

**FACTORS INFLUENCING QUALITY OF RESIDENTIAL BUILDINGS  
PROJECTS: A CASE OF KASARANI CONSTITUENCY IN NAIROBI  
COUNTY, KENYA**

**BY**

**KENNEDY KIBUCHI KIMARU**

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of Master of Arts in Project Planning and Management of the University of Nairobi**

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## DECLARATION

This research report is my original work and has not been presented for the award of a degree in the University of Nairobi or any other Institution.

Signed:



Date: 9<sup>th</sup> December 2021

**Kennedy Kibuchi Kimaru**

**L50/88072/2016**

This research report is submitted for examination with my approval as the University of Nairobi supervisor.

Signed:



Date: 9<sup>th</sup> December 2021

**Prof. Timothy Maitho,**

Department of Public Health, Pharmacology and Toxicology,

University of Nairobi.

## **DEDICATION**

I dedicate this research work to my parents Zachary Kimaru and Jane Kimaru, and special appreciations for your constant encouragement throughout my studies.

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## **ABBREVIATIONS AND ACRONYMS**

<b>AAK</b>	Architectural Association of Kenya
<b>BIM</b>	Building Information Modeling
<b>BORAQS</b>	Board of Registration of Architects and Quantity Surveyors
<b>CAD</b>	Computer Aided Design
<b>CSR</b>	Corporate Social Responsibility
<b>EBK</b>	Engineers Board of Kenya
<b>ICPMK</b>	Institution of Construction Project Managers of Kenya
<b>IEK</b>	Institution of Engineers of Kenya
<b>IQSK</b>	Institute of Quantity Surveyors of Kenya
<b>KNBS</b>	Kenya National Bureau of Statistics
<b>KPDA</b>	Kenya Property Developers Association
<b>NCA</b>	National Construction Authority
<b>QS</b>	Quantity Surveyor
<b>SPSS</b>	Statistical Package for Social Sciences
<b>VRML</b>	Virtual Reality Modeling Language

## ABSTRACT

In the last three decades, the buildings industry has experienced challenges of quality which are complex and different. The buildings industry in Kenya has been associated with disruptions in quality therefore causing cost and time problems. Many of the quality challenges are a product of inadequate planning. In Kenya, there have been reports of poor administration of residential buildings projects, a superfluous surge in project usage lacking organization and budgetary arrangements, and exorbitant project management. Unsafe residential buildings have become rampant in the recent past, especially in the Nairobi Metropolitan region. The purpose of the study was to assess the factors which influence quality of residential buildings projects in Kasarani Constituency of Nairobi County. The following specific objectives guided the research; to assess the influence of construction equipment, project funding, project management, and modern technology on quality of residential buildings projects in Kasarani Constituency of Nairobi County. The study adopted a descriptive survey research design targeting practitioners in the residential building industry including Architects, Civil and Structural Engineers, Mechanical Engineers, Electrical Engineers, Land Surveyors, Quantity Surveyors, Construction Project Managers and Private Developers. The sample size was 385 respondents, and the non-probability sampling technique was used in the study. Data collection in the study was done by administering questionnaires and carrying out interviews. Descriptive statistics, such as frequency, means, percentage and standard deviation, were used to interpret the data. A regression analysis was conducted in order to show how construction equipments, project funding, project management and modern technology influence quality of residential buildings projects in Kasarani Constituency of Nairobi County. There was a positive and significant relationship between construction equipment ( $r=0.695$ ,  $p\text{-value} < 0.05$ ) and quality of residential building projects in Kasarani Constituency of Nairobi County. There was a positive and significant correlation between project funding ( $r=0.831$ ,  $p\text{-value} < 0.05$ ) and quality of residential building projects in Kasarani Constituency of Nairobi County. There was a positive and significant relationship between project management ( $r=0.776$ ,  $p\text{-value} < 0.05$ ) and quality of residential building projects in Kasarani Constituency of Nairobi County. There was a positive and significant relationship between modern technology ( $r=0.743$ ,  $p\text{-value} < 0.05$ ) and quality of residential building projects in Kasarani Constituency of Nairobi County. This implied that the nature of construction equipment, the level of project funding and project management as well as the level of application of modern technology were positive determinants of quality of residential building projects in Kasarani Constituency of Nairobi County. The recommendations are that the right construction equipment should be used in the construction of residential buildings. Competent project managers should be engaged in order to manage the construction of residential buildings. Clients and contractors should have enough cash flow in order to execute projects. Appropriate technologies such as Building Information Modelling should be adopted quickly in the residential buildings sector in order to minimize errors, and improve quality of works. The study recommends that a similar study should be carried out in other Constituencies in the Country since this study was only limited to Kasarani Constituency of Nairobi County.

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background of the Study

The conceptual changes in the building industry have popularized the issue of quality. Consequently, quality and quality systems subject has increasingly received scholarly attention globally (Oke, Aigbavboa and Dlamini, 2017). In any industry, the end product should meet certain set standards, and be satisfactory to the client. The need for achievement of excellence in the building industry can thus not be overemphasized. The management of quality in the building construction industry is therefore an important area that is highly researched from many perspectives including total quality control, quality performance management systems, cost of quality, and best practice among others. All these efforts have resulted in improved ways of looking at the building construction industry's quality management.

Courtesy of competitiveness in the building industry, attention on the excellence in performance of construction projects has increasingly become important. In light of this, it has become imperative to establish quality factors in the construction industry. Project managers must thus have means of ascertaining and controlling quality in building construction projects.

Naoum (2016) established that the factors which influence quality of building construction projects include; site layout, designs, subcontractors involved, nature of contract, materials used, nature of labour, equipment used, site personnel, and style of execution of the project. Compliance with codes and regulations, client specifications, design and procedures, scheduling requirements, cost requirements and constructability are factors that influence quality of building construction projects (Abas, Khattak, Hussain, Maqsood and Ahmad, 2015).

From the different studies, it is clear that quality is an intangible term and more so in the construction industry. Construction projects involve multidisciplinary teams with each discipline having a different definition of success and failure depending on individual goals and objectives. Consequently, the definition of quality as a first step is important for assessment of different projects. Quality is looked at in terms of compliance to timelines and client satisfaction. Success or failure of construction projects is contributed by many factors. The factors which influence the success of residential construction projects is examined when it

comes to the development of tools that are critical in controlling project cost and scheduling (William and Dettmer, 2017).

Across the globe, the construction industry has had a mix of success and failures courtesy of an array of influencing factors. A research by Sinesilassie et.al, (2018), examining the factors which influence performance of local building construction projects in the Middle East revealed that quality in the construction industry is influenced by material costs, availability of financial resources, the average delay due to closure resulting in material shortage, staff expertise, the project manager's leadership skills, standard of machinery, and raw materials used in the project. According to Burgess and Stern (2020), the quality process in the construction industry is positively influenced by factors such as commitment by the management. Commitment by management ensures continuous improvement in quality. Equipping of personnel with appropriate skills positively influences the quality process.

In Africa, a study done in Egypt by Willar, Coffey and Trigunarsyah (2015) observed that compromise in quality in the building industry has devastating effects and as such project managers need to take specific actions to ensure quality. Among the actions they suggested include, coming up with appropriate goals and objectives, setting up a good administrative structure, establishing public relations practices, obtaining professional and technical staff, ensuring a pleasant working atmosphere and adequate technological resources and encouraging workers to advance their careers.

In Kenya, in the last three decades, the building construction industry has grown exponentially. The industry has developed to become one of Kenya's most important sectors, contributing significantly to the country's growth. The construction industry in Kenya has been frequented by sporadic disruptions and delays leading to cost and time overruns. These interferences are the origin of possible hazards; which present studies researching on how to control these hazards are currently looking into. Possible control measures include: technological, economic, legal, financial and commercial (Gaba, 2019).

Funding the construction industry is done with an intention of gaining payback from the ventures. The building industry is recognized as a material depleting and time-consuming industry. This is due to its uncertainty and instability, which is brought about by a wide range of desires, requirements, and tastes. No investor will put money into a project with unknown costs or schedules. A study done by Holden (2018) established that time and cost are inextricably linked in the construction industry. The study shows that construction programmes

have a start and end date, use money, and must meet certain conditions in order to satisfy the beneficiaries. Additionally, contracts are often dependent on the expense and turnaround time.

In context, there are no studies which have been conducted in relation to the quality of residential building projects and factors such as construction equipment, project funding, project management and modern technology in Kasarani Constituency of Nairobi County. Consequently, this research was carried out to fill in the knowledge gaps by assessing the factors which influence the quality of residential building projects in Kasarani Constituency of Nairobi County.

## **1.2 Problem Statement**

The population in urban areas is estimated to rise to around 2.5 billion people by the year 2050 with Africa and Asia expected to have 90% of this growth (World Bank, 2021). Currently, the lack of affordable housing is approximated to be at 350 million households in the cities. By 2025, it is projected to grow by at least 30% to 440 million households with 1.6 billion people (King et al., 2017). As a result, many cities are encouraging its residents to move to the urban periphery in order to solve this problem. To this end, this approach itself is a problem on its own since it cuts off people from economic opportunities and social networks. Consequently, contractors are in a rush to complete construction development projects with residential buildings being at the center-stage (Carter, 2018). The requirement for accomplishing quality projects in building development is essential. Quality is a fundamental component of manageability and consumer loyalty. Activities such as production, procurement of building materials or the supply of construction facilities has guaranteed the survival of construction firms (DFID, 2020). To achieve success and productivity, construction firms aim to increase the efficiency of their goods in the market. In building projects, the project manager's role is to execute successful projects that meet the agreed-upon targets and bring value to the project. The literature indicates that the management process of the project is aimed at achieving effective projects (Demirkesen and Ozorhon, 2017). In the design of buildings, quality control has become exceedingly important. If quality is properly controlled, the success of the project and the viability of the organization can increase (Leng, 2018).

Yap, Chow and Shavarebi (2019), stated that most quality problems reported in projects under construction are as a result of inexperienced planning and execution. Project management, issues with technology, site-related challenges, ineffective procedures, equipment cost overruns, completion time, safety and health, environment, customer satisfaction, and

communication are defined as factors which influence quality of building construction projects. A report by The Standish Group (2015) shows that cost overruns ranged from 51% to 100% on 29.6% of the projects investigated. 35.5% of projects have gone over budget by 101% to 200%, and 39.1 % of projects have changed from the original schedule by 75% to 99%. For all businesses, the average rise from the initial estimate cost is 189% to 222%. More than a quarter of the projects are finished with just 25% to 49% of the characteristics and intent stated at the start. In Kenya, there have been reports of poor administration undertakings, a superfluous surge in project usage, lacking organization and budgetary arrangements, and exorbitant project management (Arrow and McGrath, 2019). Kenya has a huge housing shortfall, which is developing each year and is progressively passive in urban zones and especially Nairobi County. As per the Ministry of Housing statistics, the present yearly housing shortfall is assessed to be more than 156,000 units given the population development and urban relocations (KNBS, 2020). The speed of building is still restricted to slightly above 50,000 units built annually and the remaining part is filled by growth in slum existence and poor-quality housing (Blake, 2018). Recent research has been done on factors which influence construction projects, however, the lack of consistent studies, scarcity of data, and a lacuna in the studies present a clear problem on quality of residential building projects. Therefore, this research was done to address this deficiency in the body of knowledge by studying the factors which influence quality of residential building projects in Kasarani Constituency of Nairobi County.

### **1.3 Purpose of the Study**

The purpose of this study was to assess the factors which influence quality of residential buildings projects in Kasarani Constituency of Nairobi County.

### **1.4 Objectives of the Study**

The following objectives guided the study:

- i. To assess the influence of construction equipment on quality of residential buildings projects in Kasarani Constituency of Nairobi County.
- ii. To assess the influence of project funding on quality of residential buildings projects in Kasarani Constituency of Nairobi County.
- iii. To assess the influence of project management on quality of residential buildings projects in Kasarani Constituency of Nairobi County.

- iv. To assess the influence of modern technology on quality of residential buildings projects in Kasarani Constituency of Nairobi County.

### **1.5 Research Questions**

The research was guided by the following research questions;

- i. What is the influence of construction equipment on quality of residential buildings projects in Kasarani Constituency of Nairobi County?
- ii. How does project funding influence quality of residential buildings projects in Kasarani Constituency of Nairobi County?
- iii. How does project management influence quality of residential buildings projects in Kasarani Constituency of Nairobi County?
- iv. How does modern technology influence quality of residential buildings projects in Kasarani Constituency of Nairobi County?

### **1.6 Significance of the Study**

Data collected in this study will help policy-makers in order to understand the factors which influence quality of residential buildings projects in Kasarani Constituency of Nairobi County. Policy-makers will be in a position to develop, devise, and enforce policies which are effective in order to ensure quality and affordable residential buildings in the Country.

The analysis will assist the different stakeholders in the building industry to improve the quality of building projects which would then save their money and time.

The findings of this study will benefit building contractors in Kenya. By using broken down results, contractors will get to know the causes of poor quality residential building projects and be aware of the best solutions with regards to performance in their pursuit of increased return and sustainability.

The study findings will benefit academicians, scholars and researchers since the study will provide directions for further studies. The research report will be published and used as a repository in the University of Nairobi library hence it will be used as a source of reference in the future.

### **1.7 Limitations of the Study**

With the numerous stakeholders in the construction sector, the problem of project financing has been a very sensitive subject. Many were suspicious and reluctant to supply information. This problem was addressed by permitting those who were willing to take part in the study. Some questionnaires were not returned to the researcher on time. The researcher reassured the respondents of anonymity and that the information gathered was strictly for academic objectives in order to break confidentiality and lack of openness owing to secrecy and confidentiality policies at most institutions.

Another limitation was the inability to include more construction firms and consultants around the Country, since this study focused on buildings contractors, consultants and clients within Kasarani Constituency of Nairobi County.

### **1.8 Delimitations of the Study**

The study examined the influence of construction equipment, project financing, project management and modern technology on quality of residential buildings projects. The focus of the study was on the major players in the building construction industry including: Contractors, Technicians, Civil & Structural Engineers, Architects, Mechanical Engineers, Electrical Engineers, Quantity Surveyors and Building Owners. In order to enhance the accuracy of insights and information, the study used a large sample. The research was carried out on residential building projects in Kasarani Constituency of Nairobi County.

### **1.9 Basic Assumptions of the Study**

The answers to the research instruments was impartial and honest. The research assumed that the managers of the various companies gathered data from their employees with the appropriate consent. The makeup of the target population, which affected the efficacy of the sample, was also anticipated not to vary in a serious way.

### **1.10 Definition of Significant Terms**

**Construction Equipment:** These are the machinery or hand tools used in a construction project.

**Project:** This refers to activities undertaken towards the achievement of a particular goal.



<b>Project funding:</b>	Sum of money budgeted and used to facilitate the accomplishment of the project being constructed.
<b>Project management:</b>	Refers to processes, techniques, expertise, information and experience that is used to accomplish particular project objectives.
<b>Modern Technology:</b>	Is the group of innovated tools, modifications of machinery, software's etc., which are used to enhance construction.

### **1.11 Organization of the Study**

The first chapter contains the introduction of the study, statement of the problem and purpose of the study. This is followed by the research objectives, research questions, significance of the study, limitations of the study, delimitations of the study, basic assumptions of the study, definition of significant terms, and concludes with the organization of the study. Chapter Two covers literature review from various sources in order to establish work done by other researchers, their findings, conclusions, and identification of knowledge gaps which forms the basis of setting objectives and research questions of the study. The theoretical and conceptual frameworks are also explained. Chapter Three covers research methodology, design, target population of the study, sample size and sampling procedures. This is followed by data collection procedures, data collection instruments, the validity of the instruments, reliability of instruments, data analysis techniques, ethical considerations and concludes with operationalization of the variables. Chapter Four covers data analysis, presentation and interpretation of the findings. Chapter Five contains summary of findings, discussion, conclusion, and recommendation of the study. The chapter also includes areas for further research and contributions to the body of knowledge.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter contains relevant literature related to the study. This chapter contains an overview of the factors which influence quality of residential buildings projects from a global perspective, regional perspective and a local perspective with regards to the four objectives of construction equipment, project funding, project management, and modern technology. It contains the theoretical review, conceptual framework, knowledge gaps, and empirical reviews that support the variables under investigation. The section also presents a summary of the literature review.

#### **2.2 An Overview of Quality of Residential Buildings Projects**

One of the main indicators of performance in a residential building project is quality (Muriithi and Mwenda, 2021). Kerzner (2017) defines quality as those products and services that are perceived to meet the expectations and needs of the customer at a cost that represents value. Poor contractor job efficiency may cause project delays due to rework, thereby pushing the client's budget out of control. The quality of works for the contractor becomes vital because the contractor's efficiency contributes to increased customer loyalty, a boost in the contractor's image and thereby increased construction productivity in the market (McCord et al., 2015).

The key performance indicators for construction projects defined by Bryan, Darrin and Wolf (2020) are efficiency, financial stability, good client relationships, good management skills, good consultant relationship, no contractual conflicts, subcontractor partnerships, time efficiency, client satisfaction and good communication (Cheungel et al., 2016). A control system is essential for identifying factors which influence quality of residential building construction projects.

Human factors, according to McCord et al., (2015) play a significant role in measuring project success. Early contractor and supplier involvement, according to Safapour and Kermanshachi (2019), will reduce construction-related performance issues including lawsuits, delays and rework costs. Regulating the content of contractual text, and the frequency of contract revisions are the most relevant scope management practices.

Edum and McCaffer (2017) investigated the factors which influence construction project output focusing on two attributes: success and failure. The following variables according to the results have aided in the attainment of target quality standards, these include; competence and experience of the project manager, top management competence, client's expertise, feedback and monitoring. Additionally, the following factors have a detrimental impact on the quality of building construction projects, these include; hostile socio-economic environment, project manager's incompetence, faulty project conceptualization, and resource unavailability.

Maingi and Marsh (2020) opined that there are major factors which influence the quality of public housing projects, these include; inadequate labor capabilities, lack of skilled labour, availability of construction materials, and project management. The subcontractor's difficult status, labourers lack of experience and competency, unfavorable weather conditions, lack of coordination, inappropriate construction equipment, limited time budget are all factors which contribute to poor workmanship in construction projects (Ali and Wen, 2016). However, they suggest education and training, strict oversight, proper communication among stakeholders, and appropriate construction management as potential solutions to the quality challenge.

Eiran and Feinberg (2019) suggest that quality problems in the buildings construction industry are related to construction regulations and procedures, substandard materials, poor design calculations, and environmental forces. Work by Abdul-Rahman et al., (2017) discovered that there are five factors which influence quality of residential building construction projects including lack of site layout studies; insufficient construction skills, lack of proper design reviews and engineering sketches, poor quality programmes, and unavailability of trained personnel.

### **2.3 Construction Equipment and Quality of Residential Buildings Projects**

A study was done by Ayodeji and Aigbavboa (2017) on the impact of construction equipment on the quality of building construction projects in Swaziland. 50 building and civil contractors and consultants (architects, quantity surveyors and design managers) who are members of Construction Industry Council (CIC) were surveyed. Since this research was quantitative in nature, the study adopted standardized questionnaires. Ayodeji and Aigbavboa (2017) observed that the use of proper and new construction machinery had a positive and beneficial impact on the quality of building construction projects.

According to Ardit and Gunaydin (2016) construction machinery equipment are vital components of new construction, reflecting the company's construction force and possessing a significant result on the project's success and performance. The standard of management guarantees that the type and production characteristics of construction equipment correspond to the site's needs and technology. The contractor should choose appropriate construction equipment by taking into account technological advances, rationality of economics, application of production, dependable performance and security, as well as project pertinence and durability. The performance parameters should be adjusted to meet construction standards and quality controls.

In India, Venkatesh and Saravana (2019) conducted research into the impact of construction equipment on the efficiency of Indian residential building projects. A total of 104 respondents were consulted for the report. They included project managers, general managers, site managers, equipment managers, and professional engineers. The study's primary data was gathered by questionnaires. Research found that the efficiency of building construction projects is substantially and positively linked to heavy construction machinery, both directly and indirectly.

In Malaysia, Nugraha and Putranto (2019) carried out investigations into the effects of heavy construction machinery on performance of construction projects. A descriptive research method was used in the analysis. A scouting group of 30 questionnaires was used to conduct a pilot analysis of the questionnaire. According to the survey, heavy construction equipment was discovered to be strongly linked to the increased productivity in the building construction sector in Malaysia.

#### **2.4 Project Funding and Quality of Residential Buildings Projects**

Bassam and Hallaq (2020) carried out a research whose topic was "Effect of project financing on the quality of residential construction projects in Gaza Strip". An exploratory study employed and 93 questionnaires were distributed to contracting companies that work on the Qatari grant programmes, consulting offices that oversee Qatari grant projects, and the Ministry of Finance. According to the report, planned financing had a substantial and positive impact on the quality of residential building projects. Further, it revealed that good construction project execution, as well as staying within budget and schedule is dependent on a methodology that needs sound engineering judgement.

Baviskar and Singh (2020) studied the schedule and cost factors which influence international development (ID) projects in Asia. They performed an empirical study of 100 Asian Development Bank-sponsored projects in various Asian countries. Their study identified that several of the projects that were finished late suffered from overspending. Project financing has been identified as a key factor that decides whether or not a project is successful. According to Ogwueleka (2018), projects should be viewed as strategic activities that begin with the goal of generating economic value and competitive advantage. As a result, financiers can ensure that a road construction project is sustainable long before it is initiated.

Studies on the influence of project funding to construction works is not a new phenomenon since the 1960's. The phenomenon has been examined from different perspectives ranging from application that is based on theory and researcher's experience. Time and cost efficiency are qualified as global issues in the construction industry. Work by Francist and Ronald (2020), shows that time productivity is highly correlated with project complexity, customer style, team experience, and communication; moreover, the cost is strongly linked with project complexity, characteristics of the clients, and that of the contractor. Schedule of the project and budget performance stand regulated by complex response mechanisms. Feedback cycles, the rework stage that induce shifts in the efficiency output, and impacts between phases of work are all examples of these cycles. The financial ability of a contractor plays a critical role in the project's timely completion and schedule to deliver the required quality. Lack of cash flow and other financial constraints will adversely influence the progress of construction.

According to Gimeno (2018), a successful project should be allocated adequate funds to enable its completion and guarantee quality. Many building projects in the developing countries are donor-funded. Many a time the donors specify their conditions of payment. The prolonged payment procedures harm the project's functioning. The availability of project funds, according to Mohammed and Isah (2012) is a significant aspect that influences quality of building construction projects.

Managers can prepare, manage, and document the project's progress because reports are an effective means of keeping stakeholders updated. According to Linhares (2019), strategic processes determine the success or failure of large engineering projects. Each construction project has its own group of stakeholders and environmental factors. A project's environment is distinct and cannot be compared to other projects. According to Assaf, Hassanain and

Abdallah (2018), a project is regarded successful if the technical requirements are met while also achieving a high degree of satisfaction among the key players and stakeholders.

## **2.5 Project Management and Quality of Residential Buildings Projects**

Mohammed (2019) conducted a study on the influence of project management on the quality of building construction projects in Palestine. The researcher mainly used qualitative and quantitative methods. The researcher enlisted the help of a majority of experts in the building construction field and carried out 36 interviews with managers of the Palestinian Union of Contractors in three groups in the various sections of the West Bank. According to the findings, project management has a significant positive impact on the quality of building construction projects. Adoption of the practices of project management allow efficient completion of a project as intended with cost minimization and in a way that meets the customer's needs (Larsson, Eriksson and Pesämaa, 2018).

Keng and Shahdan (2015) conducted a research on the influence of project supervision on the quality of building construction projects in Malaysia. In the research, descriptive research design was used. 12 project management professionals were interviewed using a semi-structured interview schedule and data was analyzed using Statistical Package for Social Sciences version 20. According to the findings of the research, project management had a substantial influence on the quality of building construction projects. The study's findings revealed that the present condition of building management of projects in Malaysia needed to be improved as there were challenges in relation to project management implementation that needed to be addressed such as quality control, monitoring, evaluation and resource flow.

Adinyira (2020) also conducted a study in Ghana on project management and its influence on high quality construction projects. The research was founded on the positivist paradigm which enabled the researcher to make an objective analysis. The study's results showed that project management and the quality of construction projects have a substantial relationship. Whereas the project goals may appear achievable and straightforward, construction is not always completed on time and within budget thereby failing to meet the project objectives (Hyväri, 2016). In 1916, Henry Gantt invented the bar chart which is widely used today (Mwandali, 2018). In a subsequent study of the literature, it was discovered that Hermann Schuerch, a Swiss engineer, used a similar instrument in 1912 on a bridge project. Hermann Schuerch invented and effectively used the bar chart as a scheduling method, contributing to the fact that

current project management began about 40 years earlier than previously thought. The idea of project management is relatively new. As a result, its literature is still in its infancy, evolving in principles and analytical underpinnings.

It is contended that project management philosophies date back as early as 2550 BC and that the Pyramids were constructed using a project management methodology. When contrasted with routine work, projects are better intended to react to anticipated vulnerabilities, while project undertakings require legitimate arrangement. In addition, Omran (2017) calls attention to the adoption of project management practices as it is certainly the answer to ensuring high quality projects.

## **2.6 Modern Technology and Quality of Residential Buildings Projects**

Gwahula and Wittonde (2016) conducted a study on the influence of technology on the quality of residential building construction projects financed by the Government of Tanzania. A survey was administered to 80 respondents working in the construction industry. The data was analyzed using Statistical Package for Social Sciences. The study showed that Government financed development projects are influenced by technological innovation. A different relapse model showed a positive straight connection between the nature of building development projects and the utilization of technological innovation in the development cycle.

Ayudhya (2018) explored the present condition of technology in the building industry and announced some effective methods. The research outlined the merits of incorporating technology into the construction processes to enhance quality. As per the study the motivating factors behind adoption of technology were; output, which increased corporate competitiveness and efficiency; globalization, to resolve competition; strict scheduling; organizational proximity issues, as well as construction industry idiosyncrasies; i.e., orientation of the industry's project, the structural organization and temporary as well as short-relationships of short terms businesses. Technology should propel the organization to achieve its set goals in the construction sector. The study showed that technology had facilitated collaboration and synchronization of job procedures thus creating a constructive effect on the quality of the works and satisfaction of the clients. Technology therefore helps construction organizations to attain their quality goals efficiently (Hosseini et al., 2018). Aladag et al., (2016) using a case study in China revealed that Building Information Modelling (BIM) helps in reducing errors and omissions in the construction documents. Moreover, throughout the planning and maintenance

phases, it enables project teams to create effective design strategies. The study also revealed that 'BIM standardized tools' can be employed to increase the benefits in the construction profession.

Aladag et al., (2016) identified usage of BIM, its adoption, challenges and benefits brought by its use. Qualitative research was carried out by conducting focus group discussions with professionals in the construction field. The structure and culture of the organization was the greatest obstacle that Turkish construction firms were facing in terms of BIM adoption. It was also observed that apart from increasing profitability of a firm, BIM increased the satisfaction of the customers. In terms of project management, BIM led to effective monitoring and reporting and improved budgeting and costing. The findings also showed that in the current era, firms are facing the pressure of becoming more competitive, because of globalization, improved technology and changing demands of the consumers. To counter these challenges, a construction firm can employ BIM and become more competitive at a global level (Aladag et al., 2016).

Friend and Keskinen (2019) examined how wireless technology is used in the construction industry in Ohio, USA. Data was collected using a web-based survey. It employed quantitative data study and participants' interested in the wireless technology were significantly higher than their use. According to the findings of the study, modern technologies allow construction management to develop their expertise, efficiency, and customer experience. Its application, however, became unsuccessful to boost their capability to bargain and oversee the costs of the project. On the other hand, slow download speeds hindered the implementation of wireless technology.

Muller and Turner (2017) studied technology use in the Turkish construction industry. The researchers wanted to explore the current use and needs of Turkish firms relevant to technology. The data was collected through 22 semi-structured interviews with senior construction experts from both the public and private sectors. The analysis showed that sixty per cent of organizations used technology at the strategic level, and considered it a critical component of future corporate planning. Email was also discovered to be used by 81 percent of the organizations, making it the most widely used electronic correspondence mechanism in the building industry. Similarly, 64% of the firms used Computer Aided Design (CAD) to make 2 Dimension and 3 Dimension designs, and they were aware of the benefits of using Virtual Reality Modelling Language (VRML), i.e., software for electronic drawing in their everyday



professional operations. But they failed to implement it due to the lack of educated staff. When they were asked about the use of databases, 50% of all respondents said that they used databases to store contact details of their customers, stock details, material-specific information and machinery details.

## **2.7 Theoretical Review**

The section contains three theories that include; Resource Dependency Theory, Stakeholder Theory and Technology Acceptance Model and is as presented below;

### **2.7.1 Resource Dependency Theory**

In 1978, Pfeffer and Salancik introduced the Resource Dependency Theory. Its main point was that the involvement of external support has a significant impact on an organization's development (Omran, Abdalrahman and Pakir, 2020). This approach implies that the organization's capacity in terms of finance and resources is a vital determinant of the project performance. According to the advocates of the theory, like Mohammed (2019), it is critical for an organization to possess enough capital for the execution of a project or the achievement of established goals. Finances, qualified human capital, supplies, and infrastructure are among the resources defined by the researcher as critical to the achievement of organizational goals. However, opponents of the hypothesis, such as Tabishl and Jha (2018) contend that certain organizations have flourished without funding therefore calling for other factors like instillation of the appropriate strategies, the effectiveness of the management and organizational culture. Despite the fact that such critiques are warranted in light of the theory's general proposition, it is crucial to remember that providing the requisite tools must be balanced with other enablers such as a positive working environment and a sound plan.

The resource dependency theory is relevant to this study since it provides the theory in knowing the capability of an organization like the builder to carry out his/her quality work, therefore, building projects become disturbed by the presence of inadequate project funding. The usefulness of supplies and tools, as well as the expertise of human resources, are critical factors in the building project's success. A contractor's experience is usually taken into account when assessing his or her ability to handle construction projects. Experienced contractors are required to have valuable tools that can help minimize the time it takes to complete the building projects. The theory can be useful in explaining the project funding variables and its influence on the quality of residential buildings projects. It can also explain the effect of efficiency in projects.

### **2.7.2 Stakeholder Theory**

According to Edward Freeman (1983) an organization has got several parties that influence its operations. Other people who support this theory like Arkin and Skitmore (2008) remark that it is important to involve the organization's stakeholders and consider their interests. Putting into consideration the concerns of the stakeholders guarantees a successful and high quality project. The theory considers the different types of organizational stakeholders and their input. Stakeholder approach is a management instrument. The attribute elements and authenticity of cases characterize an association's stakeholders.

According to the stakeholder theory, open division can be defined as being intricate settings having numerous stakeholders that regularly possess various, ambiguous and separating objectives. In any case, no critical proof has been found that completely keeps the exchange of working thoughts, strategies and theory from the private area to general society segment. Still, the probability of effective results of such exchanges is thought to be identified with the level of acclimation to fit the attributes of the objective setting.

The theory is critical to the comprehension of the interests of key stakeholders bearing in mind the desired goal which is to get a high quality project. Stakeholder examination is helpful in identifying important project stakeholders and recognizing their particular advantages in the project with relation to quality of works. The stakeholder investigation is a suitable solution for the multifaceted nature-related difficulties of the adjusted scorecard as a vital administration apparatus. Wyatt and Baird (2018) attribute the growth of corporate social responsibility to stakeholder theory. It recommends an association's survival and the achievement to be perceived by accomplishment of non-financial goals in light of a legitimate concern for their stakeholders.

The management of any firm takes into account every stakeholder aggregate in either of the three diverse ways, to be specific; regularizing, instrumental and unmistakable. The perspective of standardizing recommends that the firm should consider the interests of the stakeholders as a whole and not just of the clients or stockholders. According to the above perspective, a firm should outline the structure of a complete CSR activity in a manner which offers consistency to the entire stakeholder group. The key perspective supports a firm's concentration in enhancing monetary execution holding on the fact that financial achievement is the main goal in organizations. To make this real, proposals are for firms to establish accentuation on just the CSR characteristics that particularly enhance financial management.

The distinct perspective recommends that an organizations conduct can be anticipated by the shareholders, their qualities and relative impact, and stakeholder theory determines the degree to which a partnership treats its stakeholders properly, and in this manner is connected to corporate social obligations (Kartam, 2018). The study is appropriate to the stakeholder theory as it helps to appreciate that project management is important in identifying and engaging various stakeholders such as contractors and other parties that should be taken into consideration while undertaking construction projects in order to attain quality of works. Project managers should, for that matter, be in a position to adjust their operational mode to be in agreement with the stakeholders' needs and to ensure the accomplishment of the overall objective.

### **2.7.3 Technology Acceptance Model**

The study has been anchored on Davis Fred's Technology Acceptance Model (TAM) developed in 1989. This is one of the most popular models to predict acceptance and use of technology by users. In the Technology Acceptance Model, there are two factors, perceived ease of use and perceived usefulness in technological adoption. Perceived usefulness is the prospective user's subjective probability that using a certain technology will enhance job performance. Perceived ease of use is the degree to which the prospective user expects the new technology to be free of effort. These two are the most important determinants of system use.

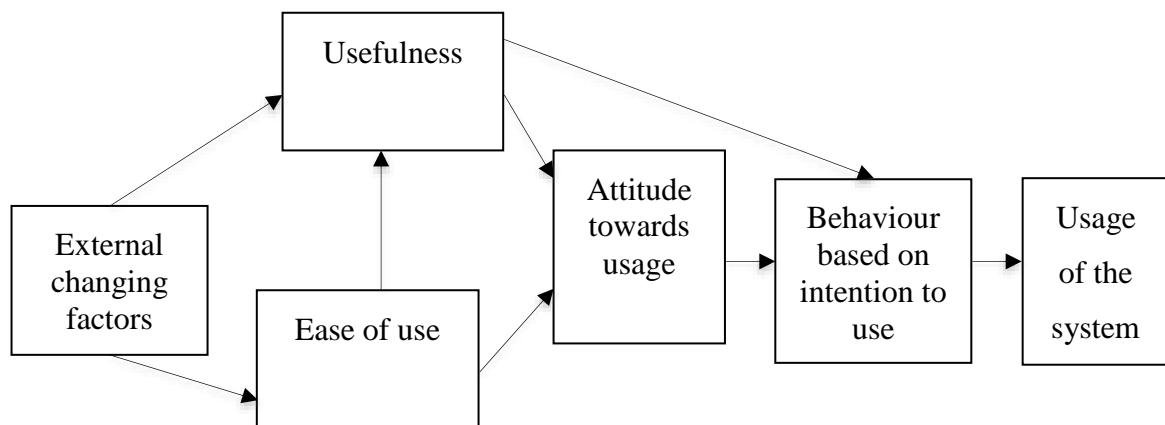
Several factors influencing acceptance of technology were identified by Arditi and Günaydın (2016). The factors are related to understanding of the technology and its effectiveness. Kartam (2018) started with the Theory of Reasoned Action (TRA) which he adopted for instituting the connection between how people understand the ease of using technology and the perceived usefulness of the technology, and the intentions to give explanations of adopting the technology.

The level at which a technology is perceived to be of more benefit than the previously used technology is what is referred to as relative advantage. The relative advantage leads to improved status, better efficiency and financial benefits. Previous research has created the positive presence relationship between relative advantage and rate of adoption. According to the research, users tend to adopt a new technology if they find it to be more useful and advantageous than the old one.

The Technology Acceptance Model is specifically designed to predict users' adoption of information technology and its application in the workplace. Technology Acceptance model

deals with expectations rather than actual use by relying on mindset explanations of purpose to use a given device or service. It is suggested that when a prospective adopter is faced with a new technology, perception determines how they can use it (Mohammed, 2019). Yuan et al., (2018) advocated for the Theory of Reasoned Action (TRA). This was an addition to the TAM. The theory stressed that human behaviour stems from their intentions and behavioral intentions (BI). Behavioural Intentions is a type of cognitive function that has two facets: attitude and subjective standards. According to the Theory of Reasoned Action, a salient conviction determines both the mindset and subjective norm portion of individual conduct.

Primarily, this model is useful to assess the intentions of the users, and to accept or reject the usage of a specific technology. This model best explains the reasoning behind an employee accepting or declining a particular technology on the basis of how the employee perceives it useful as well as its ease of use as explained by the TAM.



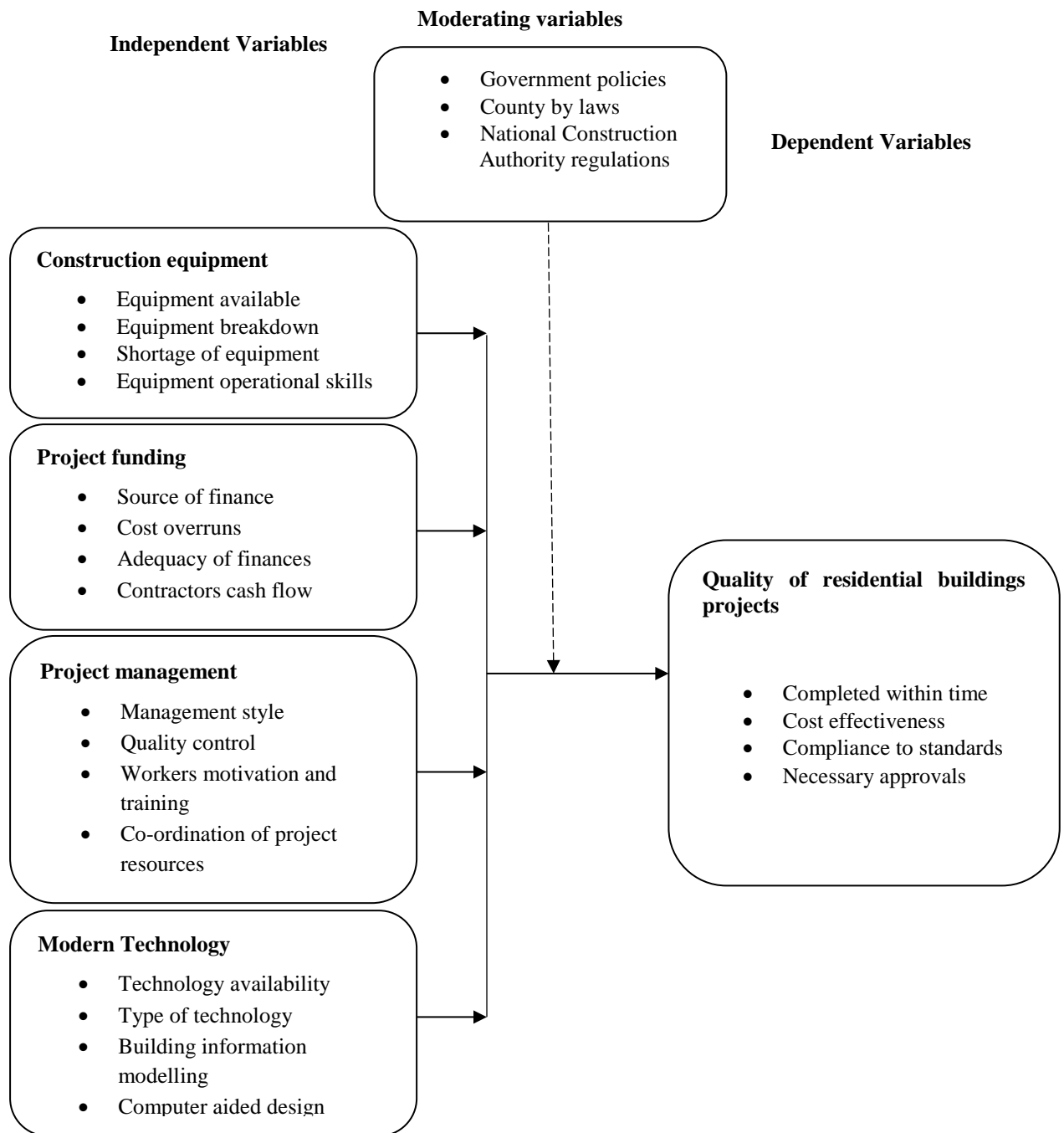
**Figure 1: Technology Acceptance Model**

A potential consumer of technology believes that technology consumption will require less energy, and this is what is perceived as the ease of use. The Technology Acceptance Model will help in explaining and predicting the behaviour patterns of users and the effect of new technologies on building design and the quality of building projects. The theory points out that the user’s mood, intentions and understanding of the system, directly or indirectly affects the application of a modern technology system.

## 2.8 Conceptual Framework

The conceptual framework presents the interrelationships of key variables which are involved in the research and how they are interrelated. This is shown in Figure 2. The framework is based on the assumption that improved quality of residential building projects is influenced by

construction equipment, project funding, project management and modern technology. A marginal alteration in all of the independent variables will influence the dependent variable.



**Figure 2: Conceptual Framework**

## 2.9 Knowledge Gaps

The study identified knowledge gaps illustrated in Table 2.1.

**Table 2.1: Knowledge Gaps**

Author	Purpose	Major findings	Research gaps	Focus of the Study
<b>Construction Equipment</b>				
Ayodeji and Aigbavboa (2017)	Impacts of construction equipment on the efficiency of projects in Swaziland	Use of proper and modern construction equipment significantly and positively influenced the standard of buildings projects	The study was done in Swaziland, therefore cannot be generalized to the local context	Was done in Kenya to get the local context
Venkatesh and Saravana (2019)	Effect of construction equipment on the efficiency of Indian building projects	Quality of building projects significantly and positively related to construction equipment	The study was done in India thus lacks local context	Was done in Kenya to have the local context
Burgess and Stern (2020)	Efficient methods of managing project teams	The study found that source of finance and cost overruns influence the quality of buildings projections	The study did not address the issues of adequacy of finances and contractors cash flow	The current study included the two variables
<b>Project Funding</b>				
Bassam and Hallaq (2020)	Impact of funding on quality of residential building	The quality of residential buildings projects was significantly	The study was done in the Gaza Strip and concentrated on grant projects only	Have the local context and scope will be broadened to residential

	schemes in Gaza Strip	influenced by project financing		building projects within Kasarani Constituency
Najmi (2019)	The effect of project management on the quality of Palestinian building projects	Significant positive relationship between project management and quality of buildings projects	The study has generalizability issues due to the location of the study	Present the local context of the influence of Project management on the quality of building projects.
Ahsan and Gunawan (2018)	Schedule and cost issues affecting international development (ID) projects in Asia	Project funding was noted as a critical factor that determined project success	The study was done in Asia and did not specifically focus on quality as the dependent variable	Had the quality of construction projects as the dependent variable and will be done locally
<b>Project Management</b>				
Keng and Shahdan (2015)	The effect of project management on the quality of Malaysian building projects	The quality of buildings projects was greatly influenced by project management.	The study was done in Malaysia. The population used was very small to make conclusive findings	The study had a bigger population and will be done locally
		The study found that management style and quality control significantly influenced the building projects performance	The aspects of workers motivation and training and co-ordination of project resources where ignored in this study	The current study used the four variables to draw their influence on quality of building projects

Arkin and Skitmore (2008)	Factors for the success of a construction project	The study found a significant influence between project management and quality of building projects	The study focus was on the community as the beneficiaries only	The current study targeted Quantity Surveyors, Architects, Civil & Structural Engineers, Electrical Engineers, Mechanical Engineers, Land Surveyors and Construction Project Managers. Developers
<b>Modern Technology</b>				
Gwahula and Wittonde (2016)	Influence of technology on the quality of residential building projects financed by the Government of Tanzania	Quality of government financed residential building projects was significantly influenced by technology	The study focused on Government funded projects only	Widened the scope to private residential projects in Kasarani Constituency of Nairobi County
Assaf, Hassanain, and Abdallah, (2018)	Review and assessment of the causes of deficiencies in design documents for large construction projects.	The study found that technology availability influenced performance of buildings projects	Building information modelling and computer aided design were not used	Inclusion of the variables was done
Ahsan and Gunawan, (2018)	Critical Factors Affecting Quality Performance in Construction Projects	Type of technology which include current innovation influenced the quality of projects	The focus was on Thiba dam in Kirinyaga county	The current study focus was on building projects within Kasarani constituency



## **2.10 Summary of Literature Review**

Chapter two gives literature review related to the objectives of the study which are construction equipment, project funding, project management, and modern technologies, and how they influence quality of residential building projects. The objectives are discussed from a global perspective, regional perspective and the local context. This is also captured in the conceptual framework which is tabulated and shows the relationship between the independent variables and the dependent variable. The research gaps are also identified in the chapter.

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

This chapter presents details of the research methodology. The chapter gives details on the research design, target population, sampling procedures, sample size, sample frame and data collection instruments. It also contains the validity and reliability of instruments, a pilot study, data collection procedures, data analysis techniques and ethical considerations. It also includes the operationalization of the variables.

#### **3.2 Research Design**

Research design is the plan, framework, blueprint and strategy which is used to set up requirements for obtaining answers to the study questions, data collection and data analysis. Simply, it's like a "glue" which sticks together the elements of a research project (Akhtar, 2016). Descriptive survey research design was employed in this research which described demographic characteristics of the population. The mean, standard deviation, percentages and frequencies were provided and descriptive statistics established by how predictor variables and the outcome variables were related. This was centered on the outcomes of data processing; it assists in describing the interaction between the dependent and independent variables using a descriptive approach. Therefore, the researcher adopted a descriptive survey research design because it allows a researcher to gather and analyse data using both quantitative and qualitative techniques (Keman, 2020).

#### **3.3 Target Population**

A target population can be defined as a specified community of individuals or a set of things, households, firms and services which are to be studied (Wambugu, 2013). The study was carried out in Kasarani Constituency of Nairobi County. The target population was practitioners in the construction industry. They included; Quantity Surveyors, Architects, Civil & Structural Engineers, Electrical Engineers, Mechanical Engineers, Land Surveyors and Construction Project Managers. Developers also formed part of the target group. The sample size was 385 respondents. The primary objective of choosing this population was to collect

recent and historical evidence from people who have participated in the execution of building projects and have firsthand familiarity with execution of residential building projects.

### 3.4 Sample size and sampling procedures

The sampling is described as sampling unit, sampling frame, and sampling size. Sampling procedures are the approaches a researcher adopts in selecting the elements of the population that will participate in the study (Parveen et al., 2017). The study adopted non probability sampling design and purposive sampling techniques. The sampling procedure was driven by the data of the licensed building industry workers who made up the population. To reflect the whole population, a certain number of subjects were chosen from a characterized population. Sample size is an absolute size of the selected participants who are included in the study and its findings are used in generalization of the entire population.

#### 3.4.1. Sampling Frame

The researcher’s interpretation and its relevant application in data information realization required for the study was put into consideration. The population sampled was selected in Kasarani Constituency of Nairobi County, Kenya. The Yamane’s formula of 1967 was useful in computing the sample involved in the study.

$$n = \frac{N}{1 + Ne^2}$$

Where: N = Population size as per the study, n = sampled size, e = Margin of error expected out of the study set at ±5%

In this case, the sample size will therefore be

$$= \frac{10547}{1+10547(0.05)^2} = \frac{10547}{1+10547(0.0025)} = \frac{10547}{1+26.3675} = \frac{10547}{27.3675} = 385 \text{ respondents}$$

which is 3.65% of the total population

The study sampling matrix is illustrated in Table 3.1.

**Table 3.1 Sampling Matrix of the Study**

<b>Population Description</b>	<b>Target Population</b>	<b>Registering body</b>	<b>Sample Size (3.65%)</b>
Architects	1,308	BORAQS/AAK	48
Quantity surveyors	687	BORAQS	25
Engineers	6,330	EBK/IEK	230
Land surveyors	206	ISK	8
Property developers	16	KPDA	1
Construction project managers	2,000	BORAQS/ICPMK	73
<b>Total</b>	<b>10,547</b>		<b>385</b>

**Source, NCA 2020**

Out of the 385 participants, the study picked two interviewees from each of the category to be key informants. Therefore those who participated in questionnaires were 374 and there were 11 key informants. All the participants were picked randomly.

### **3.5 Data collection instruments**

Primary data was gathered using questionnaires from the respondents. Questionnaires were designed to elicit information on demographic information and specific questions which included; influence of construction equipment, project funding, project management, and modern technology on the quality of residential buildings projects in Kasarani Constituency of Nairobi County. Questionnaires were mainly used to collect quantitative data and they were administered to Quantity Surveyors, Architects, Civil & Structural Engineers, Property Developers, Construction Project Managers, and Land Surveyors. Structured interview schedule was conducted to the Key Informants (KI). An interview schedule was suitable to obtain insights and in-depth information that questionnaires failed to capture. Secondary data was obtained from brochures, journals, periodicals, websites, and other relevant sources that were available.

#### **3.5.1 Piloting of the Research Instruments**

A pilot study is a pretest which is conducted before the actual study. The pilot study was done in the neighbouring Constituency of Roysambu in Nairobi County. The collected pilot data was excluded from the actual study. The reliability and validity of the research instruments was pretested by pilot testing. The pilot test was done on 10 respondents who were not part of

Kasarani Constituency of Nairobi County. Random sampling was used in order to form the pilot group. This was due to the fact that in this system, each unit was chosen. A pre-trial finding was not included in the actual study. A pilot study in a research plays a significant role by providing the researcher with valuable information that enables the researcher to evaluate data, rethink analysis methods, clarify, redefine, restructure and even remove vague items in the study (Doody and Doody, 2015).

### **3.6 Validity of the Instruments**

According to Surucu, Lutfi & Maslakci, Ahmet & Sesen, Harun (2020), validity is an essential element used in research in order to yield beneficial results. The degree to which a test instrument accurately tests what it claims to measure is known as validity. Whiston (2016) describes validity as when a research instrument obtains data appropriate to achieve the intended purpose. Validity is concerned with whether the research instruments measure the quality or behaviour that it is supposed to measure. Additionally, validity determines whether the research instruments express the scale that is suitable to its function and measures its desired results. It examines the accuracy and significance of inferences drawn from the research findings. Research instruments were authenticated by a panel of experts in the study area in order to determine the internal validity and determine if it was appropriate for use in order to achieve the research's goals and objectives. The panel ensured that the items properly reflected topics that addressed applicable aspects of the study in order to determine the internal relevance and whether or not it was appropriate for use. The panel ensured that the objects denoted ideas which tackled all applicable issues being investigated in an adequate way. Face validity, predictive validity and construct validity tests were performed on the instruments based on previous studies.

### **3.7 Reliability of the Instruments**

Reliability is an essential factor in a research process since it enables a study to yield beneficial outcomes (Sururu, 2020). The degree to which a test instrument produces stable outcomes under similar conditions and after repeated trials with the same participants is known as reliability. The reliability of the measuring procedure is said to be higher if consistent outcomes are gotten by the common participants in similar repetitive measurement. If tools used in research are stable and consistent, and hence, accurate and predictable, this means it is consistent. The testing instrument's dependability was investigated using an inter-item

reliability measure. Various elements were used to gauge every idea present in the questionnaire. It involved a series of similar questions that were used to assess how far one definition was linked to another. To assess reliability, the Cronbach's coefficient test was used. A Cronbach's alpha value of 0.5 to 0.7 was considered suitable as an indicator of the instrument's internal reliability. A score of more than 0.7 was considered sufficient evidence of internal accuracy. Cronbach's formula

$$\alpha = \frac{k}{k-1} \left( 1 - \frac{\sum_{i=1}^k p_i(1-p_i)}{\sigma_x^2} \right)$$

Where  $k$  is the number of elements and  $\alpha$  is the Cronbach's coefficient. The proportion of respondents who answer a study question in a certain way is known as  $p_i$ . The results of Cronbach's alpha test were obtained by questionnaires from different respondents as illustrated in Table 3.2.

**Table 3.2 Cronbach's Alpha Values**

Values	Reliability
< 0.5	Not reliable
0.5 to 0.7	Mode
> 0.7	Good

**Nunally (1978)**

The reliability results are presented in Table 3.3 which shows an expectable level of 79%.

**Table 3.3 Reliability results**

Variable	Cronbach's coefficient results	Verdict
Construction equipment	0.826	Reliable
Project funding	0.725	Reliable
Project management	0.766	Reliable
Modern Technology	0.851	Reliable
Quality of residential buildings projects	0.783	Reliable
<b>Average</b>	<b>0.7902</b>	<b>Reliable</b>

### 3.8 Data collection procedure

The researcher acquired a permit from the National Commission for Science, Technology and Innovation (NACOSTI). Later, the instruments were administered to the respondents. The targeted population included literate people who could read and understand questions provided in the questionnaires. Hard copies of the questionnaires were handed to the respondents. The drop and pick method was used whereby questionnaires were administered to the research participants and they were picked after two weeks to give the respondents ample time to respond to questions and to increase data accuracy. The researcher booked interviews with key informants and the interview took twenty minutes to one hour. The collected data was analyzed to make meaningful inferences to the study.

### 3.9 Data Analysis Techniques

The research was quantitative in nature. Data analysis involves examining data with the aim of making any useful analysis, to make deductions and inferences of the study goals and plans. Data analysis involves coding, arranging data, removing errors and processing data. Therefore, quantitative and qualitative data obtained from research instruments was cleaned, coded in a computer and analysis done using Statistical Package for Social Sciences version 21. To present quantitative data in various ways, the researcher used statistical figures such as percentages, frequencies, means, and standard deviation. Popular patterns, narrative structure, and content analysis was used to interpret the qualitative results. Data analysis, according to Kothari (2014), is the method of assigning numerical values to observations or products, with the unit of measurement defined by the laws used to assign the quantities. The study also employed inferential statistics by adopting a simple regression analysis in order to test the link between variables. The regression model was as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \epsilon$$

Where:

Y = Quality of residential building construction projects

$\beta_0$  = Constant Term

$\beta_1$  = Beta coefficients

$X_1$  = Construction equipment

$X_2$  = Project funding

$X_3$  = Project management

$X_4$  = Modern technology

$\epsilon$  = error term (This is a residual term that includes the net effect of other factors not in the model and the measurement of errors both in the dependent and independent variables).

### **3.10 Ethical Considerations**

Ethics in research is not regarded as an afterthought or a liability, but as a crucial part of research planning and execution (Gakuu and Kidombo, 2013). This study was regulated by stringent scientific ethics, which forbid the researcher from engaging in fraud or privacy violations. The researcher acknowledged all work, sources borrowed from others by referencing and test for originality index and present a plagiarism report in Appendix 5. The respondents were informed of the right to or not to respond to questions and consent from the onset. The respondent's anonymity was protected during the study as well as their confidentiality. The researcher preserved modesty and performed the study with utmost integrity, avoiding data manipulation and distortion. The researcher made every effort to maintain academic integrity and sought out mutual help that was properly recognized. The researcher strived to draw conclusions based on the inferences of priorities which were driven exclusively by the information gathered. Confidentiality was maintained.



### 3.11 Operationalization of the variables

The operationalization of the variables is presented in Table 3.3

**Table 3.3 Operationalization of the variables**

Objective	Variable	Indicators	Measurement scale	Tools of analysis	Type of data analysis
To assess the influence of construction equipment on quality of residential buildings projects in Kasarani Constituency of Nairobi County	<b>Independent</b> Construction equipment	Equipment available	Ordinal	Mean	Descriptive Inferential.
		Equipment breakdown		Percentage	
		Shortage of equipment		Standard deviation	
		Equipment operation skills		Frequencies	
To assess the influence of project funding on quality of residential buildings projects in Kasarani Constituency of Nairobi County	Project funding	Source of finance	Ordinal	Mean	Descriptive Inferential
		Cost overruns		Percentage	
		Adequacy of finances		Standard deviation	
		Contractors cash flow		Frequencies	

To assess the influence of project management on quality of residential buildings projects in Kasarani Constituency of Nairobi County	Project management	Management style	Ordinal	Mean	Descriptive
		Quality control		Percentage	Inferential
		Workers motivation		Standard deviation	
		Coordination of project resources		Frequencies	
To determine the influence of modern technology on quality of residential buildings projects in Kasarani Constituency of Nairobi County	Modern Technology	Computer Aided Design	Ordinal	Mean	Descriptive
		Building Information Modeling		Percentage	Inferential
		Technology availability		Standard deviation	
		Type of technology		Frequencies	
	<b>Dependent</b>	Timely completion	Ordinal	Mean	Descriptive
Improved quality of residential building projects in Kasarani Constituency of Nairobi County		Cost effectiveness		Percentage	Inferential
		Compliance to standards		Standard deviation	
		Compliance to approvals		Frequencies	

## CHAPTER FOUR

### DATA ANALYSIS, PRESENTATION, INTERPRETATION AND DISCUSSION

#### 4.1 Introduction

The chapter gives the study findings which are presented using Tables followed by interpretation. The findings are arranged following the objectives as outlined from chapter one. This was however presided by background information of the respondents. Descriptive statistics was used in order to analyze the data. The presentation flows chronologically and reflects the structure of the questions presented in the questionnaire.

#### 4.2 Questionnaire Return Rate

A total of 374 questionnaires and 11 interview guides were issued to the relevant population in Kasarani Constituency of Nairobi County. 291 questionnaires and 8 interview guides, which accounted for 78% and 67% of the total, were duly completed and returned from the disseminated questionnaires, as indicated in Table 4.1.

The instruments were therefore considered responsive and were used to analyze the data. A 50% response rate is deemed appropriate and 60% is seen as acceptable while a rate higher than 70% is regarded as outstanding for analysis and reporting Mugenda and Mugenda (2008). The technique utilized by the researcher was attributed to the high response rate attained in the study.

**Table 4.1 Questionnaire Return Rate**

Response Rate	Questionnaires		Interview Guides	
	Frequency	Percentage	Frequency	Percentage
Responded	291	78	8	67
Not Responded	83	22	3	33
<b>Total</b>	<b>374</b>	<b>100</b>	<b>11</b>	<b>100</b>

### 4.3 Demographic Characteristics of the Respondents

The study sought personal data of the respondents to determine their personality in terms of knowledge about the quality and reliability of the information they provided. The researcher wanted to know the fields of expertise, gender, level of education, value of projects executed, nature of projects and the contract duration.

**Table 4.2 Demographic Characteristics of the Respondents**

<b>Respondents Area of Specialization</b>	<b>Frequency</b>	<b>Percent</b>
Quantity Surveyors	12	4.1
Land Surveyors	75	25.8
Engineers	60	20.6
Property developers	40	13.7
Construction Project Managers	28	9.6
Architects	76	26.1
Total	291	100
<b>Gender of Respondents</b>	<b>Frequency</b>	<b>Percent</b>
Male	189	64.9
Female	102	35.1
Total	291	100
<b>Highest Level of Education</b>	<b>Frequency</b>	<b>Percent</b>
Certificate	21	7.2
Diploma	165	56.7
Bachelor	69	23.7
Masters	30	10.3
PhD	6	2.1
Total	291	100
<b>Total value of works of projects executed</b>	<b>Frequency</b>	<b>Percent</b>
10M and below	66	22.7
11-20 Million	188	64.6
21-30 Million	29	10.0
More than 30 Million	8	2.7
Total	291	100
<b>Nature of Projects</b>	<b>Frequency</b>	<b>Percent</b>
Industrial buildings	49	16.8
Commercial buildings	204	70.1
Residential buildings	38	13.1
Total	291	100
<b>Time of completion of the residential building construction projects</b>	<b>Frequency</b>	<b>Percent</b>
1 to 5 years	58	19.9
5-10 years	208	71.5
10-15 years	5	1.7
15-20 years	20	6.9
Total	291	100

The researcher sought to find out the area of specialization of the respondents. Table 4.2 shows that 26% of the respondents were Architects, 25% were Land Surveyors, 21% were Engineers, 14% were Property Developers, 10% were Construction Project Managers and 4% were Quantity Surveyors. The major reason why this population was chosen is to ensure that recent and historical evidence from people who have participated in the execution of building projects and are therefore thought to have firsthand familiarity of the project's shortcomings was collected.

The respondents were 291 and the researcher established that 189 were male while 102 were female. This is shown in Table 4.2. The selection of the participants was convenient since all had the knowledge of what happens in the residential building construction sector. From the results it was noted that there were more males (65%) were involved in the residential building construction industry than females (35%), as construction has been perceived to be a male dominated industry.

Respondents were required to indicate their highest level of education, since education gives people the ability to work and communicate, have effective oral and written communication, have skills in information & technology, have skills in research and analysis, and have problem-solving skills (MacDermids, 2011). The research was successful in ensuring that participants were informed, have comprehended the issues and have provided trustworthy and relevant data. Table 4.2 shows that 56% of the respondents were Diploma holders, 23% had a Bachelor's degree, 10% had a Master's degree and 7% had a Certificate, while 2% had a PhD.

The results show that majority of the participants 64%, indicated that the total value in Kenya Shillings of the projects they have executed in the last five years was between 11 and 20 million, 22% indicated that the total value in Kenya Shillings of the projects carried out in the last five years was 10 million and below, 10% indicated that the total value in Kenya Shillings of the projects carried out in the last five years was between 21 and 30 million whereas 3% indicated that the total value in Kenya Shillings of the projects carried out in the last five years was more than 30 million.

It was noted that 70% of the respondents indicated that their companies dealt with construction of commercial buildings, 17% indicated that their companies dealt with construction of industrial buildings, and 13% indicated that their companies dealt with construction of residential buildings. This is shown in Table 4.2.

It was necessary to know the period in years respondents took to complete the residential building projects. 72% of the respondents indicated that they took between 5 to 10 years to complete residential building construction projects, 20% indicated that they took between 1 to 5 years to complete residential building construction projects, 7% indicated that they took between 15 to 20 years to complete residential building construction projects, and 2% indicated that they took between 10 to 15 years to complete residential building construction projects. This is shown in Table 4.2.

#### 4.4 Construction Equipment

To analyse the study the researcher adopted the following key; NE = No extent, LE = Low extent, M = Moderate, GE = Great extent and VGE = Very great extent. For mean = M and Standard deviation = SD. This is shown in Table 4.3.

**Table 4.3 Construction Equipment**

	NE		LE		M		GE		VGE		M	SD
	F	P	F	P	F	P	F	P	F	P		
	(%)		(%)		(%)		(%)		(%)			
The desired Equipment for the work are readily available	4	1.3	25	8.5	36	12.3	131	45.0	95	32.6	3.89	0.951
There is a ready team to address equipment breakdown	3	1.0	10	3.4	41	14.0	140	48.1	97	33.3	4.02	0.850
Shortage of equipment is outsourced to cover the gaps	6	2.0	26	8.9	34	11.6	140	48.1	85	29.2	3.78	3.440
Our manpower is equipped with operational skills	5	1.7	19	6.5	46	15.8	134	46.0	87	29.8	3.81	4.319
<b>Composite Mean</b>											<b>3.87</b>	<b>2.391</b>

On analyzing aspects of construction equipment of the projects which was found to be to a great extent as shown by a mean score of 3.87. In the tabulation majority 131 (45%) of the

respondents agreed that the desired Equipment for the work was readily available, 140 (48.1%) agreed to a great extent that there was a ready team to address equipment breakdown, 140(48.1%) agreed to a great extent that shortage of equipment was outsourced to cover the gaps and 134 (46.0%) also agreed to a great extent that the project’s manpower was equipped with operational skills.

The key informants indicated that equipment prices and cost of hiring the equipment influenced the quality of residential building construction projects. Poor work is done due to the high cost of high-quality equipment. The better the equipment, the better the quality of residential building construction projects. Proper equipment ensure that the project is fast tracked, safety is enhanced, and eventually cost and time of the project is reduced.

#### 4.5 Project Funding

To analyse the study the researcher adopted the following key; NE = No extent, LE = Low extent, M = Moderate, GE = Great extent and VGE = Very great extent. For mean = M and Standard deviation = SD. This is shown in Table 4.4.

**Table 4.4 Project Funding**

	NE		LE		M		GE		VGE		M	SD
	F	P	F	P	F	P	F	P	F	P		
	(%)		(%)		(%)		(%)		(%)			
Source of finance are identified on the early stages of the project	10	3.4	18	6.1	29	9.9	153	52.5	81	27.8	4.12	0.885
Cost overruns are well covered	9	3.0	21	7.2	37	12.7	151	51.8	73	25.0	3.83	1.838
Adequacy of finances is ensured at all levels of the project	11	3.7	23	7.9	29	9.9	149	51.2	79	27.1	3.96	0.808





Workers motivation and training is frequently done	7	2.4	21	7.2	35	12.0	153	52.5	75	25.7	3.88	0.920
Co-ordination of project resources is supervised by the management	8	2.7	19	6.5	34	11.6	157	53.9	73	25.0	3.92	0.909
<b>Composite Mean</b>											<b>3.89</b>	<b>0.927</b>

Management style was ensured through proper training by the projects to a great extent as shown by majority of the respondents 149 (51.2%), 151 (51.8%) of the respondents agreed to a great extent that quality control measures were well set, 153 (52.5%) agreed to a great extent that workers motivation and training was frequently done and 157 (53.9%) also agreed to a great extent that co-ordination of project resources was supervised by the management.

The key informants indicated that technology ensures time savings and efficiency in design as well as in communication, which in time enhances project quality. Modern technology as compared to the traditional ways provides a variety of options on how to go about a project in an advanced way. Modern technology comes with more advanced quality and makes construction more simplified and it helps in better construction standards and saves on turnaround time.

These findings concur with the study finding of Larsson, Eriksson and Pesämaa, (2018) who concluded that project management and the quality of building construction projects have a significant positive connection. Adoption of the practices of project management allow for efficient completion of a project as intended with cost minimization and in a way that meets the customer's needs.

#### **4.7 Modern Technology**

To analyse the study the researcher adopted the following key; NE = No extent, LE = Low extent, M = Moderate, GE = Great extent and VGE = Very great extent. For mean = M and Standard deviation = SD. The findings are shown in Table 4.6.

**Table 4.6 Modern Technology**

	NE		LE		M		GE		VGE		M	SD
	F	P	F	P	F	P	F	P	F	P		
	(%)		(%)		(%)		(%)		(%)			
Technology availability is											4.04	0.819
all round ensured	11	3.7	24	8.2	37	12.7	151	51.8	68	23.3		
Type of technology is												
considered on the project	9	3.0	29	9.9	34	11.6	149	51.2	70	24.0	3.99	0.782
onset												
Building information												
modelling is adopted	13	4.4	27	9.2	33	11.3	152	52.2	66	22.6	3.84	0.776
Computer aided design												
used are current	12	4.1	25	8.5	31	10.6	151	51.8	72	24.7	3.79	0.757
<b>Composite Mean</b>											<b>3.91</b>	<b>0.783</b>

Technology availability was all round ensured to a great extent as shown by 151 (51.8%), 149 (51.2%) agreed to a great extent that type of technology was considered on the project onset, 152 (52.2%) also agreed to a great extent that building information modelling was adopted while 151 (51.8%) agreed to a great extent that computer aided design used was current.

The key informants indicated that technology ensures time savings and efficiency in design as well as in communication, which in time enhances project quality. Modern technology as compared to the traditional ways provides a variety of options on how to go about a project in an advanced way. Modern technology comes with more advanced quality and makes construction more simplified and it helps in better construction standards and saves on turnaround time.

#### 4.8 Quality of Residential Buildings Projects

To analyse the study the researcher adopted the following key; NE = No extent, LE = Low extent, M = Moderate, GE = Great extent and VGE = Very great extent. For mean = M and Standard deviation = SD. This findings are shown in Table 4.7.

**Table 4.7 Quality of Residential Building Projects**

	NE		LE		M		GE		VGE		Mean	Std. Deviation
	F	P	F	P	F	P	F	P	F	P		
	(%)		(%)		(%)		(%)		(%)			
We ensure our projects are completed within time	14	4.8	20	6.8	33	11.3	153	52.5	71	24.3	3.87	0.817
Cost effectiveness is guaranteed in the project lifecycle	11	3.7	23	7.9	36	12.3	157	53.9	73	25.0	3.93	0.812
We ensure compliance to the required standards	13	4.4	27	9.2	34	11.6	149	51.2	71	24.3	4.01	0.785
Necessary approvals are made before hand	12	4.1	24	8.2	37	12.7	144	49.4	74	25.4	3.81	0.790
<b>Composite Mean</b>											<b>3.90</b>	<b>0.801</b>

On quality of residential building projects, majority of the respondents 153 (52.5%) agreed to a great extent that the respondents ensured the projects were completed within time.

#### 4.9 Regression Analysis

The study utilized multiple regression analysis to find out the relationship between the predictor variables and quality of residential buildings projects in Kasarani Constituency of Nairobi County. The study utilized SPSS version 24 to generate output of the regression statistics after cleaning and coding data from the field. The coefficient of determination was used to explain how the change in the dependent variable can be explained by the change in the independent variables. The dependent variable for the current study was quality of residential buildings

projects in Kasarani Constituency of Nairobi County while the independent variables were construction equipment, project funding, project management, and modern technology.

#### 4.9.1 Model Summary

The Table below provides the model summary of the relationship between the predictor variables and quality of residential buildings projects in Kasarani Constituency of Nairobi County. The findings are as shown in Table 4.8.

**Table 4.8. Model Summary**

Model	R	R Square	Adjusted Square	RStd. Error of the Estimate	F	P-value
1	0.89	0.792	0.742	0.312	31.341	0.001

a. Predictors: (Constant), construction equipment, project funding, project management, and modern technology.

b. Dependent Variable: quality of residential buildings projects in Kasarani Constituency of Nairobi County

From the results in the Table 4.8,  $R^2=0.792$  that is 79.2% disparity in quality of residential buildings projects in Kasarani Constituency of Nairobi County is explained by the independent variable in the model. However, 20.8% unexplained difference in quality of residential buildings projects in Kasarani Constituency of Nairobi County is as a result of other unrepresented determinants in the regression model. As per the findings in the above Table it can be ascertained that the model is good and can be utilized for the purposes of estimation. From the results in the Table a significant relationship was established which is indicated by the variables as depicted by  $R^2=0.792$  that is 79.2% which shows that a significant relationship exists between the independent variables and quality of residential buildings projects in Kasarani Constituency of Nairobi County.

#### 4.9.2 ANOVA Results

Table 4.9 shows the ANOVA results of the relationship between the predictor variables and quality of residential buildings projects in Kasarani Constituency of Nairobi County. The findings are shown in Table 4.9.

**Table 4.9. ANOVA of the Regression**

<b>Model</b>		<b>Sum of Squares</b>	<b>df</b>	<b>Mean Square</b>	<b>F</b>	<b>Sig.</b>
1	Regression	12.492	4	3.123	25.185	0.002 <sup>a</sup>
	Residual	45.756	369	0.124		
	<b>Total</b>	<b>58.248</b>	<b>373</b>			

a. Predictors: (Constant), construction equipment, project funding, project management, and modern technology.

b. Dependent Variable: quality of residential buildings projects in Kasarani Constituency of Nairobi County

The significance value is 0.002 which is less than 0.05 thus the model is statistically significance in predicting how the factors (construction equipment, project funding, project management, and modern technology) impact the quality of residential buildings projects in Kasarani Constituency of Nairobi County. The F critical at 5% level of significance was 3.123. Since F calculated is greater than the F critical (value = 25.185), this shows that the overall model was significant.

### **4.9.3 Coefficient of Determination**

The Table below provides the coefficient of determination on the relationship between the predictor variables and the quality of residential buildings projects in Kasarani Constituency of Nairobi County. The findings are as shown in Table 4.10.

**Table 4.10. Coefficient of Determination**

	Unstandardized		Standardized		
	Coefficients		Coefficients		
	B	Std. Error	Beta	T	Sig.
Model 1(Constant)	0.289	0.116		2.491	0.005
Construction					
Equipment	0.319	0.122	0.514	2.61	0.001
Project Funding	0.287	0.117	0.452	2.45	0.002
Project Management	0.245	0.106	0.413	2.31	0.001
Modern Technology	0.229	0.098	0.398	2.34	0.001

a. **Dependent Variable:** quality of residential buildings projects in Kasarani Constituency of Nairobi County

Simple regression analysis was conducted as to determine the quality of residential buildings projects in Kasarani Constituency of Nairobi County. As per the SPSS generated Table below, regression equation

$$(Y = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \epsilon)$$

Becomes:

$$(Y = 0.289 + 0.319X_1 + 0.287X_2 + 0.245X_3 + 0.229X_4 + \epsilon)$$

From the regression taking the independent variable at constant (construction equipment, project funding, project management, and modern technology) constant at zero, quality of residential buildings projects in Kasarani Constituency of Nairobi County was 0.289. The data findings analyzed also showed that taking all other independent variables at zero, a unit increase in construction equipment will lead to a 0.319 increase in quality of residential buildings projects in Kasarani Constituency of Nairobi County, a unit increase in project funding will lead to a 0.287 increase in quality of residential buildings projects in Kasarani Constituency of Nairobi County, a unit increase in project management will lead to a 0.245 increase in quality of residential buildings projects in Kasarani Constituency of Nairobi County, and a unit increase in modern technology will lead to a 0.229 increase in quality of

residential buildings projects in Kasarani Constituency of Nairobi County. This infers that at 5% level of significance and 95% level of confidence, construction equipment, project funding, project management, and modern technology were all significant on quality of residential buildings projects in Kasarani Constituency of Nairobi County.

#### **4.10 Discussion of the Findings**

On analyzing aspects of construction equipment of the projects which was found to be to a great extent as shown by a mean score of 3.87. These findings concur with the findings by Arditi and Gunaydin (2016) who showed that construction equipment are vital components of new construction, reflecting the company's construction force and possessing a significant result on the project's success and performance. The standard of management guarantees that the type and production characteristics of construction equipment corresponds to the site's needs. The contractor should choose appropriate construction equipment by taking into account technological advances, rationality of economics, applications of production, dependable performance and security, as well as the project's pertinence and durability. The performance parameters should be adjusted to meet the construction standards and quality controls.

On project funding, most of the respondents as shown by a composite mean of 3.92 presents to a great extent that source of finance was identified on the early stages of the project. This agrees with Gimeno (2018) who reported that a successful project should be allocated adequate funds to enable its completion and guarantee good quality works. Mohammed and Isah (2012) also added that contractor's cash flow significantly influences the quality of building construction projects. Project funding is a key factor that decides whether or not a project is successful.

Management style was ensured through proper training by the projects to a great extent as shown by a composite mean of 3.89. These findings concur with the study finding of Larsson, Eriksson and Pesämaa, (2018) who concluded that project management and the quality of building construction projects have a significant positive connection. Adoption of the practices of project management allow for efficient completion of a project as intended with cost minimization and in a way that meets the customer's needs.

Technology availability was all round ensured to a great extent as shown by composite mean of 3.91 which shows to a great extent that type of technology was considered on the project onset. These findings concur with the study findings by Ayudhya (2018) who explored the

present condition of modern technology which exists within the building industry and announced some effective methods. The researcher outlined the merits of incorporating technology into the construction processes to enhance efficiency and quality. As per the study the motivating factors behind adoption of technology were; output, which increased corporate competitiveness and efficiency; globalization, to resolve competition; strict scheduling; and regional and organizational proximity issues, as well as construction industry idiosyncrasies; i.e., orientation of the industry, the structural organization and temporary as well as short-relationships of businesses. The aforementioned itemized that technology should propel the organization to achieve its set quality goals.



## **CHAPTER FIVE**

### **SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS**

#### **5.1 Introduction**

This chapter presents summary of the findings, discussion, conclusion and recommendations of the research. The chapter also contains suggestions for further studies which can be carried out in future.

#### **5.2 Summary of the Findings**

This section presents summary of the findings and is organized into four parts which follow the objectives of the study.

##### **5.2.1 Construction Equipment**

It was found that the cost of hiring or purchasing construction equipment determined what respondents adopted at the construction site. According to the findings, many of the respondents indicated that proper selection and use of construction equipment influenced the quality of residential building projects in Kasarani Constituency of Nairobi County to a great extent and that the respondents agreed on the construction equipment statements to a great extent.

A positive and significant correlation was established between construction equipment and quality of residential building projects in Kasarani Constituency of Nairobi County. This implies that the quality of residential building construction projects would be enhanced by improvements in construction equipment.

##### **5.2.2 Project Funding**

The study assessed the influence of project funding on quality of residential building construction projects in Kasarani Constituency of Nairobi County. The study revealed that project funding greatly influences quality of residential building projects in Kasarani Constituency of Nairobi County.

It was established that adequacy of funds greatly influences quality of residential building projects. This correlates with Gimeno (2018) who claimed that a successful project should be allocated adequate funds to enable its completion and guarantee good quality works.

It was also found that the contractor's cash flow greatly influences quality of building projects. This is in line with Mohammed and Isah (2012) who stated that contractor's cash flow significantly influences quality of building projects.

A positive and significant correlation was established between project funding and quality of residential building projects in Kasarani Constituency of Nairobi County, implying that the quality of residential building projects in Kasarani Constituency of Nairobi County would be enhanced by adequate project funding.

### **5.2.3 Project Management**

Majority of the respondents indicated that project management influences the quality of residential building projects in Kasarani Constituency of Nairobi County to a great extent.

A positive and significant correlation was established between project management and quality of residential building projects in Kasarani Constituency of Nairobi County, implying that the quality of residential building projects in Kasarani Constituency of Nairobi County would be enhanced by improvements in project management.

Mohammed (2019) showed that project management has a significant positive impact on the quality of building projects. Adoption of project management practices allow for good quality works as intended with cost minimization and in a way that meets the customers' needs (Larsson, Eriksson and Pesämaa, 2018).

### **5.2.4 Modern Technology**

It was found that modern construction technologies influence to a great extent the quality of residential building projects in Kasarani Constituency of Nairobi County.

A positive and significant correlation was established between modern technology and quality of residential building projects in Kasarani Constituency of Nairobi County, implying that the quality of residential building projects in Kasarani Constituency of Nairobi County would be enhanced by wider/greater application of modern technology.

## **5.3 Conclusion**

The research was conducted in order to study the factors which influence quality of residential building projects in Kasarani Constituency of Nairobi County. The following conclusions were made from the study;

On the influence of construction equipment on quality of residential building projects, it was found that construction equipment had a positive and significant influence on quality of residential building projects in Kasarani Constituency of Nairobi County. It was deduced that equipment breakdown, shortage of equipment, equipment operation skills, and cost of equipment influenced quality of residential building projects. The findings show that proper and new construction equipment had an important and beneficial impact on the quality of residential building projects.

The findings show that project funding greatly and positively influences quality of residential building projects in Kasarani Constituency of Nairobi County. It was found that adequacy of finances, source of finances, and contractor's cash flow greatly influence quality of residential building projects.

It is concluded that project management had a substantial influence on quality of residential building projects in Kasarani Constituency of Nairobi County. The study's findings revealed that the present condition of building management of projects in Kasarani Constituency needed to be improved as there were challenges in relation to project management implementation that needed to be addressed such as quality control, monitoring & evaluation and resource flow.

It is also concluded that modern technologies had an influence on the quality of residential building projects. The findings conclude that technology facilitates collaboration and synchronization of job procedures thus creating a constructive effect on the quality of works and satisfaction of clients. Lastly, the findings show that adoption of Building Information Modelling (BIM) helps in reducing errors and omissions in construction. It enables project teams to create effective design strategies.

#### **5.4 Recommendations**

The following recommendations based on the research findings were made;

- i. Contractors should choose appropriate construction equipment by taking into account technological advances, rationality of economics, application of production, dependable performance & security, as well as project pertinence and durability in order to enhance quality of residential building projects.
- ii. It is recommended that clients and project developers should increase their sources of funds during project formulation and initiation so as to ensure that the project is not cash strapped during implementation. The contractors should be well evaluated

before contract award to ensure that they do not have cash flow problems. The contractors should also provide performance security insurances and deposits prior to project execution in order to cushion the client from risks.

- iii. Competent and experienced project managers should be engaged in order to ensure that the right project managers lead project implementation. The programme of works should be formulated and accompanied by good supervision in order to ensure that standards and best practices are followed to the letter so as to ensure good quality residential buildings.
- iv. Modern construction technologies should be adopted in order to facilitate collaboration and synchronization of job procedures thereby creating a constructive effect on the quality of works and satisfaction of the clients. Building Information Modelling (BIM) should be adopted quickly to help in reducing errors and omissions in construction therefore enhancing quality.
- v. Lastly, quality checks and balances should be encouraged in the residential building construction industry so that deliberate efforts and synergies are made to deliver high quality projects.

### **5.5 Suggestions for further research**

The following suggestions for further research are made;

- i. It is recommended that a similar study should be done in other Constituencies in the Country since this study was only limited to Kasarani Constituency of Nairobi County.
- ii. It is recommended that further research should be done in order to establish the influence of forces of demand and supply on the quality of construction buildings in urban areas.
- iii. It is recommended that for future analysis of Building Information Modelling, a set of interoperability and design standards should be adopted, and a major shift from Computer Aided Designs (CAD) to Building Information Modelling (BIM) needs to happen.

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## **APPENDICES**

### **APPENDIX 1: LETTER OF INTRODUCTION**

Kimaru Kennedy Kibuchi,

P.O. Box 2815-10100,

**NYERI.**

Dear Respondent,

#### **RE: REQUEST FOR PARTICIPATION IN A RESEARCH**

I am a Postgraduate student at the University of Nairobi, pursuing a Master's Degree in Project Planning and Management. As a partial fulfillment for the degree, I am conducting a research on "Factors Influencing Quality of Residential Buildings Projects: A Case of Kasarani Constituency of Nairobi County."

Therefore, I would appreciate if you could spare a few minutes of your time to answer the following questions in the questionnaire frankly and precisely. All information given will be treated with utmost confidentiality and will be used for academic purposes only.

Your assistance will be highly appreciated and thank you in advance.

Yours Faithfully,



**Kimaru Kennedy Kibuchi**

**L50/88072/2016**

## APPENDIX 2: QUESTIONNAIRE FOR THE RESPONDENTS

The information collected by the questionnaire will be kept confidential and will be used only for research purposes. All of the answers will be used in the study.

### INSTRUCTIONS:

1. Kindly fill/tick in the relevant brackets and blank spaces.

### SECTION 1: GENERAL INFORMATION

1. Indicate your area of specialization?

Quantity surveyors  Land surveyors  Engineers

Property developers  Construction Project Managers  Architects

2. Indicate your gender

Male  Female

3. Show highest level of education you have achieved?

Certificate  Diploma  Bachelor  Master  PhD

4. What is the total value in Kenya Shillings (in millions) of the projects carried out in the last five years?

10 and below  11-20

21-30  more than 30

5. What sort of project does your company deal with?

Industrial buildings  Commercial buildings  Residential Buildings

6. What period in years do you take to complete a residential building construction project?

1 to 5 years  5 to 10 years

10 to 15 years  15 to 20 years

**SECTION 2: Factors Influencing Quality of Residential Buildings Projects**

Use a scale of 1 to 5 where; 1 No extent, 2 Low extent, 3 Moderate, 4 Great extent and 5 Very great extent.

<b>Construction equipment</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
We the desired Equipment for the work as readily available					
There is a ready team to address equipment breakdown					
Shortage of equipment is outsourced to cover the gaps					
Our manpower are equipped with operational skills					
<b>Project funding</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Source of finance are identified on the early stages of the project					
Cost overruns are well covered					
Adequacy of finances is ensured at all levels of the project					
Contractor’s cash flow is well monitored					
<b>Project management</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Management style is ensured through proper training					
Quality control measures are well set					
Workers motivation and training is frequently done					

Co-ordination of project resources is supervised by the management					
<b>Modern Technology</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Technology availability is all round ensured					
Type of technology is considered on the project onset					
Building information modelling is adopted					
Computer aided design used are current					
<b>Quality of residential building projects</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
We ensure our projects are completed within time					
Cost effectiveness is guaranteed in the project lifecycle					
We ensure compliance to the required standards					
Necessary approvals are made before hand					



### **APPENDIX 3: INTERVIEW QUESTIONS FOR KEY INFORMANTS**

1. In your view, what do you understand by quality of residential building projects?

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2. In your opinion, how does construction equipment influence quality of residential building projects?

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3. In your view, how does project funding influence quality of residential building projects?

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4. How does project management influence quality of residential building projects?

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5. How does the use of modern technology influence quality of residential building projects?

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6. What are factors that hinder the quality of residential building projects?

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7. In your view, suggest measures that can be established to ensure quality of residential building projects?






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**APPENDIX 4: NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION LETTER**

 REPUBLIC OF KENYA	 NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION
Ref No: 787752	Date of Issue: 24/June/2021
<b>RESEARCH LICENSE</b>	
	
<p>This is to Certify that Mr., Kennedy Kibuchi Kimaru of University of Nairobi, has been licensed to conduct research in Nairobi on the topic: <b>FACTORS INFLUENCING QUALITY OF RESIDENTIAL BUILDING CONSTRUCTION PROJECTS; A CASE OF KASARANI CONSTITUENCY IN NAIROBI COUNTY, KENYA.</b> for the period ending : 24/June/2022.</p>	
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## APPENDIX 5: PLAGIARISM REPORT

### APPENDIX 5: PLAGIARISM REPORT

*Semantic*  
*10/12/2021.*

#### FACTORS INFLUENCING QUALITY OF RESIDENTIAL BUILDING CONSTRUCTION PROJECTS; A CASE OF KASARANI CONSTITUENCY IN NAIROBI COUNTY, KENYA

##### ORIGINALITY REPORT

<b>15%</b> SIMILARITY INDEX	<b>11%</b> INTERNET SOURCES	<b>3%</b> PUBLICATIONS	<b>8%</b> STUDENT PAPERS
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##### PRIMARY SOURCES

<b>1</b>	Submitted to School of Oriental & African Studies Student Paper	<b>1%</b>
<b>2</b>	www.ijssit.com Internet Source	<b>1%</b>
<b>3</b>	Arowolo T. A, Kolawole O.A, Adewale A.K, Adeyemi O.M. "Factors Affecting Quality Control in Building Construction", International Journal of Advances in Scientific Research and Engineering, 2019 Publication	<b>1%</b>
<b>4</b>	Submitted to Universiti Teknologi MARA Student Paper	<b>1%</b>
<b>5</b>	Submitted to Technical University of Mombasa Student Paper	<b>1%</b>
<b>6</b>	web.usm.my Internet Source	<b>1%</b>

## **APPENDIX 6: PUBLISHED JOURNAL PAPER**

The following paper has been published in the journal below;

Kennedy Kibuchi Kimaru and Prof. Timothy Maitho.

Factors influencing quality of residential building construction projects; a case of Kasarani Constituency in Nairobi County, Kenya.

*International Academic Journal of Information Sciences and Project Management*, (6), 461-482.

Available Online at: [https://iajournals.org/articles/iajispm\\_v3\\_i6/-461\\_482.pdf](https://iajournals.org/articles/iajispm_v3_i6/-461_482.pdf)

# **FACTORS INFLUENCING QUALITY OF RESIDENTIAL BUILDING CONSTRUCTION PROJECTS; A CASE OF KASARANI CONSTITUENCY IN NAIROBI COUNTY, KENYA**

**Kennedy Kibuchi Kimaru.**

Master of Arts in Projects Planning and Management of the University of Nairobi,  
Kenya

**Prof. Timothy Maitho.**

University of Nairobi, Kenya

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## **ABSTRACT**

In the last few decades, the building construction industry has experienced challenges of quality which are complex and different. The building construction industry in Kenya has been associated with disruptions in quality therefore causing cost and time problems. Many of the quality challenges are a product of inadequate planning. In Kenya, there have been reports of poor administration of residential building construction projects, a superfluous surge in project usage lacking organization and budgetary arrangements, and exorbitant project management. The collapse of residential buildings has been reported severally, especially in the capital city of Nairobi. The purpose of the study was to assess the factors influencing quality of residential building construction projects in Kasarani Constituency of Nairobi County. The following specific objectives guided the research; to assess the influence of construction equipment, project funding, project management, and modern technology on quality of residential building construction projects in Kasarani Constituency of Nairobi County. The study adopted a descriptive research design targeting practitioners in the residential building construction industry including architects, structural engineers, civil engineers, mechanical engineers, electrical engineers, land surveyors, quantity surveyors, construction project managers and private developers. The sample size was 385 respondents, and the non-probability sampling technique was used in the study. Data collection in the study was done by administering questionnaires and carrying out interviews. Descriptive statistics, such as frequency, means, percentage and standard deviation,

were used to interpret the data. A regression analysis was conducted in order to show how construction equipment, project funding, project management and modern technology influence quality of residential building construction projects in Kasarani Constituency of Nairobi County. The key finding of the study was that there was a positive and significant correlation between construction equipment ( $r=0.695$ ,  $p\text{-value} <0.05$ ); project funding ( $r=0.831$ ,  $p\text{-value} <0.05$ ); project management ( $r=0.776$ ,  $p\text{-value} <0.05$ ) as well as modern technology ( $r=0.743$ ,  $p\text{-value} <0.05$ ) on quality of residential building construction projects in Kasarani constituency of Nairobi County. This implied that the nature of construction equipment, the level of project funding and project management as well as the level of application of modern technology were positive determinants of quality of residential building construction projects in Kasarani constituency of Nairobi County. The recommendations are that the right construction equipment should be used in the construction of residential buildings. Competent project managers should be engaged to manage the residential building construction projects. The clients and contractors should have enough cash flow to execute projects. Appropriate technologies such as Building Information Modelling should be adopted quickly in the residential building construction sector to minimize errors, and improve quality of works.

**Key words: Construction Equipment, Project Funding, Project Management, Modern Technology, Quality of**

## **Residential Building Construction Projects.**

### **INTRODUCTION**

The conceptual changes in the building industry have popularized the issue of quality. Consequently, quality and quality systems subject has increasingly received scholarly attention globally (Oke, Aigbavboa and Dlamini, 2017). In any industry, the end product should meet certain set standards, and be satisfactory to the client. The need for achievement of excellence in the building industry can thus not be overemphasized. The management of quality in the building industry is, therefore, an important area that is highly researched from many perspectives including total quality control, cost of quality, and quality performance management systems, and best practice among others. All these efforts have resulted in improved ways of looking at the building industry's quality management.

Courtesy of competitiveness in the building industry, attention on the excellence in performance of construction projects has increasingly become important. In light of this, it has become imperative to establish quality factors in the construction industry. Project managers must thus have means of ascertaining and controlling quality in their projects.

Naoum (2016) established that the factors influencing building construction projects include; site layout, designs, subcontractors involved, nature of contract, material used, nature of labour, equipment used, site personnel, and execution of the project. Compliance with codes and regulations, owner specifications, design phase and procedures, scheduling requirements, expense requirements and constructability are the elements that influence quality of building construction projects (Abas, Khattak, Hussain, Maqsood and Ahmad, 2015).

From the different studies, it is clear that quality is an intangible term and more so in the construction industry. Construction projects involve multidisciplinary teams with each discipline having a different definition of success and failure depending upon individual goals and objectives. Consequently, the definition of quality as a first step is important for assessment in different projects. Quality is considered in terms of compliance to timelines and client satisfaction in the study that is under investigation. Success or failure of construction projects is contributed by many factors. The factors influencing the success of residential construction projects is examined when it comes to the development of tools that are critical in controlling project price and scheduling in the building construction industry (William and Dettmer, 2017).

Across the globe, the construction industry has had a mix of success and failures courtesy of an array of influencing factors. A research by Sinesilassie et.al, (2018), examining the factors that affect performance of local building projects in the Middle East revealed that quality in the construction industry is influenced by material costs, availability of resources, the average delay due to closure resulting in material shortage, staff expertise and credentials, the project manager's leadership skills, as well as the standard of machinery, and raw materials used in



the project. According to Burgess and Stern (2020), the quality process in the construction industry is positively influenced by factors such as commitment by the management. Commitment by management ensures continuous improvement in quality. Equipping of personnel with appropriate skills positively influences the quality process.

In Africa, a study done in Egypt by Willar, Coffey and Trigunarysyah (2015) observed that compromise in quality in the building industry has devastating effects and as such project managers need to take specific action to ensure project quality. Among the actions they suggested include, coming up with appropriate goals and objectives, setting up a good administrative structure, establishing public relations practices, obtaining professional and technical staff, ensuring a pleasant working atmosphere and adequate technological resources and encouraging workers to advance their careers.

In Kenya, in the last few decades, the building industry has grown exponentially. The industry has developed to become one of Kenya's most important sectors, contributing significantly to the country's growth. The construction industry in Kenya has been frequented by sporadic disruptions and delays leading to cost and time overruns. These interferences are the origin of possible hazards; which present studies researching on how to control these hazards include: technological, economic, building, legal, financial resource and commercial levels (Gaba, 2019).

Funding the construction industry is done with an intention of gaining paybacks from the ventures. The building industry is recognized as a material depleting and time-consuming industry. This is due to its uncertainty and instability, which is brought about by a wide range of desires, requirements, and tastes. No investor will put money into a project with unknown costs or schedules. A study done by Holden (2018) established that time, expense, and the construction industry are inextricably linked. The study further shows that construction programmes have a start and end date, use money, and must meet certain conditions in order to satisfy the beneficiaries. Additionally, contracts are often dependent on the expense and time required to complete a job.

In context, there are no studies which have been conducted and little information is provided in relation to quality residential building construction projects and factors such as construction equipment, project funding, project management and modern technology. Consequently, this research will be carried out to fill in the knowledge gaps by investigating the factors influencing quality of residential building construction projects; a case of Kasarani Constituency in Nairobi County.

### **Problem Statement**

The population in urban areas is estimated to rise to around 2.5 billion people by the year 2050 with Africa and Asia expected to have 90% of this growth (World Bank, 2021). Currently, the lack of affordable housing is approximated to be at 350 million households in the cities. By 2025, it is projected to grow by at least 30% to 440 households with 1.6 billion

people (King et al., 2017). As a result, many cities are encouraging its residents to move to urban periphery in order to solve this problem. At this end, this approach itself is a problem on its own since it cuts off people from economic opportunities and social networks. Consequently, contractors are in a rush to complete construction development projects with residential buildings playing the center-stage (Carter, 2018). The requirement for accomplishing quality projects in building development is essential. Quality is a fundamental component of manageability and consumer loyalty. Activities such as production, procurement of building materials or the supply of construction facilities has guaranteed the survival of construction firms (DFID, 2020). To achieve success and productivity, construction firms aim to increase the efficiency of their goods in the market. In building projects, project management's role is to execute successful projects that meet the agreed-upon targets and bring value to the project. The literature indicates that the management process of the project is aimed at achieving effective projects in general (Demirkesen and Ozorhon, 2017). In the design of buildings, quality control has become exceedingly important (Bui, 2018). If quality is properly controlled, the success of the project rates and the viability of the organizational can also increase (Leng, 2018).

Yap, Chow and Shavarebi (2019), stated that most quality problems reported in projects under construction are the product of inexperienced planners and builders, as well as inadequate planning. Project management, issues with technology, site-related challenges, ineffective procedures, equipment cost overruns, completion time, safety and health, environment, customer satisfaction, and communication were defined as factors that influence the quality of building construction projects. A report by The Standish Group (2015) shows that cost overruns ranged from 51% to 100% on 29.6% of the projects investigated. 35.5% of projects have gone over budget by 101% to 200%, and 39.1 % of projects have changed from the original schedule by 75% to 99%. For all businesses, the average rise from the initial estimate cost is 189% to 222%. More than a quarter of projects are finished with just 25% to 49% of the characteristics and intent stated at the start. In Kenya, there have been reports of poor administration undertakings, a superfluous surge in project usage, lacking organization and budgetary arrangements, and exorbitant project management (Arrow and McGrath, 2019). Kenya has a huge housing shortfall, which is developing each year and is progressively passive in urban zones and especially Nairobi County. As per the Ministry of Housing statistics, the present yearly housing shortfall is assessed to be more than 156,000 units every year given the population development and urban relocation (KNBS, 2020). The speed of building is still restricted to slightly above 50,000 units built annually and the remaining part is filled by growth in slum existence and poor-quality traditional housing (Blake, 2018). Recent research has been done on factors influencing construction schemes, however, the lack of consistent studies, scarcity data, information and lacuna in studies present a clear problem on the quality of residential construction projects. Therefore, this research will address this deficiency in the body of knowledge by studying the factors influencing quality of residential building construction projects in Kasarani Constituency of Nairobi County.

## **Objectives of the Study**

The following objectives guided the study:

- i. To assess the influence of construction equipment on quality of residential building construction projects in Kasarani Constituency of Nairobi County.
- ii. To assess the influence of project funding on quality of residential building construction projects in Kasarani Constituency of Nairobi County.
- iii. To assess the influence of project management on quality of residential building construction projects in Kasarani Constituency of Nairobi County.
- iv. To assess the influence of modern technology on quality of residential building construction projects in Kasarani Constituency of Nairobi County.

## **THEORETICAL REVIEW**

### **Resource Dependency Theory**

In 1978, Pfeffer and Salancik introduced the Resource Dependency Theory. Its main point was that the involvement of external support has a significant impact on an organization's development (Omran, Abdalrahman and Pakir, 2020). This approach implies that the organization's capacity in terms of finance and resources is a vital determinant of the mission and project performance. According to advocates of the theory, like Mohammed (2019) it is critical for an organization to possess enough capital for the execution of a project or the achievement of established goals. Finances, qualified human capital, supplies, and infrastructure are among the resources defined by the researcher as critical to the achievement of organizational goals. However, opponents of the hypothesis, such as Tabishl and Jha (2018) contend that certain organizations have flourished without funding therefore calling for other factors like instillation of the appropriate strategies, the effectiveness of the management and the organizational culture. Despite the fact that such critiques are warranted in light of the theory's general proposition, it is crucial to remember that providing the requisite tools must be balanced with other enablers such as a positive working environment and a sound plan.

The resource dependency theory is relevant to this study since it provides the theory in knowing the capability of an organization like the builder to carry out his/her quality work, therefore, building projects become disturbed by the presence of inadequate project funding. The usefulness of supplies and tools, as well as the expertise of human resources, are critical factors in the building project's progress. A Contractor's experience is usually taken into account when assessing his or her ability to handle construction projects. Experienced contractors are required to have valuable tools that can help minimize the time it takes to complete building construction projects. The theory can be useful in explaining the project funding variables and its influence on the quality of residential building construction projects. It can also explain the effect of project efficiency in projects.

## **Stakeholder Theory**

According to Edward Freeman (1983) an organization has got several parties that inflame its own operations. The theory itself was disclosed by Edward Freeman. Other people who support this theory like Arkin and Skitmore (2008) remark that it's important to involve the organization's stakeholders and consider their interests. Putting into consideration the concerns of the stakeholders guarantees a successful project. The theory considers the different types of organizational stakeholders and their input. Stakeholder approach is a management instrument. The attribute elements and authenticity of cases characterize an association's stakeholders.

Power in addition to desperation ought to be gone in order for the chiefs to serve the lawful as well as the good interests of honest to goodness shareholders (Oyewobi et al., 2018). According to the stakeholder theory, open division can be defined as being intricate settings having numerous stakeholders that regularly possess various, ambiguous and separating objectives. In any case, no critical proof has been found that completely keeps the exchange of working thoughts, strategies and theory from the private area to general society segment. Still, the probability of effective results of such exchanges is thought to be identified with the level of acclimation to fit the attributes of the objective setting.

The theory critical to the comprehension of the interests of key stakeholders bearing in mind the desired goal which is to move a project with least disturbance. Stakeholder examination is helpful in identifying important project's stakeholder and recognizing their particular advantages in the project with relation to quality of works. The stakeholder investigation along these lines appears like a suitable solution for the multifaceted nature-related difficulties of the adjusted scorecard as a vital administration apparatus. Wyatt and Baird (2018) attribute the growth of corporate social responsibility to stakeholder theory, it recommends an association's survival and the achievement to be perceived by accomplishment of non-financial goals in light of a legitimate concern for their stakeholders. The management of any firm takes into account every stakeholder aggregate in either of the three diverse ways, to be specific; regularizing, instrumental and unmistakable. The perspective of standardizing recommends that the firm should consider the interests of the stakeholders as a whole and not just of the clients or stockholders. According to the above perspective, a firm should outline the structure of a complete CSR activity in a manner which offers consistency to the entire stakeholder group. The key perspective supports a firm's concentration in enhancing monetary execution holding on the fact that financial achievement is the main goal in organizations. To make this real, Proposals are for the firms to establish accentuation on just the CSR characteristics that particularly enhance financial management. The distinct perspective recommends that an organizations conduct can be anticipated by the shareholders, their qualities and relative impact, and stakeholder theory determines the degree to which a partnership treats its stakeholders properly, and in this manner is connected to corporate social obligations (Kartam, 2018). The study is appropriate to the stakeholder theory as it helps to appreciate that project management is important in identifying and engaging various stakeholders such as contractors and other parties that should be taken into

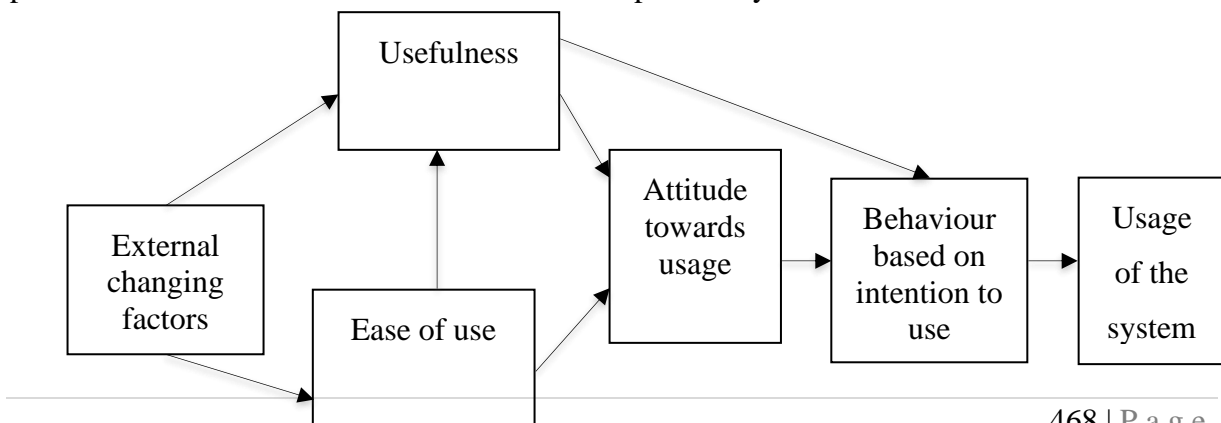
consideration while undertaking construction projects in order to attain quality of works. Project managers should, for that matter, be in a position to adjust their operational mode to be in agreement with the stakeholders' needs and to ensure the accomplishment of the overall objectives.

### Technology Acceptance Model

The study will also be anchored on Davis Fred's Technology Acceptance Model (TAM) of 1986. The consequences of the characteristics of the system on the user acceptance is examined by this model among others. To determine whether or not to employ technology in the work place, one uses data in a structural way. Three main factors were identified by Arditi and Günaydın (2016), influencing acceptance of technology. The factors are related to understanding of the technology and its effectiveness. Kartam (2018) started with the TRA which he adopted for instituting the connection between how people understand the ease of using technology and the perceived usefulness of the technology, and the intentions to give explanations of adopting the technology.

The level at which a technology is perceived to be of more benefit than the previously used technology is what is referred to as relative advantage. The relative advantage leads to improved status, better efficiency and financial benefits. Previous research has created the positive presence relationship between relative advantage and rate of adoption. According to the research, users tend to adopt a new technology if they find it to be more usefulness and advantageous than the old one.

The Technology Acceptance Model is specifically designed to predict users' adoption of information technology and its application in the workplace., TAM model deals with expectations rather than actual use by relying on mindset explanations of purpose to use a given device or service. It is suggested that when a prospective adopter is faced with a new technology, perception determines how they can use it (Mohammed, 2019). Yuan et al., (2018) advocated for the Theory of Reasoned Action (TRA). This was an addition to the TAM. The theory stressed that human behaviour stems from their intentions and behavioral intentions (BI). Behavioural Intentions is a type of cognitive function that has two facets: attitude and subjective standards. According to the Theory of Reasoned Action, a salient conviction determines both the mindset and subjective norm portion of individual conduct. Primarily, this Technology is useful to assess the intention of the users, and to accept or reject the usage of a specific technology. This model best explains the reasoning behind an employee accepting or declining a particular technology on the basis of how the employee perceives it useful as well as its ease of use as explained by the TAM.



### **Figure 1: Technology Acceptance Model**

A potential consumer of technology believes that technology consumption will require less energy. This is what is perceived as the ease of use. The Technology Acceptance Model will help in explaining and predicting the behavioral patterns of the users and the effect of new technologies on the building design and the efficiency of construction projects. The theory points out that the user's mood, intentions and understanding of the system, directly or indirectly affects the application of a modern technology system.

## **RESEARCH METHODOLOGY**

### **Research Design**

The plan, framework, blueprint and the strategy used to set up requirements for obtaining answers to study questions, data collection and data analysis is used to describe the research design. Simply is like a "glue" which sticks together the elements of a research project (Akhtar, 2016). Descriptive research design was employed in this research which described demographic characteristics of the population. The mean, frequencies standard deviation and frequencies were provided and inferential statistics by establishing how predictor variables and the outcome variables were related. This was centered on the outcomes of data processing; it assists in describing the interaction between the dependent and independent variables using a descriptive approach. Therefore, the researcher adopted descriptive research design because it allows a researcher to gather and analyse data using both quantitative and qualitative techniques (Keman, 2020).

### **Target Population**

A target population can be defined as a specified community of individuals or a set of things, households, firms and services which are to be studied (Wambugu, 2013). The study was carried out in Kasarani Constituency of Nairobi County. The target population was practitioners in the construction industry. They included; Quantity Surveyors, Architects, Structural Engineers, Civil Engineers, Electrical Engineers, Mechanical Engineers, Land Surveyors and Construction Project Managers. Developers also formed a part of the targeted group. The sample size was 385 respondents. The primary objective of choosing this population was to collect recent and historical evidence from people who have participated in the execution of building programmes and are therefore thought to have firsthand familiarity with execution of residential building construction projects.

### **Sample size and sampling procedures**

The sampling is described as sampling unit, sampling frame, and sampling size. Sampling procedures are the approaches a researcher adopt in selecting the elements of the population that will participate in the study (Parveen et al., 2017). The study adapted probability sampling design and random sampling techniques. The sampling procedure was also driven by the data of the licensed building industry workers who made up the population. To reflect the whole population, a certain number of subjects were chosen from a characterized

population. Sample size is an absolute size of the selected participants who are included in the study and its findings are used in generalization of the entire population.

The researcher’s interpretation and its relevant application in data information realization required for the study was also put into considerations. The population sampled was selected in Kasarani constituency of Nairobi County. The Yamane’s formula of 1967 was useful in computing the sample involved in the study.

$$n = \frac{N}{1 + Ne^2}$$

Where: N = Population size as per the study, n = sampled size, e = Margin error expected out of the study set at ±5%

In this case, the Sample size will therefore be

$$\frac{10547}{1+10547(0.05)^2} = \frac{10547}{1+10547(0.0025)} = \frac{10547}{1+26.3675} = \frac{10547}{27.3675} = 385 \text{ respondents}$$

which is 3.65% of the total population

Therefore, the study sampling matrix is illustrated in Table 1.

**Table 1: Sampling Matrix of the Study**

Population Description	Target Population	Registering body	Sample Size (3.65%)
Architects	1,308	BORAQS/AAK	48
Quantity surveyors	687	BORAQS	25
Engineers	6,330	EBK/IEK	230
Land surveyors	206	ISK	8
Property developers	16	KPDA	1
Construction project managers	2,000	BORAQS/ICPMK	73
<b>Total</b>	<b>10,547</b>		<b>385</b>

Source, NCA 2020

Out of the 385 participants the study picked two interviewees from each of the category. Therefore those who participated in questionnaires were 374 and there were 11 key informants. All the participants were picked randomly.

### Data collection instruments

Primary data was gathered using questionnaires from the respondents. Questionnaires were designed to elicit information on demographic information and the specific questions which included; influence of construction equipment, project funding, project management and modern technology on quality of residential building construction projects in Kasarani Constituency of Nairobi County. Questionnaires were mainly used to collect quantitative data and they were administered to Quantity Surveys, Architects, Engineers, Property Developers, Construction Project Managers and Land Surveyors. Structured interview schedule was conducted to the Key Informants (KI). An interview schedule was suitable to obtain insights

and in-depth information that questionnaire failed to capture. Secondary data was obtained from brochures, journals, periodicals, websites, and other relevant sources that are available.

### **Piloting of Research Instruments**

A pilot study is a pretest that is conducted before the actual study. The pilot study was done in the neighbouring Constituency of Roysambu. The collected pilot data was excluded from the actual study. The reliability and validity of research instruments was pretested by pilot testing. Pilot test was done on 10 respondents who were not part of Kasarani Constituency. Random sampling was used in order to form the pilot group. This was due to the fact that in this system, each unit was chosen. A pre-trial finding was not included in the actual study. A pilot study in a research plays a significant role by providing the researcher with valuable information that enable the researcher to evaluate data, rethink analysis methods, clarify, redefine, restructure and even remove vague items in the study (Doody and Doody, 2015).

### **Validity of the Instruments**

According to Surucu, Lutfi & Maslakci, Ahmet & Sesen, Harun, (2020), validity is an essential factor used in research in order to yield beneficial results. The degree to which a test instrument accurately tests what it claims to measure is known as validity. Whiston (2016) describes validity as when a research instrument obtains data appropriate to achieve the intended purpose. Validity is concerned with whether the research instruments measure the quality or behaviour that it is supposed to measure. Additionally, validity determines whether the research instrument expresses the scale that is suitable to its function and measures its desired results. It examines the accuracy and significance of inferences drawn from research findings. Research instruments were authenticated by a panel of experts in the study's area. To determine the internal validity and determine if it was appropriate for use as an instrument to achieve the research's goals and objectives. The panel ensured that the items properly reflected topics that addressed all applicable aspects under requested to determine the internal relevance and whether or not it was appropriate for use. The panel ensured that the objects denoted ideas which tackled all applicable issues being investigated in an adequate way. Face validity, material validity and construct validity tests were performed on the instrument based on previous studies.

### **Reliability of the Instruments**

Reliability is an essential factor in a research process since it enables a study to yield beneficial outcomes (Sururu, 2020). The degree to which a test instrument produces stable outcomes under similar conditions and after repeated trials with the same participants is known as reliability. The reliability of the measuring procedure is said to be higher if consistent outcomes are gotten by the common participants in the similar repetitive measurement. If tools used in research is stable and consistent, and hence, accurate and predictable, this means it is consistent. The testing instrument's dependability was investigated using an inter-item reliability measure. Various elements were used to gauge every idea present in the questionnaire. It involved a series of similar questions that were



used to assess how far one definition was linked to another. To assess reliability, the Cronbach’s coefficient test was used. A Cronbach's alpha value of 0.5 to 0.7 was considered suitable as an indicator of the instrument's internal reliability. A score of more than 0.7 was considered sufficient evidence of internal accuracy. Cronbach’s formula

$$\hat{\alpha} = \frac{k}{k-1} \left( 1 - \frac{\sum_{i=1}^k P_i(1-P_i)}{\hat{\sigma}_x^2} \right)$$

Where a is the number of elements and is the Cronbach's coefficient. The proportion of respondents who answer a study question in a certain way is known as pi. The results of Cronbach’s alpha test were obtained by questionnaires with different respondents. As illustrated in Table 2.

**Table 2: Cronbach’s Alpha Values**

Values	Reliability
< 0 .5	Not reliable
0.5 to 0 .7	Mode
> 0.7	Good

Source: Nunally (1978)

### Data collection procedure

The researcher acquired a permit from the National Commission for Science, Technoolgy and Innovation (NACOSTI). Later, the instruments were administered to the respondents. The targeted population included literate people who could read and understand questions provided in the questionnaires. Hard copies of the questionnaires were handed to respondents. The drop and pick method was used whereby questionnaires were administered to the research participants and they were picked after two weeks to give the respondents ample time to respond to questions and to increase data accuracy. The researcher booked interviews with key informants and the interview took twenty minutes (20) to one hour (1). The collected data was analyzed to make meaningful inferences to the study.

### Data Analysis Techniques

The research was quantitative in nature. Data analysis involves examining data with the aim of making any useful analysis, to make deductions and inferences of the study goals and plans. Data analysis involves coding, arranging data, removing errors and processing data. Therefore, quantitative and qualitative data obtained from research instruments were cleaned, coded in a computer and analysis done using Statistical Package for Social Sciences version 21. To present quantitative data in various ways, the researcher used statistical figures such as percentages, frequencies, means, and standard deviation. Popular patterns, narrative structure, and content analysis was used to interpret the qualitative results. Data analysis, according to Kothari (2014), is the method of assigning numerical values to observations or products, with the unit of measurement defined by the laws used to assign the quantities. Analysis of correlation were used to demonstrate the connection between construction equipment, project

funding, project management and modern technologies on the quality of residential building construction projects in Kasarani Constituency of Nairobi County.

## RESEARCH FINDINGS

The study utilized Pearson’s Correlation Analysis to evaluate the association between the study’s independent variables (construction equipment, project funding, project management and modern technology) and the study’s dependent variable (quality of residential building construction projects) in Kasarani Constituency of Nairobi County at 5% significance level. The correlation analysis results are as illustrated in Table 3.

**Table 3 Correlation matrix**

	Quality of residential building construction projects	Construction equipment	Project funding	Project management	Modern technology
Quality of residential construction projects (r) (p) Sig. (2 tailed)	1.000				
Construction equipment (r) (p) (2 tailed)	0.695* 0.016	1.000			
Project funding (r) (p) (2 tailed)	0.831* 0.000	0.113 0.509	1.000		
Project management (r) (p) Sig. (2 tailed)	0.776* 0.000	0.068 0.424	0.228 0.121	1.000	
Modern technology (r) (p) Sig. (2 tailed)	0.743* 0.009	0.090 0.631	0.175 0.149	0.106 0.327	1.000

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

Results of the Pearson’s correlation coefficients depicted that there was a positive and significant correlation between construction equipment ( $r=0.695$ ,  $p\text{-value} < 0.05$ ); project funding ( $r=0.831$ ,  $p\text{-value} < 0.05$ ); project management ( $r=0.776$ ,  $p\text{-value} < 0.05$ ), modern technology ( $r=0.743$ ,  $p\text{-value} < 0.05$ ) and quality of residential building construction projects in Kasarani Constituency of Nairobi County. This implied that the nature of construction equipment, the level of project funding and project management as well as the level of application of modern technology positively influenced quality of residential building construction projects in Kasarani Constituency of Nairobi County. As such the quality of residential building construction projects in Kasarani Constituency of Nairobi County would be enhanced by improvements made in the areas of construction equipment, project funding, project management and use of modern technology.

### Construction Equipment

The study assessed the influence of construction equipment on quality of residential building construction projects in Kasarani Constituency of Nairobi County and found that it greatly influences the quality of building construction projects. The study found that the cost of hiring or purchasing construction equipment determined what respondents adopted at the construction site. According to the findings, most of the respondents indicated that proper

construction equipment affected residential building in Kasarani Constituency to a very great extent and that respondents agreed on construction equipment statements to a great extent. These findings concur with the study findings by Arditi and Gunaydin (2016) who claimed that construction equipment is vital component of new construction, reflecting the company's construction force and possessing a significant result on the project's success and performance. The standard of management guarantees that the type and production characteristics of construction equipment corresponds to the site's needs. The contractor should choose appropriate construction machinery and equipment by taking into account technological advances, rationality of economics, applications of production, dependable performance and the security, as well as the project's pertinence and durability. The performance parameters should be adjusted to meet the construction standards and quality controls.

### **Project Funding**

The study assessed the influence of project funding on the quality of residential building construction projects in Kasarani Constituency of Nairobi County and found that it greatly influences the quality of building construction projects. This correlates with Gimeno (2018) who reported that a successful project should be allocated adequate funds to finance its completion and guarantee good quality works. It was also found that contractor's cash flow greatly influences quality of residential building construction projects. This is in line with Mohammed and Isah (2012) who stated that contractor's cash flow significantly influences quality of building construction projects. Project funding is a key factor that decides whether or not a project is successful.

### **Project Management**

The study assessed the influence of project management on quality of residential building construction in Kasarani constituency of Nairobi County and found that it greatly influences quality of residential building construction projects. Majority of those interviewed indicated that project management influenced quality of residential building construction projects in Kasarani Constituency and project management factors influenced construction quality to a great extent. These findings concurs with the study finding of Larsson, Eriksson and Pesämaa, (2018) who concluded that project management and the efficiency of building design programmes have a significant positive connection. Adoption of the practices of project management allows efficient completion of a project as intended with cost minimization and in a way that meets the customer needs. Project management had a substantial influence on the building project's efficiency.

### **Modern Technology**

The study assessed the influence of modern technology on quality of residential building construction in Kasarani constituency of Nairobi County and found that it greatly influences quality of residential building construction projects. A positive and significant correlation was also established between modern technology and quality of residential construction

projects in Kasarani constituency, Nairobi County, implying that the quality of residential construction projects in Kasarani constituency, Nairobi County would be enhanced by wider/greater application of modern technology. These findings concur with the study findings by Ayudhya (2018) who explored the present condition of modern technology that exists within building industry and announced some effective methods too. The research outlined the merits of incorporating technology into the construction processes to enhance efficiency and quality. As per the study the motivating factors behind adoption of technology were; output, which increased corporate competitiveness and efficiency; globalization, to resolve competition; strict scheduling; and regional and organizational proximity issues, as well as construction industry idiosyncrasies; i.e., orientation of the industry's project, the structural organization and temporary as well as short-relationships of short terms businesses. The aforementioned itemized that technology should propel the organization to achieve its set quality goals.

## **Conclusion**

The research was conducted in order to study the factors influencing quality of residential building construction projects in Kasarani Constituency of Nairobi County. The following conclusions are made from the study;

On the influence of construction equipment on quality of residential building construction projects, it was found that the study has a positive and significant influence on quality of residential building construction projects in Kasarani Constituency of Nairobi County. It was deduced that equipment breakdown, shortage of equipment, equipment operation skills, and cost of equipment influenced quality of residential building construction projects. The findings observe that proper and new construction machinery had an important and beneficial impact on the quality of residential building construction projects.

The findings show that project funding greatly and positively influences quality of residential building construction projects in Kasarani Constituency of Nairobi County. It was found that adequacy of finances, source of finances, and contractor's cash flow greatly influence quality of residential building construction projects.

It is concluded that project management had a substantial influence on quality of residential building construction projects. The study's findings revealed that the present condition of building management of projects in Kasarani Constituency needed to be improved as there were challenges in relation to project management implementation that needed to be addressed such as quality control, monitoring and evaluation and resource flow.

It is also concluded that modern technologies had an influence on quality of residential building construction projects. The findings conclude that technology facilitates collaboration and synchronization of job procedures thus creating a constructive effect on quality of works and satisfaction of the clients. Lastly, the findings show that adoption of Building

Information Modelling (BIM) helps in reducing errors and omissions in construction. It enables project teams to create effective design strategies.

## **Recommendations**

The following recommendations based on the research findings was made;

- i. The contractors and designers should strictly follow the required standards of materials for construction of residential buildings construction projects. This will ensure that the management competence is put into consideration by encouraging those in management to embrace risk management practices such as risk identification, quantification, monitoring and mitigation to help prevent risks and improve quality and safety.
- ii. It recommended that clients and project developers should increase their sources of funds during project formulation and initiation and so as to ensure that the project is not cash strapped during implementation of the project. The contractors should be well evaluated before contract award to ensure that they do not have cash flow problems. The contractors should also provide performance security insurances and deposits prior to project execution in order to cushion the client from risks.
- iii. Competent and experienced project managers should be engaged in order to ensure that the right project managers lead project implementation. The programme of works should be formulated and accompanied by good supervision to ensure that standards and best practices are followed to the letter so as to ensure good quality residential buildings.
- iv. A culture of quality should be encouraged on the residential building construction industry so that deliberate efforts and synergies are made to deliver high quality projects.

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