisfied at the end. It is common mistake at planning stage is to use a schedule of accommodation with areas and apply some historical costs without making adjustments for the many factors which affect construction costs such as size of the project, location, price increases since the date of the data used, procurement method, overall quality of the space envisioned, access and locational factors such as dense urban, traffic and sidewalk protection, water location, bid competitiveness in the local market, etc.("WBDG," 2011).

Preliminary Estimates are developed during the planning stage of a proposed project in line with a clients needs as expressed in an agreed spatial requirements brief, and with budget constraints in order to establish its overall scope and quality expectations. The bid-based price estimation is most common and relies on using elemental costs tabulations from recently awarded projects of similar size and nature.

The preliminary construction schedule gives an indication of the construction duration, critical path items and identifies major milestones. The preliminary construction schedule identifies the time line dates; absolute or relative to a start date; that a project task or activity will be started and completed. The schedule allows applicable resources to be identified and an anticipated timeframe to be established. This estimated time provides the basis for budgeting individual tasks and the project as a whole.

Program Evaluation and Review Technique (PERT) is a network scheduling technique that helps to determine where the greatest effort should be made to keep a project on schedule. PERT is used to determine the probability of meeting deadlines by development of alternative plans. PERT has the ability to evaluate the effect of changes in the program. Adopting PERT procedures can lead to reduction of the project cost and schedule and to better coordinate and expedite planning (Kerzner, 2009). PERT procedures help to cut the time required for routine decisions, but allows more time for decision-making.

2.4.6 Project Cost performance

Project Management Body of Knowledge guide (PMBOK) defines cost estimates as a developed approximation of the monetary resources needed to complete project activities. The accuracy of cost estimates starting from the planning phase of a project through to the tender estimate can affect the success or failure of a construction project. Many failures of construction projects are as a result of cost escalations (Gkritza & Labi, 2008). The process of determining the project budget involves aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline (PMI, 2008).

The project budget that results from the planning cycle must be reasonable, attainable, and based on contractually negotiated costs and the statement of work. The basis for the budget is historical cost, best estimates, or industrial engineering standards. The budget must identify planned manpower requirements, contract-allocated funds, and management reserve Performance results standards are quantitative measurements and include such items as quality of work, quantity of work, cost of work, and time-to-complete (Kerzner, 2009).

Earned value is a management technique that relates resource planning to schedules and technical performance requirements. Earned value management (EVM) is a systematic process that uses earned value as the primary tool for integrating cost, schedule, technical performance management, and risk management. A variance is defined as any schedule, technical performance, or cost deviation from a specific plan. The cost variance compares deviations only from the budget and does not provide a measure of comparison between work scheduled and work accomplished. In order to calculate variances, we must define the three basic variances for budgeting and actual costs for work scheduled and performed (Archibald, 1976).

The first variable is the budgeted cost for work scheduled (BCWS) which is the budgeted amount of cost for work scheduled to be accomplished plus the amount or level of effort or apportioned effort scheduled to be accomplished in a given time period. The second variable is the budget cost for work performed (BCWP) which is the budgeted amount of cost for completed work, plus budgeted for level of effort or apportioned effort activity completed within a given time period. This is sometimes referred to as “earned value.” The third variable is the actual cost for work performed (ACWP) is the amount reported as actually expended in completing the work accomplished within a given time period.

BCWS represents the time-phased budget plan against which performance is measured. For the total contract, BCWS is normally the negotiated contract plus the estimated cost of authorized but unpriced work (less any management reserve). For any given time period, BCWS is determined at the final cost account level by totaling budgets for all work packages, plus the budget for the portion of in-process work (open work packages), plus the budget for level of effort and apportioned effort (Kerzner, 2009).

2.4.7 Project Time performance

The project time schedule includes a planned start date and a planned finish date for each activity. A project schedule may be presented in a summary form referred to as a master schedule or milestone schedule or may be presented in detail. Often, the project schedule is presented graphically using milestone charts, bar charts, and project schedule network diagrams. The schedule baseline is developed from the schedule network analysis and is accepted and approved by the project management team as the baseline with baseline start dates and baseline finish dates. The baseline is a key element in schedule control and time management.

Project time performance is established by measuring, comparing and analyzing schedule performance such as actual start and finish dates, percent complete, and, remaining duration of work in progress. The performance is assessed by the use of techniques such as earned value management (EVM), schedule variance (SV), schedule performance index (SPI). These techniques help to assess the magnitude of schedule variances. The critical chain method compares the amount of buffer remaining to the amount of buffer needed to protect the delivery date and thus can help determine the schedule status (PMI, 2008).

The total float variance is an essential planning component to evaluate project performance. Project management software for scheduling such as MsProject and Itask provides the ability to track planned date versus actual dates and to forecast the effects of changes to the project schedule.

2.5 Critique of existing literature

It is apparent from the literature review that there is no common view of risks among the different players in construction projects. The value of systematic risk management of project activity is not fully recognized by the construction industry (Walewski, Gibson, & Vine, 2002). Since no common view of risk exists, owners, investors, designers, and constructors have differing objectives and adverse relationships between the parties are common.

The literature review shows that most researchers have focused on different techniques for risk management and the role of risk management in construction projects.

While most literature acknowledge that risk management is a process, the issue of how this process should be adapted to the construction process is not very clear. Most literature approaches the construction process as an organized and standardized production process like manufacturing. However the construction process often has special features for every project that burden the process and makes changes leading to process improvement difficult.

Production processes duration in construction projects is often long, which increases the probabilities of risk and uncertainty events on both cost and schedule. When process time is long, often many several years, risk management becomes theoretical and the only other way is to add an arbitrary contingency sum. While a lot of literature is available on how to calculate risk, there is very little appreciation of the fact that extended process durations brings about risks that cannot be accurately analyzed and quantified.

While the construction industry continues to mechanize, the fact that a lot of work is still manual makes change and process improvement slow compared to other industries. Most literature on construction risk management does not address the need for other employee performance theories such as motivation theories as part of risk management. General production processes anticipate general or often unknown clients. Products are generally developed then marketed. However the construction process is unique in that the client is known and plays a pivotal role in project success is often inexperienced. The investor or client stipulates the location, quality, size and purpose of a project and is therefore the first source of risk. Most literature ignore this source of risk and the fact that often these risks have to be accepted and may cause project failure.

The many players in the construction industry bring many risks. While many scholars appreciate this source of risk, there is no theory on how to ensure that the construction process is well integrated. There is need to integrate the separate operations and interests of the client, the designers and the contractors and suppliers to ensure unwavering commitment to the success of the project.

2.6 Summary

The review of the literature revealed a wide range of risk types and sources in construction projects, and that various risk management methods and techniques can be employed in the management of construction projects in order to control potential risks. Risk management in construction projects is a widely researched area.

2.7 Research Gaps

There is no research on risk management in construction projects in Rwanda. Despite the volumes of literature on risk management in construction industry, delays and cost overrun remain an every day event in most construction projects. There is therefore need for research to develop a better understanding of what effective risk management is in construction industry. While the literature review indicate that the planning stage provides the best opportunity for risk management for project success, very little research has been done to show the impact of specific process at this stage on project performance. This research aims to contribute to this knowledge and with an emphasis on Rwanda construction industry.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter investigates the most appropriate methodology for the proposed research project, research strategy and the sample selection procedure to be used.

3.2 Research Design

The research project used both qualitative and quantitative research. The research was both descriptive and explanatory. The research is descriptive as it attempts to answer the question of what risk management practices should be included in construction projects planning phase. The research is explanatory as it seeks to show why such risk management practices affect the project performance. The research attempts to predict, correlate a risk management practices at planning stage with project performance. The research has a cross-sectional design, which involves getting views of respondents or informants at one point in time.

The research is probabilistic rather than deterministic. Risk management is in the field of human social behavior. The complexity of human social behavior and the subjective, meaningful and voluntary components of human behavior mean that it will never be possible to arrive at causal statements that are purely deterministic.

3.3 Methodology

The proposed study was designed to obtain views from consulting architects, engineers, project managers, quantity surveyors and contractors in regard to risk management and cost and schedule performance in construction projects. This research is both qualitative and quantitative (Kumar, 2005). The research used two data collection approaches - structured interviews and physical and online surveys. The research sample for the interview was selected on a purposive basis, according to the judgment of the researcher as to who could provide the best information to achieve the objectives of the study (Kumar, 2005) .The research sample comprised of construction professionals drawn from commercial and civil construction contracting organizations that are registered in Rwanda.

The target populations interviewed or surveyed were related to a specific project. The survey obtained recollections of exact field experiences. These projects must have been nearly completed, or completed within the last ten years. In order to gather necessary technical data, respondents were required to be construction professionals such as architects, project managers or senior site engineers.

3.4 Population

The population of the study comprised of registered architects and engineers in Rwanda. There were 234 registered engineers and 35 registered architects in Rwanda This gives a total of two hundred sixty nine consultants. The key clients in construction industry are the Rwanda Social security Board, RSSB, and National Bank of Rwanda. Both clients have recently undertaken major construction works in Rwanda. The regulatory Authorities are the Rwanda Public Procurement Authority (RPPA), Rwanda Housing Authority, the Institution of Engineers of Rwanda (IER) and the Rwanda institute of Architect (RIA).

3.5 Sampling Frame

The sampling frame included the list of engineers and Architects in Rwanda as published by the respective registration boards. The sample for interview were those clients, consultants and contractors who have been involved in at least two construction works worth over 10 million USD each in Rwanda in the past ten years.

3.6 Sample and Sampling technique

Two sampling procedures were used due to the nature of respondents to be involved in the study. Lists of consultants and contractors who have their offices based in Kigali was obtained from respective regulatory boards offices and websites. An online questionnaire containing the first section of the questionnaire on basic information was sent to all the registered engineers and architects. There was a 75% response rate that indicated that only 30% of the respondents had project related knowledge and experience. Random sampling was be used to select consultants and contractors from the list of registered engineers and architects. Random sampling is the probability whereby people, place or things are randomly selected (Kombo & Tromp, 2006). A sample of 10 construction professionals who had returned the questionnaires was selected using purposive sampling for face-to-face interview. Purposive sampling is a useful sampling method, which allows a researcher to get information from a sample of the population that one thinks knows most about the subject matter (Walliman, 2011).

Using Yamane (1967:888) $n=N/1+N(e)^2$

$n = 269/1+269(0.05)^2$

$n=161$

Where N is the population size; n is the Sample size; and e is the level of precision (Yamane, 1967). A precision level of 5% was assumed for random sampling survey; the sample size was 161.

3.7 Instruments

A questionnaire containing six sections was developed to facilitate data collection. The first section aimed to collect the background information of the respondents, e.g. their age, gender, position, education, work experience and professional background. The second section included the respondents' opinion on the aspects of the risk management process through the different phases. The third section included an investigation of the Architect/engineer selection process and the respondents' opinion on its impact to project success. The fourth section of the questionnaire explores how the site for the project was selected, evaluated and validated. The fifth section explores how the needs identification and validation was done in the project. The sixth section explored how the budget and schedule development was done in the project.

3.8 Data collection procedure

Among the available methods in collecting data three methods were adopted. These were literature review, interviews and questionnaires. Literature was reviewed to establish what others have documented on the subject matter. Useful information was collected from seminar and workshop papers, journal papers and Internet sources. Questionnaires were used to gather information for the study. The questionnaires were both online and hand delivered. Structured interviews with selected client and regulator representatives were conducted to gain information in the subject matter.

The questionnaire was distributed either physically or via e–mail to members of top and middle management in the architectural and engineering consultancy firms and construction companies, and to client or developer representatives in construction projects. The valid questionnaires returned for analysis in time was included in the analysis. Due diligence was done to ensure that the respondents in the study comprised at least 90% of the total respondents.

3.9 Pilot test

Instruments were initially piloted to small numbers of respondents to verify whether the questions are easy to understand, appropriate to the research topic, unambiguous (Fellows & Liu, 2008), and to gain some idea of the time required to administer the questionnaire. It is also important to get feedback and input on other important issues that may be worthy of consideration that the initial instrument may have missed. This also gives the researcher and indication of whether the instrument is measuring the right concept, hence its validity and reliability.

Validity is the degree to which an instrument measures what it is supposed to measure. The reliability of a research instrument is the extent to which the instrument yields the same results on repeated measurements. The tendency toward consistency found in repeated measurements is referred to as reliability (Carmines & Zeller, 1979). The researcher used the retest method to determine the reliability of the instruments by giving the same test to the same people. This was achieved by asking the same question in a slightly different way at a later time or in a different part of the questionnaire. The reliability of the instrument was estimated by examining the consistency of the results between the two measurements.

3.10 Data processing and analysis

Analysis is an interactive process by which answers are examined to see whether the results are relevant to each research question (Backstrom & Hursh-Cesar, 1981). Quantitative statistical analysis for questionnaire was done by using Statistical Package for Social Sciences (SPSS version:21.0.0.0 for MACOS). Correlation test was done to determine the relationship between the independent and the dependent variables in the research.

The qualitative data collected through the interviews was analysed qualitatively using thematic analysis. This process involved reading verbatim transcripts, identifying possible themes, comparing and contrasting themes, and, identifying structure among them (Ryan & Bernard, 2000).

CHAPTER 4

RESEARCH FINDINGS AND DISCUSSION

4.1 Introduction

This chapter presents the finding of the research project. The specific objectives that have guided this study are:

I. To identify the level of importance attached to risk identification practices during planning stage in construction projects in Rwanda.

II. To establish the effect of the architect and engineer selection process on the project performance.

III. To determine the effect of the site selection and validation process on the project performance.

IV. To determine the effect of the needs identification and validation process on the project performance.

V. To identify the effect of preliminary budget and schedule on project performance.

During the study, it was discovered that only 30% of the total sample size had relevant project experience. This was after a preliminary online survey to determine the project experience levels of the population. The appropriate sample size would then be 49.

n= 161/3= 48.3

The response rate was 85.7%, which makes the results of this research project credible. There were 42 valid questionnaires returned. Since the questionnaires were project based, a sample of 42 projects is adequate to investigate the research questions of this project.

4.2 Basic Information

Table 1: Experience of the respondents

Experience	Number	%
Less than 2 years	2	4.8
2 to 4 years	2	4.8
4-10 years	23	54.8
Over 10 years	15	35.7
Total	42	100

Table 1 shows the level of experience of the respondents. 54.8% of the respondents had 4-10 years experience in the construction sector, and, 35.7% had over 10 years experience.

Table 2: Education level of the respondents

Level of education	Number	%
Apprentice	1	2.4
Upper secondary (A2)	4	9.5
Advanced diploma(A1)	1	2.4
University (AO)	22	52.4
University: post graduate	14	33.3
Total	42	100.0

52.4% of the respondents had an undergraduate degree while 33% had postgraduate degree. 9.5 % were upper secondary school graduates. Only 40.4% of the respondents had studied risk management or project management courses. 42.5% of the respondents evaluated their risk management knowledge as advanced compared to 50% who evaluated it as fair.

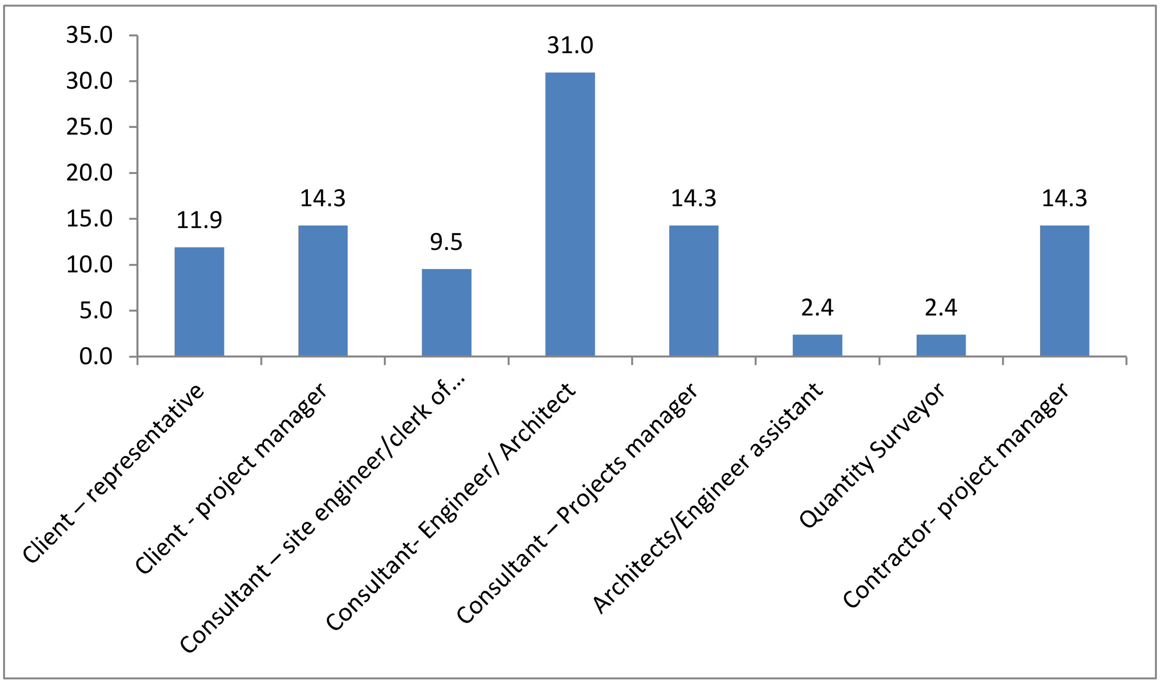

Figure 3. Current/Last Role in the construction project

50% of the respondents had worked on the cited project as part of the consultant team of architects, engineers and project managers; 14.3 % as clients Project manager; 14.3% as Contractor's project manager; and, 11.9 % as client's representatives.

The structured interviews indicated that the construction industry was growing but was facing many challenges. The key challenges were incompetence in local players, very young engineers and poor contractors. The key projects were with foreign contractors and consultants with. There were financial constraints to local contractors, which meant that they were unable to procure guarantees, credit lines and financing to acquire equipment. The interview respondents involved in many projects projects such as the RSSB district branches and pension plaza, Bnr district Branches, Rama buildings and SFB complex.

4.3 Level of importance attached to risk identification

Table 3: Risk identification at project planning phase

	No of respondents	Percentage
Yes	39	93%
No	3	7%
Total	42	100%

The first objective was to identify the level of importance attached to risk identification practices during planning stage in construction projects in Rwanda. A total of 42 projects were surveyed. There had been a risk identification process during project planning phase in 92.5% of the surveyed projects. In 60% of the projects, the risk management process was informal while it was formal in 40% of the projects.

Table 4: Level of importance attached to risk identification practices

Evaluation of the level of importance	**Clarity of space use requirements**	**Consultants' competence**	**Availability of suitable land**	**Estimated project Time**	**Budget availability**
Very important	31%	26%	24%	19%	29%
Fairly important	33%	62%	55%	52%	36%
Not so important	29%	10%	19%	24%	31%
Unimportant	7%	2%	2%	5%	5%
Total Number	42	42	42	42	42
Total %	100%	100%	100%	100%	100%

The clarity of space use as risk was considered very important by 31%; fairly important by 33 %; not so important by 29 % and unimportant by 7%. 62% of the respondents judged the qualification of consultants as fairly important and 26% as very important and only 2% thought it as unimportant.

The availability of suitable land and site was judged to be fairly important by 55% of the respondents; very important by 24%; and not so important by 19%. The estimated or expected completion time risk was judged as fairly important by 52% of the respondents, very important by 24%; and not so important by 24%. The availability of sufficient budget was regarded as not so important by 36% of the respondent and with 31% judging it as fairly important. Only 31% of the respondents thought the availability of budget as being very important.

Table 5: Project phase that the respondents participated

Participation	**Number**	**Percentage**
Planning	6	14%
Design	15	36%
Procurement	1	2%
Construction works	20	48%
Total	42	100%

48% of the respondents had participated in the construction works phase; 36% in design, 14% in planning and only 2% in the procurement or bid process. In 87.5% of the projects, identified risks occurred.

The key risks identified through the interviews were unfavorable ground conditions, changed contracts, scope creep, variations, delays in approval, client failure to accept project, prolonged defects liability period and incompetent consultants. In most projects the risk identification process was informal. Unfavorable ground conditions risks occurred though often anticipated and had some impact on cost and schedule according to the interview respondents. There were instances where specifications were enhanced during construction works and earlier omitted works were added back.

Table 6. Impact on the project cost for identified risks

Impact	**Number**	**%**
Fairly large (20-40% variation)	12	28.6
Fairly small (10-20% variation)	14	33.3
Very large (over 40% Variation)	6	14.3
Very small (1-10% variation)	4	9.5
Risk did not occur	6	14.3
Grand Total	42	100.0

There were many and varied reasons cited as reasons why these risks occurred. Most of these risks resulted in additional costs and delayed project completion time. Unforeseen risks occurred in 85.7% of the projects. These risks resulted in 10-20% project cost in 38.9% of the projects, a 20-40% variation in 33.3% of the projects and an over 40% variation in 16.7% of the projects. 39% of the respondents said that all team members had the best chance to manage cost variations while 82.5% thought that the client had the best chance to manage delayed payments risks. The consultants had the best chance to manage unsuitable design solution risks according to 53.7%. The client hand the best chance of managing design changes according to 48% of the respondents while 36.6% of the respondents thought that the consultants had the best chance of managing design change. 75% of the respondents said that the consultants had the best chance to manage delays in design.

The contractor had the best chance to manage construction delays according to 73.8% of the respondents while the client had the best chance in managing the risk of unsuitable site conditions according to 58.5% of the respondents. The contractor had the best chance in managing the risk of lack of materials according to 56.1% of the respondents.

4.4 The impact of the architect and engineer selection process

Table 7. Timing and method of engineer and architect selection

	Method of selection				Grand Total	
Time of selection	**LCBS**	**QBS**	**QCBS**	**Single source**	**%**	**Number**
Feasibility stage	4.8	4.8	54.8	11.2	75.6	30
Before project planning	0.0	2.4	2.4	9.5	14.3	6
For supervision of works	2.4	0.0	4.8	4.8	11.9	5
Grand Total	**7.1**	**7.1**	**61.9**	**23.8**	**100.0**	**42**

The architect and engineer were selected before design in 75.6% of the projects, before planning in 14.3% of the projects and for supervision works in 11.9 % of the projects surveyed. The quality and cost based selection, QCBS, was used in 61.9% of the surveyed project and single sourcing method in 23.8% of the projects.

Table 8. Correlation analysis of method and time of engineers selection and performance

	Kendall's tau-b	Functionality	Time	Cost	Communication	Selection time	Method
Functionality	Correlation Coefficient	1	.286*	.343*	0.114	-0.16	-0.012
	Sig. (2-tailed)	.	0.049	0.023	0.449	0.294	0.933
	N	39	38	35	38	38	38
Time	Correlation Coefficient	.286*	1	.803**	.496**	0.029	0.12
	Sig. (2-tailed)	0.049	.	0	0.001	0.849	0.412
	N	38	38	35	38	38	38
Cost	Correlation Coefficient	.343*	.803**	1	.533**	0.043	0.106
	Sig. (2-tailed)	0.023	0	.	0.001	0.785	0.486
	N	35	35	35	35	35	35

** Correlation is significant at the 0.01 level (2-tailed).

The correlation analysis using Kendall's tau-b indicated a weak correlation between the method and time of selection of the engineer on the projects performance. While it was expected that any method, if applied well, would ensure competent engineers were selected, it was surprising that the timing of the engineer's selection had very small effect on project performance.

Table 9. Evaluation of project performance

Perception	**Functionality**	**Time**	**Cost**	**Communication**
Very Good	26.2	9.5	9.5	9.5
Fairly Good	54.8	45.2	54.8	64.3
Fairly Bad	16.7	28.6	21.4	23.8
Very Bad	2.4	16.7	14.3	2.4
Number	**42**	**42**	**42**	**42**
%	**100.0**	**100.0**	**100.0**	**100.0**

54.8% of the respondents evaluated the functionality of the surveyed project as fairly good; 26.2 % evaluating it as very good; 16.7% as fairly bad and 2.4% as very bad. 45.2% and 54.8% of the respondents evaluated the project performance in terms of time and cost respectively as fairly good. Communication was evaluated as fairly good by 64.3% of the respondents.

Table 10. Evaluation of the engineer

	Education	**Capacity**	**Experience**	**Availability**
Very Good	35.7	28.6	28.6	26.2
Fairly Good	50.0	59.5	59.5	50.0
Fairly Bad	14.3	9.5	7.1	21.4
Very Bad	0.0	2.4	4.8	2.4
Total	**100.0**	**100.0**	**100.0**	**100.0**

The engineer was evaluated as very good in education by 35.7%, and, in experience and capacity by 28.6%. The engineer's capacity and education was ranked as fairly good by 59.5 % of the respondents. The availability of the engineer was evaluated as fairly good by 50% of the respondents, very good by 26.2%; fairly bad by 21.4% and very bad by 2.4% of the respondents.

Table 11. Correlation analysis of engineer's qualification and project performance

		Functionality	Time	Cost	Communication	Education level	Engineer Capacity	Engineer Experience
Functionality	Pearson Correlation	1	.347*	.392*	0.155	.634**	.515**	.435**
	Sig. (2-tailed)		0.033	0.02	0.353	0	0.001	0.007
	N	39	38	35	38	37	38	37
Time	Pearson Correlation	.347*	1	.852**	.495**	.438**	.325*	0.241
	Sig. (2-tailed)	0.033		0	0.002	0.007	0.05	0.152
	N	38	38	35	38	37	37	37
Cost	Pearson Correlation	.392*	.852**	1	.587**	.419*	.486**	0.313
	Sig. (2-tailed)	0.02	0		0	0.014	0.004	0.071
	N	35	35	35	35	34	34	34
Communication	Pearson Correlation	0.155	.495**	.587**	1	0.241	.363*	0.29
	Sig. (2-tailed)	0.353	0.002	0		0.151	0.027	0.082
	N	38	38	35	38	37	37	37
Education level	Pearson Correlation	.634**	.438**	.419*	0.241	1	.731**	.719**
	Sig. (2-tailed)	0	0.007	0.014	0.151		0	0
	N	37	37	34	37	38	38	38
Engineer Capacity	Pearson Correlation	.515**	.325*	.486**	.363*	.731**	1	.901**
	Sig. (2-tailed)	0.001	0.05	0.004	0.027	0		0
	N	38	37	34	37	38	39	38
Engineer Experience	Pearson Correlation	.435**	0.241	0.313	0.29	.719**	.901**	1
	Sig. (2-tailed)	0.007	0.152	0.071	0.082	0	0	
	N	37	37	34	37	38	38	38

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Table 12 shows the relationships between the engineer's competence and project performance parameters. There is a positive correlation between the engineer's education level, capacity and experience and the project performance parameters of functionality, time, and, Cost. While the engineer's education level and experience have negligible relationship with the communication performance parameter, the engineer's capacity has a positive correlation with the performance parameter of communication. These results indicate that the higher the engineers education level, capacity and experience, the higher the chances of a better project performance in terms of cost, time and function.

The thematic analysis of the interviews indicated the QCBS was the most used method of selection but there was often great preference for the lowest bidder. There were instances of extremely incompetent consultants where the client had to cancel the contract or appoint independent consultants under the main consultant.

4.5 Site selection and validation process

Table 12. Time of Site selection

Selection time	**Number**	**%**
Before planning	10	23.8
Planning	21	50.0
Design	8	19.0
Construction works	3	7.1
Grand Total	**42**	**100.0**

The project site was selected during the planning phase in 50% of the projects; before planning in 23.8% and during design in 19% of the projects surveyed. The interviews indicated that in most projects the site was selected by client but validated by consultants later during design stage. Most projects had increased costs in substructure works. Some sites were cited as being very difficult with high retaining walls.

Table. 13. Involvements in site selection

Team member	**Number**	**% Cases**
Architect/engineer	4	9.5
Client	41	97.6
Project manager	8	19.0
Contractor	4	9.5

The client was involved in 97.6% of the projects in site selection, the consultants in 9.5%, the project manager in 19% and the contractor 9.5% of the projects. 43.9 % of the respondents were not sure whether there was alternative land available for the surveyed project while 36.6 and 19.5 were aware and not aware respectively of availability alternative land.

54.8% of the respondents evaluated the suitability of the selected project site as fairly good; 26.2% as very good and 11.9% as either very bad or fairly bad. The slope of the site was evaluated as fairly good by 57.1% of the respondents while 19% evaluated it as either very good or fairly bad. 7.1% of the respondents considered the site slope as very bad.

Table 14. Site evaluation

Evaluation	Suitability	Slope	Site works Contribution to cost variation	Compliance to environmental regulation	Availability of roads
Very Good	26.2	16.7	11.9	11.9	23.8
Fairly Good	54.8	57.1	45.2	61.9	50.0
Fairly Bad	9.5	19.0	26.2	19.0	21.4
Very Bad	9.5	7.1	16.7	7.1	4.8
	42	42	42	42	42
	100.0	100.0	100.0	100.0	100.0

The site works contribution to cost variation was evaluated as fairly good by 45.2% of the respondents; fairly bad by 26.2%; very bad by 16.7% and very good by 11.9% of the respondents. The compliance with environmental regulations and accessibility was evaluated as fairly good 61.9% and 50% of the respondents.

Table 15. Site evaluation

	Availability of services	Ease of construction :	Construction Time	Availability of Landfill	Utility cost	Attractiveness of the location
Very Good	19.0	4.8	4.8	4.8	9.5	31.0
Fairly Good	52.4	61.9	73.8	40.5	35.7	61.9
Fairly Bad	23.8	21.4	16.7	50.0	50.0	4.8
Very Bad	4.8	11.9	4.8	4.8	4.8	2.4
	42	42	42	42	42	42
	100.0	100.0	100.0	100.0	100.0	100.0

Availability of services was evaluated as fairly good and very good by 76.2% of the respondents. The ease of construction in relation to excavation and foundation works was evaluated as good in 66% of the projects and very bad in 11.9% of the projects. The availability of landfill for excavated material was bad in 55% of the projects. The contribution of utilities to construction costs was evaluated as bad in 57% of the projects. The attractiveness of the site was evaluated as good in over 90% of the projects. The cost of land acquisition was good in 87.5% of the projects surveyed. The execution costs of site works in comparison with estimates in the bid bills of quantities between 1-10% in 46.3% of the projects, 10-20% in 24.4% of the projects; over 20% more than the estimate in 19.5% of the projects and less than the estimates in 9.8% of the projects.

Table 16. Correlation analysis of site performance and site selection Time and team

		Time	Team members	Site suitability	Slope	Cost	Environment	Access
Time of selection	Pearson Correlation	1	.416**	-0.073	-0.29	-0.156	-0.197	-.538**
	Sig. (2-tailed)		0.007	0.66	0.074	0.343	0.228	0
	N	41	41	39	39	39	39	39
Team members	Pearson Correlation	.416**	1	0.203	0.22	0.193	0.089	-0.068
	Sig. (2-tailed)	0.007		0.215	0.177	0.24	0.591	0.679
	N	41	41	39	39	39	39	39
Site Suitability	Pearson Correlation	-0.073	0.203	1	.492**	.566**	.517**	.347*
	Sig. (2-tailed)	0.66	0.215		0.001	0	0.001	0.03
	N	39	39	39	39	39	39	39
Site Slope	Pearson Correlation	-0.29	0.22	.492**	1	.726**	.551**	.580**
	Sig. (2-tailed)	0.074	0.177	0.001		0	0	0
	N	39	39	39	39	39	39	39
Site works costs	Pearson Correlation	-0.156	0.193	.566**	.726**	1	.589**	.383*
	Sig. (2-tailed)	0.343	0.24	0	0		0	0.016
	N	39	39	39	39	39	39	39
Environment	Pearson Correlation	-0.197	0.089	.517**	.551**	.589**	1	.319*
	Sig. (2-tailed)	0.228	0.591	0.001	0	0		0.048
	N	39	39	39	39	39	39	39
Access	Pearson Correlation	-.538**	-0.068	.347*	.580**	.383*	.319*	1
	Sig. (2-tailed)	0	0.679	0.03	0	0.016	0.048	
	N	39	39	39	39	39	39	39

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

There was a strong negative correlation between the time of selection and the accessibility of the site. The latter the site was selected the more were the chances of poor site accessibility. There was strong positive correlation between land suitability and the slope, contribution to variations of costs of substructure works and foundation, compliance with environmental regulation and accessibility. When the land was suitable, the other parameters were positive and favorable. These findings indicate that the decision-making about the location of a building is low structured and multi-criteria problem as discussed by other researchers (Jajac et al., 2013).

4.6 Needs identification and validation process

Table 17. Time of needs identification

Time	Project	%
Planning	26	61.9
Design	12	28.6
Construction works	4	9.5
Total	42	100.0

In the projects surveyed, needs identification was done during planning in 62% of the projects, during design in 29% and during construction works in 9.5% of the projects.

Table 18. Reason for the project

	Number	%
Customer request	14	33.3
Social Need	8	19.0
Political needs	1	2.4
Market demand	9	21.4
Business	9	21.4
Politics	1	2.4
Total	42	100.0

The projects were conceived for various reasons with customer request being the reason in 33% of the projects, business need in 21% of the projects; market demand in 21% of the projects and for social need in 19%.

Table 19. Correlations of end user involvement and change orders occurrence

		Change orders	Beneficiaries involvement
Change orders needs	Pearson Correlation	1	-.378**
	Sig. (2-tailed)		.000
	N	42	117
Beneficiaries involvement	Pearson Correlation	-.378**	1
	Sig. (2-tailed)	.000	
	N	42	123

**. Correlation is significant at the 0.01 level (2-tailed).

The end users or beneficiaries were not involved in needs validation in 65.1% of the projects. There is a strong negative correlation between end users and beneficiaries' involvement and the incidence of change orders. Engaging end users and beneficiaries was observed to greatly reduce the chances of change orders from changed assumptions.

Table 20. Evaluation of criteria used in project needs validation

Criteria	**Organization strategy**	**Political strategy**	**Project impact**	**Available budget**	**Expected income**
Very important	73.8	73.8	42.9	33.3	21.4
Important	4.8	7.1	31.0	19.0	14.3
Unimportant	4.8	4.8	7.1	14.3	4.8
Not applied	14.3	14.3	14.3	11.9	52.4
Fairly important	2.4	0.0	4.8	21.4	7.1
	42	**42**	**42**	**42**	**42**
	100.0	**100.0**	**100.0**	**100.0**	**100.0**

The compliance with organization strategy and external political strategy was ranked as the very important criteria in needs validation in 73.8% of the projects. The anticipated impact of the project and compliance with available budget were important criteria in 75% and 54% of the projects surveyed respectively. The expected income and return on investment criteria was not used in 52% of the projects surveyed. Only 35% of the respondents thought the return on investment was an important criteria for needs validation process. There were change orders during construction works phase in 80.5% of the projects due to changes in assumption of needs. The impact of these change orders to the project was fairly large.

The analysis of the structured interviews indicated that client's management at the high decision-making levels did the needs identification process. There were change orders caused by inclusion of items that had been omitted at design stage to keep project within available budget then. But these omitted items such structured data cabling, standby diesel generators, and internal wall partitions were necessary for the proper function of the buildings and had to be returned.

Table 21. Correlation analysis between reason and time of needs identification, and, needs validation criteria

		Reason for project	Time identified	Organization strategy	Political strategy	Impact	Budget	Expected income
Reason for the project	Pearson Correlation	1	0.11	-.494**	0.048	-0.141	-0.09	-0.121
	Sig. (2-tailed)		0.504	0.001	0.768	0.397	0.585	0.463
	N	41	39	39	40	38	39	39
Time needs identified	Pearson Correlation	0.11	1	-.457**	-0.175	0.273	0.169	-0.056
	Sig. (2-tailed)	0.504		0.004	0.285	0.102	0.311	0.738
	N	39	39	38	39	37	38	38

** Correlation is significant at the 0.01 level (2-tailed).

It was observed that there was a strong negative correlation between the reason for the project and its compliance with an organizations strategy. This meant that when the reason for the project moved from market and business need to social and political needs, the criteria of compliance with organization strategy was not used. Similarly, there was a strong negative correlation between the time of needs identification and compliance with organization strategy. This meant that the later the needs identification process happened, the higher the chance that they would not comply with an organization's internal strategy.

These findings are similar to the findings by Fageha(2014) that effective needs identification leads to clear project scope definition which can alleviate the risks of inadequate project planning and inadequate design that can lead to expensive changes during construction, delays, rework, cost overruns, schedule overruns, and project failure (Fageha & Aibinu, 2014).

4.7 Preliminary Budget and schedule development

Table 22. Time of budget and schedule development

Phase	% (Budget development)	% (Schedule development)
Planning	64.3	71.4
Design	35.7	19.0
Construction works	0.0	0.0
Total	100.0	90.5

The project preliminary budget was estimated during the planning phase in 54% of the projects; before planning in 25% and during design in 15% of the projects surveyed. The client was involved in 98% of the projects in preliminary budget and schedule development, the consultants in 23% of the projects, the project manager in 13% and the contractor in 4.1% of the projects. The interviews indicated that preliminary budget was developed by the client alone but was later adjusted to consultants confidential estimate in most projects.

Table 23. Evaluation of preliminary budget against bid price

	Projects %
Over 40% less than actual	73.8
20-40-2% less than actual	7.1
10-20% less than actual	4.8
As actual	14.3
More than actual	0.0
	100.0

In 64% of the projects, the preliminary budget was over 50% lower than the lowest returned bid price and the consultant's estimate during design. 45% of the projects were closed after design stage when it became clear that they were not feasible. The durations for the consultancy the client's procurement team alone in estimated services and construction works over 70% of the projects. The main criteria in time estimate in 64% of the projects were compliance to external budget schedules such as the government financial year. Consultancy services were rushed to meet the financial year closure deadlines and construction works time schedules were adjusted to fit within financial plans in most of the projects.

An analysis of the interview responses indicated that for most projects, the most responsive bids were much higher than the preliminary budget but were within the consultants' confidential estimate. In instances where the bids were far above the budget, some projects were abandoned, several were retendered and in most there was increased budget allowance to accommodate the extra costs. Many projects were delayed as the client sourced for more financial resources. The findings validate the view of risk as a cyclical process where a risk response may produce new events that may adversely affect the project (Ceric, 2003).

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The purpose of this chapter is to summarize the research project. It includes a restatement of the research questions, the research methodology used and a summary of the research project results, conclusions and discussion. It also recommends areas for further research in future studies.

5.2 Summary

The purpose of this research project was to evaluate the effects of risk management practices during planning stage on construction projects in Rwanda. Risk management is recognized as an important exercise in order to achieve better performance of construction projects. Success in construction project is indicated by its performance in the achievement of project time, cost, quality, safety and environmental sustainability objectives. Construction projects in Rwanda and generally in the region and the world run a high risk of being well over budget and significantly late. While some degree of cost and time schedule risks is inevitable in construction projects, it is possible to improve risk management strategies to minimize their negative impact.

Rwanda’s construction industry poor construction budget and schedule performance informed the need for this study. The objective of the study was to investigate the extent of the risk management practices at planning phase and the affect of these practices on project cost and schedule performance. The risk management practices at construction project planning phase were identified as risk identification and profiling, architect/engineer selection; site selection and validation, needs identification and validation and cost and schedule development. The study targeted architects, engineers, project managers and quantity surveyors working with consultants, contractors, clients and government. The study used both qualitative and quantitative methods of data collection. Literature review, physical and email delivered questionnaires and structured interviews were used to collect data. The data was processed using SPSS. Correlation analysis was used to analyze the relationships between the independent and dependent variables.

The research project indicated that risk management practices at planning stage had a large effect on project performance. Projects done by qualified engineers and consultants who had risk management knowledge and who used formal risk management practices had better performance in terms of communication, functionality, cost and time. Involving the consultants in site selection and validation in construction projects was discovered to be a key risk management practice to mitigate the risks of costs and time variation due to unfavorable site conditions.

The research project indicated that most projects in Rwanda had some input from a qualified engineer and architect. The level of skills in construction related fields was noted to be high, with 85% of the respondents having a degree. However most respondents had not studied risk management. While the study indicated that risk management was widely practiced at 92%, the process was mainly informal. Most respondents considered risk management practice fairly important. There was a very high incidence of occurrence of identified risks, at 85.7%. This indicates that the process of risk management was not adequate and no measures were put in place to mitigate the risks. The impact of these risks was quite high and resulted in 10 % to 40% cost variation in 72% of the projects surveyed.

Various project team members had different chances in managing the various risks. The client had the best chance to manage site selection risks, delayed payment risks, changes in project conditions, quality of contract documents risks and, changes in design risks according to the findings of this research project. The consultants had the best chance in managing the unsuitable design solution risk and delays in design. The combined effort of the whole team was the best chance in mitigation the risks of cost variations. The contractor was best placed to manage risks on availability of materials.

The research project found out that the consulting engineers and architects were often selected before the design phase of a project. It was only in 14.3% of the projects that the consultants were selected before project planning. This meant that most projects did not benefit from professional input at planning stage. The most used method of selection used for consultants was the quality and cost based selection method. Most respondents evaluated their projects as fairly good in functionality, time, cost and communication. However, the performance 19.5% to 47% of the projects surveyed, was evaluated as bad in the same parameters of functionality, time, cost and communication. Time performance was the poorest parameter with 45.2% of the projects having been evaluated as bad and very bad. Cost was the second bad performance parameter with 35.7% of the projects being bad and very bad.

The project site was selected during planning stage in majority of the projects surveyed. The client was involved in site selection in 97.6% of the project. The land was evaluated as fairly good in terms of slope, access, services and attractiveness in over 50% of the projects. However 19% to 43% of the surveyed projects had bad, and very bad sites in terms of the same parameters. The cost of land acquisition was good in majority of the projects. The site works contribution variations was found to be over 10% in 45% of the projects.

The needs identification process happened before planning and design in majority of the projects. Projects were conceived for various reasons customer request, business need and social need ranking high. The end users and project beneficiaries were not involved in the needs validation process in 64.3% of the projects. Compliance with external politics and organization strategies were key criteria used in project needs validation. The research project found out that expected income, and, return on investment as criteria for project validation, was not used 52.4% of the projects. This was surprising and contrary to expectations. This could be a result of external political strategies being key criteria in project needs validation. There were change orders in 80.5 % of the projects and their effect was fairly large.

The preliminary budget development process in most projects was done without the involvement of professionals. There were some projects that were closed before construction works, as the initially anticipated budget was not feasible. In many projects, contractors and consultants were forced to work within unfavorable client financial schedules resulting in incomplete and poor design and delay in construction works. There was strong relationship between designs done in less than two months and the occurrence of variations, change orders and design changes during construction.

5.3 Conclusions

The research projected identified an ineffective level of risk management practices at construction project in Rwanda. This was because most practice was informal, and most of the construction team members had not studied risk management or project management. The impact of identified but unmitigated risks was found to be high. Various project team members had different chances of mitigating the various risks but the client had the best chance in managing most of the risks.

In Rwanda, Architects and engineers were appointed prior to the design process in most projects. This meant that most projects were conceived with inaccurate information since there was no professional input at the planning phase in most projects. Consequently in majority of the projects, the client alone, did site selection and validation, and, the needs identification and validation, which often happens at planning phase. This lead to unsuitable sites that increased cost and time for excavation and foundation works. The end users were not involved in needs identification and validation process in many projects surveyed. Compliance with external political strategy and organization strategies was the main criteria in needs identification. There were change orders in majority of the projects arising from change in needs during construction works. The cost and schedule development process was inefficient in many projects and led to inaccurate estimates that later negatively affected project performance. Most estimates for time and cost were done early at project planning without the active role of skilled professionals.

5.4 Recommendations

The research project identified ineffective risk management practice at planning phase as a major cause of poor project performance. This research project recommends a formal and structured risk management practice during project planning and with the involvement of construction professionals and end users. The researcher recommends that risk management be included in the curriculum as an examinable subject for all students undertaking construction related studies. We propose continuous development seminars in risk management for all professionals in Rwanda and especially those in construction projects planning and procurement departments of both private and government developers. This research further recommends that qualified project managers who are either architects or engineers be included in all construction projects site selection, needs identification, and, in preliminary budget and schedule development. This research project recommends that major developers should retain the services of competent consulting architect or engineer throughout, and, this consultant should sit at top level decision meetings to advice on construction issues. End users and beneficiaries should be involved in needs identification at the early stages of a project.

This research recommends that more research is needed in this area to produce a comprehensive construction project-planning guide for use by developers and government departments. This research found a weak correlation between the architect and engineer selection process, which is contrary to the literature reviewed. There is therefore a need for further research on the effects of the architect and engineer selection process on project performance. This research project identified that many architects and engineers had not studied risk management. There is therefore a need for further research on the training gaps in the architect and engineer education.

This research project identified that many projects were initiated due to social and political needs. There is a need for further research on the factors affecting the performance of social and political projects in Rwanda. This research identified that the criteria for return on investment and profitability was not used in the validation process in many projects. There is therefore need for further research on the economic sustainability of the current investments in building infrastructure projects in Rwanda. This research project recommends for further research on the challenges faced by developers in budget and schedule development for construction projects in Rwanda. There is need to identify the extent and use of budget reserve and contingency sum and its effect on the construction project performance.

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