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MITIGATION OF BUILDING FAILURES IN UGANDA'S CONSTRUCTION INDUSTRY: A CASE STUDY OF GREATER BUSHENYI DISTRICT

BY

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CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by Kyambogo University a dissertation titled "***Mitigation of building failures in Uganda's construction industry: A case study of greater Bushenyi***" in fulfilment of the requirements for the award of a degree of Master of Science in Construction Technology and Management of Kyambogo University.

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DECLARATION

I, **Twinamatsiko Dicklus,** declare that this dissertation is my original work and that it has not been submitted before to any college, university or institution for an academic award. I wish to state that this report does not incorporate, without acknowledgement, material previously published or written by other authors.

TWINAMATSIKO DICKLUS

Signature: ………………………….. Date: ………………………….

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DEDICATION

I dedicate this report to my family and employer for the moral and financial support offered during my pursuit of this course.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
CDD	Center for Democratic Development
CIOB	Chartered Institute of Building
CMAA	Construction Management Association of America
DV	Dependent Variable
DPM	Damp Proof Membrane
HC	Health Centre
IV	Independent Variable
M&E	Monitoring and Evaluation
NGOs	Non-Governmental Organisations
MR	Malaysian Ringgit
RII	Relative Importance Index
SPSS	Statistical Package for Social Sciences
TI	Transparent International
TJN	Tax Justice Network
UNABCEC	Uganda National Association of Building and Civil Engineering Contractors
UK	United Kingdom
UNDP	United Nations Development Programme

ABSTRACT

Building failure is one of the biggest problems construction firms face. Building failure can lead to many undesirable effects. The main purpose of the study was to mitigate building failures in the construction industry in Uganda. The survey was guided by three specific objectives: To establish the causes of building failures in the construction industry in Uganda, to evaluate the impact of building failures in the construction industry in Uganda, and to develop a decision support tool for use in mitigation of building failures in the construction industry. The study adopted a descriptive survey research design. It was carried out in the districts of Greater Bushenyi district in a duration of one year (2018-2019). The study population comprised of 210 respondents: Supervising engineers, site engineer, site foremen, clerk of works and clients. The data collected were analysed quantitatively using SPSS Version 20 and Microsoft excel. Frequency tables, correlation and regression analysis tables were used to present the findings. It was observed that inadequate supervision of works (RII=0.77) is the leading cause of building failure. Based on findings, the study concluded that there is a great influence of consultant, contractor, client and external related causes of building failure. The study established that the quality of site supervision has a major influence on the overall performance and efficiency of construction projects. The study recommends that stakeholder engagements need to use a mitigation decision support tool, and skill levels should be enhanced to meet the needs of the construction project.

Keywords: Mitigation of building failure, Decision support tool, Causes of building failure, Impact of failure, RII

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

According to Kioko (2014) building failures occur due to use of sub-standard building materials, poor workmanship by contractors, use of incompetent contractors, faulty construction methodology, heavy downpour, non-compliance with specifications or standards by developers and contractors, lack of supervision, poor inspection and monitoring, structural defects, defective design/structure, illegal conversion and alterations. Building failure occurs when the building loses its ability to perform its intended (design) function. Building defects can be a result of design error by the architect, a manufacturing flaw, defective materials, improper use or installation of materials, lack of adherence to the design by the contractor, or any combination of them (Othman et. al., 2014).

Residential buildings are the ones, which experience most of the defects or failures due to poor workmanship (Othman et. al., (2014). Poor workmanship problems are closely related to the developer and also the contractor that constructs the buildings. It should be pointed out that 90% of the building failures are due to problems arising in the design and construction stages (Ahzahar et. al., 2011). Ahzahar et. al., (2011) further observes that these problems include poor communication, inadequate information or failure to check information, inadequate checks and controls, lack of technical expertise and skills, and inadequate feedback leading to recurring errors. Most defects in construction projects are due to human errors and these happen due to poor performance in workmanship during construction (Atkinson, 1999).

Most contractors working in the construction industry are beginners with low levels of construction skills and capacity to discharge their duties (Othman et, al., 2014).

Othman et, al., (2014) observes that most of the site work and finishing works are subcontracted; This is done with the objective of creating job opportunities to the rural poor without qualifications and proper on-the-job training and subsequently the effects are manifested by poor workmanship on the buildings. According to Othman (2014), lack of experience and competence of labourers must be taken into account as a factor that contributes to poor workmanship as “productivity cannot be achieved by speed and harder work only without adopting better work practices”.

Poor workmanship is one of the popular factors that lead to building failures in Uganda according to UNABCEC (2017). Poor workmanship in Uganda contributes to over 70% of construction defects hence loss of value for money as stated in the Auditor General’s report (2018).

Table 1.1: Projects with failures and estimated costs to rectify them

District	Name of project	Contractor	Financial year/ Contract sum	Defects/ Failures Observed	Expected amount to rectify defects (UGX)
Rubirizi	Construction of Residence district commissioner Administration block	MUMA construction ltd	830,239,500 /= (2016/2017)	-Peeling-off of plaster, the plaster is salty. The structure had double plaster and second layer was not protected with DPM. -Fading of iron sheets colour.	45,000,000/=
	Construction of 2 classroom blocks with a store and office at Rumuri p/s	Mutara Works Enterprises	88,954,000 (2014/2015)	-Cracks in floor -Warping of roof structure, resulting from struts and ties for supporting roof structure. -Peeling off of plaster and paint, these resulted from inferior materials like cement.	35,000,000/=
	Construction of administration of Katunguru SEED SS	Bitereko Hardware	150,456,000 (2016/17)	-Horizontal cracks in the wall.	Under pinning and ground beam it might cost 100M

Table 1.1: Cont'd

Buhweju	Construction of 3-unit classroom, 2- unit classroom with office & store and dormitory blocks at Butare p/s	Barike investment ltd	2013/2014 (256,174,000)	Cracks in floor	25,000,000/=
	Construction of doctors' house at Nsiika HC IV	Rose ST Construction Company	125,276,000/=	-Cracks in floor, -Leakage in plumbing system, -Peeling of plaster to external walls	Renovation was awarded to Mugizi Evan Construction in 2014/2015 at 15,450,000/=
	Construction of Staff house at St. Paul p/s	Bamujuni & Cosma Builders &contractors co. Ltd	2008/2009 (19,245,000)	-Peeling of plaster and paint -Cracks in floor and verandah -Broken glasses	12,000,000/=
Bushenyi	Construction of Out-patience dispensary at Kabushaho HC III	Mahaiso Construction LTD	2009/2010 (125,254,000/=)	-Cracks in verandah - Some tiles have separated from floor -Missing glasses - Internal doors warped.	25,000,000/=
	Construction of dormitory at Nyabubare SSS	NATO Engineering Co. LTD	2010/2011 (156,023,000/=)	-Cracks in floor and verandah -Warped fascia boards -Brocken glasses	18,000,000/=

Source: **Procurement and disposal unit of Greater Bushenyi district (2019)**

1.2 Statement of the problem

The main function of the construction industry is to provide infrastructure that protect the life of users and or occupants and contents from the weather, mainly rain, wind and extremes of temperature. It is most important to provide the basic needs, which will achieve all of these functions. Features such as windows, pipes, air conditioning system and finishes are only additional. Buildings for example are supposed to be structurally safe in order to survive, and the floors must be capable of resisting any normal imposed loads. This is achieved by use of good structural designs, quality materials, appropriate equipment and most importantly trained and experienced workmanship (Ahzahara et. al., 2011).

Construction failures and defects are common phenomena in the construction industry and these have negative impacts towards cost, duration and resources of project. Failures and defects often cause unnecessary expenditure, deaths and delays. In Uganda, defects on buildings and roads have been held responsible for several deaths. The recent report published by the Uganda Association of Building and road contractors revealed that a total of 58 deaths have occurred due to collapsing buildings in the last four years (UNABCEC, 2018). In Bushenyi, 5 lives have been lost in the last 4 years due to building defects while about 326,000,000/= (Three hundred twenty-six million Ugandan shillings) has been lost in repairs during the defects liability period as a result of poor workmanship.

Despite the efforts to improve the quality of work in the construction industry through use of advanced technology, increased labour force for professionals in the construction industry, increased availability of construction equipment, there is still rampant low-quality work. This research was conducted to identify and provide measures that mitigate building failures in Uganda's construction industry.

1.3 Objectives of the Study

1.3.1 Main Objective

The main objective of this study is to develop measures to mitigate building failures in the construction industry in Uganda.

1.3.2 Specific Objectives

i) To establish the causes of building failures in the construction industry in Uganda.

ii) To evaluate the impact of building failures in the construction industry in Uganda.

iii) To develop a decision support tool for mitigation of building failures in the construction industry in Uganda.

1.4 Research Questions

i) What are the causes of the building failures in the construction industry in Uganda?

ii) What is the impact(s) of building failures in the construction industry in Uganda?

iii) What can be done to mitigate building failures in the construction industry in Uganda?

1.5 Justification

In order to contribute to the improvement of the building industry, knowledge of the causes of building failures is indispensable. This research study will help to develop a decision support tool for mitigating building failures in Uganda’s building construction industry. Subsequently, the findings of the study shall inform practitioners to develop quality structures and value for money will be achieved.

If solutions to the problem of building failure are not established soon and addressed, the construction industry will continue to retrogress and not only lose money but also lives hence poor service delivery.

1.6 Significance

The study will provide more knowledge on mitigation of building failures in the construction industry in Uganda. Other researchers and scholars will use the findings of this study to conduct further similar research on the subject matter.

The study will also help clients and other stakeholders responsible for quality control in the building industry by making references and use of the established decision support tool.

1.7 Scope of the study

1.7.1 Geographical scope

This study was done in the five districts of Buhweju, Mitooma, Sheema, Rubirizi and Bushenyi that comprise the Greater Bushenyi District as shown in Figure 1.1. These districts were purposively selected because they have construction projects that have been identified to have building failures, according to the Auditor General's report (2017). In addition, the researcher is familiar with the building construction projects that have been implemented in these areas recently; even reports have revealed projects with defects. This ensured that a representative sample of respondents from the total population was purposively selected.

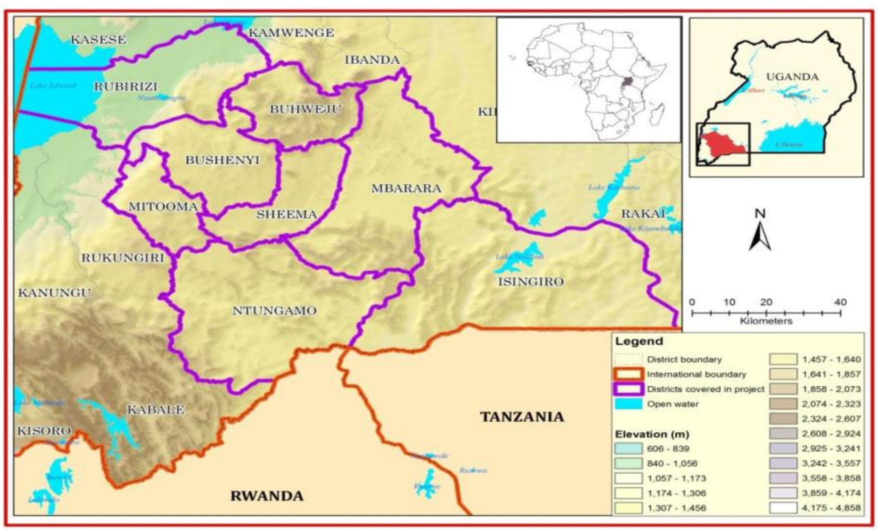

Figure 1.1: **A map of greater Bushenyi district**

1.7.2 Content scope

The study analysed building failures, causes and the impact with a view of establishing mitigation of building failures in Uganda's construction industry. This covered construction projects executed over a period of ten years in greater Bushenyi District.

1.7.3 Time scope

This research was completed within one academic year 2018-2019.

1.8 Conceptual framework

The conceptual framework has underlined a number of factors that determine the rate at which building construction projects fail. On the far right is the dependent variable that is manipulated and changes as the independent variables interact. The dependent variable in this case is building failure in the construction industry. Factors that interact to bring this influence on the dependent variable are called independent variables. They include: Consultant related causes, contractor related causes, client related causes and external factors. The four factors have some indicators that will determine whether there is project failure in the construction Industry; Poor site supervision and management, lack of experience, inaccurate cost estimate, financial management, lack of knowledge, financial problems, employer interference, delayed approval and delay in certification of works.

There are also moderating variables. These factors have a direct impact on the performance of the projects or have it coming indirectly. However, the results are felt in the rate at which these projects are implemented.

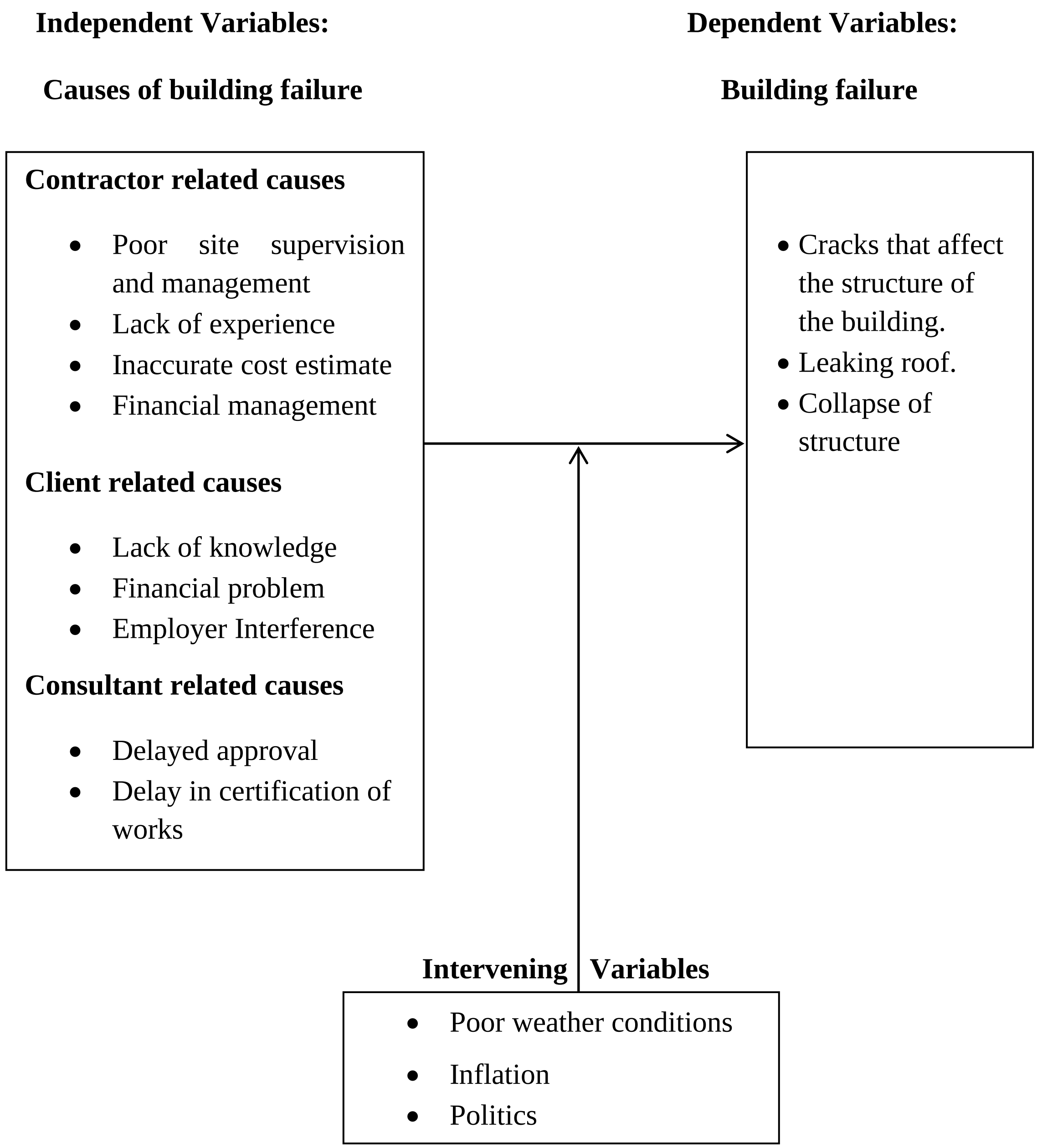

***Figure 1.2*: Conceptual framework**

1.9 Summary

This chapter gives the Background to the Study, Statement of the Problem, Objectives of the Study, Research Questions, Justification, Significance, and Scope of the Study. The Conceptual framework of mitigation of building failure in the construction industry is also presented.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review, synthesis and analysis of the existing body of literature related to the study. First, the major causes of building failure in the construction industry were reviewed. This was followed by a review of literature on the impact of building failure. It also identified the gaps in mitigating building failures. The literature is presented on each research question, together with the critique done by the author. The summary of the literature review is also presented.

2.2 Concept of building failure

This section discusses the concept of building failure. The aim of this research was to find causes and the impact of building failure. This section therefore provides the various thought about what constitutes building failure. This highlights the extent to which projects fail in the world and developing countries, and Uganda in particular.

Building failure occurs when the building loses its ability to perform the intended (design) function. Hence, building failures can be categorised into the two broad groups of physical (structural) failures (which result in the loss of certain characteristics, e.g., strength) and performance failures (which means a reduction in function below an established acceptable limit), (Douglas & Ransom, 2007).

Structural failure corresponds to the exceedance of ultimate limit state in many of the load-carrying elements, which compromise the structural stability of the building. In practice, this corresponds to extensive damage, partial or total collapse of the building, resulting in repair costs that are high relative to the replacement value of the building.

Performance failure can be induced by the failure of structural elements (as per the above), nonstructural component (non-load-bearing elements or equipment) failures or combinations.

According to this study, building failure is when the structure has developed cracks, water leakage through the roof and collapse of structure.

2.3 Causes of building failure in the construction industry

2.3.1 Poor workmanship

Poor workmanship is one of the popular factors that lead to building defects and failures problem. Residential buildings are the ones, which experience most of the defects or failures problems due to poor workmanship (Othman et. al., 2014). Poor workmanship problems are closely related to the developer and the contractor that constructs the buildings. It should be pointed out that 90% of the building failures are due to problems arising in the design and construction stages according to Ahzahar et. al.,(2011). Ahzahar et. al., (2011) adds that these problems include poor communication, inadequate information or failure to check information, inadequate checks and controls, lack of technical expertise and skills, and inadequate feedback leading to recurring errors. Most defects in construction projects are due to human error and this error happens due to poor performance in workmanship during construction (Atkinson, 1999). The most important aspect of a quality project is the workmanship; unfortunately, poor quality workmanship can destroy projects already put in place (Iwaro and Mwasha, 2012).

Mohammad and Darade (2017) stated that, Workmanship is a manual aspect of skill. This skill would develop more with more practice and experience. In the past, the quality of workmanship was excellent and it used to determine the quality of construction.

2.3.2 Improper selection of materials

According to Ahzahar et. al., (2011), most buildings use building materials, which are easily available locally. Such building materials include timber, stone, brick and plaster. In the materials management of buildings, understanding the nature of the building materials and accurate diagnosis of defects is most important.

In the construction industry, many types of materials are used from man-made to naturally available materials such as timber, steel, plastic, brick, mortar, glass, etc. Most of the times these materials are used without any test or checks to determine whether this material is fulfilling the standard specifications or not (Mohammad and Darade, 2017).

According to Basirat et. al., (2016), substandard materials especially reinforcement rods, steel sections and cement can contribute immensely to failure of buildings.

Functionality in the operating environment is generally a high priority for material selection of components, especially when it comes to the long and short-term safety and reliability of the equipment.

2.3.3 Unskilled manpower

Most contractors working in the construction industry are beginners with low levels of construction skills and capacity to discharge their duties (Othman et, al., 2014). In most cases, local contractors who acquire construction contracts hire low skilled labourers who in turn demand less pay for labour costs hence maximising profits. Further still, most of the site work and finishing works are subcontracted with the objective of creating job opportunities to the rural poor without qualification and proper on-the-job training. Subsequently the effects are manifested by poor workmanship on the buildings. Lack of experiences and competency of labourers must be taken into account as a factor which contributes to poor workmanship as productivity cannot be achieved by speed and harder work only without adopting better work practices (Othman, 2014).

Kioko (2014) recommends and suggests that as responsible professionals in the built environment, it is good for the construction companies to emphasise the need for use of qualified personnel in all construction activities as a step towards restoring sanity in the industry. According to Ayodeji (2011), it is believed that unprofessional conducts contribution is not a small measure to the menace of building collapse in Nigeria; Such unprofessional conduct like bribe collection from contractors, professional acting in the capacity beyond the scope of his profession, etc. has a negative effect indirectly on the building and may finally result into building collapse.

2.3.4 Poor site supervision and management

According to Danso (2014), poor supervision of work and use of inferior or adulterated materials are the major causes of poor workmanship in the construction industry. Also poor supervision on site contributes to the poor workmanship on construction site and it can be seen on many occasions on the jobsite (Kasun and Janaka, 2006).

According to Ahzahar et. al. (2011), the quality of site supervision has a major influence on the overall performance and efficiency of construction projects. Inadequate supervision is believed to be one of the major causes of rework. Even where a structural design is not deficient, absence of proper supervision on the site by qualified personnel can lead to building failure (Basirat et. al., 2016). The proper execution of the contract as per the requirements and design depends on continuous monitoring of the construction process (Mohammad and Darade, 2017).

2.3.5 Poor communication

Poor communication in construction industry has been investigated and researched extensively by many researchers and construction practitioners. Poor communication is a very important concern in the construction industry (Dainty et al., 2006)

Poor communication consequently leads to cost and time overruns in the form of rework occurrence (Emuze, 2013) and miscommunication among construction parties (Lee et al., 2013). There are various forms of poor communication in the construction industry. According to Tai (2009), lack of frequent communication among construction parties is one of the forms of poor communication.

A study conducted by Darvik and Larsson (2010) on the impact of material delivery deviations on costs and performance in construction projects showed that quality defects and delivery deviation of materials occurred due to lack of communication among relevant parties and communication failure. Therefore, it was suggested, stakeholders have to put more concern in the enhancement of communication regularity, means and methods. Communication skills are essential to produce effective communication however if the speaker lacks of these skills then poor communication may result. Interpersonal skills which include communication skills play an important role for the success of a project (Gunhan, 2012). Parties involved in construction possess different communication skills which also depend on their qualification and cultural background. These differences cause concurrent misunderstanding in the delivery stage (Cheng et al., 2001). In the construction industry, communication is managed by channels in all the organisations hence each department or section in the organisation is responsible for disseminating the related information to formulate complete communication system. However due to the complexity in the construction industry, several concurrent communication problems occur because no proper channeling is adopted to manage and control the communication process (Fitchet, 2007). A study by Lee and Bernold (2008) found out that effective communication in construction is seriously hampered due to a lack of appropriate data channels, improper channel and inaccurate data transfers. Tipili et al (2014) stated that unclear channels of communications result in project delay. It is therefore very important to standardise the channels of communication in construction industry to fasten and ease the communication process.

Dispute is a common issue that occurs in the construction industry. It causes an impact on the main project components such as cost, time and quality of construction projects (Gebken, 2006). Dispute is commonly known as an endemic and chronic character of construction industry (Sinha, 2007). It was emphasised by many researchers; poor communication among construction industry is one of the main causative factors of dispute occurrence. It is therefore a major consequence of unsuccessful communication. Kumaras wamy (1997) identified poor communication among construction parties as one of the significant causes of dispute. Lack of communication skills is considered one of the utmost important diffusing factor to cause dispute in the construction industry. Therefore, effective communication is very important to improve the relationship between the project team (Enshassi, 2007).

2.3.6 Planning

Planning is one of the key elements of every project and failure to plan clearly can lead to project failure. Planning is one of the most common causes of building failure in the construction industry. If project deliverable and how these would be achieved are not clearly outlined in the project-planning phase, the project is likely to fail (Mochal, 2013). In other words, projects that start without understanding the full content or the project baseline/constraints of what the project seeks to achieve are susceptible to failure. In fact, Pinto (2013) specifically traces the root cause of project failure to the poor initial planning phase of projects. Research shows that ineffective planning accounts for most project failures. For instance, in construction projects in Nigeria, studies indicate that planning and scheduling account for delays (Odeyinka and Yusif, 1997). A similar study identified this same problem in the Iranian construction industry (Pourrastam and Ismail, 2011). With regard to large construction projects, the same reason was found to account for project delays (Assaf and AL-Hejji, 2006). A survey study into causes of delay in construction projects from contractors and consultants' point of view also indicates that improper planning accounts for delays (Odeh and Battaineh, 2002).

2.3.7 Resources

The term resource covers a very broad area and can be classified as tangible or intangible resources (Teigland and Lindqvist, 2007). These include but are not limited to financial, human, goodwill, reputation, expertise, and material resources (Teigland and

Lindqvist, 2007). Studies show that many projects fail due to lack of or inadequate resources. This section discusses the most common resources often cited for failure.

Material Resources – These are the physical goods needed for the execution of a project and, without them, projects that require physical deliverables cannot be implemented. In most cases, there is lack of or inadequate physical resources. For example, in research into conflict in the Bygga Villa project, the study discovered that one major reason for conflict among project partners was the scarcity of resources, which contributed to the initial project failure (Ruuska and Teigland, 2009). The size of the partners (some partners were unable to provide resources due to their organisational size) and other projects competing for the same resources were the main issues. This lack of resources can create conflicts among various stakeholders associated with a project and this in turn leads to project failure (Ruuska and Teigland, 2009).

2.3.8 Scope change

This is one of the main areas that contributes to project failure. Most project research highlights that scope change is a major contributing factor for project failure (Kaliba et al., 2009; Liu et al., 2011). In most projects, requirements either are altered before the commencement of work or altered halfway through the project's life cycle, but rarely are these changes effected by the completion date. This is more evident in IS project management (Ahonen and Savolianen, 2010). From a more general perspective, Zhang (2013) argues that "project changes have been conventionally treated as having heavy or negative impacts on project completion and, in theory they should not happen if project activities have been perfectly planned and scheduled". In other words, changes in the scope of projects are bound to happen and if they happen, it has negative effects on the completion time – more especially in complex projects that involve multi-stage iterative process. Human Resources – The research into the conflict in the Bygga Villa project discovered that one major reason for conflict among project partners was the scarcity of resources, which contributed to the initial project failure (Ruuska and Teigland, 2009). The size of the partners (some partners were unable to provide resources due their organisational size), other projects competing for the same human resources, and lack of academia (human resources) were the underlying factors for the scarcity of resources. For the latter reason, the project had to wait for certain researchers to defend their theses before work could continue. In some situations, contractors on some projects have to hire foreign nationals before the projects can be completed, and this comes with pros and cons. A clear example is the case of Malaysia. A study to find causes of construction project failure in Malaysia shows that inadequate workers and lack of skilled workers account for why construction projects were failing (Sambasian and Soon, 2007). A significant number of construction workers had to be hired from Indonesia to contribute to Malaysia's construction projects. The lack of skilled workers and the inadequacy of the ones available in the country meant that contractors had to rely on foreign workers and, although foreign workers have their advantages, the problems that may be created due to different cultures and work ethics cannot be underestimated, as Hofstede (1983), Lubatkin et. al,. (1999), and Muriithi and Crawford (2003) have emphasised.

The need for the right people for the right job is very crucial in project management and as such the need for the right people with appropriate skills to correctly execute projects is very crucial (Mochal, 2005; Lever, 2008). Research on project failure points out that the failure of many projects can be partly attributable to lack of skills. For example, a study conducted by Ruuska and Teigland (2009) into the Bygga Villa project indicates that the project leader lacked broker skills and this was causing conflicts among project partners, which thereby caused the project to fail. In order for the project to be successful, management had to replace the project manager with a more appropriate one. This is further echoed in the work of Hwang and Ng (2013), where they argue, "a competent project manager is vital to project success". Thus, in order to manage projects professionally and successfully, the project manager has to possess the required knowledge and skills (Hwang and Ng, 2013). Statistically, according to Frank (2002) as cited by Hwang and Ng (2013), project managers have a 34-47% direct influence on project success, and therefore failure to recruit, train and nurture the right project manager for a project's management is a recipe for disaster.

Perkins (2006) attributes the root cause of project failure to 'Knowledge'; either project managers do not have the requisite knowledge, or they do have it but fail to apply it appropriately.

2.3.9 Financial difficulty

Projects have suffered several setbacks such as total abandonment and delays, mainly due to financial difficulties. Payment delays sometimes result in project abandonment, and, in some extreme circumstances, contractors go bankrupt (Adams, 2008). In some circumstances, the project fails to commence after initial planning (Heeks, 2006). Some projects fail because of the government's inability to secure funds which leads to abandonment. Financial difficulty is often cited as one of the main causes of project failure all over the world. Many projects have been abandoned in developing countries due to lack of or inadequate funding. The Chad-Cameroon pipeline project, which cost the World Bank US$4.2 billion, failed because the World Bank withdrew its financial backing (World Bank, 2006; Fabian and Amir, 2011). The project, which was one of the most expensive projects funded by the World Bank in Africa at the time, is a clear indication of how a project's success is dependent on sound financial backing. This same problem exists in the Malaysian construction industry (Sambasian and Soon, 2007). In Jordan, the problem is the same; financial difficulty faced by contractors is the most frequent and first cause of building construction project failure in the country (Sweis et al., 2008). Most experts believe that this is natural because contractors in Jordan are independent small companies who underbid to win contracts, and they have limited access to credit facilities (Sweis et al., 2008). In construction projects in Nigeria, the situation is also the same. Studies of construction projects show that financial difficulty on the part of the client contributes to delays in delivering projects (Odeyinka and Yusif, 1997). In Iran, construction projects suffer from delays due to contractors' financial difficulties (Pourrastam and Ismail, 2011).

2.3.10 Corruption

Corruption has bedeviled project management practices and government projects in particular, and it has become part and parcel of officials undertaking projects in LDCs (Ghanaian, 2012). However, this social vice has been defended and justified vehemently by some state officials. They cite among other reasons low salaries, the project not being their personal property, poverty, feeding a habit, gaining of societal status and sharing of the national ‘cake’. Even though it is difficult to find a criminal code that defines corruption (Azeem, 2009), corrupt practices such as bribery of local or foreign government officials and private companies, facilitation of payments, fraud, embezzlement, theft, collusion, and rent-seeking exist in the country. A renowned Ghanaian political scientist, Gyimah-Boadi, posits that corruption is pervasive and has to do with motive and opportunity (Gyimah-Boadi, 2002). According to Gyimah-Boadi, the opportunity for corruption normally occurs when systems and institutions of accountability are weak – lack checks and balances – and when moral decency is very low among officials. This social phenomenon fosters an anti-democratic environment which creates uncertainty, unpredictability and declining moral values which disrespect constitutional institutions and authority (Gyimah-Boadi, 2002; Mensah et al., 2003).

A study conducted by Transparent International (TI) between 1999 and 2008 points out that Ghana is far behind in the fight against corruption (TI, 2008). The scores range from 10-0, with 10 being the countries with least corruption and 0 being the most corrupt; Ghana has always been in the lower brackets (3.3-3.9). In 2007, Ghana had a Corruption

Performance Index (CPI) score of 3.7, thereby positioning the country 69th out of 180 of the world's countries that were studied (TI, 2008). According to the report, only countries with an index of 5 and above do not have a serious corruption problem. Consistent with the definition offered by the World Bank (World Bank, 2013), the definition of corruption in the study was an abuse of public office for private gain, and measured the degree to which corruption is perceived to exist among a country's public officials and politicians.

Transparency International's research findings indicate that the state of corruption in Ghana is serious. Nevertheless, this definition has been criticised for leaving the impression that it is only people who occupy public office who are capable of abusing their office or power (TJN, 2008). TJN argues that the World Bank and TI description of corruption does not provide room for corrupt practices such as market rigging, insider trading, tax dodging, non-disclosure of conflicts of interest, and illicit party funding (Azeem, 2009). Even though the TI study's findings give a picture of the state of corruption in the country, if TJN's criticism and definition is taken into consideration, the state of the phenomenon could even be worse.

Internal reports on corruption in Uganda show similar findings to that of the TI (2008) report. For example, a report in 2007 by the Public Accounts Committee on the Auditor-General's report in 2006 on Public Accounts submitted to Parliament and the follow-up public hearings states that there is a serious corruption problem among public officials.

The same report shows a similar trend in the 2010/2011 report published in 2012 (Ghanaian Chronicle, 2012). The 2013 report is not any different. A survey on corruption in Ghana conducted by the Ghana Integrity Initiative (GII) and Ghana Center for Democratic Development (CDD) also shows a similar problem. These corrupt practices in Ghana affect project management and project performance. If this happens, cost escalation becomes inevitable. However, efforts have been made over the years to curb the phenomenon.

2.3.11 Ethical issues in project management practices

Ethical issues in the management of projects have led to building failure in the construction industry. Public officials have indulged themselves in practices that raise ethical issues over the years in execution of government projects. Ethical issues in project management practices in Ghana are not perceived to be as serious as portrayed by Heidman et al. (2005).

There have been instances where a state official chairs a government project, and becomes the sole supplier of materials for the project at a rate which is above the market rate for the same project (Takyi-Boadu, 2011; Ghana web, 2011; Ghanaian Chronicle, 2012). Additionally, in some circumstances, government officials do not pay contractors on time, which leads contractors to go bankrupt, hence, causing their business to collapse (Adams, 2008).

A common design error is often made, usually in an effort to save initial construction costs. Project cost plays an important role in designing buildings. Reducing the size of columns, the size of reinforcement bars and foundations are the common design error in construction (Ahzahar et. al., 2011). During construction, many contractors either on the directive of the client or in a bid to cut corners and maximise profit, alter approved building plans without corresponding amendment to structural drawings to the detriment of the structure (Basirat et. al., 2016).

2.3.12 Foundation failures

According to Solomon and Akintayo (2009) building foundation failure is attributed mostly to the nature of soil, overloading and persistent leaking of drains in that order. This may be because many residential building developers are either unaware of the need for soil investigation before construction work or see it as a needless activity.

2.3.13 Natural disasters such as earthquakes, floods, fire

One of the major natural factors that result into building collapse is rainfall and others may include temperature and pressure (Ayodeji, 2011). Madu, 2005, identified causes of building failure as due to natural occurrences such as earthquakes, tornadoes, floods, etc. Other causes according to him include factors such as omission, carelessness, leading to use of deficient structural drawings, absence of proper supervision of projects, alteration of approved drawings, use of substandard materials, corruption in the Nigerian system, building without approved drawings and translocation of building plans to different sites.

2.3.14 Lack of maintenance culture

According to Ahzahar et. al.(2011), building maintenance prepared through an accurate program of repeated maintenance plays a major role in preventing building defects. Buildings that neglect building maintenance may fall into several defects that may lead to structural failures.

According to Sidney (1991), permanent structure requires less attention than temporary ones, any house owner will confirm that even the best-constructed building needs constant attention. According to Seeley (1997), maintenance work on a building should commence from the day the contractor leaves the site.

The necessity for maintenance work on buildings is noted in the fact that all buildings, as well as the materials and components therein, deteriorate or suffer loss in aesthetic, strength and or functional value, with exposure to the elements of weather over time. The appearance and life span of a building and also the quality of the materials would be affected depending on the manner to which maintenance is adhered to, in the building (Seeley, 1987).

If the design process is to be enhanced, the building team needs to come together and contribute towards the building's maintainability at the project inception rather than leaving it for the maintenance personnel at the end of construction to battle with the curative measure (Adejimi, 1998). This sometimes causes frustration and annoyance to maintenance personnel when taking over new buildings and finding themselves faced with bad details, poor choice of finishes, materials and components and lack of basic information about the building and its services (Seeley, 1997).

Building services rarely perform as well as desired (Stephen, 2002). The causes emanate from deficiencies in design, construction, commissioning, tenancy work and maintenance. Many researchers have also observed that the generators of maintenance problems could be looked at under three main divisions: Causes initiated during the design stage, Causes initiated during the construction stage, Causes initiated during the usage stage or the user's carefree attitudes (Bad maintenance culture).

He further said that all these could be planned for during the design stage. Maintenance problems though do manifest during the use of the building, their causes might be during the design stage. These made Dekker (2002), Kelly (2002), Kachashkin (2002) to assert that "thinking on the maintenance should start in the design phase". According to Speight (2000) it is at the design stage that the maintenance burden can be positively influenced for better or worse. Where the designer fails to make adequate consideration for minimising maintenance problems, it always turns out to be a big problem when the building is eventually occupied for usage, the consideration for effective maintenance as one of the parameters for the building design. Cheetham (1992), Both (1999), Edwin and Curtis (2000), and Mc Call (2001) described how the occurrence of defects in the building fabric could result from many unrelated designs such as unsuitable materials.

It is often said that building defects start on the drawing board, but in some cases, they can originate at an earlier stage (Arayela and Adams, 2001). Inadequate brief may lay down totally unrealistic cost limits or fail to give vital information on the building. Design deficiencies could result in a building disaster if adequate attention is not considered to the design of bearing capacity, calculation errors, deformation, shrinkage problems, errors in assumed loading (especially wind), and changes in alteration of existing structures – all these could contribute substantially to building failures and disasters. Seeley (1997) also said that a skillful design can reduce the amount of maintenance work and also make it easier to perform, since good maintenance begins on the drawing board.

2.3.15 Use of substandard materials

Substandard material especially reinforcement rods, steel sections and cement can contribute immensely to failure of buildings. Other substandard materials can also contribute to failure of buildings. Hall (1984) posited that use of low quality materials is one of the major causes of building failure. Aniekwu and Orie (2006) in their study also identified low quality materials as the most important cause of failure of engineering facilities in Nigeria.

2.4 Impact of building failure in the construction industry

The consequences are usually in the form of economic and social implications (Gana and Engr, 2015). These include loss of human lives, injuries, economic waste in terms of loss of properties, investments, jobs, incomes, loss of trust, dignity and exasperation of crises among the stakeholders and environmental disaster.

When construction projects fail, the effects are often injurious to the stakeholders. A research conducted in Nigeria by Aibinu and Jaboro (2002), studied the effects of failure in the construction industry of Nigeria. They discovered six possible common effects arising in most countries because of delay. These effects were; cost overrun, time overrun, disputes, arbitration and litigation, and total abandonment of project.

According to Anthkson (1999), a defect is defined as the non- fulfillment of the intended usage requirements in which requirements are determined by laws, regulations, building standards as well as in contract documents, site meetings records and other project documents. Apart from loss of lives (mostly innocent citizens), many other people have been rendered permanently disabled in one form or the other as a result of increasing rate of building collapse in the country (Ayodeji, 2011)

2.4.1 Cost overrun

This refers to the excess of the actual cost that was planned or budgeted for the project from conception phase to the construction and finishing phase. It can sometimes be referred to as cost escalation, cost increase or budget overrun (Singh, 2009). It can also be explained as the difference between the actual cost of the project and the initial cost budgeted. Researchers such as Flyvberg et. al., (2002) have shown that infrastructure projects often suffer from cost overruns. Cost overruns can sometimes be attributed to political factors (Holm and Bubl, 2002). Politicians lie by either underestimating or exaggerating the benefits of projects to make it saleable and for their own interests. When construction projects are delayed, the specific and overall cost of the project will certainly increase. This is due to the fact that prices of materials in the market fluctuate over time. Thus the amount that was budgeted for materials may increase when delay occurs. In addition, exchange rates will affect the prices of materials purchased from other countries as well as increase in price of labour. Moreover, if the delay is as a result of changes in the design, the cost of the project will increase because the new design will be more expensive than the initial. And finally the change of government policies over time will also lead to cost increase of the projects particularly due to increase in tax rates. However, the above points will be true and feasible if the project is delayed for a period of one year and above.

The following cases of cost overruns projects expressed as a percentage to the overall cost was pointed out by (Singh, 2009). These include; the Suez Canal (1900%), Sydney

Opera House (1400%), the Concorde Supersonic Aero plane (1100%), Bolton Big Dig (2750%) and the channel tunnel between UK and France (220%). Another common example or case of cost overruns caused by delay is the construction of the Kuala Lumpur International Airport Terminal 2. The initial estimated or budgeted cost was RM1.7 billion. But due to delay of the project, the final cost of the project escalated to RM4 billion (Kini Biz online, 2004).

2.4.2 Time overrun

This is one of the most common issues in the construction industry. It can be defined as the failure to complete a project within the estimate time (Ahmed et. al., 2012). It can be used as a tool for qualifying a project as a failure. In Indonesia, Kaming et. al., (1997) carried out a survey to find out the main causes of time overruns in the construction industry. The most significant factors mentioned were design changes, poor labour productivity, inadequate planning and resource shortages. When the issue of time overrun occurs, the project completion time will be further extended beyond that which was estimated. The tendency is that it will lead to dissatisfaction by the owner or the clients. Sometimes the contractor may lose the project as he will be seen as incompetent. A study was carried out in Malaysia by Aftab et. al., (2011) on time overrun construction projects. They found out that a total of 30 construction projects were facing time overruns.

2.4.3 Economic losses

According to Arayela (2005), the economic losses of construction failure include the following:-

i) Financial losses that is incurred in erecting the building up to the stage of failure or collapse;
ii) Time value or the funds expended to date;
iii) The life expected labours input of the injured and dead to the economic;
iv) Cost of removal of the collapse debris;
v) Cost of disaster response services as a result of the collapse;
vi) Opportunity cost of depriving the community of the use of the building for the extra period of replacement.

2.4.4 Loss of life

According to Gana (2015), it is certainly true that both the community and the families of the dead ones would have been deprived of the lives lost.

2.4.5 Land environmental degradation

With the collapse of any multistory building, the said site would not be accessible for an appreciable length of time. After the collapse, dust pollution of the environment would be observed, until the site is properly managed. This will pose a source of danger to the said neighborhood (Gana and Engr, 2015),

Table 2.1 gives category of impact, direct and indirect consequences of building failure in the construction industry.

Table 2. 1: Categorisation of consequences

Category	**Direct consequences**	**Indirect consequences**
Human	-Injuries -Fatalities	-Injuries -Fatalities -Psychological damage
Economic	-Repair of initial damage -Replacement/repair of contents (as a result of initial damage)	-Replacement/repair of structure -Replacement/repair of contents -Replacement/repair of nearby structures -Loss of functionality/production -Temporary relocation -Cleanup costs, Rescue costs -Regional economic effects -Investigation/compensation
Environmental	-CO2 emission -Toxic releases	-CO_2 emission -Toxic releases -Environmental studies/repair
Social		-Loss of reputation -Changes in employment/lifestyle patterns -Changes in professional practice

2.5 Decision support tool for mitigation of building failures

Decision support tool is any guidance, procedure, or analysis tool that can be used to help support a decision. According to Bardos (2001), Decision Support tool is defined as the assistance for, substantiation and corroboration of, an act or result of deciding; typically, this deciding will be a determination of an optimal or best approach.

According to Nutley et. al., (2013), a targeted decision-support tool can play a role in making data aggregation, analysis, and presentation easier and faster.

Decision support system helps the managers to manage the information in a better way that can then be used to take important decisions related to organisational success. This system is vital for any organisation’s success (Naila and Imran, 2014). It is turning out to be an integral part of any organisation (whether business, education, agriculture, medicine). It helps the managers to manage the information in a better way that can then be used to take important decisions related to organisational success.

2.6 Summary of literature review

Table 2.2 gives a summary of the existing body of literature that was reviewed.

Table 2.2: Summary of literature reviewed

Topic	**Author/Document Title**
Concept of building failure	Douglas and Ransom (2007)
Poor workmanship	Ahzahar et. al., (2011), Atkinson (1999), Iwaro and Mwasha (2012), Mohammed and Darade(2017), Othman, (2014)
Improper selection of materials	Ahzahar et. al.,(2011), Mohammed and Darade (2017), Basirat et. al., (2016)
Unskilled manpower	Othman et. al., (2014), Kioko (2014),
Poor site supervision and management	Danso (2014), Kasun and Janaka (2014), Ahzahar et. al., (2011), Almarwae(2017), Basirat (2016), Mohammed and Darade (2017)
Design deficiency	Almarwae (2017), Ahzahar et. al., (2011), Basirat et. al.,(2016)
Use to which the building is put	Ahzahar et. al., (2011)
Foundation failures	Solomon and Akintayo (2009)
Natural disasters	Ayodeji (2011)
Lack of maintenance culture	Ahzaharet. al., (2011), Gana and Engr (2015)
Economic losses	Gana and Engr (2015)
Land environmental degradation	Gana and Engr (2015)
Effects of building failures	Antkson (1999), Ayodeji (2011)
Cost overrun	Singh (2009), Flyvberg et. al., (2002), Holm and Bulb (2002), Kini Biz online (2004)
Time over run	Ahmed et. al., (2012), Kaming et. al., (1997), Afteb et. al., (2011)
Decision support tool for mitigating building failures	Bardos (2001.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter explains the research methodology that was followed in order to achieve the objectives of the study. It focuses on the following areas; research design, study population, sample size and selection, sampling techniques and procedure, data collection methods and instruments, measures of variables, the limitations and the ethical considerations that were followed in the study.

3.2 Research design

A research design is a plan used to generate answers to the issues and problems reported. The research design employed in this study was the descriptive survey method. Descriptive design is a method of collecting data by interviewing or administering a questionnaire to a sample of individuals (Orodho, 2003). This method is preferred because it allows for careful comparison of the research findings.

The study was designed to get opinions from clients, consultants and contractors of construction companies in regards to the causes, effects, as well as mitigation measures of building failures in the construction industry. The possible causes of building failures were identified from the literature and these factors were tested with the stakeholders of the construction industry in the study area. Different causes were identified from the literature and respondents were asked to give their opinion on these causes in the form of ranking. Also effects of building failures were identified from the literature and a questionnaire was developed according to these factors to get the opinion from respondents.

3.3 Research approach

The mixed methods approach of both qualitative and quantitative research approach was used in this study. A quantitative approach was used to understand the perception of respondents in Greater Bushenyi district towards the factors causing building failures in the construction industry. The qualitative approach was employed to have more understanding of the experience of respondents. To achieve this, emphasis was placed on words rather than quantification of collection and analysis of data.

3.4 Study population

The study population comprised of supervising engineers, site engineers, site foremen, clerk of works and users. A total of 210 persons formed the population of study. The approved structure of the District Technical Staff in Local Governments is 12 positions. Hence population (p) for each District is 12.

i) 5 supervising engineers, 5 site engineers, 5 site foremen and 5 clerks of works were purposively selected on ongoing projects in every district in Greater Bushenyi.

ii) 10 clients of completed projects with major defects in the last five years (2013/14 – 2017/18) were purposively selected in the five districts of greater Bushenyi district.

Table 3.1: Population of respondents per district

District	Technical Staff	Supervising Engineers	Site Engineers	Site foremen	Clerk of works	Clients
Buhweju	12	5	5	5	5	10
Sheema	12	5	5	5	5	10
Rubirizi	12	5	5	5	5	10
Bushenyi	12	5	5	5	5	10
Mitooma	12	5	5	5	5	10
Total	60	25	25	25	25	50

3.5 Sampling methods and Sample size

According to the table developed by Krejcie and Morgan (1970), the total population of the selected respondents being 210, the sample size was 136 respondents. The respondents were drawn from a population of supervising engineers, site engineers, site foremen, clerk of works and clients from the five districts of Greater Bushenyi (Rubirizi, Bushenyi, Buhweju, Sheema and Mitooma).

Purposive and stratified sampling was used to determine the respondents but also key informants were purposively identified. Purposive sampling is where members of a population are selected on a basis of a specific purpose which will help the researcher achieve specific objectives (Bryan, 2012). Purposive sampling was selected because it enabled the researcher select respondents relevant to the study. A sampling frame of stakeholders in the construction industry was selected from civil servants, politicians, contractors, consultants, beneficiaries/users, and civil society organisations.

Table 3.2: Sample size and sampling techniques

Category	**Sample**	**Sampling technique**
Technical staff	60	Purposive sampling
Supervising engineers	25	Purposive sampling
Site engineers	25	Stratified sampling
Site foremen	25	Purposive sampling
Clerk of works	25	Purposive sampling
Clients	25	Purposive sampling

3.6 Data collection methods

Both qualitative and quantitative approaches were employed due to the nature of the study. The study involved assessing attitudes and opinions which assumed to have influenced building failure. The qualitative approach enabled the researcher to make an in-depth investigation of the variables related to building failure.

A combination of methods was used to collect both qualitative and quantitative data. These included structured and semi structured interviews, checklists for physical observation and field observations. The use of a combination of methods in data collection was due to diversity of information that was required to achieve the objective of the study. The interview was adopted as a method for data collection partly due to its cost effectiveness and its strength of capturing empirical data in both informal and formal settings (Kothari, 2011). The interview guide consisted of both open and closed ended questions. Open ended questions were designed to solicit information relating to actual and expected returns on the respondents and study area characteristics, and their relations to building failure. Closed ended questions on the other hand were intended to capture information relating to respondents' opinions towards the causes and impact of building failure. The questions that were asked to all respondents were identical in order to solicit homogeneous information.

The interview was made up of three major parts: the first part was designed to collect background information on respondents in the study area; part two was aimed at collecting information on causes of building failure; part three was designed to capture information relating to impacts of building failure. Interviewing in research involves a meeting between a researcher and respondent, and involves the interviewer asking a predetermined set of questions using basically the same wording and order of questions within the interview schedule. The interview method was very useful since it allowed face-to-face interaction with respondents and allowed the researcher to restructure the question or give clarification to questions when necessary. The choice of interview method for this study was dictated by the experience gained during a pilot survey whereby the majority of respondents preferred oral discussions with the researcher to filling in the questionnaires. This may be attributed to the nature of sample population (rural residence) where illiteracy is high. Rwegoshora (2006) mentions the advantages of the interview, among others as: (i) it makes possible to study events that are not open to observation, (ii) allows for the study of abstract factors like attitude, back emotions and reactions of the respondents, (iii) allows for the study of phenomenon in its historical background, (iii) allows for gathering information that is quite reliable, and (iv) enables the study past events.

Semi-structured interviews were used during discussions with key informants. Unlike structured interview which involves tight control over the format of questions and answers, in semi-structured interview the questions are open ended and emphasis is on the respondent to elaborate points of interest (Denscombe, 2008). Interviews were found useful as they allowed face-to-face discussion with respondents, restructuring of some questions to suite the situation and to capture some controversial issues between different groups of people in a community. Due to the nature of the study which required the investigation on people's opinions on the causes and impacts of building failure, semi structured interviews were appropriate and offered more opportunity in gathering information.

3.6.1 Pilot survey

Prior to detailed field survey, a pilot survey was conducted using a total of 15 respondents from the five districts. The pilot study was administered for the purpose of; (i) soliciting background information about the study areas (ii) familiarising with the areas where the main survey was to be conducted (iii) establishing sampling frames and units (iv) pre-testing the questionnaires to validate the relevance of the questions to the intended respondents (v) determining the approximate time or duration taken to fill a questionnaire with one respondent and (vi) finding out the most efficient way of carrying out the main survey. Following the pilot survey some amendments were made to the questionnaires and interview guidelines. Some questions were added, others deleted while others were reframed to make them clearer and easier to understand.

During pilot survey research, assistants were recruited and trained to assist in data collection.

3.6.2 Detailed field survey

The formal survey was conducted from December to June 2019. It involved household interviews, focus group discussions and discussions with government officials, representatives of NGOs and other key informants. The interviews were conducted by the researcher with the assistance of three well-trained enumerators. Prior to commencement of interviews, the researcher visited the districts, divisions, wards and villages to inform relevant authorities about the purpose of the study and to arrange the modality of conducting interviews. Individual respondents were interviewed in their homes or offices after an initial appointment. The objectives of the study were explained precisely by the researchers to each respondent prior to interviews in order to win the willingness and cooperation of the respondents. The interviews were conducted in Swahili to overcome language barrier since most household respondents did not speak English language. Furthermore, there were few respondents (especially old people) who did not speak even Swahili, for such cases the local language was used with the assistance of two research assistants who spoke the language.

3.7 Data collection instruments

3.7.1 Questionnaires

In order to determine the perception of different stakeholders in the construction industry regarding factors causing building failures, a questionnaire was developed. This was the main tool used to collect the data from the target respondents. The questionnaire was structured into 4 sections to meet all the research objectives.

Section A had questions to determine the respondents' background.

Section B was designed to get the opinions of construction stakeholders regarding causes of building failures.

Section C questions were designed to ascertain the effects of building failure.

Section D questions were to bring out measures to mitigate the effects of building failure. For the factors causing delays and the effects of delay, the questions were designed and assessed on a 5 point Likert Scale which measures from 1-5 according to the level of contribution and impact of each factor.

Strongly Agree (5)

Agree (4)

Note sure (3)

Disagree (2)

Strongly Disagree (1)

For questions relating to impacts of building failure, a total measure was identified from the literature and the questionnaires were developed using the 4 point Likert scale to determine the impact of each of these measures.

Very high (4);

High (3);

Low (2);

Very low (1).

3.7.2 Interview guide

The interview method was adopted because of its cost effectiveness and its strength in capturing empirical data in both informal and formal setting (Kothari, 2011). It was also used to validate the data collected using questionnaires. The interview guide was used during semi-structured interviews.

Observations were used during discussions with government officials and other key informants. Unlike the questionnaire, the questions in the interview guide were open ended and emphasis was on the respondent to elaborate points of. The interviewer had a list of issues, which he wished to obtain answers from respondents, but was flexible in terms of the order of the questions.

3.8 Data quality and control

3.8.1 Validity

Validity refers to the extent to which results obtained from data analysis actually represents the understanding of the occurrence. Additionally, reliability refers to a measure of the extent to which research instruments give consistent results (Mugenda & Mugenda, 2003). In this study, data reliability was achieved by pre-testing the questionnaire with a selected sample. Contents of the validity helped the researcher to ascertain whether they included or represented all the content of the research in the study. Verbal consent was also acquired from the respondents who agreed to be part of the study. Privacy and confidentiality was observed during the study. The researcher treated all the data collected from the respondents with a high level to confidentiality. This enabled the researcher to observe ethics during the study.

3.9 Procedure of data collection

An introductory letter was sought from the Department of Civil and Building Engineering after the selection of respondents. An informed consent from the respondents as well was first sought by the researcher. The process of collecting data commenced depending on the method being used at that time. Field visits were conducted to verify some of the structures in the study area. Two research assistants formed part of the team who took part in the study.

3.10 Data analysis

Triangulation was used in data analysis. Both qualitative and quantitative methods of data analysis according to Mathew et.al, (2013) were used.

3.10.1 Qualitative method

This was used to examine the data collected to make inductive inferences in a non-arithmetic manner. The semi-structured interviews were analysed with the use of words.

The analytical methods used are thematic analysis and content analysis. This enables the researcher to take an inductive position where analysis is made using the theoretical framework created from the literature review as a guide. This coding was performed both manually and via software. The manual coding was carried out with the use of a computer by highlighting the various themes that were raised by respondents. This was achieved by using Microsoft Word. The transcribed data were coded based on the various performance criteria, and causes and effects that were mentioned.

First of all, all the performance criteria, and causes and effects mentioned by respondents were coded. Similar codes were put together to obtain other codes and subsequently put into main themes. These themes were analysed in order of how often they were mentioned. In addition, the causes under each theme were also analysed based on the number of respondents who mentioned that theme.

3.10.2 Quantitative methods

This was used to analyse data that involved figures that needed to be measured numerically. The results of the questionnaires were analysed using quantitative data analysis software known as SPSS ver.20. Frequency tables and descriptive statistics were constructed to display results with respect to each of the questions of the data obtained. The correlation analysis (Spearman's rank correlation coefficient) was used to identify the significance of the relationship between the mean responses of the respondents. The Spearman rank correlation coefficient can be used to describe the relationship between linear or nonlinear data. Also, it can be used for data at the ordinal level and it is easier to calculate by hand.

The Spearman (rho) rank correlation coefficient is given by equation.

$$\rho = 1 - \frac{6 \sum d^2{}_i}{n(n^2-1)} \quad \text{(Equation 3.2)}$$

Where: Rho ρ=Spearman rank correlation coefficient;

d_i=Difference between ranks given by two respondents for each variable

n=Number of pairs of values in the data set.

Regression analysis was also used to determine the impact of each of the independent variable on the dependent variable.

3.11 Measurement of variables

A five-point Likert rating scale with 5 the highest rank; a scale of “Strongly disagree” (1) “Disagree” (2) “Not sure” (3) “Agree” (4) and “strongly agree” (5). Based on the five-point Likert rating scale, a standard method of ranking was used which is the relative importance index (RII). RII is defined by the relationship in equation 3.3; Relative Importance Index

$$RII = \frac{\sum W}{AN} \quad \text{(Equation 3.3)}$$

Where:

W is the weighting given to each element by the respondents;

This will be between 1 and 5, where 1 represents the least significant impact and 5 the most significant impact;

A is the highest weight; and

N is the total number of respondents. While the remaining are evaluated by simple descriptive statistics (in percentages)

The respondents were asked to give their opinions on the impact of building failure in the construction industry. The responses were measured by a four point Likert scale; Very high, High, Low, Very low.

- Very low impact for loss of human life, economic, social or environmental consequences are negligible;
- Low impact for loss of human life, economic, social or environmental consequences are small;
- High impact for loss of human life, economic, social or environmental consequences are considerable;

- Very High impact for loss of human life, economic, social or environmental consequences are great.

3.12 Ethical considerations

A clearance was obtained from Kyambogo University and all ethical aspects of research were put into consideration. Data were collected with informed consent of the respondents in the five Districts of greater Bushenyi district. The permission was sought from the local authorities before the study was done, and from all the responsible parties. Any information that the researcher found compromising to the privacy of any respondent or other actors was treated as a confidential matter. The output of this research will be available at least for the major actors involved in the study for possible future use and reference.

CHAPTER FOUR

PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

4.1 Introduction

This chapter presents the analysis of data and discussion of results of the survey. The data was analysed using SPSS (version 20) and Microsoft excel. The data were analysed according to the research objectives i.e. to establish the causes of building failures in the construction industry in Uganda, to evaluate the impact of building failure in the construction industry in Uganda and to develop a decision support tool for use in mitigation of building failures in the construction industry.

4.2 Background information of respondents

4.2.1 Response rate

The researcher distributed 136 questionnaires of which 112 were filled and collected from the respondents. Some respondents refused to fully participate in the study. This represented a response rate of 82% as summarised in Table 4.1.

Table 4.1: Response rate

Category	**Frequency**	**Percentage**
Returned	112	82
Not returned	24	18
Total	**136**	**100**

***Source:* Primary data**

According to Baruch (1999), the average and reasonably acceptable response rate is 60% +/-20 meaning that anything below 40% is not reasonably acceptable and would generate validity issues. Therefore, in this study, a high response rate was recorded and this improves acceptance and credibility of the research findings.

4.2.2 Gender of the respondent

In this study, respondents were asked to indicate their gender and the results are displayed in figure 4.1.

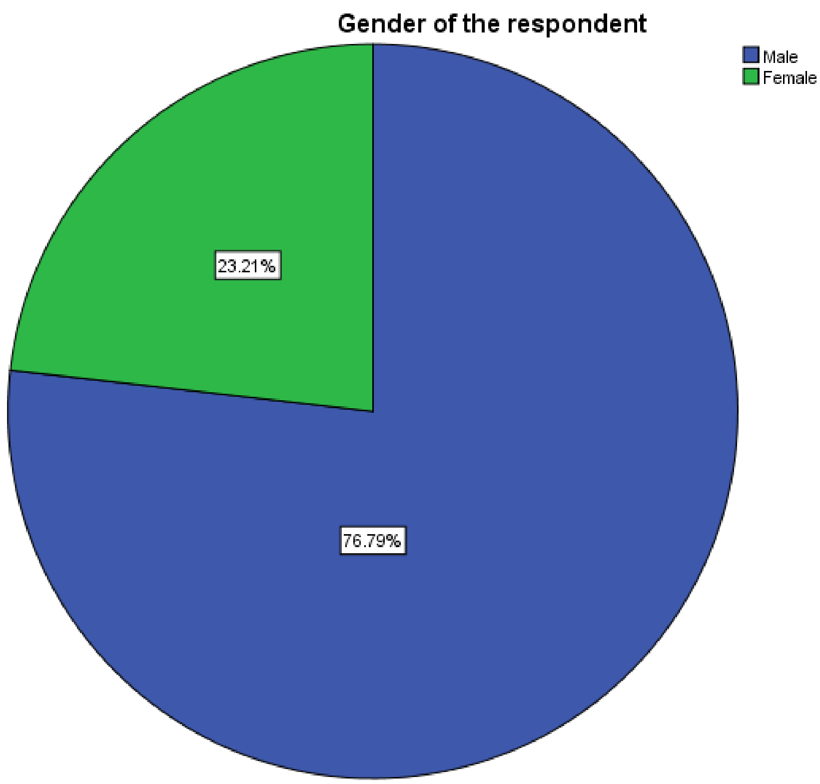

***Figure 4.1*: Gender of the respondents**

Figure 4.1 reveals that there was a gap in the representation of both male and female respondents. The majority (76.79%) of the respondents were males while females accounted for only 23.21%. This could be because construction projects require more of manual labour of which males edge females in terms of participation. This is because male gender is able to perform tough jobs that require rigorous engagement, which is common in constructions projects. This encourages males to participate in construction projects compared to females.

4.2.3 Reliability

Reliability was tested using Chrobach's Alpha reliability test using SPSS. The results are displayed in Table 4.2.

Table 4.2: Chronbach's alpha reliability test

	Chranbach's Alpha	Number of questions
Consultant related causes	0.65	10
Contractor related causes	0.89	10
Client related cause	0.78	10
External factors	0.57	10

Mathematically, Cronbsch's alpha is calculated as follows:

$$\alpha = \frac{k}{k-1}\left(1 - \frac{1}{S_T^2}\sum_{i=1}^{k} S_i^2\right)$$ ……………………………………………………(Equation 3.1)

Where k is the number of items, s_i^2 is the variance of the item, and S_T^2 is the variance of the total score formed by summing all items. The results in Table 4.2 indicate that there is high internal consistency. This is because the Cronbach's Alpha is high and close to one. This shows that the tests were reliable.

4.2.4 Age of the respondents

Age was categorized according to particular ranges and respondents were required to indicate their age. The results are summarised in Table 4.3.

Table 4.3: Age of the respondents

Age category	**Frequency**	**Percent %**
Below 20 years	2	1.8
21-30 years	44	39.3
31-40 years	35	31.3
41-50 years	25	22.3
Above 50 years	6	5.4
Total	**112**	**100.0**

***Source:* Primary data**

Table 4.3 reveals that majority of the respondents were aged between 21 to 30 years representing 39.3% of the respondents followed by 31.3% who were aged between 31-40 years. In the third position (22.3%) were respondents who were aged between 41-50 years, followed by 5.4% who were above 50 years. Only 1.8% was below 20 years of age.

The majority of the respondents were in their most active and productive years of 21 - 30 years. This could be a characteristic of young people’s desire to acquire as much experience and exposure as possible as well as earn a decent living. The low representation of the age bracket below 20 years could be associated with experience. Low experience may lead to low quality consequently leading to building failure.

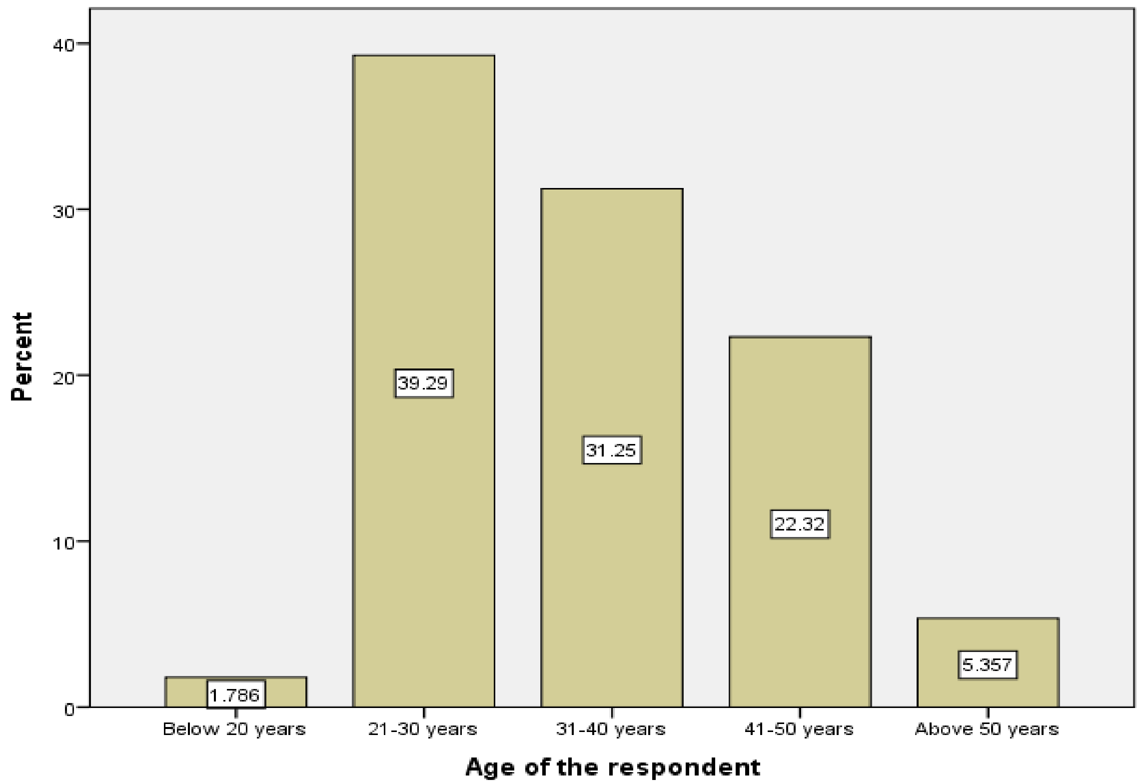

***Figure 4.2*: Age distribution of the respondents**

4.2.4 Position of respondents

Respondents were asked to indicate their positions in the construction firms. The positions were categorised as supervising engineer, site engineer, site foreman, clerk of works and client. The results are displayed in Table 4.4.

Table 4.4: Position of the respondents

Position	Frequency	Percent %
Supervising engineer	13	11.6
Site Engineer	14	12.5
Site Forman	34	30.4
Clerk of works	19	17.0
Client	32	28.6
Total	**112**	**100.0**

Regarding the position of the respondents in the industry, the majority were site foremen (30.4%), followed by the clients (28.6%), 17.0% were clerk of works, 12.5% site engineers and only 11.6% were supervising engineers. High representations of site foremen shall provide better results since they are conversant with building failures.

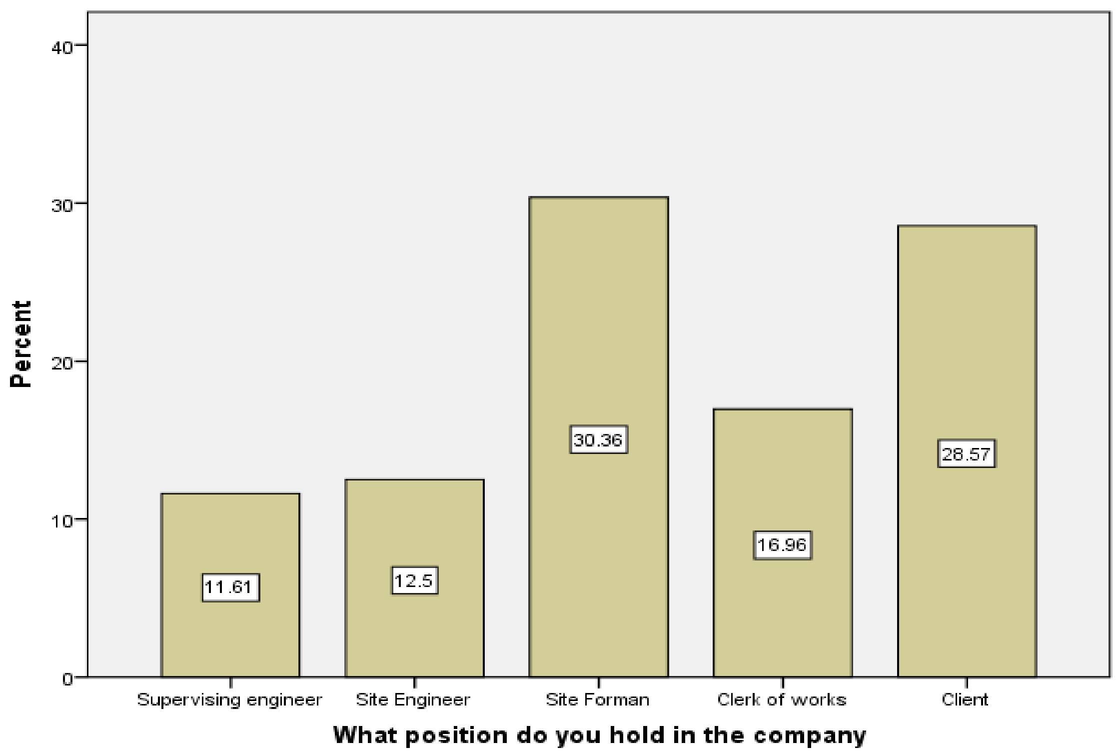

***Figure 4.3*: Position of the respondents**

4.2.5 Years of experience

Respondents were asked to indicate years of experience in the construction industry. Years of experience were categorised according to different ranges and the results are displayed in Table 4.5.

Table 4.5: Respondents' experience

Years of experience	Frequency	Percent %
Below 5 years	24	21.4
5-10 years	40	35.7
10-15 years	40	35.7
Above 20 years	8	7.1
Total	**112**	**100.0**

Source: Primary data

The results indicate that most of the respondents have been in the industry for 5-10 years and 10-15 years, each category representing 35.7%. 21.4% of the respondents were of below 5 years of experience and those above 20 years represented only 7.1%. Having well experienced respondents shows that the results obtained will provide valid information on building failures.

4.3 Empirical findings

4.3.1 Causes of building failure in the construction industry

Respondents for this study were requested to rank the critical factors causing building failures in the construction industry. The causes were categorised as consultant related, contractor related, client related and external related.

4.3.1.1 Consultant related causes of building failure in the construction industry

The respondents were requested to rate their opinions on the consultant related factors that affect building failure in the construction industry. The responses were measured on a five-point Likert scale; strongly disagree=1, disagree=2, not sure=3, agree=4 and strongly agree=5. This section presents the results as shown in Table 4.6

Table 4.6: Consultant related causes of building failure in the construction industry

No	Cause of building failure	Relative Importance Index (RII)	Rank
1	Inadequate supervision of works	0.77	1
2	Inadequate experience of consultants	0.68	2
3	Conflicts between consultant and design engineers	0.67	3
4	Late approval of changes	0.63	4
5	Rigidity of consultants	0.62	5
6	Late issuance of instructions	0.60	6
7	Inadequate experience of consultant	0.58	7
8	Schedule delays	0.57	8
9	Incomplete drawings	0.56	9
10	Poor communication/coordination of the consultant and other parties	0.53	10

Source: **Primary data**

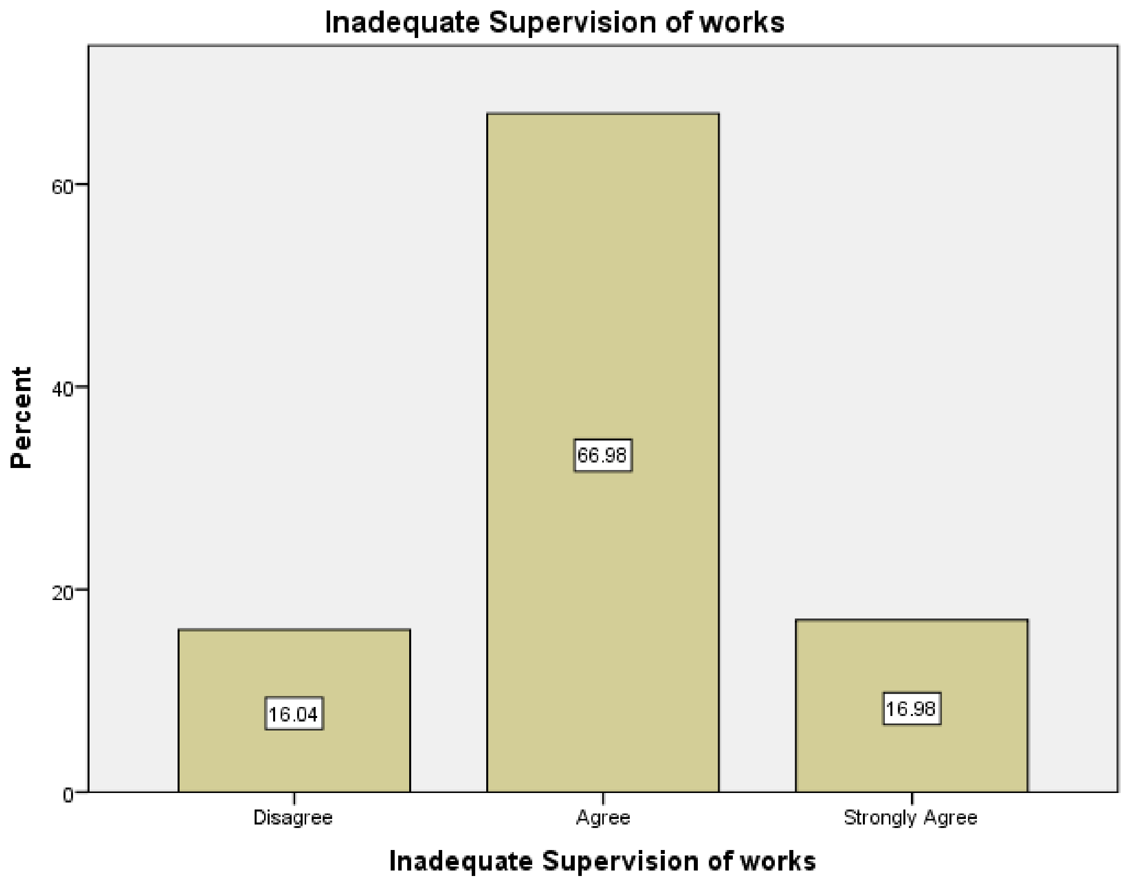

Figure 4.4**: Inadequate supervision of works**

Based on the computed Relative Importance Index (RII), the findings of the study reveal that inadequate supervision of works (RII=0.77) is the leading cause of building failure. This is in agreement with Ahzahar et. al., (2011) which revealed that, the quality of site supervision has a major influence on the overall performance and efficiency of construction projects. Inadequate supervision is believed to be one of the major causes of rework. Respondents agreed to a high extent that inadequate experience of the consultant (RII=0.68) causes building failure. According to Uthman (2014), lack of experiences and competency of labourers must be taken into account as a factor that contributes to poor workmanship, as productivity cannot be achieved by speed and harder work only without adopting better work practices. Conflicts between consultant and design engineer (RII=0.67) was ranked number three.

Incomplete drawings (RII=0.56) was ranked number nine. Complete construction plans consist of multiple sheets including architectural, mechanical engineering, electrical engineering, civil engineering, structural engineering, and possibly other disciplines. The more complex the project, the more sheets of drawings will be required.

This problem is especially common when a complex project like an apartment building has been drafted by a home builder or an architect who does not have extensive experience in larger projects. If the incomplete drawings are allowed to go to construction, they will lead to change orders when the contractor gets on site and starts pointing out the missing pieces to the owner.

Poor communication between the consultant and other parties (RII=0.53) ranked number 10. Poor communication in construction industry has been investigated extensively by many researchers and construction practitioners. It has attracted the concern of the studies due to its importance in construction industry (Dainty, 2006). It is one of the main causes of project failure which subsequently causes cost and time overruns in the form of rework occurrence and miscommunication among construction parties.

4.3.1.2 Contractor related causes of building failure

The respondents were-asked to rate their opinions on contractor related factors that influence building failures in the construction industry. The responses were measured by a five-point Likert scale: Strongly disagree, Disagree, Not sure, Agree and Strongly agree. This section presents the outcomes of the analyses as depicted in Table 4.7.

Table 4.7: Contractor related causes of building failure

No	**Cause of building failure**	**Relative Importance Index (RII)**
1	Shortage of equipment and materials	0.76
2	Financial difficulties	0.69
3	Improper construction methods	0.66
4	Poor planning and scheduling of contract activities	0.66
5	Inaccurate cost estimates	0.63
6	Poor site management and supervision of contract activities	0.57
7	Unexperienced technical staff	0.56
8	Rework due to errors during construction	0.55
9	Poor communication/coordination of the contractor and other parties	0.51
10	Poor maintenance and breakdown equipment	0.48

Source: **Primary data**

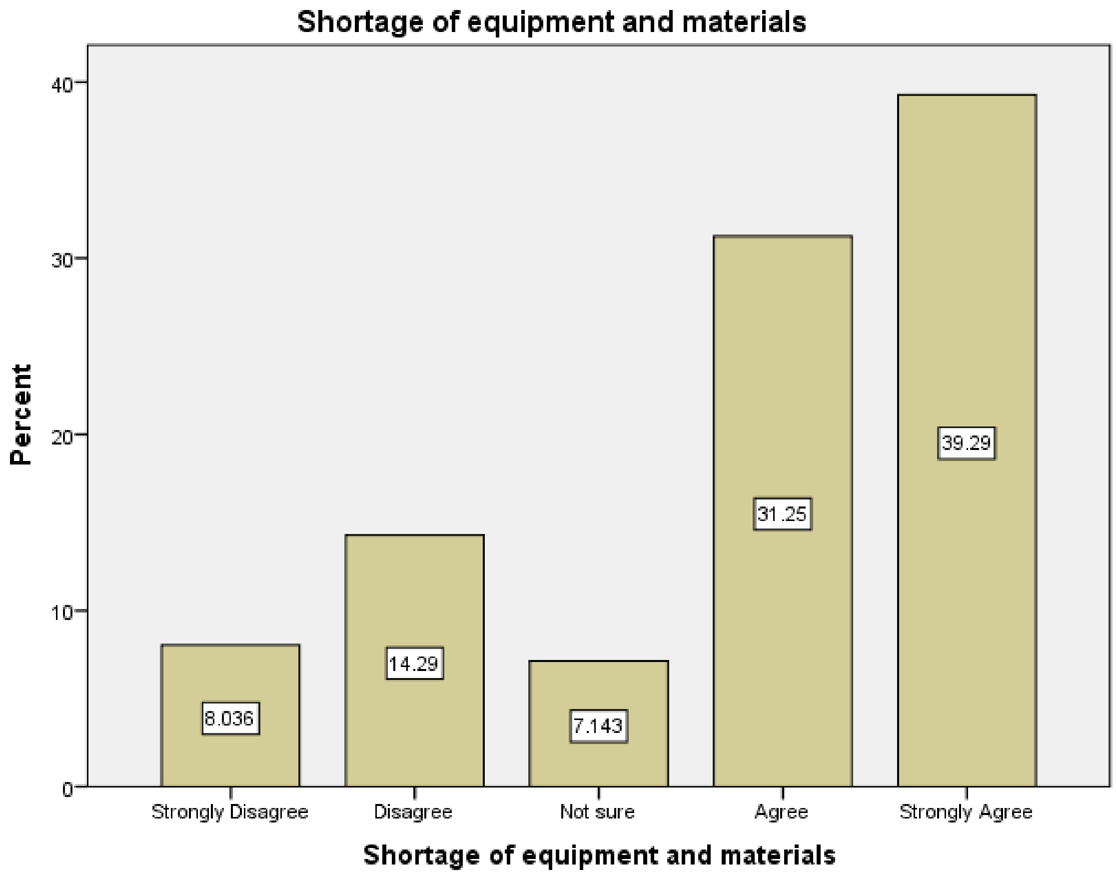

***Figure 4.5*: Shortage of equipment and materials**

The results in Figure 4.5 indicate that shortage of equipment and materials (RII=0.76) was the leading factor that causes building failure. This result is in agreement with the study by Hillebrandt (2000), where many contractors complained that they had inadequate plant and machinery, and indeed often this is the case. In many instances, however, it is not so much the absence of the plant, which is the problem but shortage of spares, which often have to be imported, as well as lack of good mechanics and capable plant operators. The reasons for shortage of both the plant and spares are basically the same as for materials. The consequences of the shortage of spares are in some ways worse than those of the shortage of the plant itself because capital has been locked up in the purchase of the plant and if that cannot be used, the capital is being wasted. In some instances, the existing plant is not being properly used.

Financial difficulties (RII=0.69) were ranked second. Money or rather lack of it is probably the most discussed problem of contractors in developing countries. Contractors need relatively few fixed assets and have a low capital base compared with other industries. They should need relatively little working capital because the traditional contractual arrangements provide for payment as the project proceeds. However, clients often do not pay the monies due to them for work done. They may be behind with payments from the first monthly certificate to the last. Final payment, including retention may never be paid (Hughes et. al., 1998). Hughes et. al., (1998) further point out that in some countries the problem is greater with public sector clients but in others the private sector is the worst payer. Reasons for lack of funds for specific projects include initial underestimation of the cost of a project. This fault may be due to inefficiency or it may be deliberate because it is easier to get the finance ministry to give approval for a cheaper project and, once it is started, it will not be stopped. Inflation may be greater than has been allowed for, especially as projects are often delayed. The detailed implications of the failure to get paid vary greatly from one country to another. Because contractors usually, for the reasons cited above, have very little collateral for loans, it is difficult for contractors to borrow from banks. Moreover, banks do not really understand the contracting process and are unable to make an assessment of risk. They are right to be suspicious, even in some developed countries, insolvencies occur more in contracting than manufacturing businesses (Hughes et. al., 1998). Similarly bank guarantees are difficult to obtain and expensive.

Improper construction methods were ranked number three with RII=0.66. This is in conformity with Basirat et. al., (2016). Substandard material especially reinforcement rods, steel sections and cement can contribute immensely to failure of buildings. Functionality in the operating environment is generally a high priority for material selection of components, especially when it comes to the long and short term safety and reliability of the equipment.

UN experienced staff (RII=0.56) was ranked number six as a cause of building failure. This is in agreement with Othman (2014). In most cases, local contractors who acquire construction contracts hire low skilled laborers who in turn demand less pay for labour costs hence maximising profits.

Further still, most of the site work and finishing works are subcontracted with the objective of creating job opportunities to the rural poor without qualification and proper on-the-job training, and subsequently the effects are manifested by poor workmanship on the buildings. Lack of experiences and competency of labourers must be taken into account as a factor that contributes to poor workmanship as "productivity cannot be achieved by speed and harder work only without adopting better work practices"(Athuman, 2014).

Kioko (2014) recommends and suggests that as responsible professionals in the built environment, it is good for the construction companies to emphasise the need for use of qualified personnel in all construction activities as a step towards restoring sanity in the industry.

Poor maintenance and breakdown of equipment was ranked number 9 with RII=0.48. This is in agreement with Premjith and Monisha (2017), who state that today's construction projects are highly mechanised and becoming more so every day. With the growing industrialisation of construction work, the role of onsite equipment and machineries is vital in achieving productivity and efficiency.

4.3.1.3 Client related causes of building failure

The respondents were requested to give their opinions on client related causes of building failure in the construction industry. The responses were measured on a five point Likert scale; strongly disagree (1), disagree (2), not sure (3), Agree (4) and strongly agree (5). The findings are presented in Table 4.8.

Table 4.8: Client related causes of building failure

No	Cause of building failure	Relative Importance Index (RII)
1	Cash flow problems	0.67
2	Unavailability of incentives	0.66
3	Slow decision making and variation orders	0.62
4	Delay in site handover	0.61
5	Lack of knowledge	0.60
6	Delay in reviewing and approving design documents	0.58
7	Suspension of works	0.56
8	Employers' interference	0.53
9	Poor communication/coordination of the client and other parties	0.52
10	Unrealistic contract duration	0.51

***Source*: Primary data**

According to the study findings, clients' cash flow problem was identified as the leading cause of building failure with RII=0.67. According to Reeves (2003), the main factor contributed by clients is when they take longer than the stipulated time in terms of the contract to certify the claim. This might be because they have become increasingly subject to claims arising out of their design and construction administration services. There are cases where clients are wrongfully withholding the payment.

Contractors are highly dependent on regular interim payments from employers during the course of construction to help discharge the debt so accrued. Therefore, when a contractor does not receive interim payments on time or in accordance with the terms agreed or for the proper amount, the interest he or she needs to pay in the form of finance charges to the bank will invariably increase. Delayed payment will also affect the contractor's performance. This is because one may lose workers. In a nutshell, delayed payments or non-payment to contractors have a negative influence on the overall construction process. It should be understood that 'the practice of efficient and timely payment in construction projects is a major factor that can contribute to a project's success (CIOB, 2004), thus mitigating building failure.

This was followed by unavailability of incentives with RII=0.66. Incentive schemes require continual review and redirection (Aina, 2011). Incentive schemes are usually utilised in the construction industry to generate higher level of performance from works, promote greater output, reduce cost of production and increase workers' earning through a system which recognises the difference in performance and ties pay of performance. Fagbenle et. al., (2004) revealed that the application of non-financial incentive schemes increases the productive time and consequently enhances productivity. The United Nations Development Programme (UNDP, 2006) asserted that incentives and incentive systems are essential to evolving capacities and to translating developed capacities into better performance.

Variation of orders ranked number three with RII=0.62. One of the major problems faced by the construction project is the issue of the variation order occurring during the construction phase (Ibb et al., 2001) which results in delaying projects, overruns the cost and causes other negative effects. Hence, it is very important to control variation orders. Variation order is the deviation experienced in any project from base contract or work scope mutually agreed at contracting time (Keane et.al., 2010). It is written agreement between the contracting parties that represent an addition, deletion, or revision to the contract documents, identifies the change in price and time, and describes the nature of the work involved (CMAA, 1993). Variation orders arise for a variety of causes, of which some causes are foreseeable and others are not.

Poor communication/coordination of the client and other parties was ranked number nine with RII=0.52. According to Mitkus (2014), communication between client and contractor is affected by so many factors such as lack of trust and inadequate responsibility, which causes misunderstanding among the two parties during the construction process that leads to conflict among them. The lack of communication between client and contractor creates fears of exploitation and betrayal, which results in avoidance of commitment of the team, thus leading to building failure (Wong et al., 2008). Unrealistic contract duration ranked number 10 with RII=0.51.

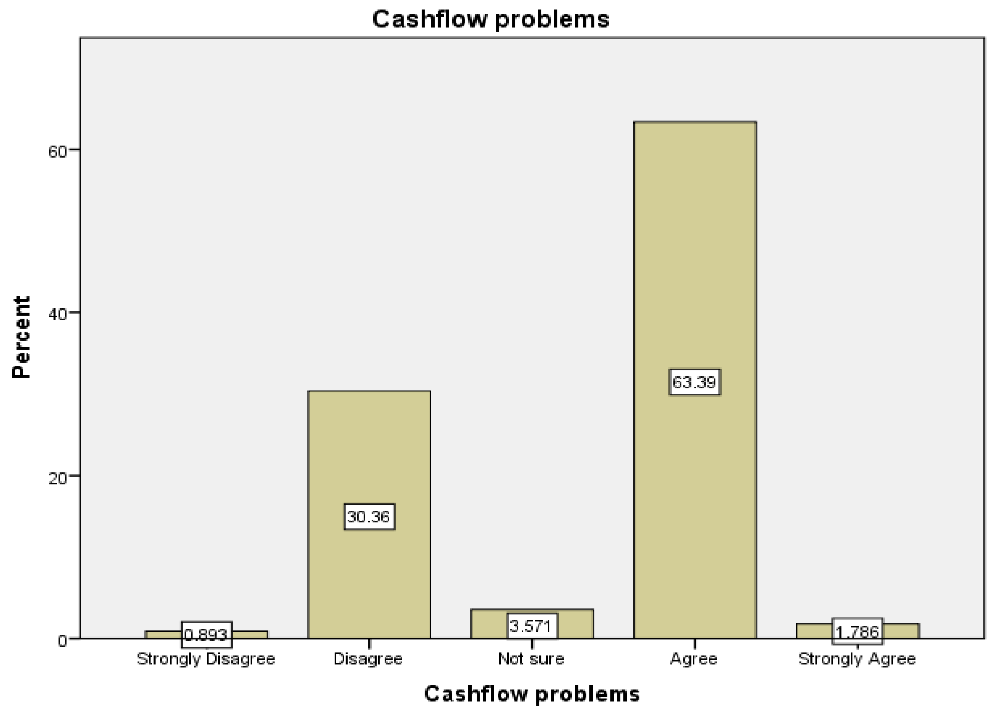

***Figure 4.6*: Cash flow problems**

4.3.1.4 External related causes of building failure

The respondents were asked to give their opinions on external related causes of building failure in the construction industry. The responses were measured by a five point Likert scale; strongly disagree (1), disagree (2), not sure (3), Agree (4) and strongly agree (5). The results are displayed in the Table 4.9.

Table 4.9: External related causes of building failure

No	Cause of building failure	Relative Importance Index (RII)
1	Inflation	0.70
2	Deferring site conditions	0.66
3	Shortage of construction materials in the market	0.64
4	Government regulations and policies	0.63
5	Labour disputes and strikes	0.62
6	Unpredicted weather	0.62
7	Unavailability of utilities on site	0.58
8	Effect of social and cultural factors	0.57
9	Accident during construction	0.50
10	Act of God	0.48

***Source*: Primary data**

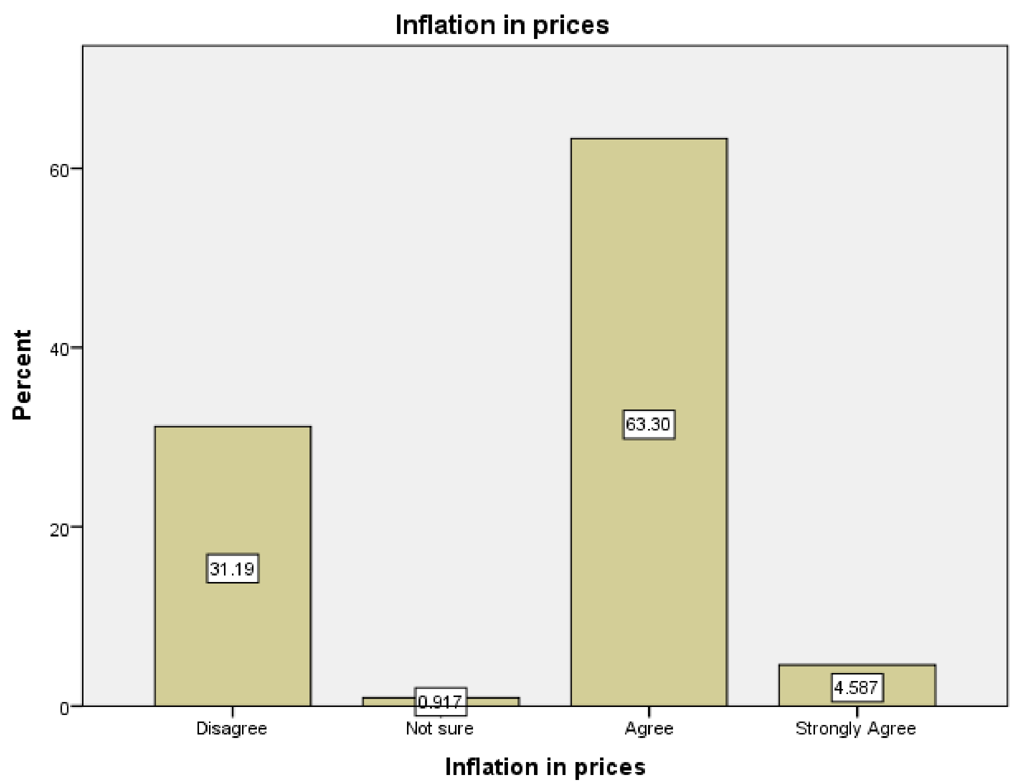

***Figure 4.7*: Inflation in prices**

Inflation in prices was ranked first with RII=0.70, Inflation causes serious problems to contractors. Oyediran (2006), observed that the rate of inflation can cause serious problems in the economic accruals or rate of return to constructors for works undertaken, thus loss of profit. In the traditional procurement method, firms price contracts, where the contractor is paid in arrears and inflation forces render submitted bids unrealistic. This has made contractors' quantity surveyors more aware of the need to price inflationary risk at the pre-contract stage to avoid building failures.

Deferring site conditions ranked second as the cause of building failure with RII=0.66. In the construction industry a "differing site condition"—or "changed condition," as it is sometimes called is generally understood to be a physical condition encountered while performing the work that was not visible and not known to exist at the time of bidding, and which materially differs from the condition believed to exist at the time of pricing the contract. Often this condition could not have been discovered by a reasonable site investigation. Examples of changed conditions or differing site condition problems include: soil with inadequate bearing capacity to support the building being constructed, soil that cannot be reused as structural fill, unanticipated groundwater (static or percolating), quicksand, muck, rock formations (excessive or insufficient quantities of rock), and artificial (man-made) subsurface obstructions.

Shortage of construction materials in the market was ranked number three with RII=0.64. If the materials needed to carry out the project are in short supply, this will lead to failure. Acts of God was ranked number 10 with RII =0.48.

4.3.2 Impact of building failure

Table 4.10: Effects of building failure

No	Effects of building failure	Relative Importance Index (RII)
1	Cracking foundation	0.70
2	Water leakage through the roof	0.68
3	Collapse, cracks	0.67
4	Cracks that affect the structure of the building	0.67
5	Cracks, weaken foundations and slabs	0.66
6	Damage to structures and contents, such as reinforcement corrosion, delamination and accelerated aging.	0.65
7	Cracks on the slab beam	0.64
8	Peeling plaster and paint	0.63
9	Cracking, weather access and corrosion	0.62
9	Crumbling and destruction of a structure	0.62
10	Building looks old and lifeless	0.58
11	Moisture damage building materials and components	0.57
12	Crack floor tile	0.55

***Source*: Primary data**

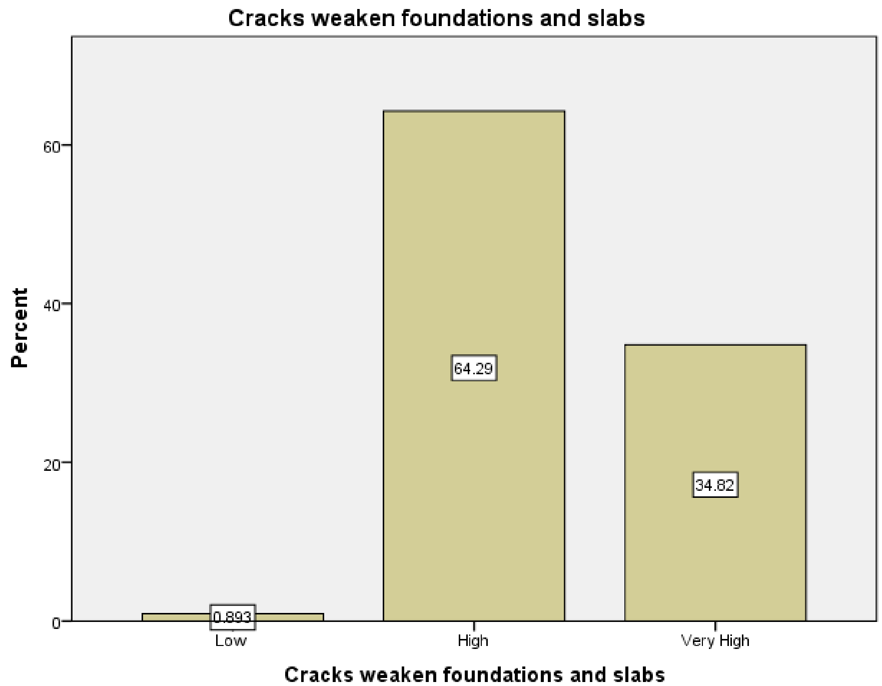

Figure 4.8**: Foundation failure**

The results in Table 4.10 indicate that cracking foundation was ranked as having the leading effect of building failure with RII=0.70. According to Rhodes & Smallwood (2002), cracks may be a sign that the foundation was laid on a poorly compacted base or poorly graded soil; wide cracks could signal a foundation problem. Generally, fine cracks are cosmetic due to normal ageing. Ahzaha et. al., (2011) states that structural defects resulting in cracks are a common type of building defect.

Cracking is normally a structural deficiency, but the nature and causes thereof might be for different reasons, e.g. material deficiencies, subsurface deficiencies or conditions. Cracks and other defects can also be the result of poor workmanship (incompetent or shortage of skilled artisans) and possibly a consequence of non-compliance with building regulations during the construction of houses. It is for this reason that the quality of site supervision is very important to ensure that defects is limited; the implementation of a quality management system will assist this process. Water leakages through the roof was ranked number two with RII=0.68. According to Chew (2005), waterproofing is known as the main contributor to the failure of buildings that leads to the moisture problems. According to Kian (2001), the wrong type of tiles and failure to observe the standard roof gradient can result in water leakage.

Cracks that affect the structure of the building were ranked third with RII=0.67. Cracks in a building are of common event. The reason for cracks is the stress component exceeding its strength component which can be correlated to the externally applied forces such as dead, live, wind or seismic loads, or foundation settlement or stresses developed internally due to thermal movements, moisture changes and/or chemical action, etc. Most buildings crack at some time during their service life. The appearance of cracks is a symptom of distress within the structure of the building. Often the cracking is of little consequence and once it is established as static, simple repair by filling or re-pointing is all that is required. However, a crack maybe the first sign of a serious defect which may affect the serviceability or the stability of the building. Structural cracks result from incorrect design, faulty construction or overloading and may endanger the safety of a building. The cracks in beam, column, slab and footing are considered as structural cracks. Crack floor tile was ranked 13th with RII=0.55.

4.3.3 Ranking the overall contribution of the causes of building failures

Descriptive statistics was run using SPSS to determine the leading contributor to the problem of building failures basing on the means. The results are displayed in Table 4.11.

Table 4.11: Consultant, Contractor and Client related causes

	N	**Mean**	**Rank**
Consultant related causes	112	3.1049	1
Contractor related causes	112	3.0273	2
Client related causes	112	2.9384	4
External related causes	112	3.0184	3

According to Table 4.11, consultant related causes have the highest impact on building failure with a mean score of 3.10. This was followed by contractor, external and client related causes respectively. This is attributed to the fact that consultants provide the technical advice and monitoring services to executors of these projects and therefore could influence the overall project performance (Damoah, 2015).

4.3.4 Determination of model parameters

In this study, regression analysis was conducted to develop the impact of the predictor variables on dependent variable. The coefficients of the parameters were estimated. In this study, correlation analysis and multiple linear regressions were used to determine the relative impact of each of the four variables with respect to causes of building failure.

4.3.4.1 Correlation analysis

Correlation analysis using Spearman's rank correlation coefficient tests the degree of agreement among the four categories of respondents.

The study had four predictor variables of building failure. The four independent variables are said to be correlated if their coefficients of correlation is greater than 0.50. As shown in Table 4.12, the matrix indicated high correlation between the independent and predictor variables; that is how consultant, contractor, client and external related factors lead to building failure in the districts of Greater Bushenyi district.

Table 4.12: Correlations

		Consultant	Contractor	Client	External	Effect
Consultant	Pearson Correlation	1	.523**	.741**	.425**	.828**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	112	112	112	112	112
Contractor	Pearson Correlation	.523**	1	.614**	.419**	.637**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	112	112	112	112	112
Client	Pearson Correlation	.741**	.614**	1	.606**	.846**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	112	112	112	112	112
External	Pearson Correlation	.425**	.419**	.606**	1	.637**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	112	112	112	112	112
Effect	Pearson Correlation	.828**	.637**	.846**	.637**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	112	112	112	112	112

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

Table 4. 13: Correlation between the predicted variable and actual independent variables

Correlations

		Effectb	Unstandardised Predicted Value
Effectb	Pearson Correlation	1	.919**
	Sig. (2-tailed)		.000
	N	112	112
Unstandardised Predicted Value	Pearson Correlation	.919**	1
	Sig. (2-tailed)	.000	
	N	112	112

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

The correlation coefficient of the predicted variable and actual independent variables is 0.919. This implies that there is a very high positive correlation between the effect of building failure and the independent variables i.e. consultant related, contractor related, client related and external related causes of building failure.

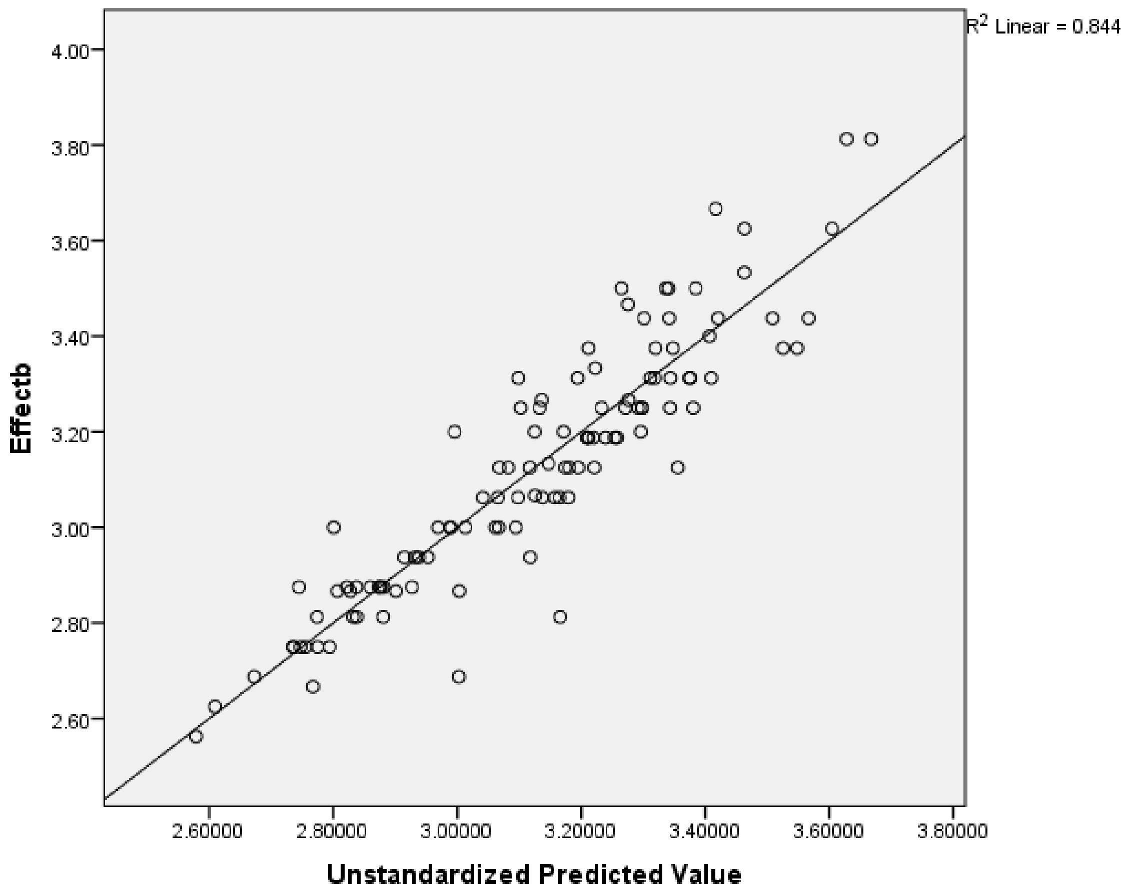

***Figure 4.9*: Scatter plot showing the relationship between the predicted variable and actual independent variables**

4.3.4.2 Regression analysis

Employing regression analysis, a multivariate linear regression model was developed to determine the relative importance of each of the four variables with respect to building failure. The regression model was developed following the general multivariate linear expression as shown in equation 4.1.

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \cdots \beta_n X_n + \varepsilon$$ …………………(Equation 4.1)

Where:

Y= Independent variable

$X_1 \ldots . X_n$= Predictor variables

α = constant

$\beta_1 \ldots . \beta_n$=Regression coefficients

ε = error term that accounts for other factors not predicted by the model

Table 4.14: Variables entered for Regression analysis

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	External, Contractor, Consultant, Client	.	Enter

a. Dependent Variable: Effect

b. All requested variables entered.

Table 4.15: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.919[a]	.844	.838	.10570

a. Predictors: (Constant), External, Contractor, Consultant, Client

Predictors: Consultant related causes of building failure, contractor related causes of building failure, client related causes of building failure and how external factors lead to building failure.

Dependent Variable: Effect of building failures

Analysis in Table 4.15 shows that the coefficient of determination (the percentage variation in the dependent variable being explained by the changes in the independent variables) R^2 equals 0.844. That is consultant related causes, contractor, client and external related factors have 84.4% percent influences on building failures, leaving only 15.6% percent unexplained. The P- value of 0.000 (less than 0.05) implies that the model is significant at 5 percent level of significance.

Table 4.16: Analysis of Variance (ANOVA)

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	6.473	4	1.618	144.855	.000[b]
	Residual	1.195	107	.011		
	Total	7.668	111			

a. Dependent Variable: Effect

b. Predictors: (Constant), External, Contractor, Consultant, Client

The purpose of the analysis of variance is to test differences in means (for groups or variables) for statistical significance. The accomplishment is through analysing the variance, which is by partitioning the total variance into the component that is due to true random error and the components that are due to differences between means. The ANOVA analysis is intended to investigate whether the variation in the independent variables explains the observed variance in the outcome. ANOVA findings (P- value of 0.00) shows that there is correlation among the predictor variables.

Table 4.17: Coefficients of the variables

Model		Unstandardised Coefficients		Standardised Coefficients	T
		B	Std. Error	Beta	
1	(Constant)	1.032	.094		11.021
	Consultant	.305	.040	.437	7.604
	Contractor	.061	.024	.126	2.569
	Client	.197	.042	.322	4.704
	External	.127	.030	.204	4.241

Dependent Variable: Impact of building failure

The established multiple linear regression equation becomes:

$Y = 1.032 + 0.305X_1 + 0.061X_2 + 0.197X_3 + 0.127X_4 + \varepsilon$……………Equation 4.2

Where;

Constant = 1.032, shows that if consultant, contractor, client and external related causes of building failure are all rated zero or are not in play, the impact of building failure would be 1.032 meaning there is impact before considering the predictor variables.

X1= 0.305, shows that one-unit change in consultant related causes of building failure results in 0.305 units increase in building failure;

X2= 0.061, shows that one-unit change in contractor related causes of building failure in 0.061 units increase in building failure;

X3= 0.197, shows that one-unit change in client related causes of building failure results in 0.197 units increase in effects of building failure;

X4= 0.127, shows that one-unit change in external related causes of building failure results in 0.127 units increase in building failure;

4.3.5 Decision Support Tool for Mitigation of building failures in the construction industry

This section illustrates decision support framework that displays and summarises proposed solutions and procedures for solving and avoiding building failures.

Table 4.18: Mitigation of elements with impact on building failures

Impact	Mitigation plan
Dampness	Control liquid water out of the structure, prevent excessive indoor humidity and water vapour migration by air flow and diffusion, and Select moisture-resistant materials for unavoidably wet locations.
Cracks in walls	Use of proper concrete mix designs, control joints and Careful back-filling.
Corrosion of reinforced steel	Design structures with Service Life in Mind, Design Structures which are Immune to Corrosion and Keep Water and Salt Away from Reinforcing Steel.
Peeling paint	Paint should be selected depending on available weather conditions.
Blemishes (scaling, honey comb)	Correct aggregate grading should be used even mixing should take place on well-sealed and leak-free

Table 4.19: Mitigation effects of building failure

Effect	Mitigation plan
Cracks in foundation	Use of proper concrete mix designs, control joints and careful back-filling
Water leakage through roof	
Cracks in the structure of the building	
Cracks weaken foundations and slabs	
Collapse, cracks	

Table 4.20 shows causes of building failure according to parties involved in the project and mitigation measures.

Table 4.20: Causes of building failure and Mitigation plan

Category	Cause of building failure	Mitigation measure plan
Consultant	Inadequate supervision	Consultant should do timely visits and inspect the site, produce weekly and monthly reports.
	Inadequate experience of consultants	Only registered professionals with valid practicing license should be allowed.
	Conflict between consultant and design engineer	Consultant should review and harmonise Design engineer's documents before works execution.
	Late approval of changes	Consultant should do timely approval changes and if not the contractor should proceed with works execution.
	Rigidity of consultants	The roles and responsibility of consultants should be clearly defined before project commencement.
Contractor	Shortage of equipment and materials	The consultant should ensure that right materials and equipment are used.
	Financial difficulties	Financial capacity of contractor should be proved before the award of contract.
	Improper construction method	Work method should be reviewed and approved by consultant.
	Inaccurate cost estimates	The contract price should be compared with reserve price. It should be +/- 5% of reserve price of consultant.
	Poor site management and supervision of contract activities	Consultants should ensure that competent contractors with qualified and experienced staff are hired for site management and supervision and regularly verified.

Table 4.20; Cont'd

External	Inflation in price	Projects should have short contract duration.
	Differing site conditions	The Professionals should ensure proper site investigations and proper analysis carried out before the commencement of any design; as such, subsoil topography and weather conditions.
	Shortage of construction materials in the market	Construction materials should be identified before commencement of project.
	Unpredicted weather	Proper investigations should be done on weather conditions.
	Labour disputes and strikes	Roles and responsibilities of every stakeholder should be clearly defined.
Client	Cash flow problems	This should be compensated by advance payment and charges for delayed payment of certified works.
	Unavailability of incentives	Client should ensure that all parties are motivated during project implementation.
	Employers' interference	The client should ensure that every stakeholder is doing their work and there is no influence to produce substandard works.
	Delay in site handover	The site should be handed over within two weeks after signing the agreement.
	Lack of knowledge	Competent contractors should be clearly identified and selected under recommendation of consultant and design engineer/architecture.

Figure 4.10 illustrates the steps and procedures recommended for action to resolve the problem of building failures and avoid or minimize them, an aide to all parties to understand the current situation and how to solve or prevent it.

According to the findings, it was established that clients had cash flow problems, unavailability of incentives and slow at decision making and variation of orders; Consultants had inadequate supervision of works, inadequate experience and conflicts between consultant and design engineer. Contractors had shortage of equipment and materials, financial difficulties and improper construction methods. External factors were inflation, deferring site conditions and shortage of construction materials in the market.

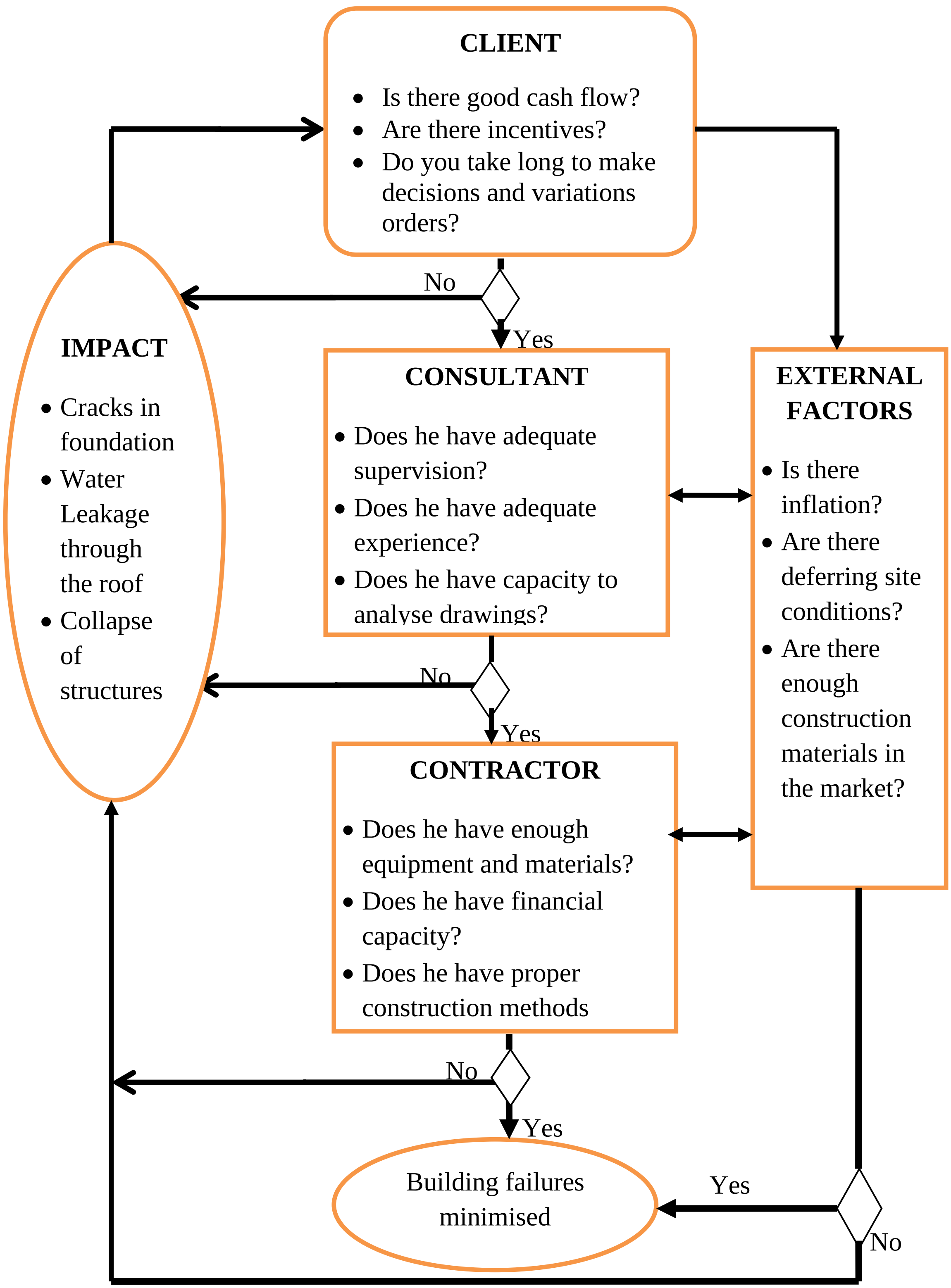

***Figure 4.10*: Decision support tool for mitigation of building failures (Researcher, 2019)**

A client develops an idea for construction of a building structure that meets his intended needs. The client should have good cash flow, incentives, and quick decision and variation orders for the intended structure; if yes, he engages the consultant and if not, the project should not proceed. During selection of the consultant, the client should select a consultant that has adequate experience, adequately supervise and capacity to analyse the drawing; if not, another consultant should be selected and analysed but if yes, the consultant should assist the client in selection of a competent contractor. The contractor should have enough equipment and materials, financial capacity and proper construction method of proposed works; if not, another contractor should be selected and analysed but if yes construction should commence since building failures shall be minimised.

External factors like inflation, differing site conditions and availability of construction materials in the market may affect the building structure but if these factors are available, they will affect the client in rong run.

The decision support tool shall greatly reduce cracks, water leakages through roof and collapse of structures, thus minimising building failures in the construction industry if properly used.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the study findings, discussions, conclusions and recommendations. It also entails suggestions for further research. The findings are summarised in line with the objectives of the study, which was to establish the causes of building failure, to evaluate the impact of building failure in the construction industry in Uganda, to develop a decision support tool for use in the mitigation of building failures in the construction industry.

5.2 Summary of Findings

5.2.1 Consultant related causes of building failure

The study found out that inadequate supervision of works was the leading cause of building failure with RII=0.77. This is in agreement with Ahzahar et. al., (2011), the quality of site supervision has a major influence on the overall performance and efficiency of construction projects. Inadequate supervision is believed to be one of the major causes of rework. Respondents agreed that inadequate experience of the consultant is the second cause of building failure with RII=0.68. Conflicts between consultant and design engineer with RII=0.67, was ranked number three.

5.2.2 Contractor related causes of building failure

Respondents agreed shortage of equipment and materials leads to building failure with RII=0.76. This is in agreement with the study by Hillebrandt (2000) where many contractors complained that they have inadequate plant and machinery and indeed often, this is the case. In many instances, however, it is not so much of the absence of the plant, which is the problem but shortage of spares, that often have to be imported, and lack of good mechanics and capable plant operators. Financial difficulties were ranked second with RII=0.69**.** Improper construction methods and poor planning and scheduling of contract activities both ranked number three with RII=0.66.

5.2.3 Client related causes of building failure

Most respondents agreed that clients' cash flow problems is the major cause of building failure with RII=0.67. This was followed by unavailability of incentives with RII=0.66., slow decision making and variation of orders ranked number three with RII=0.62.

5.2.4 External related causes of building failure

Inflation in prices ranked first with RII=0.70. Inflation causes a serious problem to contractors. Oyediran (2006), observed that the rate of inflation can cause serious problems in the economic accruals or rate of return to constructors for works undertaken, thus loss of profit. In the traditional procurement method, firm price contracts, the contractor is paid in advance. Inflationary forces render submitted bids unrealistic. This has made contractors' quantity surveyors more aware of the need to price inflationary risk at the pre-contract stage.

5.3 Impact of building failure in the construction industry

According to the study, cracking foundation was ranked number one as the leading effect of building failure with RII=0.70. According to Rhodes and Smallwood (2002), cracks may be a sign that the foundation was laid on a poorly compacted base or poorly graded soil; wide cracks could signal a foundation problem. Generally, fine cracks are cosmetic due to normal ageing. Water leakages through the roof was ranked number two with RII=0.68. According to Chew (2005), waterproofing is known as the main contributor to the failure of buildings that leads to the moisture problems.

Cracks that affect the structure of the building were ranked third with RII=0.67. The reason for cracks is the stress component exceeding its strength component, which can be correlated to the externally applied forces such as dead, live, wind or seismic loads, or foundation settlement or stresses developed internally due to thermal movements, moisture changes and/or chemical action, etc. Crack floor tile was ranked 13^{th} with RII=0.55.

5.4 Conclusions

Based on findings, the study concluded that there is a great influence of consultant related, contractor related, client related and external related causes of building failure. The study established that the quality of site supervision has a major influence on the overall performance and efficiency of construction projects. Quality assurance can reduce or eliminate defects by implementing quality-management system.

Although the research results are limited to the views of respondents in the districts of Greater Bushenyi only, there is no reason to believe that this is not the same for the other districts of Uganda.

5.5 Recommendations

Based on the findings and conclusions, the study recommends that stakeholder engagements to ensure that ideas and perspectives are represented; members of stakeholder groups should be invited to participate in project scope identification and planning. Participation improves the quality project management and that of evaluations: accuracy of information, increased credibility and acceptance of findings, and better correspondence to the practical concerns of stakeholders.

The study recommends that where necessary, skill levels should be enhanced to meet the needs of the construction project. Investment in developing such capacity for construction project teams is necessary. Although contractors are aware of the shortage of skills within the construction industry, more should be done to encourage education and training. Contractors should take the initiative to encourage their employees to obtain further education or training. This must be regarded as growth within the organisation and not as an expense or a burden. The study also recommends that various relevant government agencies should allocate enough resources needed for construction of the project, and monitoring and evaluation, and agree on a practical arrangement to financially support the associated activities. The study also recommends that organisations should consider adopting modern information and communication technologies in carrying out monitoring and evaluation activities. The study further recommends that where necessary, skill levels should be enhanced to meet the needs of M&E systems and that project leaders should allocate enough resources needed for monitoring and evaluation, and agree on a practical arrangement to finance the associated activities.

With regard to the causes of defects, it is recommended that professionals, especially contractors, concentrate on improving or implementing an effective quality-management system. They should also consider the factors relating to defects more deeply, so that preventative action can be taken at the outset of a project, as well as in the long term. Defects must be viewed as a risk due to the likely financial implications. The professional teams must ensure that they become more knowledgeable with regard to the effects of defects. Defects do increase the project restrictions of time and cost, and affect other elements such as quality.

Professionals must ensure that they concentrate on identifying and exposing corrupt activities within the construction industry. Corrupt activities within the industry portray a negative image of Uganda to the rest of the world and decrease our investment potential. This has a negative effect on all construction professionals. The government also has a role to play in countering corruption by informing members about the consequences of corruption as well as identifying and reporting corrupt practices to the authorities. For cash flow management, clients should adopt 'financial assignment' to deal with suppliers in order to supply materials to the contractor and obtain direct payment from client. Clients should be educated on the importance of 'cash flow management' and the 'financial management' in order to have a well cash flow management.

Banks should provide financing needs to most of the construction projects in order to solve most of the cash flow problems on the client's side. Also the delay in accessing funds should be minimised by speeding up the process.

Legal issues should be revised to guide contractors and clients so as to simplify the payment problems and refund processes. These problems can be mitigated by effecting of law in terms and conditions through setting a provision to deal with them. Strict actions should be placed on bad payment culture and executed, and the time of money flow between all parties legally should well stipulated.

Lastly, concerning faulty construction, professionals must ensure that they reduce or eliminate defective work within the industry. Competent people must be appointed to ensure that the technical requirements are being met. Professionals must be familiar with the relevant requirements of building standards and codes; if they are not, they must be educated or trained. Experienced construction industry professionals must be utilised to educate the youth to ensure that lessons learnt in the past can be applied in future.

5.6 Areas for further research

Further research needs to be carried out on client project financing, to find out how it should be done and establish whether it sustains project. The influence of the construction external related causes, such as changes in the prices of the materials needs to be studied so that it is understood.

Areas that requires training and contracts related issues need further research to establish how best they should be done. The future and improvement of the performance of the construction industry in Uganda with respect to quality supervision of works and any other part of construction can be achieved through research. This study has proposed the nature of research in the construction industry. The contest ahead is to make research part and parcel of the process of construction, and to utilise the result for the benefit of the construction industry.

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APPENDIX I: QUESTIONNAIRE

MITIGATION OF BUILDING FAILURES IN UGANDA'S CONSTRUCTION INDUSTRY: A CASE STUDY OF GREATER BUSHENYI DISTRICT

Dear respondent,

I am called Twinamatsiko Dicklus, a graduate student from Kyambogo University. This research is aimed at developing a decision support tool to be used for mitigating building failures in Uganda's construction industry. This study is part of the requirements for the award of a degree of Master of Science in Construction Technology and Management of Kyambogo University.

The findings will be used mainly for academic purposes but also the tool developed will be used by stakeholders in the construction industry. Your response will be treated with absolute confidentiality, so please be as honest as you can in your responses.

Thank you, in advance, for your positive participation.

SECTION A: BACKGROUND INFORMATION.

Read and complete this section by ticking the right option.

1. Gender Male ☐ Female ☐

2. Age

Below 20years ☐ 21–30years ☐ 31–40years ☐ 41–50years ☐ above 50 years ☐

3. What position do you hold in the company?

Supervising Engineer ☐ Site Engineer ☐ Site Foreman ☐ Clerk of Works ☐ Client ☐

Others; please specify. ………………………………………….

4. Years of experience in the construction industry.

Below 5years ☐ 5–10years ☐ 10–15years ☐ 15–20years ☐ above 20 years ☐

SECTION B: Causes of building failures in the construction industry

B1. Consultant related causes

Using a scale of 1-5, show to what extent you agree or disagree with the following causes of building failure by ticking.

No	Causes of building failure	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
		1	2	3	4	5
1	Incomplete drawings					
2	Inadequate supervision of works					
3	Late issuance of instructions					
4	Late approval of changes					
5	Rigidity of consultants					
6	Schedule delays					
7	Poor communication/ coordination of the consultant and other parties					
8	Delay in certification of works					
9	Inadequate experience of consultant					
10	Conflicts between consultant and design engineer					
	If others please specify					

B2. Contractor related causes

Using a scale of 1-5, show to what extent you agree or disagree with the following causes of building failure by ticking.

No	Causes of building failure	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
		1	2	3	4	5
1	Financial difficulties					
2	Inaccurate cost estimates					
3	Unexperienced technical staff					
4	Poor planning and scheduling of contract activities					
5	Shortage of equipment and materials					
6	Poor maintenance and breakdown equipment					
7	Poor site management and supervision of contract activities					
8	Rework due to errors during construction					
9	Improper construction methods					
10	Poor communication/ coordination of the contractor and other parties					
	If others please specify					

B3. Client related causes

Using a scale of 1-5, show to what extent you agree or disagree with the following causes of building failure by ticking.

No	Causes of building failure	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
		1	2	3	4	5
1	Cash flow problems					
2	Delay in site handover					
3	Delay in reviewing and approving design documents					
4	Poor communication/ coordination of the client and other parties					
5	Unrealistic contract duration					
6	Slow decision making and variation orders					
7	Lack of knowledge					
8	Employers' Interference					
9	Suspension of works					
10	Unavailability of incentives					
	If others please specify					

B4. External related causes

Using a scale of 1-5, show to what extent you agree or disagree with the following causes of building failure by ticking.

No	Causes of building failure	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
		1	2	3	4	5
1	Inflation in prices					
2	Unpredicted weather					
3	Shortage of construction materials in the market					
4	Labour disputes and strikes					
5	Effect of social and cultural factors					
6	Deferring site conditions					
7	Government regulations and policies					
8	Acts of God					
9	Unavailability of utilities in site					
10	Accident during construction					
	If others please specify					

SECTION C: To evaluate the frequency and impact of building failures in the construction industry

From the list of building defects and effects given below, tick impacts and frequency of occurrence of each on the construction industry.

Frequency of defects occurrence in construction industry on projects handled			
Very frequent	Frequent	Low frequent	Very low frequent
4	3	2	1

Impact of defects in construction industry on projects handled			
Very High	High	Low	Very low
4	3	2	1

No	**Defect**	**Effect**	**Frequency**				**Impact**			
1	Blemishes (Scaling, Honeycomb)	Peeling plaster& paint	4	3	2	1	4	3	2	1
2	Corrosion of reinforced steel	Cracking, weather access and corrosion.	4	3	2	1	4	3	2	1
3	Damage of exterior surface	Moisture damage building materials and components.	4	3	2	1	4	3	2	1
4	Dampness	Corrosion of metallic fixtures, Removal of plaster and Reduces the life of structures.	4	3	2	1	4	3	2	1
5	Peeling paint	Building looks old and lifeless.	4	3	2	1	4	3	2	1
6	Roof defect	Water to go inside the building through the roof	4	3	2	1	4	3	2	1
7	Cracking (Floor, Beam etc)	Cracks will affect the structural of the	4	3	2	1	4	3	2	1

		building								
8	Spalling/ Chipping	Crumbling and destruction of a structure	4	3	2	1	4	3	2	1
9	Foundation failure	Cracks	4	3	2	1	4	3	2	1
10	Structure instability	Collapse, cracks	4	3	2	1	4	3	2	1
11	Water seepage	Damage to structures and contents, such as reinforcement corrosion, Delamination and accelerated aging.	4	3	2	1	4	3	2	1
12	Delaminate/ Discoloured tiles	Building looks old and lifeless	4	3	2	1	4	3	2	1
13	Exposed rebar	Cracks, weaken foundations and slabs	4	3	2	1	4	3	2	1
14	Hollowness below tiles	Crack floor tile	4	3	2	1	4	3	2	1
15	Cracks in walls	Cracks will affect the structural of the building	4	3	2	1	4	3	2	1
16	Visible sunk slab beam	Cracks	4	3	2	1	4	3	2	1
	If others please specify									
			4	3	2	1	4	3	2	1
			4	3	2	1	4	3	2	1
			4	3	2	1	4	3	2	1
			4	3	2	1	4	3	2	1

SECTION D: To establish a decision support tool for use in mitigation of building failures in the construction industry

1. Is there any decision support tool used to mitigate building failures in the construction industry in Greater Bushenyi Districts?

YES ☐ NO ☐ NOT SURE ☐

2. If yes, mention the tool, author and year of publication.

…………………………………………………………………………………………………

3. Have you ever used a decision support tool in construction industry?

YES, ☐ NO ☐ NOT SURE ☐

4. Do you think a decision support tool can improve building failures in the construction industry?

YES ☐ NO ☐ NOT SURE ☐

5. If yes or no, briefly explain your answer in 4 above.

…………………………………………………………………………………………………

6. Mention any other element you think should be added to the decision support tool to be used for mitigation of the building failures in the construction industry.

……………………………………………...

THE END

THANK YOU VERY MUCH

APPENDIX II: PUBLICATION