THE UNIVERSITY OF NAIROBI

THE APPLICATION OF DESIGN MANAGEMENT METHODS FOR DESIGN PROCESS SUCCESS FOR CONSTRUCTION PROJECTS IN KENYA.

[A CASE STUDY OF NAIROBI COUNTY]

BY

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A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF ARTS IN CONSTRUCTION MANAGEMENT IN THE FACULTY OF BUILT ENVIRONMENT AND DESIGN, DEPARTMENT OF REAL ESTATE, CONSTRUCTION MANAGEMENT AND QUANTITY SURVEYING.

2023

DECLARATION

Declaration by the Candidate

I, **Nzioki Lucy Nzilani**, registration number **B53/34363/2019**, hereby declare that this project is my original work and has not been presented for the award of any other degree in any other university.

.... 15th September 2023

Signed **Date**

NZIOKI LUCY NZILANI

Declaration by the Supervisor

This project has been submitted for examination with my approval as a University of Nairobi Supervisor.

.... 15/09/2023.

Signed **Date**

QS. ROBERT ODUOR

DEDICATION

This project is dedicated to my dear daughter Michelle, my parents Mr. John Nzioki Nguluu and Mrs. Marietta Nzioki, my brothers Harrison and Stanley and, my sister Agnes for being my support group and for walking with me throughout my academic journey. God bless you abundantly.

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I attribute the success of this project to a wide array of people and institutions who were dedicated to helping me.

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Special Thanks to the Architectural, Quantity Surveying, and Engineering firms who took their time to respond to my questionnaire. It is my hope that this research will shade light on how the firms can successfully improve their performance in terms of producing higher quality designs within shorter periods.

Special Thanks to my parents for their material and moral support through my life. You have been my rock. For this, I will forever be grateful. I appreciate my brothers and sister who have given me moral support and have cheered me on.

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ABSTRACT

The failure of construction projects to meet target objectives is a major concern in developing countries. Even though there are numerous reasons why projects fail, the construction sector faces serious issues that are either directly or indirectly related to poor designs, poor design processes, and poor design management practices. This study discussed the research problem as the need to intentionally apply design management methods to the design process to curb the challenges arising from its complexities and promote project success in Kenya. It was therefore the purpose of this study to investigate whether the arising issues regarding management of the design process of projects, as established by other studies elsewhere, is also true for the Kenya construction industry. The study also evaluated the extent of the application of design management methods on the design process of construction projects in Kenya.

This study employed a survey research methodology based on the descriptive studies approach. Data was collected via questionnaires administered to a sample of 63 consulting firms of Architects, Engineers, Quantity Surveyors and Construction Managers in Nairobi. The findings indicate that Chapter 525 of the Laws of Kenya, that contains details of design approaches amongst other regulations, is the most applied plan of work of the design process of construction projects in Kenya. It also found that other design management and evaluation methods identified in literature, exist in the Kenya construction industry but were only used occasionally. The study found that inadequate design time and unclear client briefs are the most significant challenges faced by the design team in the achievement of designs of construction projects in Kenya.

The implications of these findings point to the need for designers in Kenya to consider documenting a design process and policies that help stem the negative consequences that are currently existing in the country. The study recommends that design firms should consciously and intentionally apply the established different design management methods so as to improve performance of the designs and the completed buildings. To address the major challenges, design firms should ensure that they interpret client briefs correctly so as to meet client requirements. The study also recommends that designers should explore

the use of scientific methods to establish minimum time required to carry out tasks and complete the design processes so as to mitigate the challenge of inadequate design time.

ACRONYMS

AdePT	Analytical design planning Technique
AEC	Architecture, Engineering, and Construction
AI	Artificial Intelligence
AR	Augmented Reality
BIM	Building Information Modeling
BORAQS	Board of Registration of Architects and Quantity Surveyors
CE	Concurrent Engineering
CIRIA	Construction Industry Research and Information Association
CPM	Critical Path Method
DM	Design Management.
DMP	Design Management Plan
DPM	Design Process Measurements
EBK	Engineers Board of Kenya
KPIs	Key Performance Indicators
PERT	Project Evaluation and Review Technique
RIBA	Royal Institute of British Architects
RII	Relative Importance Index
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
VR	Virtual Reality

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CHAPTER 1: INTRODUCTION

1.1 Introduction and Background to the Study

The failure of construction projects to meet target objectives is a major concern in developing countries. This is an area of concern because construction projects consume a significant portion of a country's budget for capital assets investment (Shahhosseini, et al., 2017). These failures can be measured by indicators such as cost-overruns, time-overruns, functionality, and aesthetics amongst other performance measures.

The overall project failures in many studies have been attributed to lack of application of effective management processes right from inception through to design and construction. Poor designs, ineffective design processes, and ineffective design management techniques are directly or indirectly responsible for significant issues in the construction industry (Pikas, et al., 2020) . This situation has at times resulted in the appointment of contractors who lack sufficient experience, underestimation of project duration, inadequate project budget (Isensi, 2006), development of poor designs (Shamsudeen & Biodun, 2016), amongst other oversights. Poor management of the design process has a substantial impact on the performance of the subsequent processes of a project, and the finished product.

Design Management is an emerging discipline in Architecture that deals with managing the design process and is intended to address the managerial problems in design (Pandit, et al., 2015). It separates the management function of a project design phase from the design function.

Setting goals that can be quantified at the conclusion of the design stage allows designers to evaluate how well the design process is working. These measurable targets may consist of, but are not restricted to, whether the design is within targeted cost budget, whether it is aesthetically acceptable, and whether it meets client satisfaction.

Good quality designs can be achieved through the intentional application of certain design processes that have been well formulated and developed by designers, professional institutes, and regulatory bodies over the years. Notable examples include the Royal Institute of British Architects (RIBA) Plan of Works and the Board of Registration of Architects and Quantity Surveyors (Kenya) Design Stages in chapter 525 of the laws of Kenya. For these design processes to function effectively and achieve their objectives, they need to be put in place at commencement of the design and managed by an expert who is knowledgeable in design process management The members of the design team must also share a united understanding of the process.

Effectiveness of a process requires the selection of a system and management technique that fits the peculiarity of a project and that can monitor activities, identify errors and effect corrective measures so as to achieve the desired objectives. The desired objectives are also normally unique to the project. These may comprise, the budget that the client can afford, client-specified requirements, functionality of the building, sustainability of the design, design duration and construction duration, the quality of the design and the quality of the product “inter Lia”.

A method of measuring the extent to which the known selected performance targets are achieved is therefore of paramount importance.

1.2 Problem Statement

While there are many causes of project failure, significant problems in the construction sector are directly or indirectly related to poor designs, ineffective design processes, and ineffective design management techniques (Pikas, et al., 2020) , (Shamsudeen & Biodun, 2016). According to (Love, et al., 2000) design issues have been a pre-eminent contributor to building and infrastructure failures like project time overruns, project cost overruns, and fatal accidents and injuries during the construction and operation of buildings. (Baldwin, et al., 1999) in his research also found that problems caused by inadequate information dissemination alone were more significant than those related to subpar workmanship and poor site management.

Research by (Williams & Johnson, 2013) reiterated that projects fail because technical issues are overlooked during the design process. (Johansen & Carson, 2003) found that many designs fail to meet the required standards during the design stage in the UK due to insufficient design time, lack of sufficient information at the brief stage leading to lack of detailed designs. The lack of teamwork amongst participants and a low understanding of the design processes was also cited as a contributory factor in design failures. All of these attests to the fact that many problems are usually encountered during the design stage that require attention and professional management.

A thesis, on improving design management techniques of construction firms in the UK (Bibby, 2003), lead to the development of a design management handbook to provide direction on critical aspects of design management practice and tools, thereby reinforcing the need for the activities and tasks at the design stage to be managed.

Research conducted by (Tatsiana &Saad, 2007), attempted to identify process- based Key Performance Indicators for construction project managers to use for controlling the design process in the Netherlands. It came up with functionality, cost predictability, time predictability, client satisfaction amongst other indicators that can help in assessing the achievement of set and agreed objectives at the design stage of a project.

A lot of research has been conducted on project performance at the university of Nairobi. A master's thesis by (Isensi, 2006) identified the thirty-six quality, time and cost related causes of project failure in Kenya, while an article by (Nyika, 2010) analyzed the causes of failures in the implementation of projects in Kenya, one of which was poor project design. A study by (Lekamparish, 2017) studied the influence of the Monitoring and Evaluation component of Project Management on the performance of the Mombasa-Nairobi Pipeline construction Project. Research by (Mutie, 2009) investigated the extent of application of quality management systems during the design stage of construction projects, while basing his theoretical framework on quality concepts such as the Total Quality Management (TQM) as utilized in the manufacturing sector. His study however did not delve into other KPIs of design. This again is a further indication that the management of the activities at the design stage is attracting serious considerations from researchers and designers as a possible means of mitigating project failures.

It is, therefore, an absolute necessity to manage the design process because the performance of the design stage of a construction project has a significant impact on the subsequent phases and the final product. Project delays, at times, come about when information that should have been generated during the design stage is not available during the construction stage and contractors have to request for it. If this delay of information affects activities on the critical path, it is very likely that the project program will be affected. Several similar instances can eventually lead to time overruns. Also, some of the design details that normally get issued result to huge cost variations. These changes may include change of materials specifications, abortive works, extension of time and subsequent extra costs. A buildup of many of these variations eventually translates to cost overruns.

It is therefore the purpose of this study to investigate whether the design process management issues cited in the above referred studies are also true for the Kenya construction industry and to establish the methods used in management of the design processes and their effectiveness in Kenya.

1.3 Research Objectives

The main objective of this study was to improve performance of construction projects in Kenya by efficiently applying management methods to the design process.

The specific objectives are:

1. To identify the plan of work /procedures applied in the designs processes of construction projects in Kenya.

2. To establish the design management methods that are used for managing and evaluating the design process performance in Kenya.

3. To establish the barriers to the effective application of the design management methods in the construction industry in Kenya.

1.4 Research Questions

1. What plan of work/ approaches do designers follow while carrying out the design of construction projects in Kenya?

2. What design management methods are normally applied in managing and evaluating the achievement of design objectives at the design stage?

3. What are the barriers to the effective application of the established design management methods in construction projects in Kenya?

1.5 Research Proposition

The research was guided by the proposition that:

The Design Team in the construction industry in Kenya do not adequately apply design management methods and techniques, leading to poor performance of project objectives at the design stage. Consequently, the process takes longer than necessary, the designs produced are not achievable within the client's budget, clients are dissatisfied with the process and the final product.

The setbacks in the performance are abetted by the production of project documents that are incomplete, inconsistent and conflicting in information amongst other ills.

1.6 Justification of the study.

Construction projects in Kenya have become international affairs following the wake of many infrastructure construction projects and booming real estate industry. There has been a shift towards global market driven concepts (Njuguna, et al., 2016). However, even with increased pace and broadened scope of construction projects, vibrancy in architectural and engineering consultancy services and the evolving construction technology, Kenyan Construction industry firms are facing stiff competition from foreign players, probably because it still suffers the problem of poor management of the design process amongst other ills (Omondi, 2015).

The findings of this study will play a big role in helping design firms in Kenya identify the areas of improvement for efficient design process and improve their competitiveness for the global market.

1.7 Significance of the study

This study's findings of this study will help consultancy firms improve their design management process by prioritizing activities that could have more impact on project performance while remaining aware of the factors affecting their design management efficiency. This will go a long way in producing designs that are well detailed, well planned, and consequently reduce the negative effects of time overruns, cost overruns and client dissatisfaction amongst others. It will also guide the design team players on mitigating challenges and conflicts experienced amongst consultants during the design phase.

The study can also contribute to the training curriculum of designers to prepare them for challenges around developing high quality design solutions through the numerous constraints.

1.8 Limitations of the study

The study was limited mainly by time and financial resources. These challenges led to the study being limited to Nairobi County, and to the design stage of the projects.

1.9 Delimitations of the study

The design of construction continues through the design stage, construction and even operations. This study was however limited to the design stage as it was the focus of the research objective. The study was also limited to one of forty-seven counties in Kenya, Nairobi due to the limited resources of money and time, however, the firms in Nairobi offer services in all parts of the country where construction projects sites are. Therefore, the findings of this study, based in Nairobi, are construed to be a true representative of the whole country.

1.10 Assumptions of the study

To fulfill the stated objectives, the study expected that the intended respondents would offer objective and appropriate information. The study assumed that the organizations would be open to objectively scrutinizing their processes in a bid to find the areas of improvement on the design process for construction projects in Kenya.

1.11 scope of the study

1.11.1 Theoretical Scope

Design management is the practice of overseeing design over the course of a project to make sure its goals are realized. This means managing the design from Inception, outline proposal, scheme design, detailed design, production drawings, tender action, contract administration and construction, completion and handover, use of the facility and eventually disposal of the facility.

The scope of the study is limited to the phase between inception, up to and including tender action and contractor selection but before commencement of construction.

1.11.2 Geographical Scope

The study was carried out in the Nairobi County because 92% of the Architectural, 96% of Engineering and 98% of Quantity Surveying firms are registered in Nairobi (Board of Registration of Architects and Quantity Surveyors, Kenya, 2021)and (Engineers Board of Kenya, 2021). These firms offer services in all parts of the country where construction projects sites are. Therefore, the findings of this study, based in Nairobi, are construed to be a true representative of the whole country.

1.11.3 Methodological Scope

This study employed a survey research methodology based on the descriptive studies approach. Data was collected via questionnaires administered to a sample of 63 consulting firms of Architects, Engineers, Quantity Surveyors and Construction Managers in Nairobi as they are essentially the design team players. The primary data collection method was structured questionnaires that were used to determine the perspective of the target population on the design process and the management methods applied.

1.12 Definition of important terms

Design: The process of coming up with a solution to a project brief and then coming up with instructions to allow that solution to be implemented (Pressman, 2012).

In this context, it will mean developing detailed drawings and specifications that serve as a description of a building.

Design Management: The process of Managing the design process. It entails comprehending, organizing, and synthesizing a wide range of inputs while collaborating with a diversified cross-section of multidisciplinary colleagues (Emit, 2010). It entails putting management practices to use in the design process.

Design Stage: The design stage in this research project will be based on the definition of (Chan & Kumaraswamy, 1997) the stage when a primary concept is turned into an expression of functional and technological specifications that satisfactorily and economically satisfy the client's requirements.

The Design Team: The design team is accountable for the building's design and for producing the data required for fabrication or construction. The team requires a lead, who oversees the workflow and and coordinates the contributions and information from each team member. The design team must include everyone who designs, engineers, and provides recommendations or information that will be used during the design process (RIBA, 2020) .

The design team in this context will therefore constitute: The Architect, Quantity Surveyor, Civil and Structural Engineer, Services Engineers, Landscape Architect and Interior Designers

Designer: A person who produces a design. They are a professional in one of the various design disciplines such as Architects, Engineers, Interior designers, Product designers, Fashion designers, Web designers, among others. . In this context, it shall refer to the Architects and Engineers

Design process: A designer's sequence of activities

Design Performance: The evaluation of design process outputs

Key Performance Indicator: a metric used to benchmark initiatives in order to get good results. It serves as a gauge for a success aspect. Performance indicators outline the quantifiable data required to demonstrate that a deliberate effort has produced the desired outcome.

Lagging indicators: Performance metrics that evaluate a design's accuracy. These can only be known after construction is finished, at which time all information regarding the design outcome is made available.

Leading indicators: Performance Indicators that concentrate on measuring the process in order to assess how well an organization or specific activity is functioning throughout the design stage of a project. They offer quick feedback, enabling quick adjustments to be performed.

Plan of work: a design process map used to provide guidance to clients and designers through briefing, design and construction (RIBA, 2020) . The professional institutes set the process maps in the majority of the world's countries.

1.13 Organization of the study

There are five chapters in this study. In chapter one the researcher introduces design process management and its importance to project success. Thee research problem is discussed as the need to intentionally apply management methods to the design process to address the complexities involved in the process and promote project success in Kenya. The research objectives, questions, proposition, study area and scope of study, research methodology and justification of the study were also elaborated in this chapter.

Chapter two includes a review of the literature. This includes literature regarding the design process, managing the design process, and design process success indicators. A conclusion was made and a conceptual framework was established.

Chapter three discusses the research methodology. It shows the data needed, the data sources, the data collection methods, the respondents, and states the ways in which the data is analyzed after collection.

Chapter four presents and analyzes the data collected, both primary data and secondary data.

Chapter five is the last chapter and contains a review of the research problem and objectives and gives a summary of the findings, the conclusions and the suggested areas of further study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter discusses the design processes established by different authors and organizations and lists the different activities that they undertake in designing to end up with a smooth process. It then discusses the different aspects of the process that need to be managed and gives key performance indicators that exist for the different aspects of management. A theoretical framework is then developed to guide the research on the factors that were tested in the field.

The design process is complex and poses difficult managerial problems. Complexities arise from interactions between different stake holders, information availability, technical knowledge, the uniqueness of the design, statutory requirements, amongst other factors (Tzortzopoulos & Cooper, 2007). Design management has therefore emerged in Architecture and the construction industry to help designers better understand and tackle some of these issues, so as to manage the design process and achieve the objectives (Pandit, et al., 2015).

Design Management is expected to deliver a completely coordinated design that satisfies all stakeholder criteria promptly, making it intimately correlated to project management. This is accomplished by organizing, managing, and keeping an eye on design activities while interacting with other project stakeholders and outside parties (Bibby, 2003).

Design management should be a collective effort of all the design team members. In Kenya, the construction sector is distinctive in that the design teams relationships are short-term because they are mostly project based. Meaning each construction project has a unique and specific design team. Teams are formed for a particular project and dissolved at the end of the project, and new teams formed for the next project and so on. This characteristic must be taken into consideration by Design Managers to ensure that all the design team members have a similar outlook when it comes to managing the design process of a particular project.

2.2 The Design Processes in Building Projects

Most nations lack a standardized, formal method for designing a building (RIBA, 2020). The informal procedures are frequently passed down from one generation of professionals to the next without being written down or recorded. To help clients and consultants in their region, many professional institutes and regulatory organizations have established a number of design process maps or plans of work. Table 2-1 below illustrates some of the various organizations plans of works.

Table 2-1 Comparison of international plans of work

	Pre-Design		Design				Construction	Handover	In Use	End of Life
RIBA (UK)	0	1	2		3	4	5	6	7	
	Strategic Definition	Preparation and Brief	Concept Design	NOT USED	Spatial Coordination	Technical Design	Manufacturing and Construction	Handover & Close Out	In Use	NOT USED
CAP 525 (Kenya)	0	1	2	3		4				
	NOT USED	Inception	Outline proposal	Scheme Design		Detailed Design and Production drawings	NOT USED	NOT USED	NOT USED	NOT USED
ACE (Europe)	0	1	2.1	2.2	2.3	2.4	3		4	5
	Initiative	Initiation	Concept Design	Preliminary Design	Developed Design	Detailed Design	Construction	NOT USED	Building Use	End of Life
AIA (USA)			–		–	–	–			
	NOT USED	NOT USED	Schematic Design	NOT USED	Design Development	Construction Documents	Construction	NOT USED	NOT USED	NOT USED
APM (Global)	0	1	2		3	4	5	6	7	
	Strategy	Outcome Definition	Feasibility	NOT USED	Concept Design	Detailed Design	Delivery	Project Close	Benefits Realisation	NOT USED
Spain			–			–	–	–		
	NOT USED	NOT USED	Proyecto Básico	NOT USED	NOT USED	Proyecto de Ejecución	Dirección de Obra	Final de Obra	NOT USED	NOT USED
NATSPEC (Aus)		_	_	_	–	–	–		–	
	NOT USED	Establishment	Concept Design	Schematic Design	Design Development	Contract Documentation	Construction	NOT USED	Facility Management	NOT USED
NZCIC (NZ)		–	–	–	–	–	–		–	
	NOT USED	Pre-Design	Concept Design	Preliminary Design	Developed Design	Detailed Design	Construct	NOT USED	Operate	NOT USED
Russia			–	–	–	–	–			
	NOT USED	NOT USED	AGR Stage	Stage P	Tender Stage	Construction Documents	Construction	NOT USED	NOT USED	NOT USED
South Africa		1	2	3	–	4	5			
	NOT USED	Inception	Concept and Viability	Design Development	NOT USED	Documentation	Construction	Close Out	NOT USED	NOT USED

Table 2-1 Comparison of International Plans of Works

Source: RIBA, 2020. RIBA Plan of Work 2020 Overview. Portland Place, London: RIBA. Updated by Author,2022

The RIBA Plan of Work as indicated above, is a comprehensive guide on building design and construction. It breaks down building project's briefing, design, construction, and operation into eight stages. Also, it describes the results, primary duties, and information exchanges necessary at each level (RIBA, 2020).

Chapter 525 of the laws of Kenya borrows significantly from the RIBA Plan of Works. This Act is significant to the design process as over and above regulating the professions of Architecture and Quantity Surveying, (The Architects and Quantity Surveyors Act (Chapter 525), 2010) it also describes what the Architect and the Quantity Surveyor is expected to do at every step of the design process and even regulates the fees payable at these stages.

Several authors have also published design sub stages: (Association of Ducth Architects; BNA, 1997), (Kagioglou, et al., 1998), (Baldwin, et al., 1999), (Austin, et al., 2002), (Hughes, 2003), (Al-Reshaid, et al., 2005). The study has summarized them in table 2-2 below.

Table 2-2 Summary of the literature on design stage of the construction project

Author	Name of the Phase	Main sub-process
(RIBA, 2020)	Preparation and Brief	Developing the brief's specifics and making sure the design process's prerequisites are met
	Concept Design	Making sure that the design is developing in accordance with the client's vision, instructions, and budget, as well as ensuring that the design concept is sound.
	Spatial Coordination	Spatially coordinating the design before the focus turns to preparing the detailed information required for manufacturing and constructing the building.
	Technical Design	Developing the information required to manufacture and construct the building.
(The Architects and Quantity Surveyors Act (Chapter 525), 2010)	Inception	obtaining from the client an initial statement of requirements and outlining possible courses of action.
	Outline Proposal	Developing the brief by preparing proposals which incorporate a detailed presentation of the client's requirements and approximate costs of meeting them.
	Scheme Design	Preparation of a scheme design consisting of small-scale working drawings which indicate spatial arrangements and appearance
	Detailed Design and production Drawings	Completion of detailed design from all consultants and preparation of the Bills of Quantities
(Association of Ducth Architects; BNA, 1997)	Conceptual design	Develop a spatial and architectural vision for the project, a conceptual cost estimate, and a comprehensive understanding of the building's investment costs.
	Definitive design	Develop the project's spatial and architectural provisions, integrate buildings and installations architecturally, materialize and scale the architectural work, and conduct a thorough cost estimation.

(Kagioglou, et al., 1998)	Outline conceptual design	Prepare cost estimates, draft concept designs, work packages, revisions to the project plan, business case, project execution plan, procurement strategy, CDM evaluation, and process execution plan.
	Full conceptual design	complete the design concept and create the maintenance schedule.
	Coordinated design	create a product model
(Baldwin, et al., 1999)	Concept design	site planning, preliminary site investigation, drainage concept design, estimating costs, concept design report production
	Scheme design	site investigations, project specifications, product outline, revised cost calculation, scheme structural design, scheme service design, scheme design for exterior works, scheme drainage design, and scheme architectural design
	Detailed design	
(Austin, et al., 2002)	Conceptual design	Business needs should inform design strategies, and design strategies should inform conceptual proposals.
	Detailed design	architectural design, civil design, structural design, mechanical design, electrical design
(Hughes, 2003)	Detailed design	assemble the design team, finish the user research, evaluate the budget, the detail design, the engineering detail design, the services detail design, the cost studies, the finished design, and the specification notes
(Al-Reshaid, et al., 2005)	Preliminary design	formulation; analysis; search; decision; specification; modifications
	Detailed design and engineering	calculation and analysis; checking and assessment; cost estimate and value engineering; review and audit; use of information technology; approval.
	Tender phase	tender scheduling; milestones allocation; schedules monitoring and follow up

Source Author 2022 and Tatsiana, H. & Saad, A.-J., 2007. Identifying the KPIs for the design stage based on the main design sub-processes, The Netherlands: University of Twente.

The authors primarily divided the design stage into four primary phases, each with a distinct title but with identical contents. The inception stage of the process establishes the client needs. The preliminary design concept is converted into potential design solutions during the conceptual or preliminary stage. Following analysis of these prospective design options, the best design option is subsequently chosen during the scheme design phase. The solution is thoroughly developed in technical and functional aspects throughout the detailed design phase in order to meet the requirements of the client. The design stages can therefore be described as follows:

Stage 0: Strategic Definition

This is not part of the design stage, however, the study found it important to discuss it as a significant part of the project formulation and advises on whether the project should continue to stage 1 below. The goal of this stage is to determine the best way to satisfy the client's needs, which may or may not involve a physical structure. The client moves on to stage one if the decision shows that a building is the most effective way to meet their needs.

A common misapplication of this stage as reported in the 2020 RIBA plan of work overview, is that design team services often start at this stage. The recommendation is that at this stage the team should be very different in composition compared to stage one. (RIBA, 2020).

Stage 1: Preparation and Brief

This stage is also called the "Program of requirements stage" and is aimed at figuring out the client's requirements. It is about finding out the client's needs that the facility should satisfy. The designers, through interviews, observations, workshops, find out how much the client requires at the present, and how much they will require in the future; and how to use, arrange and organize that space (Schneider, 2020).

An initial statement of needs is obtained from the client by the architect, who then suggests potential actions (The Architects and Quantity Surveyors Act (Chapter 525), 2010) . The Architect also oversees the preparation of a feasibility study report, project program, procurement strategy, and responsibility matrix (RIBA, 2020). In this stage, the structural engineer identifies the survey information required and provides survey scopes, identifies structural constraints of the brief, and identifies the information required for structural design (The Institution of Structural Engineers, 2020). The Quantity Surveyor draws up a Preliminary cost plan that is used to study the feasibility of a project. They also give preliminary cost advise, establish a cost plan and budget, and advice on procurement methods (Lu, et al., 2019).

This stage results in a Program of Requirements that outlines how the completed project will "work"—specifically, how it will function for building occupants and how it will satisfy all project needs.

Stage 2: Concept Design

The designer takes the Program of Requirements and begins the process to translate it into potential design solutions. The key ideas and various possibilities for the site are covered in the concept design. Via rudimentary models and sketches, the designers explore architectural concepts and space planning at this stage. A discussion about the design proposal that takes into account and responds to site conditions and opportunities within the program of requirements is started during concept design. Following analysis of these prospective design options, the best design option is subsequently chosen during the scheme design phase.

The Architect creates proposals that include a description of the Client's requirements and an approximation of the costs of meeting them. Any significant decisions that require the client's input, as well as any revisions or instructions received from the client, are documented in a report (The Architects and Quantity Surveyors Act (Chapter 525), 2010).

The Architect then creates a scheme design consisting of small-scale working drawings that show the appearance and spatial arrangements in collaboration with other consultants. The team then gives the client a report on the plan that includes an evaluation of the costs and a schedule for the project. The Architect delivers copies of the plans, if necessary, to the local authorities for town planning approval and consent in accordance with the building by law (RIBA, 2020).

The structural concept design is created by the engineer, outlining the scope, scale, and shape of the structure as well as its connection with other design disciplines. They review survey data, note any new surveys that are necessary, and offer survey outlines. Also, the engineer creates, evaluates, and assesses structural options. Additionally, they specify the standards and criteria for structural design, such as embodied carbon goals, static and dynamic loading, durability and design life, fire resistance (in relation to the fire strategy), thermal and ground movements, and serviceability criteria (including deflection and vibration criteria). This stage also sees the definition of structural grids and structural zones, and development of the foundation strategy. The Engineer must also consider a strategy for in-use, maintenance, and deconstruction costs. (The Institution of Structural Engineers, 2020).

At this concept design stage, the Quantity Surveyor develops the elemental cost plan to refine and specify the details of the estimate (Lu, et al., 2019).

The output of the concept design phase is a signed off-stage report with architectural and engineering strategies, outline specifications, and a cost plan.

Stage 3: Spatial Coordination/ Design Development

The Architect, in Collaboration with other consultants, take the approved concept design and develops it into an efficient building design. To validate the presumptions made during the concept design stage and to add specifics to the design, in-depth design studies and engineering analyses are conducted. Usability, functionality, required adjacencies, adherence to codes, security, safety, and aesthetics are all assessed and improved upon in the schematic designs. The project requirements program/scedule and the schematic drawings are examined carefully for any potential flaws or omissions.

The structural design is developed by the engineer, who specifies every component's precise form and function in terms of its overall size, typical detail, performance, and outline definition. The structural design is spatially coordinated, and it is integrated with other design disciplines, such as architecture. In order to facilitate and validate design solutions as well as to confirm structural grids and structural zones, the engineer prepares calculations in sufficient detail. A plan is also designed for building, upkeep, and demolition. At this point, the engineer creates designs that make efficient use of material by creating a sufficiently in-depth study to ensure that components perform their functions securely but without using unnecessary amounts of extra material. They also make sure the client is aware of the load conditions and load combinations that can be justified based on the knowledge of the anticipated use at the time of design (The Institution of Structural Engineers, 2020).

The cost plan is updated by the Quantity Surveyor in consideration of the details provided at this juncture.

Stage 4: Technical Design

In this stage, the design team advances the design significantly. It involves defining the building materials and finishes, developing the services systems, detailing the structural system, and so on. A closer inspection of project components is conducted. The project program, the budget, or both may need to be revised when issues arise that have an impact on constructability or are essential to completing the project program.

After combining the design work done by various consultants, the Architect completes the detailed design providing production drawings and data needed for Bills of Quantities. The Quantity Surveyor prepares a pre-tender cost estimate and a cost plan based on the detailed design drawings. They also advise on the options to be used for tendering. (Lu, et al., 2019). The structural technical design and detailed information for setting out for all structural components are prepared by the Engineer, who then coordinates and integrates them with other design elements.

By the time this phase is complete, the design drawings and specifications are adequate to determine and specify the facility's size, purpose, configuration, spaces, equipment use or operation, and the materials for all the key building structures and systems. This information allows for the completion of the project's budget, schedule, and building designs.

The deliverable in this phase is a complete set of drawings, specification, Bills of Quantities, referred to as construction documents, which get submitted to contractors to prepare bids.

Stage 5: Tender Documentation

In this stage, the drawings, specifications, and bills of quantities, prepared from stage four above are consolidated and coordinated and submitted to contractors as a basis for the preparation of their quotes.

In conclusion, there is no rigid set processes for designing a building. However, many authors and institutions such as The Royal Institute of British Architects (RIBA), and the Board of Registration of Architects and Quantity Surveyors (BORAQS) Kenya have developed a work plan to act as a guide to consultants. This research intends to find out which plan of work is preferred for the design of building projects in Kenya and whether the consultants find the plans of works effective in the achieving construction projects objectives in Kenya.

This section concludes that the Design phase has multiple stages and activities involving many professionals and stake holders. The output in one phase is used as input for the next. The process is however iterative in nature, and not linear. Because of this, design is a complicated process that presents challenging administrative issues. Technical expertise, information accessibility, the distinctiveness of the design, and stakeholder relationships all provide challenges.

With the understanding developed on the design process, the next part of this research seeks to identify the methods used to manage the foregoing described process.

2.3 Design Management Methods.

The traditional method for managing design is through the project management process, where design management is simply viewed as a part of the entire project management process, with design of the project being controlled largely in terms of delivery of a program schedule and cost plan. The principal consultant, the architect, typically takes leadership of the coordination of the process, leaving the administration of the design itself to the design team (Sancandi, 2012).

Managing the design process can be effected by identifying the areas that require management and putting in place a method of evaluating the achievement of the objectives of those aspects of management.

The performance of the design process can be evaluated using Result indicators (lagging indicators) and Process Indicators (leading indicators). Lagging indicators are used to gauge a design's degree of correctness. These can only be known after construction is finished, at which time all information regarding the design outcome is made available. The realization of the design and satisfaction with the design make up the anticipated outcome. Usually, a project's building phase is when a design is realized (Budawara, 2009).

While result indicators look to assess whether predicted results were achieved, process indicators look to gauge the development of activities connected to the critical processes needed to produce the end product (Orihuela, et al., 2017). They concentrate on assessing the process in order to assess how effectively a specific task is being completed. They offer quick feedback, enabling quick adjustments to be performed.

Design Management Plan

In collaboration with the Design Team, the Design Manager or lead designer should prepare the Design Management Plan (DMP). It gives a designer's viewpoint on the framework, plans, tactics, and methods for carrying out and delivering a project. The project manager's project execution plan is supplemented by this document. Its goal is to inform the client, the design team, and other interested parties about how the project will be handled and completed.

Project objectives are outlined in the DMP based on the Strategy Brief. It makes use of sketches, charts, and diagrams to explain to participants their roles, processes, and key messages. (Stokes & Akram, 2020).The DMP should be prepared during the brief stage and referred to throughout the design process.

2.3.1 Project Time Management During Design

Time management is one of the major project management functions according to (Project Management Institute Standards Committee, 2013). It is the management of the time allotted to project tasks and activities as well as the rate of advancement made. For excellent time management, all project operations must be planned, scheduled, monitored, and managed.

During the design process, a design schedule is frequently the most effective way to illustrate the design procedure and important dates. However, design schedules particularly in a Gantt chart format, are often put together at the last minute. They are not properly coordinated and do not accurately and visually reflect the design process. Below are methods for developing realistic schedules.

2.3.1.1 Methods for developing a realistic time schedule.

Project Evaluation and Review Technique (PERT)

This statistical method is employed in project management to determine the lowest amount of time needed to complete a project by examining all necessary tasks and determining the amount of time needed to perform each activity in the project. (N Task, 2019). Three durations—optimistic, realistic, and pessimistic—are estimated for each task to determine how long it will take to complete it. Assuming that these predictions are accurate, the length ranges from the best case to the worst-case scenarios. This helps the design manager in allocating resources efficiently and in coming up with realistic timelines.

<u>The Critical Path Method (CPM)</u>

This is a PERT method extension that serves as a project activity scheduling algorithm. The critical path is the longest (in terms of duration) sequence of key project tasks that must be completed on time. A project's overall duration, milestones, deadlines, and crucial tasks that must be finished on time can all be determined by calculating the critical path. (Actitime, 2019).

<u>The Critical Chain Method (CCM)</u>

This is one of the methods used in performing Schedule Network Analysis. Task interdependencies, resource constraints, and buffers are all considered. It is used to create the project schedule when there are limited resources available to the project (Actitime, 2019). This method places a strong emphasis on prioritization, placing the majority of the high-risk or crucial activities in the early phases of the project schedule. This makes it possible to finish crucial activities earlier than expected and leaves room for unanticipated problems.

The Critical Chain Method (CCM) is different from the Critical Path Method (CPM) in that managing activity is the main focus of CPM, whereas controlling buffers is the main focus of CCM. The critical path approach takes for granted that all resources will be available when required. On the other hand, the critical chain method takes into account that resource availability is restricted and creates a realistic plan based on the resources available. Even though this technique lengthens the plan, a better, more realistic schedule is produced.

The PERT, CPM and CCM play a significant role in the development of the design programme. A design schedule is frequently the most effective way to illustrate the design procedure and important dates. From the beginning of the design team's appointment until the end of the design, it outlines the order of design duties. For simple projects, this may be a straightforward Gantt chart displaying the resources and contributions scheduled for each stage by each consultant. It might be a highly thorough document for more complicated projects, demonstrating how suppliers, contractors, subcontractors, and consultants all contributed to the design in a variety of interrelated and interdependent ways.

The design manager should create a design program with input from all project designers. This shouldn't be a simple paper exercise where you write down what has already happened or what is probably going to happen. A program must be used as a tool to aid in planning activities and identifying areas where additional resources might be needed for success. The design manager should update the design program regularly and make revisions to suit the project schedule. They should compare the design program to actual actions and update the client on their progress.

2.3.1.2 Methods of Evaluating Time Performance During design.

Result Indicators

The result indicators for the design time measure the relationship between the Design Phase's contracted time and actual time (Department of the Environment, Transport and the Regions (DETR), 2000). It is crucial to ensure that the design time does not go beyond the time given because it is crucial in connection to the overall time permitted for the project. (Odeh & Battaineh, 2002).

Result Indicators that can be measured after the design process is complete include:

1. Time of design. This compares the actual design time to the estimated (programmed/ scheduled) design time.
2. Time predictability of design considering change orders emanating from the client or client representatives. This is the additional design time attributed to client change orders.
3. Time predictability of design considering change orders originating from the design manager. This includes measuring additional design time attributed to design manager change orders.

Process Indicators and Leading Indicators

Process indications to take into account when attempting to speed up the design process include:

1. The time needed to develop the proper alignment of the project stakeholders' needs and values, which entails coming to a good overall grasp of the project's parameters (Orihuela, et al., 2017). Here, the primary leading indicators that can speed up consultants'

characterization of the project's scope are: the investors comprehension, the designer's experience and expertise, and the information management system used .

2. The response times for investor approvals. The Leading Indicators for securing investor approvals as quickly as possible are the proposal's technical details and its clarity for the investor.
3. The reviewing entity's approval response times. Leading indicators that influence how quickly the reviewing entity responds to requests are adherence to regulations and familiarity with required documentation and formality.
4. The lag times for expert consultations between members of the design team. The efficiency of the communication channels and the project designers' accessibility, adaptability, promptness, and punctuality are the Leading Indicators suggested to reduce inter-consultation delay.
5. The actual time to develop drawings and specifications of all specialties of the design. The leading indicators suggested to accomplish an effective design and development of plans and specifications include the experience of project designers, the clarity of standards, and the protocol of timely interventions.

2.3.2 Project Cost Management During Design

The goal of project cost management is to keep costs within the allocated budget by estimating, planning, and controlling costs throughout the project life cycle. (Project Management Institute Standards Committee, 2013). Although the function of cost management is divided into four stages—resource planning, estimate, budgeting, and control—it still helps to think of it as a continuous process. It is possible that some resource changes could happen in the middle of the project, requiring an adjustment to the budgets, despite the fact that the order of these operations is typically chronological. When variations are found during the control phase, estimates may need to be revised.

2.3.2.1 <u>Methods for Estimating and Controlling Costs During the Design Process.</u>

<u>Cost estimation Methods</u>

At the Inception stage, the unit cost method of estimation can be used in providing the client with advice on project affordability and a rough estimate for decision making. As the project proceeds in to the concept and schematic design stages, more accurate estimates can be generated by use of the superficial floor area method, and the approximate quantities method. By the time the technical design is developed, Bills of Quantities are prepared to establish the Pre-tender Estimate, and for bidders to use in preparing their quotations.

Cost Control Methods

Cost controls requires that the cost estimate at every stage of the design process, should be compared to the baseline cost which is the estimate established at the inception stage (Project Management Institute Standards Committee, 2013). Measuring cost deviations from the baseline and taking appropriate corrective action, such as increasing the budget allotted or lowering the scope of work, are part of the control process. Here, the emphasis is on timeliness, clarity of reporting, and accuracy of measurement. The reporting can be done in the form of cost plans to show the construction costs estimated at inception all through to the costs established at tender.

2.3.2.2 Methods of Evaluating the Project Cost Performance During Design.

Cost variance was found to be the most widely utilized method for gauging project cost performance, according to research by (Salter & Torbett, 2003). The total cost of a project from start to finish, including any costs associated with changes, modifications made during construction, and expenditures associated with legal claims, such as those associated with litigation and arbitration, is not merely limited to the tender sum (Ali & Rahmat, 2010).

Result Indicators

Result indicators measurable by the end of the design process include:

1. Cost of construction, which compares the tendered construction cost of the current project, to the tendered cost of a similar project tendered one year earlier (probably in cost per square meter).
2. Construction Cost predictability during design which compares the construction costs estimated at inception stage, to the construction costs received from tender.
3. Construction cost predictability during design that considers client approved change orders that originate from the client or client representatives. Additional construction costs may originate from client change orders.

4. Construction cost predictability during design that considers client approved change orders that originate from the design manager. It acknowledges that additional construction costs can be attributed to project design manager change orders.

Process Indicators and Leading Indicators

Process Indicators take into account the selected structural and construction system, installation kinds including electrical, mechanical, plumbing, communication, and fire protection services, and finish quality (Orihuela, et al., 2017). The final cost of the construction is typically impacted by every choice made during the design phase.

The expertise and capacity of project designers and cost managers to keep tabs on costs throughout the design phase are some leading indicators. It can entail selecting new materials, weighing your options, thinking about constructability, getting good compatibility levels, and creating thorough designs. All of this result in the project cost being within the anticipated range.

2.3.3 Quality Management During Design

Quality is arbitrary and can imply various things to various people. Although it can be challenging to evaluate a building design objectively, quality objectives are nonetheless crucial to projects since they are the primary manifestation of stakeholders' shared expectations (Vallerand, 2020).

The ability to adhere to defined standards is the key component of quality in the building sector. (Ali & Rahmat, 2010) . Requirements are the established characteristics of a product, process or service as specified in the contractual agreement. All project participants must have an awareness of customer expectations in order to produce a finished project that fulfills the owner's quality requirements (Ganaway, 2006).

2.3.3.1 Quality Management Methods During Design.

Establishing the quality standards to be referenced.

A product is examined during an inspection to see if it complies with established standards. An inspection can be done at any level and the results often include measurements. One could examine the outcomes of a single activity, for instance, or the project's finished product. You can refer to inspections as reviews, peer reviews, audits, or walkthroughs. These phrases have limited and particular meanings in select application areas. Inspections are also used to validate claims and correct flaws (Project Management Institute Standards Committee, 2013).

Benchmarking.

Benchmarking is the process of comparing the procedures used in a project, whether it be current or planned, to those used in similar projects in order to find best practices, create suggestions for improvement, and establish a baseline for performance evaluation. Whether they are inside or outside of the performing organization, or even in the same application area, benchmark projects can be found there. Analogies from projects in various application areas can be drawn through benchmarking.

Quality Audit

A quality audit is a planned, impartial technique to check if project operations adhere to organizational and project policies, processes, and procedures. A quality audit may have the following objectives: Identifying all good and best practices already in use; Identifying all nonconformities, gaps, and deficiencies; and sharing of good practices adopted or implemented in similar projects within the organization or industry. proactively providing constructive support to enhance the execution of activities that will help the team increase productivity and Highlighting contributions of each audit in the lessons learned archive of the organization (Project Management Institute Standards Committee, 2013).

2.3.3.2 Methods of evaluating Quality Performance During Design.

Result Indicators

Result indicators of quality performance that are measurable by the end of the design phase include:

1. Defects. This indicator measures the levels of defects in the design on a scale of 1 to 10 where1 is “totally defective”, and 10 is “apparently defects free”.
2. The number of quality issues arising during design.
3. The number of quality issues outstanding after the completion of the design stage.

A quality issue is described as a problem that impacts the project and necessitates redoing, modifying, or compromising work to a lesser standard than originally agreed (DETR, 2006). Hence, a quality issue will include flaws, but it is also a much broader measure that incorporates problems that aren't typically thought of as defects. An example of a quality problem might include erroneous information on a drawing, subpar materials, bad site craftsmanship, etc.

Process Indicators and Leading Indicators

Process indicators in this case can include taking into account customers' opinions of the building's physical safety, health conditions, functioning, aesthetics, thermal, auditory, visual, and ergonomic comfort. Proactivity, teamwork, ongoing training, and project designers' experience are some of the most crucial Leading Indicators.

2.3.4 Stakeholder and Client Satisfaction Management

Products must adhere to criteria that are acceptable to all interested parties. Often, there are multiple interested parties/ stakeholders with competing interests. The final design is expected to meet the needs of the different stakeholders, making the management of the design process complex.

2.3.4.1 Stakeholders and Client Expectation Management Methods.

Stakeholder analysis

Stakeholder analysis is a process for gathering iformation, assessing, and determining which parties' interests should be taken into consideration at each stage of the project. The project's objective is connected to the stakeholder interests, expectations, and power. It also helps to uncover stakeholder relationships that may be used to forge alliances and possible collaborations in order to increase the likelihood that the project will succeed. Included in this are stakeholder relationships that must be influenced differently at various project stages (Project Management Institute Standards Committee, 2013).

Design review meetings

Design meetings are forums to review and discuss milestones, drawings and documents . This can yield valuable design inputs and increase team collaboration. This also forms a forum in which the owners and stakeholders can engage the design process at a deeper level (Jenkins, 2021).

Progress reports

Progress reports should be brief but thorough, and they shouldn't include any more details than are necessary for the project managers and client to comprehend the major issues that are developing at any given time (Plan A Consultants, 2015). To draw the client's attention to exceptional issues without overwhelming them with trivial design development difficulties, the Design Manager should receive, review, and produce the executive summary, isolating the important issues from the report.

Interpersonal skills

Interpersonal skills are normally used for managing stakeholder expectations. These abilities include active listening in order to overcome change resistance, as well as the ability to develop trust and resolve problems.

Management Skills

Managing competencies such as encouraging agreement on project goals, persuading others to support the project, and negotiating contracts to meet project requirements, can be used to coordinate and harmonize the stakeholders' groups expectations in order to achieve project objectives.

2.3.4.2 Evaluation of Client Satisfaction During Design Phase

Customer satisfaction is a relative concept that, as a result, is influenced by each individual customer's needs. In order to meet the specific criteria that clients believe are significant, a set of Client Satisfaction Key Performers Indicators has been developed (Construction Industry Research and Information Association, 2004). These include:

1. Client Satisfaction with the product. This measures how satisfied the client is with the developed design.
2. Client satisfaction with the services. This measures how satisfied the client is with the services rendered by the advisors and consultants.
3. Client satisfaction with specific criteria unique to the project such as; low running costs, low maintenance costs, good sound insulation, company colors, decorations, sizes of working spaces, amongst others.
4. Client satisfaction with the cost of the finished design in comparison with costs received from tenders. Cost of professional services in comparison with costs of statutory fees. These measure whether the client have received value for money from the services rendered and the product delivered.
5. Client satisfaction with the time it takes to develop the design.

Consultancy firms can improve their performance on client and end user satisfaction by obtaining and documenting feedback from the clients on the final design, on the services rendered by the design team, and finally on the final product of the design.

2.3.5 Change Management

The first project brief must pose the question and give the design team enough guidance so that the subsequent design process may be carried out without having to revisit essential requirements that interfere with the effective advancement of Concept Design response (Plan A Consultants, 2015).

2.3.5.1 Change Management Methods During the Design Process.

Change Management Strategy

The change management strategy document highlights the response strategy the design team will employ to deal with change. It is a method designed to take advantage of the change while minimizing any unfavorable effects it may have (Hindmarch, et al., 2010). The document should highlight potential areas of change and their impact on the cost and schedule.

Change Orders

When a change occurs, the design manager should provide a narrative precisely outlining the design revisions, a compelling reason, and any ramifications for cost and timeline. A change order may be used to document the changes. For various reasons, it is crucial to use a standardized document to direct the design team in capturing and validating design revisions outside the bounds of the original contract. The most crucial justification is having a record that can be distributed to project participants for future reference.

Integrated change control

Integrated Change Control is the procedure for evaluating, approving, and managing changes to deliverables. It entails authorizing and managing changes to the project management plan, project documents, assets, and organizational processes. All parties involved must be informed of everyone's disposition. The primary benefit of this method is that it lowers project risk while enabling documented modifications to be taken into account in an integrated manner. Changes made without taking into account the overall project objectives and strategies frequently result in risks (Project Management Institute Standards Committee, 2013).

2.3.5.2 Methods for Evaluating Change Management During Design

The goal should be to have zero change orders, which suggests that the design was ‘right first time’. However, achieving such a goal shouldn't come at the expense of improving client satisfaction and eliminating shortcomings, if the project value can be enhanced by allowing changes throughout the design and construction process (Department of the Environment, Transport and the Regions (DETR), 2000).

Result Indicators

Change management performance can be measured by:

1. Number of individual change orders approved by the client and client representatives that originated from the client.
2. Number of individual change orders approved by the client and client representatives that originated from the design manager.

3. Construction cost predictability during design taking into consideration the additional construction costs attributable to change orders originating from both the client team and the design team.
4. Time predictability during design taking into consideration the additional design time attributable to change orders originating from both the client team and the design team.

2.3.6 Design Team Management

A wide range of professionals from the fields of architecture, engineering, quantity surveying, interior design, landscape architecture amongst others, participate in design. In addition to allocating resources, the project manager must promote collaboration among people involved in the project to increase the efficacy of design teams (Girard & Robin, 2006).

Teamwork is essential to obtaining outcomes. The volume of information generated and communicated during the design phase makes teamwork crucial for managing projects (Atsrim, et al., 2015).

2.3.6.1 Design Team Management Methods During Design.

Design Reviews

Design reviews forums allow the team to review and evaluate the progress of the project's design. Regular, effective design reviews can foster beneficial cooperation between the project's design team and its stakeholders (Jenkins, 2021).

Progress Reports

It is important to establish a monthly reporting procedure for progress early on to make sure that everyone on the design team is aware of what must be reported and why. Reports should be brief but thorough, and they shouldn't contain extraneous details that would make it difficult for the project's lead consultants and clients to understand the critical problems that are now being faced (Plan A Consultants, 2015).

Interpersonal skills

Interpersonal skills are behavioral abilities that comprise aptitudes like verbal and nonverbal communication, emotional intelligence, negotiation, influence, dispute resolution, team building, and group facilitation. The management of the project team benefits from having these soft talents (Project Management Institute Standards Committee, 2013).

Continuous Training

All actions aimed at boosting the project team members' competencies are considered training. Both formal and informal training are possible. If a project team member lacks the required technical or management abilities, those abilities might be trained as part of the project activity.

Team building

Team-building exercises can range from a brief agenda item during a status review meeting to an off-site, professionally supervised activity intended to strengthen interpersonal links. Activities that promote teamwork are designed to improve the effectiveness of each team member.

Ground rules

Clear expectations are set forth in the ground rules regarding how project team members are expected to behave. Early commitment to precise rules reduces misunderstandings and boosts efficiency. Team members can learn about shared values by talking about ground rules in areas like communication, cooperation, working together, and meeting etiquette. Once the rules have been set, it is the duty of the entire project team to enforce them.

2.3.6.2 Design Team Management Performance Evaluation Methods

A team's performance is evaluated in terms of technical accomplishment in accordance with predetermined project goals (such as quality standards), performance on schedule (projects are completed on time), and performance on budget (projects are completed within the allotted budget). These goal- and task-focused outcomes are characteristics of high-performance teams (Project Management Institute Standards Committee, 2013).

The evaluation of a team's effectiveness may take into account metrics such as improved team cohesiveness, where team members openly share information and experiences and support one another to improve the overall project performance; improved skills that enable individuals to perform tasks more effectively; and improved competencies that help the team perform better as a team.

2.3.7 Information Flow Management

The design procedures encompass highly imaginative and intellectually demanding activities that call for the sharing of a variety of information and excellent communication within the project teams. Information must be communicated clearly. If the information needed for any task is insufficient or not provided clearly, a gap will develop between what is actually needed and what has already been processed, creating uncertainity. Therefore, it's important to carefully manage the information in the design process such that both inputs and outputs benefit. The design brief is an input by the client and the offered design solutions are outputs. Both sides must be able understand the ideas of each other. Effective information exchange is the only way to do this. (Atsrim, et al., 2015).

2.3.7.1 Methods of Information Management During Design.

Information flow models

Information flow models are used to show the data generated at each stage and by who, where and the information should be relayed for action and decision making.

Communication Technology

Information management is significantly influenced by the technology option utilized to move information across stakeholders. The techniques of communication may range from quick meetings to drawn-out discussions, and from simple written papers to substantial internet resources including databases, websites, and schedules (Project Management Institute Standards Committee, 2013).

Information management systems

Hard copy document management, such as letters, memos, and reports, may be included in information management systems. electronic management tools including online conferencing, telephone, and email. Web interfaces, project management programs, and collaborative work management systems are examples of electronic project management technologies (ibid).

2.3.7.2 Information Flow Performance Evaluation Methods.

The performance of information management can be measured by asking questions such as: does the information get to the right person? Does it get to the right person in a timely manner? Is it in a format that is easily consumable by the intended user? Is the information secure and accessible only by the intended user? Is the information stored appropriately? Is it easily retrievable? (Govindaraju & Usman, 2005)

2.3.8 Managing Sustainability of Designs

Social, economic, and environmental balance are key components of sustainable development. Because it impacts all stakeholders, it is widely accepted. It is necessary for the long-term viability of construction projects. (Zimmermann, et al., 2005).

According to the (United Nations Environment Programme, 2020). The construction sector is responsible for 35% of the annual energy consumption and 38% of all carbon dioxide emissions worldwide. Therefore, a construction project needs to strike a balance between accomplishing its traditional goals and the needs of sustainable development.

2.3.8.1 Methods of Evaluating Sustainability of Designs

Result Indicators

The Result Indicator contrasts the environmental certification credits earned during the design phase with the anticipated credits for each stage. There are numerous methods now that are centered on certifying sustainable buildings across the globe. While they do not completely address the triple bottom line, these do a good job of covering environmental issues.

The performance of the sustainability of the design can be measured by subjecting it to standards of certification bodies such as Leadership in Energy and Environmental Design (LEED), Excellence in Design for Greater Efficiencies (EDGE), Kenya Green Building Society (KGBS), United States Green Building Council (USGBS), amongst others.

It is crucial to consider the most important effects of buildings and the socioeconomic context when choosing a set of indicators to measure sustainability (Araújo, et al., 2013). The indicators can be split into categories:

1. Energy and emissions where indicators include Non-renewable primary energy, Renewable primary energy, and Greenhouse gases emissions,
2. Water Consumption,
3. Materials and waste where indicators include materials embodied energy, ozone depletion potential, acidification potential, eutrophication potential, photochemical potential, reused and recycled materials, responsible sourcing materials, and waste production.,
4. Users' health and comfort such as Indoor air quality, Lighting, Thermal comfort, and Acoustic comfort,
5. Process quality indicators include Integrated design projects and commissioning.
6. Economy whose indicator is the life Cycle Costs

Process Indicators

Process indicators take into account factors like energy efficiency, water efficiency, promoting sustainable mobility, and environmental contamination, all of which are taken into account during the design phase to lessen the influence on the environment.

Leading Indicators

Leading indicators include familiarity with low-power and water-saving devices; familiarity with sophisticated monitoring tools for energy and water consumption; the environmental commitment of project designers and investors; familiarity with the advantages of eco-friendly transportation; and familiarity with the reduction of heat islands, light pollution, and rainwater management. The environmental impact of the project will be lessened as a result of everything.

2.3.9 Health And Safety Management

Any construction project must include goals for occupational health and safety. It is best to create KPIs that focus on the safety culture within an organization, such as risk consideration, manager safety training, and risk group monitoring, reporting of close calls and management's dedication to investigating them, among other things (Vallerand, 2020).

According to the Health and Safety Authority of Ireland, The hazards to safety and health during the construction phase, as well as during the future use and maintenance, can be considerably reduced by designers' actions. Designers can design out or minimize health hazards by: specifying the use of materials known to be less hazardous such as low solvent adhesives and water-based paints. The designers can also avoid processes that create hazardous fumes, vapors, dust or vibration. They can also specify use of materials that are easy to handle, design access areas to accommodate work-at-height equipment, amongst others.

Performance Indicators for measuring health and safety include:

1. Reportable accidents including fatalities per hours worked,
2. Reportable non-fatal accidents per hours worked,
3. Hours lost due to accidents, and
4. Fatalities per hours worked.

A lot can be done during the design stage to ensure designs are constructible and can be implemented safely. However, the performance of a project in terms of health and safety cannot be measured by the end of the design process. This can however be measured during construction.

2.3.10 Design Coordination

In an ideal situation, the design and documentation developed for construction products should be precise, complete, and unambiguous. A study by (Johansen & Carson, 2003) in the UK however, found that this is rarely the case. They found that, contractors frequently receive inconsistent, inaccurate, or insufficient project documentation, necessitating changes to and explanations of the contract agreements provided.

The process of combining designs created by several project team members into a single, cohesive piece of information that can be put together without causing conflicts between components is known as design coordination. When difficulties arise on the job site and remedial, abortive, or redesign work is required, effective design coordination can help to save costs, delays, and inconvenience (Marcus, 1969).

The use of technology like BIM (Building Information Modeling), which enables contractors, architects, and engineers to collaborate on coordinated models, has also made it simpler to coordinate design. This gives everyone a better understanding of how their work fits into the overall project and ultimately helps them work more productively.

In conclusion, the design management practices are an application of project management to the management of the programme (time), changes, design team, flow of information, amongst others all aiming at ensuring that project employers get value by the end of the design process. Whether or not a design process has been managed successfully will be determined by the extent to which the project objectives have been met.

2.4 Barriers to the Application of Design Management Methods

In the past, design could be controlled using straightforward planning and administration methods. However, fast tracking and the increasingly complex structure and contents of buildings have made the administration of the design process more difficult, necessitating a tremendous amount of coordination effort that rarely achieves its objectives. (Austin, et al., 2000). Currently, the design process is characterized by ineffective communication, poor information management, inadequate documentation, missing or incomplete input data, uneven resource allocation, a lack of cross-disciplinary collaboration, and uncoordinated decision-making.

2.4.1 Unstructured and iterative nature of the design process

The study by (Bibby, 2003) in the UK found that the design process is often unstructured, which results in a lack of mutual understanding between stakeholders. This prevents people from collaborating efficiently. Also, the iterative nature of the design process presents complexity and uncertainty to the process. Addressing this challenge requires significant management effort.

This research intends to identify the challenges that were found by other studies in other parts of the world and test if they exist in the Kenya construction industry.

2.4.2 High volume information processing

Processing information is one of the primary tasks of the design process. A significant volume of information needs to be gathered, coordinated, and analyzed during the design stage, yet one area where construction is said to do poorly is information coordination.

According to (Austin *et al*, 1998), schedules are the main method used to handle design information. These schedules are set up to deliver information to contractors at the appropriate times. However, the inherent logic of the design process is not taken into account. As a result, designers are inundated with needless information and lack access to the relevant information at the right moment if the timeliness of information transfer is not adequately controlled. Due to the possibility for wasteful rework, this raises the risk of design task failure, inadequate analysis, and poor conclusions.

2.4.3 Design not planned in enough detail

Traditional thinking held that design could not be thoroughly planned due to its creative and iterative character (Austin, et al., 2000). Conflicts on construction documents are caused by a lack of detailed design preparation, which leaves designers without enough information to accomplish their responsibilities.

The fragmented approach to planning the design stage develops when the different disciplines do not fully comprehend how their work contributes to and impacts the whole building design process (Baldwin, et al., 1999). This has detrimental impacts on the coordination of design disciplines and general process control, resulting in an ill-advised design program.

Another aspect of ineffective design planning is that resources are frequently distributed in an imbalanced manner, which results in delays. Further delays can be caused in an attempt to save the situation by recruiting new designers. This can cause further delay as they require time to familiarize themselves with project characteristics, requirements, and history. This might lead to more design errors and subsequent time-consuming rework (Love, et al., 2000).

To strengthen disciplinary coordination and impose administrative control over the design process, a strong and practical design program is required.

2.4.4 Disintegration of design and construction

The realization of a construction project calls for the collaboration of a vast range of professionals. The traditional approach to construction groups these professionals to the design team and the construction team. These teams work together only during the duration of the project, separate upon its completion, and form new teams for the future/other projects.

Due to the fragmented character of the construction sector, it is difficult to increase performance because each project partner has distinct aims from the others and consequently, client values are not sufficiently taken into account.

Integration of the design teams and the construction teams would be critical in preventing problems in the construction phases and in selecting suitable design solutions in a project.

2.4.5 Changes that can significantly affect progress.

A significant cause of project time and cost overruns is design revisions.Traditional design management techniques struggle to identify all potential change paths and choose which one is the best to take, making it impossible to predict how changes will affect the design programme and costs. Numerous design modifications are being made without fully considering all of their potential effects. Such an inability to anticipate the effects of modifications must be viewed as a roadblock to the management of the design process and the effective control of design changes. As a result, there is a larger possibility of project success if changes can be properly controlled (Bibby, 2003).

2.4.6 Inadequate Design Time

The amount of time given to the designers to complete their task is essential. Lack of sufficient time has an impact on the quality of the design and, eventually, on the contractor's performance on site. Instead of negotiating for a suitable amount of time to complete design work, design teams tend to accept the time that is allocated to them.

Unrealistic expectations by the clients created both intentionally and unintentionally are part of the problems the designers must grapple with. This may include unrealistic timelines set by clients for realizing project objectives (Craig, 2020). Clients might need to use tax credits that expire at a certain time and may fall victims of penalties when timelines are not met for project completion and disposal. Regardless of these, bona fide but unrealistic requirements, there is the risk that a series of deadlines can be missed in rapid order.

The challenge presented by unrealistic timelines is that oftentimes construction projects are not properly planned, with commonly cited reason being, a perceived lack of time by both clients and designers. Lack of effective planning and process of implementation is a significant issue. Research has found that poor planning can cause delay, cost overruns, and owner dissatisfaction. A longitudinal study by (Lines, et al., 2014) on the pre-contract planning model demonstrated a 36.8% reduction in cost growth rate and a simultaneous reduction in schedule growth rate of 68.3% on projects with an extended planning duration. The findings show that the pre-contract planning methodology has the potential to positively affect project performance as evaluated by cost and schedule variances.

2.4.7 Incomplete Brief

In the design phase, the client brief's clarity is essential. A precise knowledge of what is necessary cannot be mapped out if the client's brief is not thoroughly understood by all parties. Before starting to design, the brief serves as both a blueprint and a technique for comprehending what needs to be done. More awareness and understanding of the "briefing" process and what goes into creating a competent brief are needed.

2.4.8 Conflicts whithin the Design Team

The following were identified as conflicts that can occur in a design team: task conflicts, process conflicts, relationship conflicts, cognitive conflicts, affective conflicts and process conflicts (Shawa, et al., 2018).

A task conflict arises when parties contend over the objectives to be met or the work to be done. It involves contrasting points of view, concepts, and opinions. Task conflicts can arise when there are disagreements over how resources should be distributed, methods, policies, judgment, and the interpretation of the facts (Jehn, 1997).

Process conflicts are disagreements over the best way for the work unit to do tasks, as well as who should be in charge of what and how tasks should be assigned. Process conflicts involve disputes over the distribution of responsibilities (Puck, et al., 2010).

Relationship conflicts are the sense of interpersonal incompatibility, which includes tension, anger, aggravation, and hatred amongst team members and individuals (Senaratne & Udawatta, 2013).

2.4.9 Lack of a Designated Design Manager

An effective Design Manager must have a solid technical foundation, a solid understanding of the technical features of the majority of building types, good communication skills, drive and determination, and the capacity for making decisions (Johansen & Carson, 2003).

2.4.10 Design Tasks and Information Interdependencies

In many projects, the best order for carrying out design tasks and identifying their interdependencies to provide the necessary coordinated information are not really taken into account. Therein lies one of the main problems of managing design. The entire design process would be much improved if at least the primary design development stages were taken into account and the best order to complete those jobs together with the information interdependencies was established. Monitoring progress would be easier if those jobs and their interdependencies were then planned and scheduled as "deliverables."

2.4.11 Lack of Communication.

Lack of communication between various teams and specialties in the construction business is a significant issue, according to (Anumba, et al., 2002). The study found that, at the beginning of the design process, communication between builders, subcontractors, and designers is frequently Poor and that there is little communication between different disciplines and stakeholders in the building sector.

The successful design of a project requires extensive coordination among the various project teams to ensure that all the inter-disciplinary interactions such as architects, civil engineers, and quality registrars are facilitated. This includes updating all partners on ongoing changes to the project's status. Ineffective communication can cause delays, increased costs, and inefficiency. This occasionally could influence the coordination and timeline of a project (Dahmas, et al., 2019).

2.4.12 Adversarial Culture.

The crux of the construction industry's complexity is the temporary relationships between many stakeholders. The issue of project fragmentation in the construction sector extends beyond project relationships to project operations. For instance, there are lots of potential flashpoints where parties transfer risks to others. The problem is readily apparent across all project teams and can be brought on by a straightforward misunderstanding or presumption that is mostly attributable to the existing conventional technique, which is founded on the separation of design and construction. The construction sector is generally fragmented, disorganized, and full of miscommunication between many players (Nawi, et al., 2014).

2.4.13 Lack of Customer Focus.

Lack of client participation in the initial design phase is what defines this difficulty. This lack of influence over design choices also increases the risk that a design may be created that does not adhere to consumer requirements. Product marketing in the construction sector is badly impacted by abandoning a customer-focused approach because this ignores the true needs of the market (Walker, 2006).

2.4.14 Design Co-ordination Challenges

In the traditional practice, where the design and production are completely separated, construction short comings can be ascribed to insufficient coordination between design and production. These may include interface coordination, workmanship control, planning for maintenance, relationships between parties, clashes between functional programme and the assembly between procurement and design amongst other problems. (Tombesi & Whyte, 2013)

2.4.15 Design Documentation challenges

Missing or incorrect information might be problematic because it can create complications when construction is taking place. These difficulties may cause delays and rework. On top of that, teams of designers working remotely on the same project frequently make mistakes (Kenniston, 2003).

Since deadline pressure is the primary cause of difficulties, setting expectations is the appropriate first step. For preventing errors, a strong quality control procedure must be launched. To prevent future problems and standardize the entire design process, it is crucial to have a quality assurance checklist and a library that records all previous inconsistencies. This should greatly reduce the inaccuracies (ibid).

2.4.16 Concerns with constructability

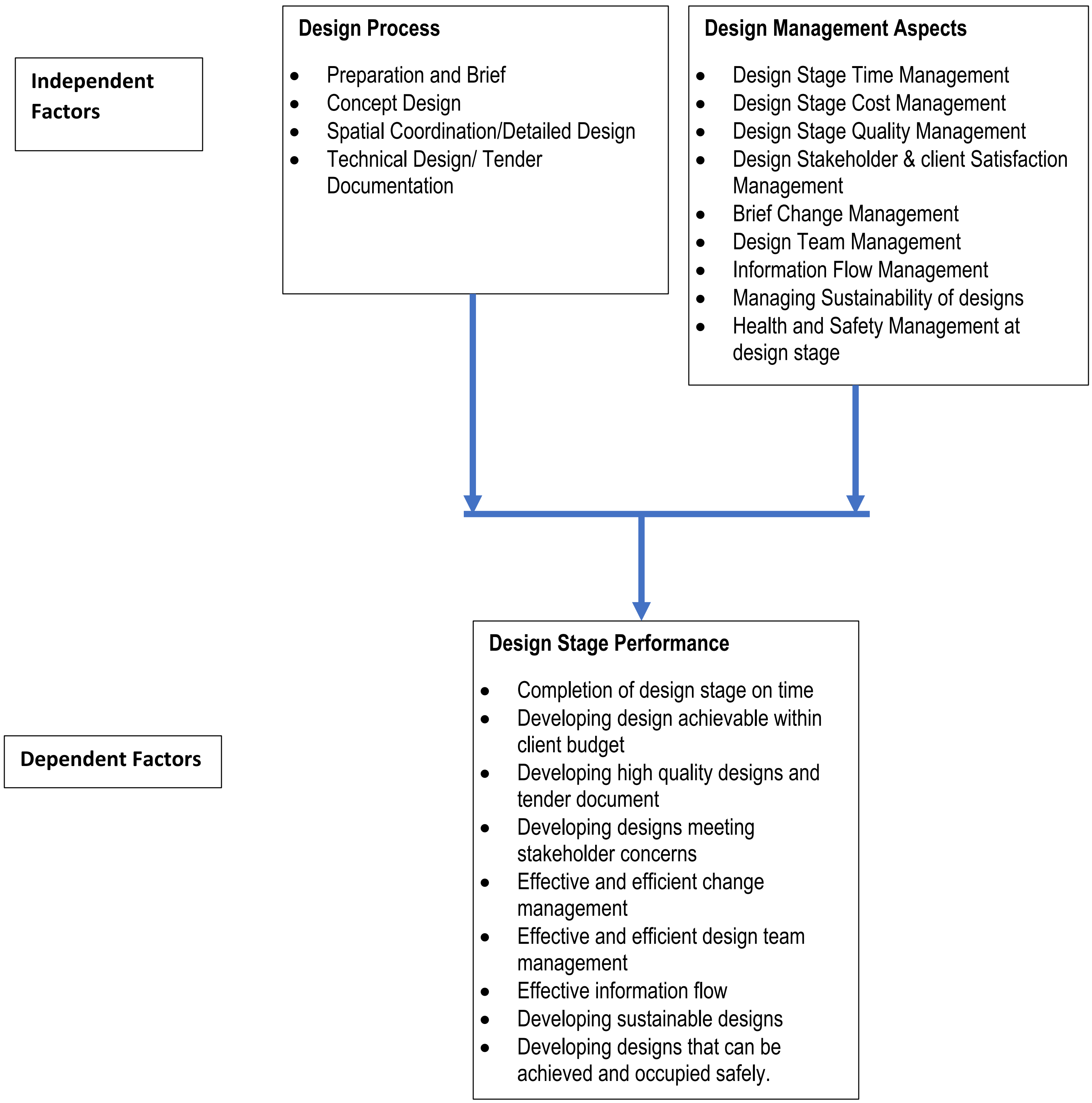
A drawing is a piece of art, and it takes a designer a lot of creativity and time to execute a design project. But if the same is not flawlessly functional, the magic might not occur. Roadblocks during the building process can include inconsistent scales, amenities in the wrong locations, and unbuildable features. The last thing any contractor or homeowner wants to see is a mismatch between the blueprints and the finished project (Kenniston, 2003).

These challenges have been there for quite some time. Some concepts and tools have been developed over time to help alleviate some of these challenges. This study therefore purposed to establish the existence and extent of these challenges in the construction industry in Kenya.

2.5 Conceptual Framework

The interrelationship of the variables of the study is displayed in the conceptual framework in Figure 2-1 below.

Figure 2-1Conceptual Framework



Source: Author, 2023.

2.6 Summary of Literature

The design process and the aspects of management identified and discussed in literature can be summarized in table 2-4 below. The table illustrates the link between the design process, the design management methods, and the challenges incurred during the design process.

In conclusion, the success of the design process requires that there is a structured and explicit design process. The team should be aware of all the activities that will be carried out during a project, including their order, any dependencies and who should be involved. The design Firms can borrow from established processes, or better still, develop processes unique to the different types of processes.

The study concluded that design is a complex process that requires application of management tools to the different aspects of design. The Design Manager should ensure there is a robust and detailed Design Plan and that the different aspects of the process are managed and controlled throughout the process. The design firms should also develop a feedback system that provide historical information to support the needs of other improvement mechanisms. The challenges encountered during the design process should also be identified and addressed.

This study therefore purposed to identify the design process applied in Kenya, establish the existence and extent of application of the identified design management methods and the challenges facing design process management in the construction industry in Kenya.

Table 2-3 Summary of Literature

Design Process / Design Management Aspect	Preparation and Brief	Concept Design	Spatial Coordination/ Detailed Design	Technical Design	End of design stage
Design Stage Time Management	**Methods to manage the design programme during the design process (Time Management)**				
	-PERT				
	-CPM				
	-CCM				
	Time Performance indicators during the process				
	-Actual time it takes for DM and client to agree on the brief	-Actual time it takes develop concept design	-Actual time it takes to develop detailed design	-Actual time it takes to develop technical design and tender documents	-Actual design time vs time allocated in programme
		-Actual time it takes to get investor approval	-Actual time it takes to get statutory approval		-Additional design time attributable to client change orders
					-Additional design time attributable to project manager\ design manager change orders
Design stage Cost Management	**Methods to manage the project costs during the design process**				
	-Unit cost estimation method	-superficial floor area method for Elemental estimates	-Approximate quantities method	-Bills of Quantities	-Contract Bills of Quantities received from tender
	-Establishing project Budget/ Baseline	-Cost Plan	-Cost Plan	-Cost Plan	-Cost Plan
	Cost Performance indicators during the design process				
		-Concept Design estimated costs compared to baseline costs	-Spatial design estimated costs compared to baseline costs	-Pretender estimates compared to baseline costs	-Construction costs received from tender compared to baseline costs
			-Spatial design estimated costs compared to concept design estimates	-Pretender estimates compared to spatial design estimates	-Construction costs received from tender compared to pre-tender engineer's estimate
		- Cost implication of the proposed structural system	- cost implication of the materials proposed		-Tendered costs of the current project compared to the tendered cost of a similar project a year earlier (cost/ square meter)
		-Cost implication of the proposed installations such as electrical, mechanical, etc.			-Additional construction costs attributable to client change orders
Design Stage Quality Management	**Methods to manage the design quality during the design process**				
	-Identify/ Establish the quality Standards to be referenced	-Benchmark current project against successful case studies	Coordinate the drawings by different experts to avoid conflict	Review of the drawings by different experts	Review tender documents to ensure they are precise, complete and unambiguous
			Proactively offer assistance to the team	Proactively offer assistance to the team	**Quality audit** - Identify all good and best practices implemented -Identify all nonconformity, gaps, and shortcomings -Share good practices introduced or implemented in similar projects in the organization and/or industry
	Quality Performance indicators through the process				
		-Number of quality issues arising (e.g. incorrect information on a drawing)	-Number of quality issues arising	-Number of quality issues arising (e.g. incorrect description in the Bills of Quantities)	-Levels of defects in the design on a scale of 1 to 10 where 1 is "totally defective", and 10 is "apparently defects free"
					-Number of quality issues outstanding after the completion of the design stage
					- customer perception on functionality, aesthetics, thermal, acoustic, visual and ergonomic comfort

Process Design Management Aspect	Preparation and Brief	Concept Design	Spatial Coordination/ Detailed Design	Technical Design	End of design stage
Stakeholder and Client Satisfaction Management	**Methods to manage stakeholder's and clients during the design process**				
	-Stakeholder Analysis	-Design review meetings	-Design review meetings	-Design review meetings	-Design review meetings
		-Progress reports	-Progress reports	-Progress reports	-Progress reports
		-Interpersonal skills	-Interpersonal skills	-Interpersonal skills	-Interpersonal skills
		-Management skills	-Management skills	-Management skills	-Management skills
					-Obtaining client feedback
	Client satisfaction Performance indicators through the process				
		-Client satisfaction with the concept design			-Client satisfaction with the design
					-Client satisfaction with the services rendered
					-Client satisfaction with certain client specified criteria
					- Client satisfaction with the cost of the design
					-Client satisfaction with the design time
Brief Change Management	**Methods to manage change during the design process**				
	-Change Management Strategy	-Integrated change control	-Integrated change control	-Integrated change control	
		-Change Orders	-Change Orders	-Change Orders	
	Change Management Performance indicators through the process				
					-Number of individual change orders approved by the client client/client representative, originating from the client
					-Number of individual change orders approved by the client client/client representative, originating from the project manager/ design manager
					- Additional construction costs attributable to change orders
					-Additional design time attributable to change orders
Design Team Management	**Methods to manage the design team during the design process**				
	-Establishing Ground rules	-Continuous Training	-Continuous Training	-Continuous Training	
	-Responsibility matrix	-Team Building activities	-Team Building activities	-Team Building activities	
		-Design review meetings	-Design review meetings	-Design review meetings	
		-Progress reports	-Progress reports	-Progress reports	
		-Interpersonal skills	-Interpersonal skills	-Interpersonal skills	
		-Management skills	-Management skills	-Management skills	
	Design Team Management Performance indicators through the process				
					-Improvement in skills
					-Improvement in competencies
					-Reduced turnover rate
					-Increased team cohesiveness
Information Flow Management	**Methods to manage information flow during the design process**				
	-Information flow models	-Communication technology	-Communication technology	-Communication technology	
	-Information Management system	-Meetings	-Meetings	-Meetings	
	Design Team Management Performance indicators through the process				
					-Does the information get to the right person?
					-Does it get to the right person in a timely manner?
					-Is it in a format that is easily consumable by the intended user?
					-Is the information secure and accessible only by the intended user?
					-Is the information stored appropriately?
					-Is it easily retrievable?

Process Design Management Aspect	Preparation and Brief	Concept Design	Spatial Coordination/ Detailed Design	Technical Design	End of design stage
Managing Sustainability of deigns	**Methods to manage design sustainability during the design process**				
	-LEED				
	-EDGE				
	-KGBS				
	-USGBS				
	Design Team Management Performance indicators through the process				
					-Energy efficiency
					-Water efficiency
					- Materials efficiency
					-Efficient waste management
					-Users health and comfort
					-Process quality
					-Lifecyle cost
Health and safety Management	**Managing health and safety during the design process**				
		- Ensuring constructible designs		-Specification of materials known to be less hazardous	
				-specify use of materials that are easy to handle	
				-design access areas to accommodate work-at-height equipment	
				-Avoid specifying processes that create hazardous fumes, vapors, dust or vibration	

General Factors	Leading Indicators- General Factors affecting Design Process Performance	Barriers to the design management process
	-The experience of the designers	-Inadequate Design Time
	-The experience of the developer/client in construction	-Incomplete/unclear client brief
	-Information systems in place for the project and efficacy of the means of co	-Conflicts within the design team
	-The clarity of the design proposals	-Lack of a Designated Design Manager
	-The clarity of the technical details	-Communication Breakdown
	-Compliance of the design with the statutory requirements	-Adversarial Culture
	-Availability, flexibility, promptness and punctuality of project designers	-Lack of customer focus
	-The clarity of standards and protocol of the design process	-The disintegrated nature of the industry
	-The ability of consultants to monitor costs during the design process	-Design Co-ordinating challenges
	-The ability of consultants to evaluate several materials and alternatives to m	-Design Documentation challenges
	-Ability of the designer to offer a good level of constructability and detailing	-Concerns with constructability
	-Obtaining and documenting feedback from project stakeholders.	-Design Tasks and Information Interdependencies
	-Knowledge of designer on sustainable designs	-Unstructured Design Process
		-High Volume of Information to be processed
		-Design process not planned in enough detail

Source: Author, 2023.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

Research methodology is a way to systematically solve the research problem (Patel & Patel, 2019). It entails laying out the guidelines, processes, and research techniques employed in a study for information gathering, data analysis, and conclusion-drawing with a view to resolving the research problem.

This chapter outlines the research design, data needed, data sources, identification of responses, data collection methods, data analysis and presentation procedures.

3.2 Research Design

According to (McMillan & Schumacher, 1984), research design describes how a researcher organizes and carries out a study, as well as the methods and strategies used to address the research problem or questions.

Descriptive study design is utilized in this study. This is because descriptive study design provides answers to predetermined research questions. A descriptive study makes an organized effort to characterize a circumstance, issue, event, service, or program. Its primary goal is to describe what is typical in relation to the issue under investigation (Kumar, 2011).

Surveys and many types of fact-finding inquiries are included in descriptive research. The primary goal of descriptive research is to describe the current situation as it stands. The main feature of this methodology is that the researcher can only describe what has already occurred or is now occurring; he has no control over the variables (Kothari, 2004). Notably, Survey research comprises a cross-sectional design in relation to which data are collected predominantly by questionnaire or by structured interview on more than one case and at a single point in time in order to collect a body of quantitative or quantifiable data in connection with two or more variables, which are then examined to detect patterns of association.

Descriptive research was used in this study as it allows the researcher to use both qualitative and quantitative information. This study involved a collection of quantitative data and tabulating it in continuum and numerical form and using narrative descriptions to organize data into patterns that emerge during analysis.

Descriptive survey research method was used in this study to give accurate and pertinent information on the management of the design process of construction projects in Kenya.

This study collected and analyzed data from design team firms in Nairobi.

3.3 Data needed

The data required was the sequence of design tasks, the use of design management methods and practices in managing and evaluating the various aspects of the design process, as well as the difficulties experienced by design team members in designing building projects in Nairobi.

3.4 Data sources

The data sources included design team members of: Architectural, Engineering, Quantity Surveying and Construction Project Management firms in Nairobi. The researcher elected to collect data from firms instead of individual professionals as firms can provide a more holistic and industry-oriented perspective on the efficiency of design processes as they have established protocols and procedures, which the research was very keen about.

3.5 Data Collection Instruments

Structured questionnaires distributed electronically to architectural, engineering, quantity surveying, and construction project management organizations were used to collect primary data. The questionnaire had closed, opened and Likert scale-based questions. The questionnaire was structured to have the following sections: Section A sought to gather General Information on the firms. Section B sought to establish the sequence of design tasks, Section C gathered information on the application of design management methods identified for use in the management and evaluation of the design process, and Section D investigated the challenges of applying Design Management methods in Kenya.

Secondary data was gathered from textual materials that were published and unpublished, including books, conference proceedings, journals, and internet-sourced data.

3.5.1 Pilot Study

Prior to being sent to the respondents, the online questionnaire was pre-tested on a small sample of people. Any ambiguities were then addressed, and the questionnaire was adjusted accordingly.

3.5.2 Validity of the Research Instruments

Validity is the degree to which a research tool—in this example, a questionnaire—measures what it is intended to measure. This makes it possible to make insightful deductions. The study used content validity to guarantee alignment with the study variables, resulting in consistency in respondents' knowledge and replies.

3.5.3 Reliability of the Research Instruments

Reliability implies the consistency of the study instruments meaning it should yield findings that are consistent when administered to an individual more than one time or by many respondents (Mugenda & Mugenda, 1999). The piloting enabled conducting of a test-retest and subsequently used Cronbach Alpha Co-efficient via SPSS to determine reliability of the questionnaires. The threshold for acceptance of reliability of the questionnaires was set at 0.7 as was used by (Taber, 2018). Variables below this threshold were edited for correctness and ambiguities were removed.

3.6 Sampling Design

3.6.1 Location of Study

This study was conducted in Nairobi City County, Kenya. Nairobi, in addition to being the capital of Kenya, entered the UN list of the top 4 investment cities in Africa in 2018, as international corporations descended on the nation in search of a foothold in the East African market. Nairobi attracted $5.9 billion in foreign direct investment in the 13 years between 2003 and 2016, which was the second-fastest rate of investment growth on the continent. Nairobi has had to keep up with the infrastructure, housing, and basic urban living demands of an expanding middle class and global city as money poured into the capital (mace group, 2018).

Nairobi also happens to host most of the Architectural, Engineering, Quantity Surveying, and Construction Project Management Firms. According the website of the (Board of Registration of Architects and Quantity Surveyors, Kenya, 2021) as of 29th October 2021, there were 195 registered Architectural Firms in Kenya, 180 of which were in Nairobi. 131 of the 133 Quantity Surveying firms registered in Kenya are in Nairobi. From the (Engineers Board of Kenya, 2021) website, there were 145 Engineering Consulting firms ,140 of which were registered in Nairobi as at 29th of October in 2021. The Association of Construction Managers of Kenya website indicated 11 firms as members as of 15th September 2022, 10 of which were registered in Nairobi.

3.6.2 Target Population

A population is a collection of people about whom it is necessary to gather particular information (Banerjee & Chaudhry, 2010).The population frame of this study included design team member companies viz. Architects, Engineers and Quantity Surveyors and construction Managers in Nairobi.

According the (Board of Registration of Architects and Quantity Surveyors, Kenya, 2021) website, as of 29th October 2021, there were 180 architectural firms and 131 quantity Surveying firms in Nairobi. There are 140 engineering consulting firms registered in Nairobi by the (Engineers Board of Kenya, 2021). There are 10 construction project management firms registered in Nairobi by the Association of Construction Project Mangers in Kenya

Table 3-1 Registered Architectural, Quantity Surveying, Engineering, and Construction Project Management Firms in Nairobi

Category	Number
Architectural Firms	180
Quantity Surveying Firms	131
Engineering Consulting Firms	140
Construction Project Management Firms	10
Total	**461**

Source: Author (2022)

3.6.3 Sampling Techniques

Research studies are usually carried out on samples of subjects rather than whole populations (Banerjee & Chaudhry, 2010). A sample is a group of people, or records or a number of observations from a larger population.

The probability sampling methods utilized in this study gave each member of the population a chance of being chosen. More specifically, this study used Random stratified sampling. This method of sampling makes sure that the sample contains a predetermined number of sample units from various categories that each have a set of attributes to reflect all characteristics (Daniel, 2011).

The random stratified sampling method divides the population into subgroups (referred to as strata) based on the pertinent feature, and then estimates the number of individuals who should be sampled from each strata based on the proportions of the entire population. The selection of a sample from each subgroup is then done using random or systematic sampling (McCombes, 2019).

The strata in this research will be based on the roles the respondents play in the industry. i.e., Architects, Engineers, Quantity Surveyors and Construction Project Managers of construction projects in Nairobi.

Since the population is known, the sample size will be calculated from the (Mugenda & Mugenda, 1999) formula: $n = \frac{(Z*Z)(p*q)N}{e*e(N-1)+(Z*Z)(p*q)}$,

Where,

n=sample size.

z=standard normal deviate ((1.96),

p=% target population assumed to have similar characteristics, i.e. percentage of the population likely to provide the same answer, the worst case scenario being 50%, in this case p=95%

q=1-p, (1-0.95=0.05)

N= Population size

e= confidence interval (margin of error) say 0.05

So that for this instance,

$$\frac{(1.96*1.96)(0.95*0.05)461}{0.05*0.05(451-1)+(1.96*1.96)(0.95*0.05)}$$ *=63 respondents*

After determining the minimum necessary sample size, it is necessary to make further provisions to account for any non-responder subjects (Bujang, 2021). The sample size was increased by 130%, making it 83, in order to protect against nonresponse problems.

The proportional allocation approach ,as discussed by (Kothari, 2004) , which keeps the sizes of the samples from each stratum proportional to the sizes of the strata, was used to allocate this sample size to each stratum.

$P_i = n \ (Ni/N)$

where P_i is the sample size of the stratum i, N_i is the population size for stratum 'i'; 'N' is the total population size of the Architectural, Quantity Surveying and Engineering firms=461, and n is the total sample size = 83.

Table 3-2 Stratified Random Samples of Respondents

Stratum	Population Size	Sample size	Percentage
Architectural Firms	180	33	39%
Quantity Surveying Firms	131	23	28%
Engineering Consulting Firms	140	25	31%
Construction Project Management Firms	10	2	2%
Total	**461**	**83**	**100%**

Source: Author (2022)

Each of the individual respondents: firms of the Architects, Quantity Surveyors, Engineers, and Construction Management firms constituted the unit of analysis, which was also the unit of observation.

3.7 Data Analysis and Interpretation

Data analysis is the process of giving collected data organization, structure, and interpretation (McMillan & Schumacher, 1984). Data analysis requires that the obtained data be cleaned, edited, and coded in order to be processed by the SPSS application. MS Excel spreadsheets were used to present the data that was gathered. The information was then entered into SPSS, a program with a number of statistical tools for interpreting data.

The findings of this research were presented as follows;

i) Textual and numerical data were presented in tables.

ii) The distribution of survey responses according to respondents' responsibilities was presented in charts and graphs using representations like bars in a bar chart and lines in a line chart, among others.

iii) Some of the study's findings were communicated using descriptive statistics, particularly when it was necessary to demonstrate the relationships between variables.

3.7.1 Analyzing Likert Scale Data

This study significantly used Likert scale questions in the questionnaire. Although Likert scale data are excellent for survey items, there is much disagreement over how to analyze them, with the primary issue being whether to apply parametric or non-parametric tests.

Data are presumed to be continuous and distributed normally in parametric testing. However, parametric tests are still valid for non-normal data when the sample size is sufficient. Nonparametric tests, on the other hand, are accurate with ordinal data and do not make this assumption. However, there is a risk that nonparametric tests have a decreased likelihood of detecting an impact that genuinely exists (Chen & Liu, 2021).

A paper by (Boone & Boone, 2012) suggested data analysis procedures for Likert-type and Likert scale data as shown in the Table 3.3 below.

Table 3-3 Suggested Data Analysis Procedures for Likert Type and Likert Scale Data

	Likert-Type Data	**Likert Scale Data**
Central Tendency	Median or mode	Mean
Variability	Frequencies	Standard deviation
Associations	Kendall tau B or C	Pearson's r
Other statistics	Chi-square	ANOVA, t-test, regression

Source: Boone, H. & Boone, D., 2012. Analyzing Likert Data. Journal of Extension, 50(2).

A Likert-type scale differs from a full-blown Likert scale in that , while a Likert-type scale simply employs a five-point (or seven-point, or other point scale) scale to respond to a single question, a full-fledged Likert scale employs a sequence of statements that investigate various aspects of a subject.

This study uses multiple statements to test different dimensions of variable such as time, cost quality amongst others.

The study also employs the Relative Importance Index (RII) as a statistical tool to rank the different variables tested using the Likert Scale.

3.8 Ethical Issues

During and after the study, the researcher ensured that all participants were treated with the utmost privacy and discretion to guarantee anonymity and utmost confidentiality in the study.

3.9 Matrix Of Data Needs, Sources and Analysis Techniques

Table 3-4 Matrix of Data Needs, Sources and Analysis Techniques

Investigative Questions	**Data Needs**	**Data Sources**	**Analysis Techniques**
What plan of work/ approaches do designers follow while carrying out the design of construction projects in Kenya?	-Available plans of Work. -Sequence of design tasks in Kenya	Secondary Data-Literature Review -Primary Data-Questionnaires	-Descriptive Analysis -Percentages
What design management methods are normally applied in managing and evaluating the achievement of design objectives at the design stage?	-Existing design management methods -Extent of application of design management methods for project in Kenya	Secondary Data-Literature Review -Primary Data-Questionnaires	Descriptive Analysis -Percentages
What are the barriers to the effective application of the established design management methods in construction projects in Kenya?	-Challenges identified in Literature -Existence of the challenges in Kenya	Secondary Data-Literature Review -Primary Data-Questionnaires	Descriptive Analysis -Percentages

Source: Author, 2023

3.10 Conclusion on Methodology

This study uses the descriptive survey research method to investigate the application of design management methods and challenges encountered in the Kenyan construction industry and their effects on meeting project objectives in Nairobi. It does so by collecting data from Architectural, Quantity Surveying, Engineering, and Construction Management firms in Nairobi.

CHAPTER 4: DATA ANALYSIS AND PRESENTATION

4.1 Introduction

This chapter represents the outcome of the fieldwork. Here, the collected data was analyzed and presented. This chapter provides a detailed analysis of the findings based on the data gathered for this study, which included both primary and secondary data in chapter two (Literature Review).

This section analyzed the primary data collected using the questionnaire which was divided in to sub-sections which were based on the objectives of the study. Section A gathered general information on the firms. Section B sought to establish the sequence of design tasks, Section C gathered information on the usage of design management methods in the management and evaluation of the design processes, and Section D was on challenges of applying the identified Design Management methods.

The data collected was analyzed and presented in the form of reports, frequency tables, and pie charts. The information derived is used to give conclusion on the objectives of the study.

4.2 Response Rate

The study sample was 63 respondents who were Architectural, Quantity Surveying, Engineering, and Construction Project Management consulting firms registered in Nairobi. To buffer against nonresponse errors, 83 questionnaires were issued. 63 questionnaires were filled giving a response rate of 77% and a non-response rate of 23%. According to (Mugenda & Mugenda, 1999), a response rate of 50% is deemed sufficient for analysis and reporting, 60% is deemed good, and 70% is deemed really good. Thus, the 77% response rate is seen by the researcher as being excellent and sufficient for the data analysis, reporting, and conclusions. Notably, a better response rate would have been achieved if the questionnaire was shorter.

4.3 Demographic Characteristics

The study gathered the demographic and general information from the respondents. The researcher sought to gather information on the professional background, experience, and portfolio of the organization.

4.3.1 Respondents Distribution

The study sought to determine the respondents' professional distribution. This was crucial in ensuring that each member of the design team understood the design process, which is essential for effective design management.

The results indicate that 30.2% of the respondents were architectural firms, 36.5% Quantity surveying firms, 6.3% were construction project management firms, and 27.0% were engineering firms and as indicated in table 4-1 below. This large sample was intended to remove any bias or information asymmetry that might affect one group of professions, as well as to guarantee that a comprehensive and impartial viewpoint on the subject was established. To cater for respondents who offered Project Management over and above the Architectural, Engineering and Quantity Surveying Services, this question was followed by whether or not the firm offered Project Management services as discussed in section 4.3. 2 below

Table 4-1 Distribution of Actual Respondents

Respondent's Profession			
	Frequency	**Percent**	**Cumulative Percent**
Architect	19	30.2	30.2
Quantity surveyor	23	36.5	100.0
Construction Project Manager	4	6.3	50.8
Civil/structural Engineer	9	14.3	44.4
Electrical Engineer	4	6.3	57.1
Mechanical Engineer	4	6.3	63.5
Total	**63**	**100.0**	

Source: Fieldwork (2023)

4.3.2 Industry Experience

The study aimed to establish the experience of the respondents in terms of the age of the firms, their portfolio, and general project management.

<u>Age of firm</u>

To establish their experience in terms of age, the respondents were asked for how long their organization had been in business. Table 4-2 and Figure 4-1 below summarizes the age of the respondent firms.

This study found that majority of the respondents, 60.3%, were veterans in the industry with more than ten years of experience. This is beneficial to this study as most of the data collected is from firms who have been in practice for more than ten years and thus developed better understanding of the design process.

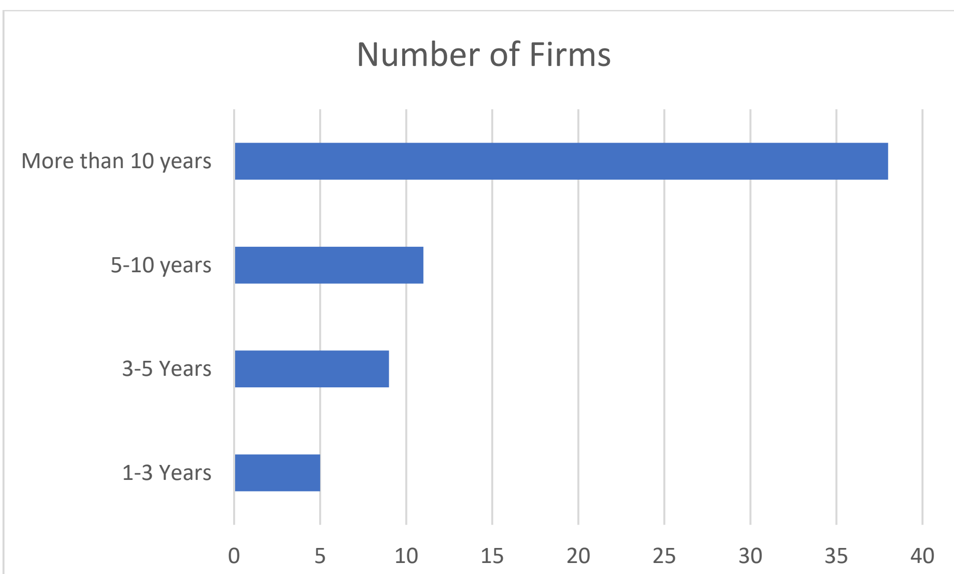
17.5% of the respondents had 5-10 years' experience, 14.3% had been in the industry for 3-5 years, while 7.9% of the firms had been in business for 1-3 years.

Table 4-2 Firm's Age

Firms Age			
	Frequency	**Percent**	**Cumulative Percent**
1-3 Years	5	7.9	7.9
3-5 Years	9	14.3	22.2
5-10 years	11	17.5	39.7
More than 10 years	38	60.3	100.0
Total	**63**	**100.0**	

Source: Fieldwork (2023)

Figure 4-1- Age of Firms

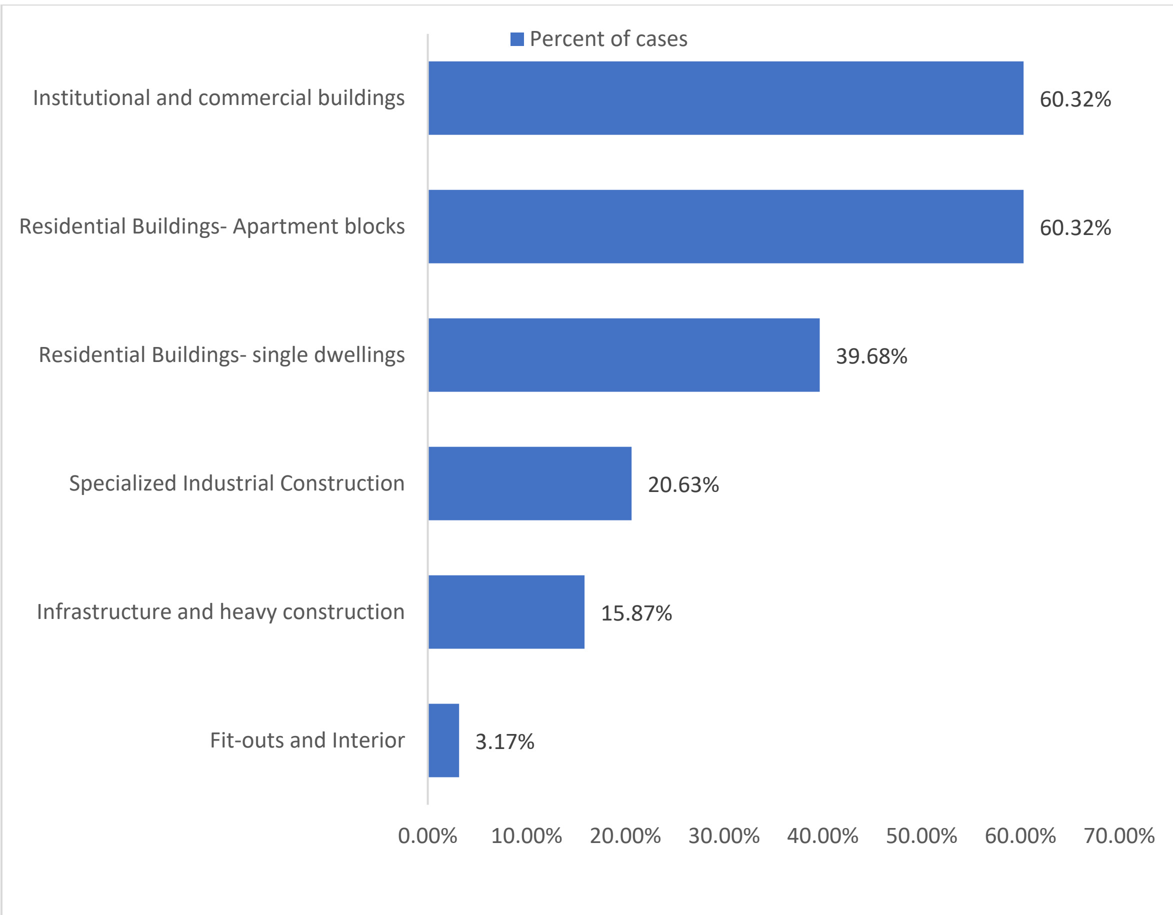


Source: Fieldwork (2023)

Organization's Portfolio

To give context on the complexity of projects handled by design teams in Kenya, the respondents were asked what type of construction projects formed the majority of projects in their organization's portfolio. Figure 4-2 below summarizes the nature of projects handled by the respondents.

Figure 4-2 Majority of Projects Forming Firms' Portfolio



Source: Fieldwork (2023)

It was found that most of the firms undertook Institutional and commercial buildings, and apartment blocks at 60.32% each. This is probably due to the fact that the study targeted firms in Nairobi where there is a growing bubble of these kinds of development.

39.68% of the firms had single dwelling residential units forming the majority of their portfolio, followed by Specialized industrial construction at 20.63% and Infrastructure and heavy construction at 15.87%. 3.17% of the respondents reported that the majority of projects they handled were fit-outs and interior design projects

This data demonstrates the nature and complexity of projects handled by the respondents.

Project Management

The study sought to find out if the respondents had experience in general project management. The findings were that 78% of the firms offered Project Management services while 22% of the firms did not, as summarized in table 4-3 below. This finding was important in establishing that a majority of the respondents had an understanding of general project management as the literature review found that some principles of project management could be applied to design management.

Table 4-3 Firms offering project management services

Firms offering project management services			
	Frequency	Percent	Cumulative Percent
No	14	22%	22.22%
Yes	49	78%	100.00%
Total	**63**	**100%**	

Source: Fieldwork (2023)

4.4 Application of Design Management Methods to The Design Process in Kenya

4.4.1 The Professionals Playing the Role of Design Management in Kenya

To create an understanding of who leads the design process in Kenya, the study sought to find out who plays the role of design management of construction projects in Kenya. The respondents were asked how often they encounter the different professionals playing design management roles. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between “never” and “always”.

To rank the consultants from those who most often play the design management role to those who least often do, the Relative Importance Index (RII) was used. The RII was calculated using the following formula:

$$RII = (\sum W)/(A*N)$$

where RII is the relative importance index, W is the weight given to each consultant by the respondents (ranging from 1 to 5), A is the highest weight (5 in this case), and N is the total number of respondents. The RII had a range from 0 to 1 (0 not inclusive). The greater the RII value, the more often the consultant played the design management role. The findings are summarized in the table 4-4 below.

Table 4-4 Frequency of Professionals playing design management roles

How often the consultants play design management roles			
Consultants	**Mean**	**RII**	**Rank**
Architect	4.48	0.895	1
Construction Project Manager	3.73	0.746	2
Quantity Surveyor	3.51	0.702	3
Civil /Structural Engineer	3.48	0.695	4
Electrical Engineer	2.89	0.578	5
Mechanical Engineer	2.83	0.565	6
Design Manager	2.16	0.432	7

Source: Fieldwork (2023)

It was found that the Architect most often plays the Design Management role (RII=0.895, Mean= 4.48). This is probably because historically, the Architect has played the role of the design team lead in building construction projects.

The Architect was followed by the construction project manager, (RII=0.746, Mean= 3.73), probably due to the emerging role of the Project Manager in the construction industry.

The Quantity Surveyor came in third with (RII=0.702, Mean= 3.51), followed by the Civil/Structural Engineer (RII=0.695, Mean= 3.48), then The Electrical Engineer (RII=0.578, Mean= 2.89), and the mechanical engineer at (RII= 0.565, Mean=2.83).

The Design Manager was found to play the Design Management role least often (RII=0.432, Mean=2.16).

4.4.2 The Design Process of Construction Projects in Kenya

The study sought to find out the prevalent design process and plan of works of construction projects in Kenya.

Plan of Works Applied in Construction project in Kenya.

To establish the most prevalent plan of work in Kenya, the respondents were asked what plan of work was applied when carrying out design in their organization. Table 4-5 below summarizes the findings.

It was found that the Architects and Quantity Surveyors Act (Cap 525) design stages is the most applied plan of works in Kenya with 68% of the respondents applying it to their design process. This is probably because it is a law of Kenya thus governing most public projects and being a benchmark for the Kenyan Architects and Quantity Surveyors. This was followed by the RIBA Plan of Works at 33% of the respondents.

16% 0f the respondents reported that their organizations had developed, and tailor made their own plans of works while 8% of the respondents reported that they did not apply any plan of work to their design process.

Table 4-5 Plan of Works Applied in Construction projects in Kenya.

Plan of Works	Frequency (n/63)	Percent
Architects and Quantity Surveyors Act (CAP 525) Design Stages	43	68%
RIBA Plan of Works	21	33%
Plan of Works developed by individual organizations	10	16%
No plan of work applied	5	8%

Source: Fieldwork (2023)

Firms who had developed their own process listed their process as follows:

- Inception, Feasibility studies, Scheme Design, Detailed Design, Working drawings, Contractor Selection.
- Inception, Feasibility Studies, Outline proposal, Scheme design, Detailed design, Production drawings, Bills of Quantities and Contractor Selection.
- Inception, Design, Tender (Procurement), Construction, Facility Use (DLP) & Project Closure
- Design, Tendering, Construction, Supervision & quality control, Snagging, Handover
- Inception and Concept design, Design development, Detailed design + Tender Implementation DLP period
- commissioning - to be appointed, confirm scope of work and employment/ consultants' terms of engagement before any work is done outline proposal scheme design detail design/ construction drawings site commencement + site supervision site hand over

Relevance of RIBA Plan Of Works and Cap 525 design stages in Kenya Construction Industry

The respondents were also asked their opinion on the relevance of the RIBA Plan of Work and the Architects and Quantity Surveyors Act (Cap 525) design stages to construction Projects in Nairobi. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between "Not relevant at all" and "very relevant".

To rank the two options, the Relative Importance Index (RII) was used. The higher the RII value, the higher the relevance of the plan of work. The findings are summarized in table 4-6 below.

It was found that The CAP 525 was more relevant (RII= 0.846, mean= 4.23) than the RIBA Plan of works (RII= 0.755, mean= 3.78) for construction Projects in Kenya.

Table 4-6 Relevance of Plan of Works

Plan of Work	Mean	RII	Rank
CAP 525 Design Stages	4.23	0.846	1
RIBA Plan of Works	3.78	0.755	2

Source: Fieldwork (2023)

<u>Involvement of Professionals in the Design Process</u>

To establish whether the different disciplines were involved throughout the design process as is expected in best practice, the respondents were asked how often their organization was involved in the different activities of the design process. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between "never" and "always".

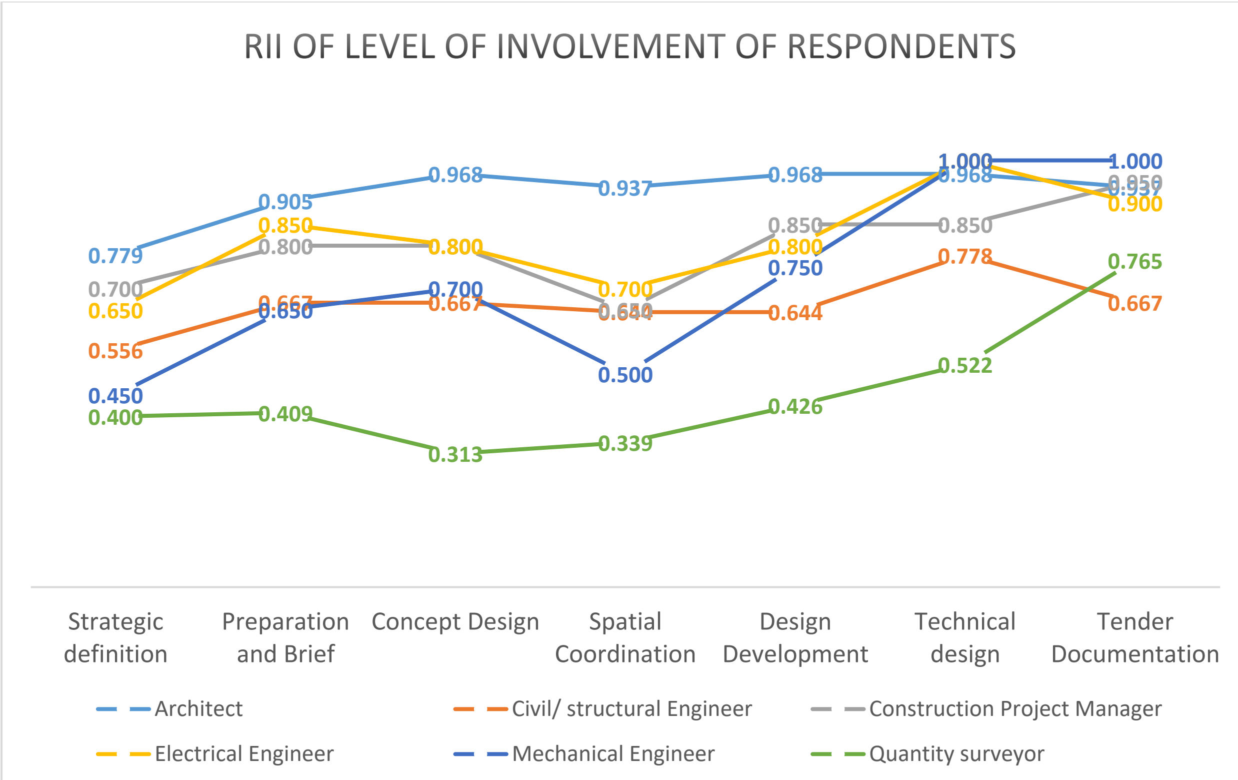
To analyze, how often the different consultants were involved in the different activities of the design process, the Relative Importance Index (RII) was used. The higher the RII value, the higher the involvement of the respondents to the design sub-stage. The findings were summarized in table 4-7 and figure 4-3 below.

Table 4-7 RII of level of involvement of respondents

RII of level of involvement of respondents						
Design process stages	**Architect**	**Civil/ structural Engineer**	**Construction Project Manager**	**Electrical Engineer**	**Mechanical Engineer**	**Quantity surveyor**
Strategic definition	0.779	0.556	0.700	0.650	0.450	0.400
Preparation and Brief	0.905	0.667	0.800	0.850	0.650	0.409
Concept Design	0.968	0.667	0.800	0.800	0.700	0.313
Spatial Coordination	0.937	0.644	0.650	0.700	0.500	0.339
Design Development	0.968	0.644	0.850	0.800	0.750	0.426
Technical design	0.968	0.778	0.850	1.000	1.000	0.522
Tender Documentation	0.937	0.667	0.950	0.900	1.000	0.765

Source: Fieldwork (2023)

Figure 4-3 RII of level of involvement of respondents



Source: Fieldwork (2023)

As illustrated in table 4-7 and figure 4-3 above, it was found that the Architects were most often involved in the different design stages with the RII ranging from 0.779 and 0.968 for the different sub stages. This aligns with the findings in section 4.4.1 above, that found that the architects most often play the design management role in construction projects in Kenya.

It was also found that the Quantity Surveyors were least involved in the design process (RII ranging from 0.313 to 0.765). While they were least involved in the concept design stage (RII=0.313), their involvement increased towards the end of the process with their most involvement being in the tender documentation stage (RII= 0.765)

The Civil/Structural Engineers were most involved in the Technical Design stage (RII=0.778) and least involved in the strategic definition stage (RII=0.556). The Construction Project Managers were least involved in the Spatial Coordination stage (RII=0.65) and most often involved in the Tender Documentation stage (RII=0.95). The Electrical Engineers were most involved in the Technical Design Stage (RII=1) and least involved in the Strategic definition stage (RII=0.65).

The Mechanical Engineers were most often involved in the Technical design stage and tender documentation stage (RII=1) and least involved in the Strategic Definition stag e(RII=0.450).

Overall, the consultants were most involved in the Tender Documentation Stage (RII= 0.87), followed by the Technical Design Stage (RII=0.853), then the Design development stage (RII=0.74). Preparation and Brief came in fourth in terms of involvement (RII= O.713) followed by concept design stage (RII=0.708) then the Spatial Coordination (RII=0.628). The consultants were least involved in the strategic definition (RII=0.589). This shows a trend of consultants getting involved as the design process progresses.

4.4.3 Design Management Methods in Kenya

4.4.3.1 <u>Time Management and Evaluation</u>

The study sought to find out the methods used to manage and evaluate design stage programmes/ schedules of construction projects in Kenya.

<u>Time Management Methods</u>

To find out the extent of application of time management methods during the design process of construction projects in Kenya, the respondents were asked how often the programme management methods were applied to the design stage of construction projects in Nairobi. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between “never” and “always”.

To rank the Programme management tools from the those most often applied to those least often applied, the Relative Importance Index (RII) was used. The higher the value of the RII, the more often the tool was applied.

The results were summarized in table 4-8 below.

It was Found that the Critical Path Method (CPM), which determines the total design duration by establishing the longest sequence of essential design activities that must be completed on time, was the most utilized programme management method (RII=0.73). The Critical Chain Method (CCM) which takes into account the limited resources availability while preparing the design programme and includes necessary buffers, was ranked second (RII=0.54), While the Programme

Evaluation Review Technique (PERT), which is a statistical tool used to estimate the minimum time it would take to complete each task in the design process was least utilized (RII=0.537)

This implies that while the design managers take into account the critical activities and the resources available, not much attention is paid to statistically establishing the time it takes to complete a task.

On average, the use of time management methods by the respondents had an RII of 0.602

Table 4-8 Frequency of use of Programme Management Methods

Time Management Methods	**Mean**	**RII**	**Rank**
Critical Path Method (CPM)	3.65	0.730	1
Critical Chain Method (CCM)	2.70	0.540	2
Programme Evaluation Review Technique (PERT)	2.68	0.537	3
Average		**0.602**	

Source: Fieldwork (2023)

Other tools that the respondents use to manage the design programme include; Programme of Works, Ms Project, PRINCE 2, Procore, Milestones, Risk assessment, ISO Quality Management systems, and Work Breakdown structures.

<u>Programme Performance Evaluation</u>

The study sought to find out to what extent time performance was measured for construction projects in Nairobi. The respondents were asked how often they measured the different aspects of time performance during the design process. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between “never” and “always”.

To rank the aspects of time performance evaluation from the those most often measured to those least often measured, the Relative Importance Index (RII) was used. The higher the value of the RII, the more often aspect was measured. The data is summarized in table 4-9 below.

Table 4-9 Prevalence of Measuring Time Performance Aspects

Aspects of Time Performance	Mean	RII	Rank
Actual time it takes to develop technical design and tender documents	3.97	0.794	1
Actual time it takes to develop detailed design	3.84	0.768	2
Actual time it takes to get statutory approval	3.76	0.752	3
Actual design time vs time allocated in programme	3.71	0.743	4
Additional design time attributable to client change orders	3.52	0.705	5
Actual time it takes to develop concept design	3.48	0.695	6
Additional design time attributable to project manager\ design manager change orders	3.33	0.667	7
Actual time it takes to get investor approval	3.17	0.635	8
Actual time it takes for Design Manager and client to agree on the brief	2.73	0.546	9
Average		**0.732**	

Source: Fieldwork (2023)

It was found that the Actual time it takes to develop technical design and tender documents against the time provided for in the programme was the most measured aspect of time performance (RII=O.794), followed by the actual time it takes to develop the detailed design (RII=0.768). This is probably because the detailed design stage, technical design stage and tender documentation stage are within the control of the design team in terms of time.

The third most evaluated item was the actual time it takes to get statutory approval (RII=0.752) followed by the actual design time [Entire design stage] taken (RII=0.743). The fifth most measured aspect was the Additional design time attributable to client change orders (RII= 0.705), followed by the Actual time it takes to develop concept design (RII= 0.695) , then the Additional design time attributable to project manager\ design manager change orders (RII= 0.667).

The Actual time it takes to get investor approval was the second least measured item (RII= 0.635) and the Actual time it takes for Design Manager and client to agree on the brief was the least measured aspect (RII= 0.546). This is probably because these two aspects are highly dependent on the client, and to some degree, subject to external factors, outside the capacity of the design manager.

On average, the evaluation of time performance by the design team during design process had a RII of 0.701

4.4.3.2 <u>Construction Costs Management and Evaluation</u>

The study sought to find out the methods used to manage and evaluate the construction costs during the design stage of construction projects in Kenya.

<u>Construction Costs Management Methods</u>

To establish to what extent they use cost management methods during the design process, the respondents were asked how often they encounter the different cost management tools being applied in the design stage of construction projects in Nairobi. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between "never" and "always".

The RII was used to rank the cost management tools from the those most often applied to those least often applied. The findings are summarized in table 4-10 below.

Table 4-10 Frequency of use of Cost Management Methods

Cost Management Tools	Mean	**RII**	Rank
Bills of Quantities	4.41	0.883	1
Establishment of a budget baseline cost at inception	4.14	0.829	2
superficial floor area Estimation method	3.95	0.790	3
Approximate quantities Estimation method	3.65	0.730	4
Unit Cost Estimation method	3.56	0.711	5
Cost Plans	3.48	0.695	6
Average		**0.773**	

Source: Fieldwork (2023)

The study found that the Bills of Quantities was the most utilized cost management tool/method among the respondents, (RII of 0.883). This is probably because it forms part of the tender documents and eventually the contract documents making it an item of significant interest and reference to the team and stakeholders.

This was followed closely by the establishment of a budget baseline cost at inception (RII=0.829). This is probably because the budget is one of the main constraints of a project. The third most utilized tool is the superficial floor area estimation method (cost per square meter), (RII= 0.79), followed by the approximate quantities method, (RII=0.73), then the unit cost estimation method at (RII=0.79). The cost plan is the least utilized tools (RII= 0.695).

On average, the use of cost management methods had an RII of 0.773.

<u>Construction Costs Performance Evaluation</u>

The study sought to find out to what extent the different aspects of cost performance were measured during the design process. The respondents were asked how often they encounter the different aspects of cost performance being measured. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between "never" and "always".

The RII was used to rank the cost performance measures from the those most often applied to those least often applied. The findings are summarized in the table 4-11 below.

Table 4-11 Prevalence of Measuring Cost Performance Aspects

Aspects of Cost Performance	Mean	**RII**	Rank
Construction costs received from tender compared to baseline costs	4.32	0.863	1
Additional construction costs attributable to client change orders	4.06	0.813	2
Pretender estimates compared to baseline costs	3.94	0.787	3
Tendered costs of the current project compared to the tendered cost of a similar project a year earlier (cost/ square meter)	3.81	0.762	4
Cost implication of the building systems used (Structural, Partitioning, Electrical, mechanical, etc)	3.75	0.749	5
Concept Design estimated costs compared to baseline costs	3.33	0.667	6
Spatial design estimated costs compared to baseline costs	3.25	0.651	7
Average		**0.795**	

Source: Fieldwork (2023)

It was found that the comparison of the costs received from tender to the baseline costs was the most utilized cost performance measure (RII=0.863). This is probably because this comparison is done on the tender analysis which is often the culmination of the design phase of a project and is very likely to form the contract sum which is binding to the client and the contractor. This was followed by the recording of additional costs attributable to client-initiated change orders at (RII=0.813), then the comparison of pre-tender estimates to the baseline costs (RII= 0.787).

The fourth most measured aspect was the comparison of the tendered costs of the current project to the tendered cost of a similar project a year earlier (cost/ square meter) (RII=0.762) , followed by the consideration of the cost implication of the building systems used (Structural, Partitioning, Electrical, mechanical, etc) (RII= 0.749).

The comparison of the concept design estimated costs to the baseline costs was the sixth most measured aspect, (RII=0.667) and the comparison of the spatial design estimated costs to baseline costs being the least measured aspects (RII=0.651)

On average, the measuring of cost performance amongst respondents had an RII of 0.756.

4.4.3.3 Quality Management and Evaluation

The study sought to analyze the application of quality management and evaluation practices during the design stage of construction projects in Kenya.

Quality Management Practices

To analyze the extent of the application of Quality Management Practices. The respondents were asked how often they encounter the different quality management practices being applied in the design stage of construction projects in Nairobi. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between "never" and "always".

To rank the quality management practices from the those most often applied to those least often applied, the RII was used. The findings are summarized in the table 4-12 below.

Table 4-12 Application of Quality Management Methods to Construction Projects in Nairobi

Quality Management Methods	Mean	**RII= (∑W)/(A*N)**	Rank
Review tender documents to ensure they are precise, complete, and unambiguous	4.13	0.825	1
Coordinating the drawings by different experts	4.00	0.800	2
Establishment of the quality Standards to be referenced	3.81	0.762	3
Reviewing of the drawings by different experts	3.81	0.762	3
Benchmarking current project against successful cases	3.78	0.756	5
Conducting a Quality audit (Identifying good practices implemented and identifying the shortcomings	3.40	0.679	6
Average		**0.764**	

Source: Fieldwork (2023)

It was found that the review of tender documents was the most applied quality management method (RII=0.825) this is a significant step towards ensuring the tender documents are unambiguous and clear as this is very important in ensuring that the client gets the best offer from the bidders. This was followed by the coordination of drawings from the different experts (RII=0.80), then the establishment of the quality Standards to be referenced the review of drawings by different experts both with an RII of 0.762. Benchmarking the current project against successful project coming in fifth (RII= 0.756). Quality audits were the least applied quality management method (RII= 0.679).

On average, the application of quality management methods had an RII of 0.764.

Other quality management tools identified from data collection include; feedback forms, request for specialist shop drawings, and selection of design consultants with proven track records.

Quality Performance Evaluation

The study sought to find out to what extent the different aspects of quality performance were measured during the design process. The respondents were asked how often they encounter the different aspects of quality performance being measured. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between “never” and “always”. The same parameters as applied in the analysis of the quality management tools were used and the results summarized in table 4-13 below.

It was found that the functionality of the design was the most applied measure (RII= 0.79) followed by the customer perception on aesthetics of the building (RII=0.766). This is in alignment with the findings of the literature review that despite quality being subjective and difficult to objectively asses, it is the main expression of stakeholder’s expectations.

Recording the number of quality issues outstanding after the completion of the design stage was ranked third, (RII=0.692), followed by the number of quality issues arising, during design (RII=0.66). Ranking the design between “totally defective” to “apparently defective frees” was the least measured aspect (RII=0.594).

On average, measurement of quality performance by the respondents had an RII=0.701.

Table 4-13 Aspects of Quality Performance Evaluation

Aspects of Quality Performance	Mean	**RII**	Rank
Functionality of the designed building	3.95	0.790	1
Customer perception on aesthetics of the building	3.83	0.766	2
Number of quality issues outstanding after the completion of the design stage	3.46	0.692	3
Number of quality issues arising (e.g. incorrect information on a drawing, incorrect description in the Bills of Quantities)	3.30	0.660	4
Levels of defects in the design on a scale of 1 to 10 where 1 is “totally defective”, and 10 is “apparently defects free”	2.97	0.594	5
Average		**0.750**	

Source: Fieldwork (2023)

4.4.3.4 Stakeholder Satisfaction Management and Evaluation

The study sought to analyze the application of stakeholder management and evaluation practices during the design stage of construction projects in Kenya.

Stakeholder Management Methods

To analyze the extent of the application of Stakeholder management methods, the respondents were asked how often they encounter the different stakeholder management tools being applied in the design stage of construction projects in Nairobi. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between “never” and “always”.

The RII was used to rank the stakeholder management methods from the those most often applied to those least often applied, and the responses summarized in table 4-14 below.

Table 4-14 Application of Stakeholder Satisfaction Management Methods to Construction Projects in Nairobi

Stakeholder management methods	Mean	**RII**	Rank
Progress reports	4.45	0.890	1
Design review meetings	4.40	0.881	2
Management skills	3.94	0.787	3
Interpersonal skills	3.60	0.719	4
Stakeholder Analysis- Identifying interests, expectations and influence of stakeholders	3.56	0.713	5
Average		**0.819**	

Source: Fieldwork (2023)

It was found that the progress reports was the most utilized stakeholder management tool (RII=0.98), followed by the Design Review meetings (RII=0.881). Notably, these two tools keep the client appraised on what is going on through the design process.

The third most utilized tool was the application of management skills (RII=0.787), followed by Interpersonal skills (RII=0.719).

Stakeholder analysis is the least utilized method (RII=0.713). This raises concern and questions on how efficiently the design process meets the needs of all varying stakeholders without conducting an analysis on their interests, expectations, and influence to the project.

On average, the stakeholder satisfaction management had an RII of 0.798.

<u>Stakeholder Ssatisfaction Management Performance Evaluation</u>

The study sought to find out to what extent client feedback was obtained on different aspects of the design process. The respondents were asked how often client feedback was obtained on the different aspects. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between “never” and “always”. The same parameters as applied in the analysis of the stakeholder management tools were used and the results summarized in table 4-15 below.

Table 4-15 Stakeholder Management Performance Evaluation

Client feedback obtained	Mean	RII	Rank
Client Satisfaction with cost of the design- (estimated construction cost)	4.05	0.810	1
Client satisfaction with the services rendered	3.86	0.771	2
Client satisfaction with the client-specified criteria such as branding and functionality	3.67	0.733	3
Client satisfaction with the design time	3.62	0.724	4
Client satisfaction with the projected lifecycle costs-(Low running and maintenance costs)	3.20	0.641	5
Average		**0.736**	

Source: Fieldwork (2023)

It was found that the Client satisfaction with the estimated construction cost was the most sort after client feedback (RII=0.810). This is probably because cost is a major constraint when it comes to construction projects.

Second was the client satisfaction with the services rendered (RII= 0.771), followed by client satisfaction with the client-specified criteria such as branding and functionality (RII= 0.733), then client satisfaction with the design time (RII = 0.724)

The least obtained feedback was on client satisfaction with the projected lifecycle costs (RII= 0.641). This implies that the design team focuses more on the construction cost than the maintenance and operation cost the projects.

On average, the measurement of stakeholder satisfaction had an RI of 0.736.

4.4.3.5 Change Management and Evaluation

To add some insight into how change is managed in construction projects in Kenya, the study attempted to analyze the application of change management and evaluation practices during the design stage of construction projects in Kenya.

Change Management Tools

To analyze the extent of the application of change management tools, the respondents were asked how often they encounter the different stakeholder management tools being applied in the design stage of construction projects in Nairobi. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between “never” and “always”.

To rank the change management tools from the those most often applied to those least often applied, the RII was used. The findings are summarized in the table 4-16 below.

Table 4-16 Application of Change Management Methods

Change Management Tools	Mean	**RII= (∑W)/(A*N)**	Rank
Change Orders	3.75	0.749	1
Change Management Strategy	2.95	0.590	2
Integrated change control	2.79	0.559	3
Average		**0.633**	

Source: Fieldwork (2023)

It was found that the change orders were the most deployed change management tools (RII=0.749). This is probably because this is a well-known tool for documenting and justifying changes. Second was the change management strategy (RII=0.59), followed by the Integrated change control (RII= 0.559)

On average, the application of change management methods had an RII of 0.633.

Change Management Performance Evaluation

The study sought to find out to what extent the different aspects of change management performance were measured during the design process. The respondents were asked how often they encounter the different aspects of change management performance being measured. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between “never” and “always”. The same parameters as applied in the analysis of the change management tools were used and the results summarized in table 4-17 below.

Table 4-17 Change Management Performance evaluation.

Change Management Performance evaluation	Mean	**RII**	Rank
Additional construction costs attributable to change orders	4.14	0.829	1
Additional design time attributable to change orders	3.63	0.727	2
Number of individual change orders approved by the client client/client representative, originating from the client	3.54	0.708	3
Number of individual change orders approved by the client client/client representative, originating from the project manager/ design manager	3.54	0.708	3
Average		**0.743**	

Source: Fieldwork (2023)

The results indicate that the additional costs attributable to change orders was the most measured aspect of change management performance (RII=0.829). This implied that the teams are okay with change as long as it does not have an impact on the construction cost, or at least those costs are documented and justified. The second most measured aspect was additional design time attributable to change orders, (RII=0.727). The number of individual change orders approved by the client, originating from the design manager, and the number of individual change orders approved by the client, originating from the client at were the least measured aspects of time performance with an RII of 0.708 each.

On average, change management performic evaluation had an RII of 0.743.

4.4.3.6 <u>Design Team Management and Evaluation</u>

Often, the design teams are unique for each project. The study sought to analyze the application of design team management and evaluation practices during the design stage of construction projects in Kenya.

<u>Design Team Management Methods</u>

To analyze the extent of the application of design team management tools, the respondents were asked how often they encounter the different team management tools being applied in the design stage of construction projects in Nairobi. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between "never" and "always".

The RII was used to rank the team management tools from the those most often applied to those least often applied. The findings are summarized in the table 4-18 below.

Table 4-18 Application of Design Team Management Methods

Design Team Management	Mean	**RII**	Rank
Design review meetings	4.40	0.879	1
Progress reports	4.32	0.863	2
Responsibility matrix	3.37	0.673	3
Ground rules	3.25	0.651	4
Continuous Training	2.79	0.559	5
Team Building activities	2.41	0.483	6
Average		**0.685**	

Source: Fieldwork (2023)

It was found that Design Review Meetings were the most utilized team management tool (RII=0.879), followed by progress reports (RII=0.863) both of which are essential in ensuring that the different professionals are on the same page towards defining and achieving the project objectives.

The third most utilized tool was the responsibility matrix (RII=0.673) which identifies all the team members, and the roles they must play towards achieving the project objectives. Fourth was the ground rules at (R=0.651).

continuous training was the 5th most utilized tool (RII=0.559) while team building activities were the least utilized (RII=0.483).

On average, the application of the design team management methods had an RII of 0.685.

Design Team Performance Evaluation

The study sought to find out to what extent the different aspects of design team performance were measured during and immediately after the design process. The respondents were asked how often they encounter the different aspects of team management performance being measured. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between “never” and “always”. The same parameters as applied in the analysis of the team management tools were used and the results summarized in table 4-19 below.

Table 4-19 Design Team Performance Evaluation

Aspects of Design Team Performance	Mean	**RII**	Rank
Team contribution to developing high quality designs	3.45	0.690	1
Team contribution to developing design within budget	3.40	0.681	2
Team contribution to completion of tasks on time	3.35	0.671	3
Improvement in skills	2.90	0.581	4
Improvement in competencies	2.87	0.575	5
Increased team cohesiveness	2.78	0.556	6
Reduced turnover rate	2.65	0.530	7
Average		**0.612**	

Source: Fieldwork (2023)

The findings show that the team’s ability to deliver high quality designs was the most measured aspect of team performance (RII=0.69), followed by the team’s contribution to develop designs within budget (RII=0.681). This was followed by the team’s contribution to completion of tasks on time (RII=0.671). This is probably because cost, time and quality are the main constraints of construction projects.

The improvement in skills was the fourth most measured aspect (RII=0.581), followed by improvement in competencies (RII=0.575), increased team cohesiveness (RII= 0.556) and lastly, the reduced turnover rate at (RII=0.53).

On average, the measurement of design team performance has an RII of 0.612.

4.4.3.7 Information Management during the design process

The design process is characterized by high volumes of information being produced and consumed by multiple players in the process making information management vital to project success. The study sought to analyze the application of information management practices during the design stage of construction projects in Kenya.

Information Management Methods

To analyze the extent of the application of information management tools, the respondents were asked how often they encounter the different tools being applied in the design stage of construction projects in Nairobi. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between “never” and “always”.

To rank the information management tools from the those most often applied to those least often

The findings are summarized in the table 4-20 below.

Table 4-20 Application of information management methods in construction projects in Nairobi

Information management methods	Mean	**RII= (∑W)/(A*N)**	Rank
Phone calls and e-mails	4.70	0.940	1
Meetings	4.68	0.937	2
Information Management systems	3.40	0.679	3
Building Information Model(BIM) Software	3.14	0.629	4
Information flow models	2.81	0.562	5
Average		**0.749**	

Source: Fieldwork (2023)

It was found that Phone calls and emails were the most utilized information management tools (RII=0.94), followed by Meetings (RII=0.937).

Information Management systems were the third most utilized tool (RII=0.679) followed by BIM software, (RII=0.629) and lastly, Information flow models (RII=0.562). The finding on the low uptake of BIM aligns with the findings of (Mosse, et al., 2020) that the main hindrance to the adoption of BIM in Kenya was lack of understanding of what BIM is; respondents were still confusing BIM for software; however, BIM is a system.

On average, application of information management methods had an RII of 0.749.

4.4.3.8 Sustainability Management during the design process.

Literature review shows that the construction industry has a significant impact on the environment making sustainability an un-avoidable discussion when it comes to construction projects. The study sought to find out which sustainability standards construction projects in Nairobi were subjected to, and to what extent the designs are geared towards sustainability.

Sustainability Standards

To establish which sustainability standards were being used for construction projects in Nairobi, the respondents were asked how often the designs of construction projects in Nairobi were subjected to the different sustainability standards. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between "never" and "always".

The RII was used to rank the standards from those most often referenced to those least often referenced. The findings are summarized in the table 4-21 below.

Table 4-21 Application of Sustainability Standards of construction projects in Nairobi

Sustainability Standards	Mean	RII	Rank
LEED (Leadership in Energy and Environmental Design)	2.49	0.498	1
KGBS (Kenya Green Building Society)	2.49	0.498	1
EDGE (Excellence in Design for Greater Efficiencies)	2.43	0.486	3
USGBC (United States Green Building Council)	2.08	0.416	4
Average		**0.475**	

Source: Fieldwork (2023)

From the findings, the designs of construction projects in Kenya were most often subjected to the KGBS (Kenya Green Building Society) standards and LEED (Leadership in Energy and Environmental Design) standards, both with an RII of 0.475. They were followed by EDGE (Excellence in Design for Greater Efficiencies) standards at (RII=0.486) and lastly, USGBC (United States Green Building Council) standards (RII=0.416).

On average, the application of Sustainability Standards of construction projects in Kenya had a RII of 0.475.

It was also noted that the Architectural Association of Kenya (AAK) in collaboration with the University of Nairobi and UN-Habitat had recently (June 2023) launched the Safari Green Building Index (SGBI) that is a National Rating System suitable for all kinds of buildings in different climatic zones in Kenya and is also applicable to the other East African Countries.

<u>Sustainability Performance Evaluation</u>

The study sought to find out to what extent the different aspects of sustainability performance were measured during and immediately after the design process. The respondents were asked how often they encounter the different aspects of sustainability performance being measured. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between "never" and "always". The same parameters as applied in the analysis of the sustainability standards were used and the results summarized in table 4-22 below.

Table 4-22 Sustainability Performance Measurement for construction Projects in Nairobi

Sustainability Measures	Mean	**RII**	Rank
Water Efficiency	3.46	0.692	1
User health and comfort	3.46	0.692	1
Materials Efficiency	3.38	0.676	3
Energy Efficiency	3.21	0.641	4
Waste Management Efficiency	3.19	0.638	5
Lifecycle costs	3.08	0.616	6
Average		**0.659**	

Source: Fieldwork (2023)

It was found that Water efficiency and user health and comfort were the most measured aspects of sustainability, each with and RII of 0.6692. These was followed by Materials Efficiency (RII=0.676), energy efficiency (RII = 0.641) waste management efficiency (RII= 0.638) and lifecycle costs (RII=0.616). These implies that incorporation of sustainability aspects to the design is geared more to user comfort, then impact on the environment, then lastly cost of achieving the sustainability.

On average, measurement of Sustainability Performance of construction Projects in Nairobi has an RII of 0.659

4.4.3.9 <u>Incorporation Health and Safety aspects during the design process</u>

Construction sites are highly hazardous and pose serious risks to the human life. While these risks are live during the construction and user phases, some of the health and safety factors can be pre-determined in the design stage. The study sought to analyze how health and safety concerns are addressed during the design stage of construction projects in Kenya.

<u>Health and safety Practices</u>

To analyze the extent of the application of information management tools, the respondents were asked how often the different aspects of health and safety were addressed during the design stage of construction projects. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between "never" and "always".

To rank the health and safety practices from the those most often addressed to those least often addressed, the RII was used. The findings are summarized in the table 4-23 below.

Table 4-23 Addressing Health and safety during design stage of construction projects in Nairobi.

Aspects of Health and Safety	Mean	**RII**	Rank
Specification of materials known to be less hazardous	3.98	0.797	1
Ensuring constructible designs	3.89	0.778	2
Avoiding specifying processes that create hazardous fumes, vapors, dust or vibration	3.81	0.762	3
Specification of materials that are easy to handle	3.75	0.749	4
Average		**0.771**	

Source: Fieldwork (2023)

It was found that the specification of materials known to be less hazardous was the most addressed Health and safety aspect (RII=0.797). This is probably because the design team decides the specifications of the designs. This was followed by ensuring constructible designs (RII=0.778) then avoiding specifying processes that create hazardous fumes, vapors, dust or vibration

(RII=0.762) specifications of materials thar are easy to handle, was the least addressed (RII=0.749).

On average, addressing the health and safety aspects during design had an RII of 0.771.

4.4.4 General factors affecting the performance of the design Process.

This study insists on measuring the performance of the design process not only at the end, but most especially during the process. There are factors / inputs into the process that will eventually determine the performance of the process, making the factors leading / process indicators. This is because these factors can be identified early on or as they come up and be addressed during the process.

The study sought to analyze the significance of these factors affecting the performance of the design process of construction projects in Kenya.

The respondents were asked how significant the different factors were to the positive performance of construction projects. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between “Not at all significant” and “Extremely significant”.

The relative importance index (RII) was used to rank the factors from the those most significant to those least significant. The findings are summarized, in the table 4-24 below.

Table 4-24 Factors affecting the Performance of the design Process.

Factors affecting project Performance	1= Not at all significant	2= Slightly significant	3= Moderately significant	4= very significant	5= Extremely significant	Mean
	[count]	[count]	[count]	[count]	[count]	
The experience of the designers	1	1	4	23	33	4.39
The experience of the developer/client in construction	3	9	16	25	9	3.45
Information systems in place for the project and efficacy of the means of communication	1	5	9	26	21	3.98
The clarity of the design proposals	0	2	2	19	39	4.53
The clarity of the technical details	0	1	1	23	37	4.55
Compliance of the design with the statutory requirements	0	1	3	24	34	4.47
Availability, flexibility, promptness and punctuality of project designers	1	0	6	31	24	4.24
The clarity of standards and protocol of the design process	0	3	8	28	23	4.15
The ability of consultants to monitor costs during the design process	0	1	4	23	34	4.45
The ability of consultants to evaluate several materials and alternatives to meet client requirements and budget	0	1	7	20	34	4.40
Ability of the designer to offer a good level of constructability and detailing	0	1	5	23	33	4.42
Obtaining and documenting feedback from project stakeholders.	0	6	10	24	22	4.00
Knowledge of designer on sustainable designs	0	4	6	26	26	4.19

Source: Fieldwork (2023)

It was found that the clarity of the technical details was the most significant factor in determining whether the design process was a success, and the experience of the developer being the least significant factor. The factors were ranked as illustrated in table 4-25 from most significant to least significant. This ranking suggests that the input from the design team has more significant impact on project success than the external factors and client factors.

Table 4-25 Ranking of Factors affecting design process performance.

Factors affecting project Performance	RII	Rank
The clarity of the technical details	0.910	1
The clarity of the design proposals	0.906	2
Compliance of the design with the statutory requirements	0.894	3
The ability of consultants to monitor costs during the design process	0.890	4
Ability of the designer to offer a good level of constructability and detailing	0.884	5
The ability of consultants to evaluate several materials and alternatives to meet client requirements and budget	0.881	6
The experience of the designers	0.877	7
Availability, flexibility, promptness, and punctuality of project designers	0.848	8
Knowledge of designer on sustainable designs	0.839	9
The clarity of standards and protocol of the design process	0.829	10
Obtaining and documenting feedback from project stakeholders.	0.800	11
Information systems in place for the project and efficacy of the means of communication	0.797	12
The experience of the developer/client in construction	0.690	13

Source: Fieldwork (2023)

4.5 Barriers to the Application of Design Management Practices for Construction Projects in Kenya

The study sought to find if the challenges identified in the literature review were true to the Kenyan context. The respondents were asked how often they experienced the different challenges in the use and application of design management techniques. The question was asked in the form of a Likert scale where the respondents were supposed to choose frequency ranging between "never" and "always".

The RII was used to rank the challenges from the most experienced challenge to the least. The findings are summarized in the table 4-26 below.

Table 4-26 Barriers to the Application of Design Management Practices for Construction Projects in Kenya

Barriers to Design Management Practices	Never [W=1] [count]	Rarely [W=2] [count]	Sometimes [W=3] [count]	Very Often [W=4] [count]	Always [W=5] [count]	Mean	**RII= (∑W)/(A*N)**	Rank
Inadequate Design Time	1	1	12	36	13	3.94	0.787	1
Incomplete/unclear client brief	0	2	23	32	6	3.67	0.733	2
Conflicts within the design team	0	14	32	13	4	3.11	0.622	10
Lack of a Designated Design Manager	3	19	18	18	5	3.05	0.610	12
Communication Breakdown	0	10	32	17	4	3.24	0.648	7
Adversarial Culture	4	21	31	5	2	2.68	0.537	15
Lack of customer focus	3	17	29	12	2	2.89	0.578	14
The disintegrated nature of the industry	2	13	22	17	9	3.29	0.657	6
Design Co-ordinating challenges	0	10	29	19	5	3.30	0.660	5
Design Documentation challenges	1	18	22	16	6	3.13	0.625	8
Concerns with constructability	1	17	28	15	2	3.00	0.600	13
Design Tasks and Information Interdependencies	1	16	25	16	5	3.13	0.625	8
Unstructured Design Process	1	19	22	16	5	3.08	0.616	11
High Volume of Information to be processed	0	16	20	18	9	3.32	0.663	4
Design process not planned in enough detail	1	10	24	21	7	3.37	0.673	3

Source: Fieldwork (2023)

It was found that Inadequate design time was the most experienced (RII=0.787) challenge by the design team members reiterating the problem that the design team often accepts the time allocated to them , and the findings of this research in section 4.4.3.1(application of time management tools).above, that the durations plugged into the programme/schedule are not scientifically established making the programme unrealistic.

The lack of customer focus (RII=0.578) and the adversarial culture (RII=0.537) were the lowest ranked challenges probably speaking to the professionalism of the design team in handling the design process.

The challenges were ranked as illustrated in table 4-27 below from the from experienced to the least experienced challenges.

Table 4-27 Ranking of Barriers to the design management process

Barriers to Design Management Practices	**RII**	Rank
Inadequate Design Time	0.787	1
Incomplete/unclear client brief	0.733	2
Design process not planned in enough detail	0.673	3
High Volume of Information to be processed	0.663	4
Design Co-ordinating challenges	0.660	5
The disintegrated nature of the industry	0.657	6
Communication Breakdown	0.648	7
Design Documentation challenges	0.625	8
Design Tasks and Information Interdependencies	0.625	8
Conflicts within the design team	0.622	10
Unstructured Design Process	0.616	11
Lack of a Designated Design Manager	0.610	12
Concerns with constructability	0.600	13
Lack of customer focus	0.578	14
Adversarial Culture	0.537	15

Source: Fieldwork (2023)

Other challenges identified during data collection include: Unattainable expectations from clients, lack of a clear understanding of the processes by some members of the design team, and political interference.

4.6 Research Proposition

The study was guided on the proposition that: The Design Teams in the construction industry in Kenya do not adequately apply design management methods and techniques, leading to poor performance of project objectives at the design stage.

The results of this study is in line with the proposition that the designers do not adequately apply the design management methods. The findings indicate that the designers in Kenya occasionally (sometimes) apply the available methods and measure their performance on the design process summarized in table 4-29 and 4-30 below. Occasional application of design management methods is not adequate for project success.

This study interprets the Relative Importance Index Interpretation based on 5-point scale as was interpreted by (Kamaruddeen, et al., 2022), and tabulated in table 4-28 below for this study.

Table 4-28 Relative Importance Index Interpretation based on 5-point scale.

Relative Importance Index Interpretation based on 5-point scale	
Relative Importance Index	**Frequency of Application of the methods**
0 to 0.19	Never
0.2 to 0.59	Rarely
0.6 to 0.79	Sometimes
0.8 to 0.99	Very Often
1	Always

Source: Author (2023)

Table 4-29 Summary on the Utilization of Design Management Methods in construction Projects in Nairobi

Design Management Methods	Average Relative Importance Index	Remarks on how often the methods are applied
Time Management Methods	0.602	Sometimes
Cost Management Methods	0.773	Sometimes
Quality Management Methods	0.764	Sometimes
Stakeholder Satisfaction Management Methods	0.798	Sometimes
Change Management Methods	0.633	Sometimes
Design Team Management Methods	0.685	Sometimes
Information Management Methods	0.749	Sometimes
Sustainability Standards	0.475	Rarely
Health and safety Practices	0.771	Sometimes
Average	**0.694**	**Sometimes**

Source: Fieldwork (2023)

Table 4-30 Summary of the Design process performance measures of Construction project in Nairobi

Design Process Performance Measures	Average Relative Importance Index	Remarks on how often performance is measured
Time performance measurement	0.701	Sometimes
Cost Performance measurement	0.756	Sometimes
Quality Performance measurement	0.701	Sometimes
Stakeholder Management Performance Measurement	0.736	Sometimes
Change Management Performance Measurment	0.743	Sometimes
Design Team Performance Measurement	0.612	Sometimes
Sustainability Performance Measurement	0.659	Sometimes
Average	**0.701**	**Sometimes**

Source: Fieldwork (2023)

CHAPTER 5: SUMMARY OF FINDINGS, CONCLUSIONS, RECOMMENDATIONS, AND AREAS OF FURTHER STUDY

5.1 Introduction

This chapter concludes this study. It represents the linkage of the data acquired in chapter two (literature review) and chapter four (data presentation and analysis) into conclusions that inform the research objectives. A summary of the findings of the research, the conclusions the recommendations and the areas of further study are presented in this chapter.

This study has examined the design process, the tools and techniques applied to manage and evaluate this process, the extent of application of these tools and techniques in the Kenya construction Industry, and the challenges experienced in the management of the design process.

5.1.1 Restatement of the research problem, research objectives and research questions.

The problem statement of this research as earlier discussed in section 1.2 is that significant problems in the construction industry are directly or indirectly to the design process which is has a lot of complexities arising from the number of professionals involved, amount of information being exchanged, limited time and resources, amongst others. It is therefore necessary to intentionally apply design management methods to the design process so as to ensure effective management of the design process and consequently promote project success.

To close this gap, the researcher came up with the following research objectives as stated in section 1.3 with the main objective being, to investigate whether the design process management issues cited in the literature review are also true for the Kenya construction industry and to establish the methods used in management of the design processes and their effectiveness in Kenya. The specific objectives were: To identify the plan of work /procedures applied in the designs processes of construction projects in Kenya; To establish the design management methods that are used for managing and evaluating the design process performance in Kenya; and To establish the barriers to the effective application of the design management methods in the construction industry in Kenya.

These objectives were achieved by answering the following research questions as stated in section 1.4: What plan of work/ approaches do designers follow while carrying out the design of construction projects in Kenya? What design management methods are normally applied in managing and evaluating the achievement of design objectives at the design stage? and What are the barriers to the effective application of the established design management methods in construction projects in Kenya?

5.2 Summary of the Findings

The literature review of the study (chapter 2) identified the plans of works and the design process of construction Projects. It also identified the design management methods and performance indicators of the different aspects of the design process, and the challenges encountered in the application of the design management tools and techniques. These were found to be sufficient for anchoring the study and its findings. Chapter 4 then analyzed findings on the plan of works most utilized in Kenya, the management tools utilized in Kenya, the evaluation of the different aspects of the design process in Kenya, the factors affecting the performance of the design process, and the challenges encountered in applying the design management tools and techniques .

5.2.1 General Information

The respondents included Architectural, Quantity Surveying, Engineering and construction project management firms. This multidisciplinary sample was intended to remove any bias or information asymmetry that might affect one group of professions, as well as to guarantee that a comprehensive and impartial viewpoint on the subject was established. The bulk of responders (60.3%) had more than ten years of industry experience, therefore they had a deeper understanding of the design process.

Institutional and commercial buildings, and residential apartment blocks formed the majority of projects in the respondent's portfolio demonstrating the nature and complexity of projects handled by the respondents.

78% of the respondents offered Project Management services meaning that a majority of the respondents had an understanding of general project management which is important as the literature reveled some principles of project management could be applied to design management.

The study found that the Architect most often played the role of the Design Manager. This is in accordance with the traditional structure of the project where the Architect is the lead of the design team. The Architect was followed by the Project Manager. This can be attributed to the growing involvement of Project managers in construction projects.

5.2.2 The Design Process of Construction Projects in Kenya.

In regard to the first objective of the study, the Literature review revealed that there were different workplans/ plans of work used around the world, including but not limited to The Royal Institute of British Architects (RIBA) Plan of Works, and The Board of Registration of Architects and Quantity Surveyors (Kenya) Design Stages (Cap525). A conceptual model was developed on the design process stages: ***Stage 0: Strategic definition, Stage 1: Preparation and brief, Stage 2: Concept Design, Stage 3: Spatial Coordination and design development; stage 4: Technical Design. and stage 5: Tender Documentation.***

Data collection from the design firms in Nairobi found that the Architects were often involved throughout the process while the rest of the consultants were involved towards the end of the process with most involvement being in the tender documentation stage and the least involvement being in the strategic definition stage.

5.2.3 Application of Design Management Methods in Kenya

To address the second objective, the literature review discussed several design management practices that were available for the design process of construction projects. It discussed the tools applicable in managing the design time, construction costs, Quality of designs, stakeholders' expectations, design teams, change, information, sustainability, and construction health and safety during the design stage. It also discussed the design process performance indicators that could be measured during and after design process to enhance project success.

The application of this management and evaluation methods was then tested in the Kenyan context. The study found that all the Design process management and evaluation methods identified in literature (chapter 2) existed in Kenya, but were only applied occasionally (sometimes), which is not adequate for project success. There is a lot of room for improvement on the effective utilization of the management methods that are available to the design teams in Kenya.

5.2.4 Barriers to the application of design management practice in the construction industry in Kenya

To address the third objective, the literature review established the challenges faced by the design team members in the use of the design management methods and techniques. Chapter four of the study then ranked the challenges from the most significant to the least significant as follows.

Inadequate design time was found to be the most experienced challenge, followed closely by incomplete or unclear client briefs. This finding is in concurrence with some of the issue highlighted in the problem statement that unrealistic expectations by clients created both intentionally and unintentionally are some of the challenges designers have to grapple with.

Having a Design process that was not planned in enough detail was ranked third, followed by high volume of information to be processed, design coordination challenges, the disintegrated nature of the industry, communication breakdown, and design tasks and information interdependencies and design documentation challenges. The tenth most experienced challenge was Conflicts within the design team, followed by the unstructured design process, and the lack of a designated design manager, then concerns with constructability.

Lack of customer focus was the second least experienced challenge and the adversarial culture was the least experienced challenge in the Kenyan context.

Other challenges identified during data collection include : Unattainable expectations from clients, lack of a clear understanding of the processes by some members of the design team, and political interference

5.2.5 Revisiting the Research Proposition

The research was guided by the proposition that:

The Design Team in the construction industry in Kenya do not adequately apply design management methods and techniques, leading to poor performance of project objectives at the design stage.

The findings of this study are in line with this proposition that the designers do not adequately apply the design management methods. The findings indicate that the designers in Kenya occasionally (sometimes) apply the available methods and measure their performance on the design process. Occasional application of the management methods is not sufficient for project success.

5.3 Conclusions

From the findings of the research, the following conclusions can be drawn in line with the objectives of the research.

Understanding the design process is key in the successful implementation of the design management and there are various plans of work that organizations can use. The Cap 525 design stages play a big role in providing guidance to the consulting firms in Kenya.

The design process management and evaluation methods identified in literature (chapter 2) exist in Kenya, but are are applied occasionally (sometimes), which is not adequate for project success. There is a lot of room for improvement on the effective utilization of the management methods that are available to the design teams in Kenya.

Inadequate design time and unclear client briefs are the most significant challenges faced by the design team in implementation of the design process management.

5.4 Recommendations

The recommendations of these study are that:

1. Design Organizations document a design process and policies to ensure consistency.
2. Design firms should consciously and intentionally apply the different design management methods to improve performance of the design stage.
3. Design firms should ensure they debrief the clients correctly so as to meet client requirements.
4. Design firms should use scientific means to establish minimum time required to carry out tasks and complete the design process to mitigate the challenge of inadequate design time.

5.5 Areas of Further Study

This research has brought up a few questions which need to be investigated further. Therefore the following are suggested areas of further study: An investigation on whether the design management methods are applied correctly; An investigation on the impact of the low Quantity Surveyor's involvement in the design process on project success, Exploration of the tools and techniques firms can apply to their design process to increase the firm's profitability and, Investigations into the organization of the design firm and its impact to the quality of the design.

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APPENDICES

Appendix I: Questionnaire

UNIVERSITY OF NAIROBI

RESEARCH PROJECT: A STUDY ON THE APPLICATION OF DESIGN MANAGEMENT PRACTICES IN CONSTRUCTION PROJECTS IN KENYA. [A CASE STUDY OF NAIROBI COUNTY]

Questionnaire for the Architectural, Engineering, Quantity Surveying and Project Management Firms

As a final year student in Master of Arts in Construction Management at the University of Nairobi, a research project is a requirement for part fulfillment for the award of a postgraduate degree.

Declaration

The information collected shall be treated as confidential and shall be used for the purpose of this research only.

Background

Design Management is an emerging discipline in Architecture and the construction industry. It deals with managing the design process and is designed to address the managerial problems in design stage of building projects.

This questionnaire consists of four sections. The first section seeks general information about you and your organization, the second section asks about the design stages in your organization, the third section enquires about the management and performance of the design process, and the last section is on challenges you encounter while applying the design management tools and techniques.

Instructions

Please tick☐ and /or state the answer in the in the boxes and spaces provided.

Part 1: General information

1. What term describes your services in the construction Industry?
    - Architect ☐
    - Civil/structural Engineer ☐
    - Mechanical Engineer ☐
    - Electrical Engineer ☐
    - Quantity surveyor ☐
    - Construction Project Manager ☐
    - Other ____________________

2. For how long have you been a professional in the built environment?
    - 1-3 years ☐
    - 3-5 years ☐
    - 5-10 years ☐
    - more than 10 years ☐
3. What is the nature of your organization?
    - Private ☐
    - Government ☐
    - NGO ☐
    - Other ____________________
4. Does your organization offer construction Project management services?
    - Yes ☐
    - NO ☐

5. For how long has your organization been in business?
    - 1-3 years ☐
    - 3-5 years ☐
    - 5-10 years ☐
    - more than10 years ☐

6. What type of construction projects forms the MAJORITY of projects in your organization's portfolio?

   (Check all that apply)

   - Residential Buildings- single dwellings ☐
   - Residential Buildings- Apartment blocks ☐
   - Institutional and commercial buildings ☐
   - Specialized Industrial Construction ☐
   - Infrastructure and heavy construction ☐
   - Other ____________________

7. In your year/s of practice, how often do you encounter the following professionals playing design management roles?

	Never	**Rarely**	**Sometimes**	**Very often**	**Always**
Architect					
Civil/structural Engineer					
Mechanical Engineer					
Electrical Engineer					
Quantity surveyor					
Construction Project Manager					
Design Manager					

Part 2: This section intends to collect data on sequence of design tasks of building projects in Nairobi County, Kenya.

8. What Plan of Work / design process is applied when carrying out design in your organization?
    - RIBA Plan of Works ☐
    - Architects and Quantity Surveyors Act (CAP 525) Design Stages ☐
    - Our Organization has developed its own plan of works ☐
    - None ☐
    - Other ____________________

9. If your organization has developed its own plan of work, please list the stages of a project according to your plan of work.

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    ____

    ____

    ____

10. In your opinion, to what extent are the following plans of work relevant for construction projects in Nairobi?

	Not Relevant at all	**Slightly Relevant**	**Somewhat relevant**	**Relevant**	**Very Relevant**
RIBA Plan of Works					
Architects and Quantity Surveyors Act (CAP 525) Design Stages					
Design Manager					

11. How often is your organization involved in the following stages of the design process of construction projects?

	Never	Rarely	Sometimes	Very often	Always
Strategic definition					
Preparation and Brief					
Concept Design					
Spatial Coordination					
Design Development					
Technical design/production drawings					
Tender Documentation					

<u>Part 3: This section intends to collect data on the tools of managing and evaluating the design process of building projects in Nairobi County, Kenya.</u>

12. In your experience, how often do construction projects in Nairobi have a project-specific design management plan?
    - Never ☐
    - Rarely ☐
    - Sometimes ☐
    - Very often ☐
    - Always ☐

13. In your experience, how often are the following tools used in managing the design stage programme of construction projects in Nairobi?

	Never	**Rarely**	**Sometimes**	**Very often**	**Always**
Programme Evaluation Review Technique (PERT)- A statistical tool used to estimate the minimum time it would take to complete each task in the design process.					
Critical Path Method(CPM)- Determining the total design duration by establishing the longest sequence of essentil design Activities that must be completed on time.					
Critical Chain Method (CCM)- Takes into account the limited resources availability while preparing the design programme and includes necessary buffers.					

14. What other tools and techniques does your organization apply in the management of the design process PROGRAMME?.

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15. In your experience, how often are the following aspects of time performance measured?

Aspects of Time Performance	Never	Rarely	Sometimes	Very Often	Always
Actual time it takes for Design Manager and client to agree on the brief					
Actual time it takes to develop concept design					
Actual time it takes to develop detailed design					
Actual time it takes to develop technical design and tender documents					
Actual design time vs time allocated in programme					
Actual time it takes to get investor approval					
Actual time it takes to get statutory approval					
Additional design time attributable to client change orders					
Additional design time attributable to project manager\ design manager change orders					

16. In your experience, how often are the following tools used in managing construction costs during the design stage of construction projects?

Cost Management Tools	Never	Rarely	Sometimes	Very Often	Always
Establishment of a budget/ baseline cost at inception					
Unit Cost Estimation method					
superficial floor area Estimation method					
Approximate quantities Estimation method					
Bills of Quantities					
Cost Plans					

17. What other tools and techniques does your organization apply in the management of construction costs during the design stage?

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18. In your experience, how often are the following aspects of cost performance measured?

Aspects of Cost Performance	Never	Rarely	Sometimes	Very Often	Always
Concept Design estimated costs compared to baseline costs					
Spatial design estimated costs compared to baseline costs					
Pretender estimates compared to baseline costs					
Construction costs received from tender compared to baseline costs					
Cost implication of the building systems used (Structural, Partitioning, Electrical, mechanical, etc)					
Tendered costs of the current project compared to the tendered cost of a similar project a year earlier (cost/ square meter)					
Additional construction costs attributable to client change orders					

19. your experience, how often are the following practices applied in managing quality during the design stage of construction projects?

Quality Management Practices	Never	Rarely	Sometimes	Very Often	Always
Establishment of the quality Standards to be referenced					
Benchmarking current project against successful cases					
Coordinating the drawings by different experts					
Reviewing of the drawings by different experts					
Review tender documents to ensure they are precise, complete and unambiguous					
Conducting a Quality audit (Identifying good practices implemented and identifying the shortcomings					

20. What other tools and techniques does your organization apply in the management of quality during the design stage?

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21. In your experience, how often are the following aspects of quality performance measured?

Aspects of Quality Performance	Never	Rarely	Sometimes	Very Often	Always
Number of quality issues arising (e.g., incorrect information on a drawing, incorrect description in the Bills of Quantities)					
Levels of defects in the design on a scale of 1 to 10 where 1 is “totally defective”, and 10 is “apparently defects free”					
Number of quality issues outstanding after the completion of the design stage					
Functionality of the designed building					
Customer perception on aesthetics of the building					

22. In your experience, how often are the following tools applied in stakeholder and client management during the design stage of construction projects?

Stakeholder management tools	Never	Rarely	Sometimes	Very Often	Always
Stakeholder Analysis- Identifying interests, expectations, and influence of stakeholders					
Design review meetings					
Progress reports					
Interpersonal skills					
Management skills					

23. In your experience, how often is the following client feedback obtained?

Client feedback obtained	1= Never	2= Rarely	3= Sometimes	4= Very Often	5= Always
Client satisfaction with the services rendered					
Client satisfaction with the design time					
Client satisfaction with the client-specified criteria such as branding and functionality					
Client Satisfaction with cost of the design- (estimated construction cost)					
Client satisfaction with the projected lifecycle costs-(Low running and maintenance costs)					

24. In your experience, how often are the following practices applied in managing change during the design stage of construction projects?

Change Management Tools	1= Never	2= Rarely	3= Sometimes	4= Very Often	5= Always
Change Management Strategy					
Integrated change control					
Change Orders					

25. What other tools and techniques does your organization apply in the management of change during the design stage?

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26. In your experience, how often are the following aspects of change management performance measured?

Change Management Performance evaluation.	1= Never	2= Rarely	3= Sometimes	4= Very Often	5= Always
Number of individual change orders approved by the client client/client representative, originating from the client					
Number of individual change orders approved by the client client/client representative, originating from the project manager/ design manager					
Additional construction costs attributable to change orders					
Additional design time attributable to change orders					

27. In your experience, how often are the following tools applied in design team management during the design stage of construction projects?

Design Team Management Tools	Never	Rarely	Sometimes	Very Often	Always
Ground rules					
Responsibility matrix					
Continuous Training					
Team Building activities					
Design review meetings					
Progress reports					

28. In your experience, how often are the following aspects of team performance measured?

Aspects of Design Team Performance	Never	Rarely	Sometimes	Very Often	Always
Increased team cohesiveness					
Improvement in skills					
Improvement in competencies					
Reduced turnover rate					
Team contribution to completion of tasks on time					
Team contribution to developing design within budget					
Team contribution to developing high quality designs					

29. In your experience, how often are the following tools applied in information flow management during the design stage of construction projects?

Information management tools	Never	Rarely	Sometimes	Very Often	Always
Information flow models					
Building Information Model (BIM) Software					
Meetings					
Phone calls and e-mails					
Information Management systems					

30. In your experience, how often are designs of construction projects in Nairobi subjected to the following sustainability standards?

Sustainability Standards	1= Never	2= Rarely	3= Sometimes	4= Very Often	5= Always
LEED (Leadership in Energy and Environmental Design)					
EDGE (Excellence in Design for Greater Efficiencies)					
KGBS (Kenya Green Building Society)					
USGBC (United States Green Building Council)					

31. In your experience, how often are the following aspects of sustainability measured for construction projects?

Sustainability Measures	Never	Rarely	Sometimes	Very Often	Always
Energy Efficiency					
Water Efficiency					
Materials Efficiency					
Waste Management Efficiency					
Lifecycle costs					
User health and comfort					

32. In your experience, how often are the following aspects of health and safety addressed during the design stage of construction projects?

Aspects of Health and Safety	Never	Rarely	Sometimes	Very Often	Always
Ensuring constructible designs					
Specification of materials known to be less hazardous					
Specification of materials that are easy to handle					
Avoiding specifying processes that create hazardous fumes, vapors, dust or vibration					

33. In your experience, how significant are the following factors to the positive performance of construction projects?

Factors affecting project Performance	Not at all significant	Slightly significant	Moderately significant	very significant	Extremely significant
The experience of the designers					
The experience of the developer/client in construction					
Information systems in place for the project and efficacy of the means of communication					
The clarity of the design proposals					
The clarity of the technical details					
Compliance of the design with the statutory requirements					
Availability, flexibility, promptness and punctuality of project designers					
The clarity of standards and protocol of the design process					
The ability of consultants to monitor costs during the design process					
The ability of consultants to evaluate several materials and alternatives to meet client requirements and budget					
Ability of the designer to offer a good level of constructability and detailing					
Obtaining and documenting feedback from project stakeholders.					
Knowledge of designer on sustainable designs					

Part 4: This section intends to collect data on challenges faced while using Design Management Techniques for construction projects in Nairobi County, Kenya.

34. From your experience, how often have you experienced the following challenges in using of design management techniques?

Barriers to Design Management Practices	**Never**	**Rarely**	**Sometimes**	**Very Often**	**Always**
Inadequate Design Time					
Incomplete/unclear client brief					
Conflicts within the design team					
Lack of a Designated Design Manager					
Communication Breakdown					
Adversarial Culture					
Lack of customer focus					
The disintegrated nature of the industry					
Design Co-ordinating challenges					
Design Documentation challenges					
Concerns with constructability					
Design Tasks and Information Interdependencies					
Unstructured Design Process					
High Volume of Information to be processed					
Design process not planned in enough detail					

THANK YOU FOR YOUR VALUABLE PARTICIPATION.

Appendix II: Research Authorization Letter

DEPARTMENT OF REAL ESTATE, CONSTRUCTION MANAGEMENT & QUANTITY SURVEYING

P.O. Box 30197, 00100 Nairobi, KENYA, ***Tel: No. +254-782383848***
E-mail: *realestate@uonbi.ac.ke*

Ref: B53/34363/2019 **Date:** 16th December, 2021

To Whom It May Concern

Dear Sir/Madam,

RE: RESEARCH LETTER - NZIOKI LUCY NZILANI B53/34363/2019

This is to confirm that the above named is a student in the Department of Real Estate, Construction Management and Quantity Surveying pursuing a Master of Arts course in Construction Management.

She is carrying out a research entitled ***"The application of Design Management Techniques in Building Projects; A Case Study of Nairobi County"*** in partial fulfillment of the requirements for the degree programme.

The purpose of this letter is to request you to allow her access to any kind of material she may require to complete her research. The information will be used for research purposes only.

Any assistance accorded to her will be appreciated.

CHAIRMAN
DEPARTMENT OF CONSTRUCTION
MANAGEMENT AND QUANTITY SURVEYING
UNIVERSITY OF NAIROBI

Isabella N. Wachira-Towey, (PhD)
Chairman & Senior Lecturer
Department of Real Estate, Construction Management & Quantity Surveying