DEVELOPMENT OF A PERFORMANCE INDEX FOR BUILDING CONSTRUCTION PROJECTS IN KENYA

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Development of a Performance Index for Building Construction Projects in Kenya

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DECLARATION

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

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DEDICATION

This thesis is dedicated to my mother, Mary Wangari Wamaitha, my sister, Catherine Wairimu Wangari, baby nephew Lexlie Ngige Wairimu and my late father, John Mbugua Ndachi. I love you deeply.

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ABBREVIATIONS AND ACRONYMS

ACMK	Association of Construction Managers in Kenya
AHP	Analytical Hierarchical Process
BORAQS	Board of Regulation for Architects and Quantity Surveyor
BSC	Balanced Scorecard
CSF	Critical Success Factors
EBK	Engineering Board of Kenya
EFQM	European Foundation for Quality Management
GDP	Gross Domestic Profit
IEK	Institution of Engineers in Kenya
KPDA	Kenya Property Developers Association
KPI	Key Performance Indicators
KPO	Key Performance Output
KPR	Key Performance Results
NCA	National Construction Authority
PerM	Perceptive Measures
PI	Performance Index
PPCF	Performance Process Conceptual Framework

ABSTRACT

Building construction projects in Kenya suffer from cost and time overruns as well as the frequent collapse of buildings. One of the major reasons why the construction industry is failing is the lack of measurement of the construction project performance. There is usually a disparity of judgement among the stakeholders when it comes to the perception of failure and success of building construction projects. The general objective of the study was to identify and rank the key performance indicators in their relative importance to assist in building construction performance assessment. The specific objectives were to determine key performance indicators and to develop a key performance index for the building construction industry in Kenya. The study was anchored on various scholarly articles which informed the formation of the study variables and the identification of the subconstructs. The study adopted descriptive research methodologies. A sample of 100 stakeholders was identified using the Glenn Israel Table. Random and stratified sampling techniques were used to reach the respondents in the study. A questionnaire was used as the main study instrument coupled with oral interviews where the questionnaire proved inadmissible to collect data. Data was analyzed using the Analytical Hierarchical Process and Pairwise Comparison Models. Data was presented in tables. The findings of the study revealed that there are 10 key performance indicators with the highest-ranked being safety and the least being environmental performance. The weighted priority index ranged from 0.154 for the safety key indicator to 0.069 for environmental performance. The study concluded that the top-ranked building construction performance measurement indicators were safety, time effective, client satisfaction, and quality taking positions one to five respectively. The study recommends that building construction stakeholders should adopt standardized and acceptable measurement indices for the delivery of quality building and construction projects in Kenya. The study also recommends that further research should be carried out on adoption mechanisms of key performance index as a tool for performance measurement across building construction industry projects in Kenya.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Performance measurement is a continuous and systematic process for obtaining valid information about the performance of a project and identifying the factors that affect performance while performance management uses the information generated from the performance measurement to manage the performance of the project (Sonson, Kulatunga, & Pathenge, 2017). Performance measurement is the heart of ceaseless improvement, and it is measured for many reasons including decision making, strategic reasons, and benchmarking (Luu, Kim, & Huyah, 2008; Kagioglou , Cooper & Aouad , 2001).

Traditionally the main aspect of construction project measurements is cost, schedule, and quality performance (Ghalayini & Noble, 1996). This is not efficient and inevitably has led to a shift to a modern way of measuring performance. This has been the focus of the research since the 1980’s when the increased globalized competition has forced companies to consider non-traditional measures (Maskell & Baggaley, 2004). The main reason for the failure in traditional performance is that they are lagging indicators; this is because they report on decisions and results that cannot be improved on. The performance should be identified with the ongoing basis also known as ‘Leading’ (Valen & Lohne, 2016).

Globally the construction industry is generally considered to have underperformed compared to other industries (Ingle & Mahesh, 2020). The lack of general agreement on measuring construction performance makes it hard for the construction top management to make the best decision on the project (Mansour *et al.,* 2020). According to Valence and Lohne (2016), the need of balancing both financial and non-financial measures in the construction industry, and the need to shift from product-oriented performance to process-oriented performance is paramount. Seshadhri and Paul (2018) noted that building construction should ensure that customer satisfaction is achieved through rigorous procedures and processes that hold the builders accountable for the work they do.

Ibem *et al*., (2013) while evaluating the performance of residential buildings in public housing estates of Ogun State, Nigeria found that different customers would be satisfied with different performance indices. Aigbvboa and Thwala (2012) grouped some of these performance indices into physical and social factors that would satisfy a customer. Arguing from the theory of Least Cost, Radosavljevic and Bennett (2005), that the approach that should be universally adopted by both the customer and the engineering, procurement, and construction entities are those performance indicators that deliver the highest levels of efficiency. The other approaches should be regarded as significant steps towards achieving that efficiency and quality (Valence, 2013).

In Kenya, construction projects seldom go according to the implementation plan (Mbaluku & Bwisa, 2013). Projects face enormous challenges in quality assurance, cost, schedule, safety, and environmental performance (Githenya & Ngugi, 2014). Despite the high quality of training of consultants in the building industry and regulation of the industry in major urban areas, construction projects do not always meet key performance goals in Kenya (Lavy, 2011). This is unfortunate and failure to try to resolve this key issue may lead to more poorly performed construction building projects (Muguchu, 2012).

Ingle and Mahesh (2020) recommend the implementation of the performance management framework. Vosa *et al.,* (2021) stress that within the larger framework of performance management, indicators enable evidence-based decision-making processes and facilitate the delivery of quality triggers. Further, they noted that the often-encountered challenge is not only the unavailability of these indicators but also the assessment effort required to achieve quality. This research aimed to identify and rank the key performance indicators according to their priority weight. This would facilitate the standardization of the performance measurement framework for building construction industry projects in Kenya.

1.2 Statement of the Problem

The major cause of failure in building construction projects is poor workmanship among those involved in construction. Developing countries have a high rate of lower project performance compared to developed countries. One of the reasons is that performance in developing countries cannot be measured, and what cannot be measured cannot be improved. The lack of categorization of performance indicators hamper frequent and widespread use of performance matrices by the build and construct industry (Lavy, 2011). Accordingly, Li *et al.*, (2019), found that quantifying building quality performance through the development and use of key performance indicators is an essential step in achieving quality goals in both new and existing buildings. Shohet (2003) described the importance of KPIs as the quantitative expression of the physical and the functional conditions of a building; where these lack systematically, every contractor, customer, and law enforcers are left to make their judgement. Currently, construction performance in Kenya is based on personal indices. It is subjective and cannot be easily measured. Commonly, two project managers would assess the performance of the same project using the same data differently. Therefore, this study focused on developing a performance index that is more robust, balanced, standardized, and acceptable for Kenya's construction building industry. The study would add value to the challenging environment of construction building through the delivery of nationally acceptable quality and standardized buildings in Kenya. This would further ensure that the cost of construction is predictable, measurable, and obtainable to the majority of investors and law enforcement agencies in Kenya.

1.3 Justification of the Study

Borrowing from the least cost theory of construction building, the majority of investors always prefer the delivery of construction building projects at the least cost. This often though, compromises on the delivered quality. As quality indicators could vary greatly, it is not easy to measure. Many customers would want keys to their projects with little or no attention to quality details if any. This often presents a precarious situation for engineers, procurement, and contractors as they have to balance between satisfaction and quality. The former often prevails (Li *et al.*, 2021). It is therefore of critical importance that a performance index could be developed to facilitate measurement and guide the EPC, and the customer in obtaining standardized quality of construction building (Seshadhri & Paul, 2018). The output of this study could contribute to the improvement of the construction industry performance in Kenya. The study could be instrumental in saving the investors the costs that are associated with legal and regulatory issues caused by underperformance. The study could also enhance the professionalism of construction project managers by learning and understanding the needs and merits of construction performance.

1.4 Objectives

The study sought to answer both the general and specific objectives.

1.4.1 General Objective

The main aim of the study was to develop a performance index for building construction projects in Kenya.

1.4.2 Specific Objectives

1. To determine the key performance indicators (KPIs) for the building construction industry in Kenya.
2. To develop a Key Performance Index for the building construction industry in Kenya.

1.5 Research Questions

1. What are the Key Performance Indicators (KPIs) for the building construction industry in Kenya?
2. What is the hierarchical importance of the performance indices within the building construction industry framework?

1.6 Scope

This study focused on consultants, contractors, and developers involved in building construction in Kenya. This group had experience and understanding of the construction industry. They have ranked the key performance indices that have resulted in the performance index in building construction.

1.7 Limitations

The study was limited by the number of respondents acceptable by the design to carry out the analysis. However, based on the used formula the numbers were representative enough and findings could be extrapolated to a larger population. The other limitation of the study aimed at examining all key performance indicators. This was not possible as it could have consumed more time and other resources. However, there is room for a future capability to analyze further the overall subjective key performance indicators that is a part of the performance index.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the conceptual review of performance frameworks and their relevant subsections, critique of existing literature relevant to the study, the summary of the literature reviewed, the research gaps, and finally ends with the diagrammatical presentation of the conceptual framework.

2.1.1 The Conceptual Review

Performance assessment remains a major problem in the construction sector. Many researchers have worked and experimented on different concepts and measures that would assist in measuring the performance of a project (Mwangi, 2016). According to Baldwin *et al.*, (2001), performance measurement is the expression of progress and without performance evaluation, it is difficult to expand a business. The building construction industry in Kenya has had its share in poor performance which is evident in the poor standard of work and the collapsing of buildings. This has been caused by a lack of performance measurement (Mwangi, 2016).

According to Egan (1998), there is a need to improve construction since all the stakeholders in construction want to benefit from the project: for the client is to get the best market price and value from their project and the contractor is to make good profits. Many previous researchers have argued that it is hard to measure project performance. Some include De Wit (1988); Pinto and Slevin (1988); they mentioned that it is still not clear how to measure project success since project stakeholders perceive success or failure factors differently.

Performance management is defined as a process that has a main input including a strategy and it is the most fundamental in management activity in providing vision for the organization. The process is the activity that takes in the input (Neely *et.al.*, 1996). Output is also a component of project management; it is quantitative and is measured against the goals planned. The results usually form an indicator. However, one can measure the output by the following: the level of the client satisfaction on the project and the degree to which the marketplace allows it to be. Performance management is more of a process than output, it is meant to create a work environment or setting in which people are enabled to perform their best ability (Vukamanovic, 2006).

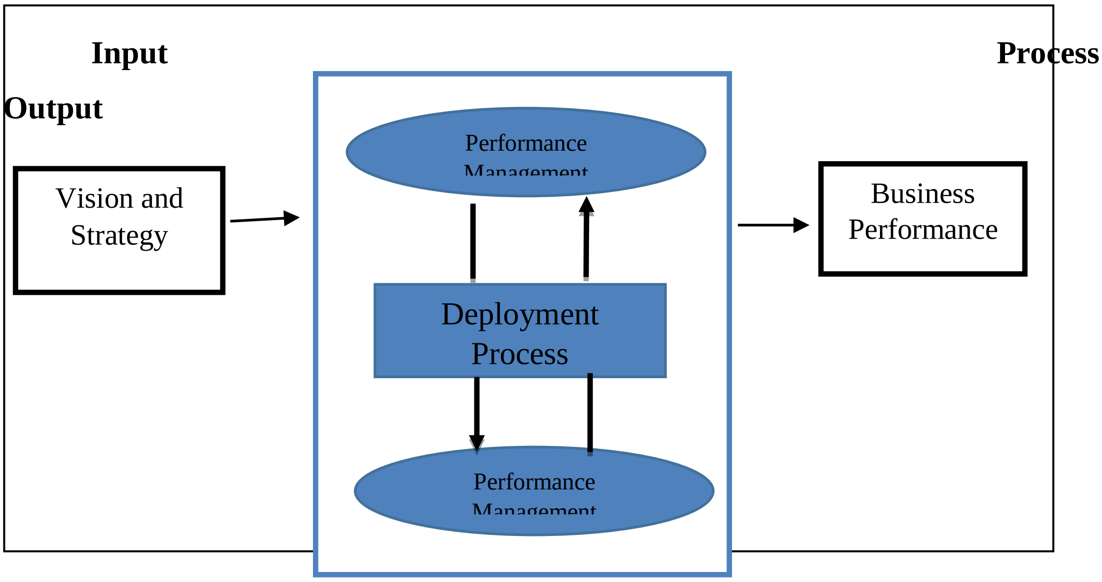

Figure 2.1: The Process of Performance Management (Source: Kagioglou, 2001).

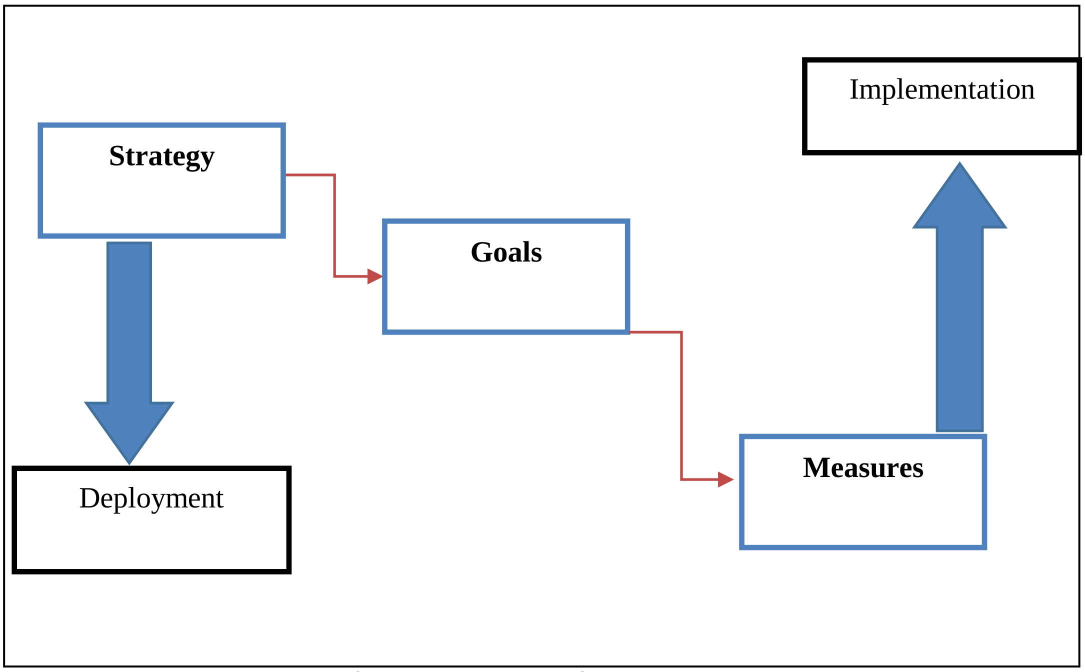

Figure 2.2: Deployment of Strategy in Performance Management (Source: EFQM Org., 2021).

Zawdie and Langford (2010) observed through a descriptive survey that good infrastructure projects can help enhance the growth process by raising productivity; this reduces poverty by solving some of the needs of the poor which includes: better health, education, housing, transport, and water and power supply services. According to Ofori (2000), several countries have recognized the need for and importance of taking measures to improve the performance of their construction industry to meet the aspirations of its developmental goals. Ofori (2000) stated that some of the functions of performance management in construction include the need for future investment, increased share value, and a high caliber of employees.

Not only does one measure the performance but also communicates to the wider market through performance management reports (Kim *et al.*, 2007). A performance indicator is one of the ways to measure performance in an industry. According to Ofori (2000), most companies believe that the indicator is only a financial measure which is false because it only indicates the results of the past, it indicates ‘when’ but not ‘how’. The indicator also includes non-financial measures such as employees’ motivation, leadership, and many others (Ingle and Mahesh, 2020).

Shenhar *et al.*, (1997), proposed that project success is divided into four determinants. The first determinant focuses on the period between project execution and right after project completion. The second determinant focuses on the impact of the project on the customer and can only be assessed when the project is delivered to the customers. The third determinant is measured when the volume of sales is achieved (probably one to two years). The fourth determinant can be assessed after project completion three to five years later. Figure 2.3 shows these four major determinants of project success are dependent on time to determine their success.

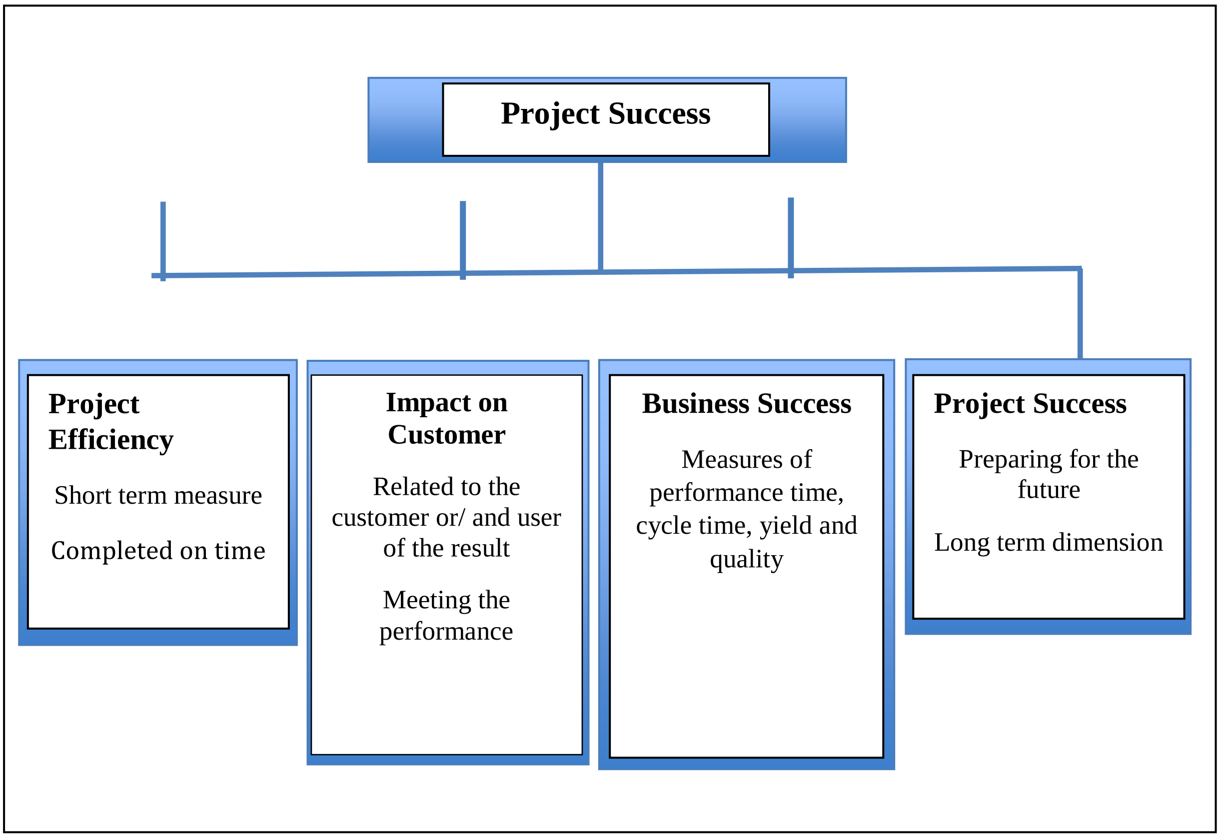

Figure 2.3: The 4 Dimensions of Project Success (Source: Shenhar *et al.*, 1997).

2.2 Key Performance Indicators

According to Vukomanovic *et al.*, (2010), performance indicators are defined as factors that have a major influence on the success or failure of construction projects and should be identified to improve the project performance. They are also referred to as critical success or failure factors. They can be classified into five core clusters namely, (i) project management mechanism, (ii) project-related factors like the project type, nature and complexity and size of the project, (iii) the external environment such as economic, social, and political issues, (iv) the procurement approaches, and (v) project culture (Vukomanovic *et al.*, 2010).

Jha (2004) conducted a study using a descriptive survey and found that there are five major variables considered in performance management, including cost performance, quality performance, time performance, safety and health, and the client's satisfaction. Other scholars refer to the criteria used in assessing the success/failure of a project as key performance indicators and even dimensions (Shenhar *et al.*, 2002; Beatham *et al.*, 2004; Chan & Chan, 2004). Models developed to measure construction project performance are the integrated performance index, and key performance indicator (KPI). A good example of KPI is the performance process conceptual framework, balanced scorecard, and European Foundation for Quality Management (EFQM) model. The EFQM defines the self-assessment framework for measuring the strengths and areas for improvement of an organization across all of its activities (Efqm Organization, 2022). The model has nine criteria on how it assesses its success, and these include leadership, people, policy and strategy, partnerships and resources, processes, people results, customer results, society results, and key performance results (Dalkir, 2011).

According to Vukamanovic (2006), project performance is measured based on the 10 identified performance indicators (PI). These indicators consist of (i) construction time, (ii) cost, (iii) cost predictability in design and construction, (iv) time predictability in design and construction, (v) defects, (vi) client satisfaction with the service, (vii) the three-company performance indicator, (viii) safety, (ix) profitability, and (x) productivity. Vukomanovic, Radujkovic and Nahod (2010) used a descriptive survey to measure how many industries employ the KPI. The findings revealed that there are three types of KPI which are: leading, lagging, and perceptive. Each of them has a role in the performance process in the industry. All KPIs are prerequisites for benchmarking, strategy alignment, and realistic goal setting. For the system to be effective, it needs a balanced set of performance indicators. Hence KPI is the measure of an activity that is critical to the success and failure of an organization (Kesik, 2015).

In determining building construction performance indicators, several countries use certain approaches and perspectives per the objectives to be achieved. For example, Hong Kong uses five indicators in building construction performance measurement costing of structural systems, closure systems, environmental modification systems, protection systems, and utility systems (Daniel *et al.*, 2008). Models such as EFQM due to their longevity in quality management can make the distinction of leading, lagging, and perceptive indices (Efqm Organization, 2022). Most people confuse KPI and key performance output (KPO). KPI is the leading measure, they are the indicative performance measures that assess unfinished processes (Vukomanonovic, 2002). They do not have a direct correlation with project outcomes. The KPOs are measures that report accomplished performance and outcome and do not enable the ability to change the future outcome (Vukomanovic, Radujkovic & Nahod, 2010). The other measures of performance such Perceptive Measures (PerMs), which are measures that report stakeholders' perception in projects and can either be lagging or leading (Leite *et al.*, 2020). Client satisfaction measured during the execution becomes the leading measure. PerMs are usually through interviews and questionnaires (Shohet, 2003). This is further illustrated in Figure 2.4 below.

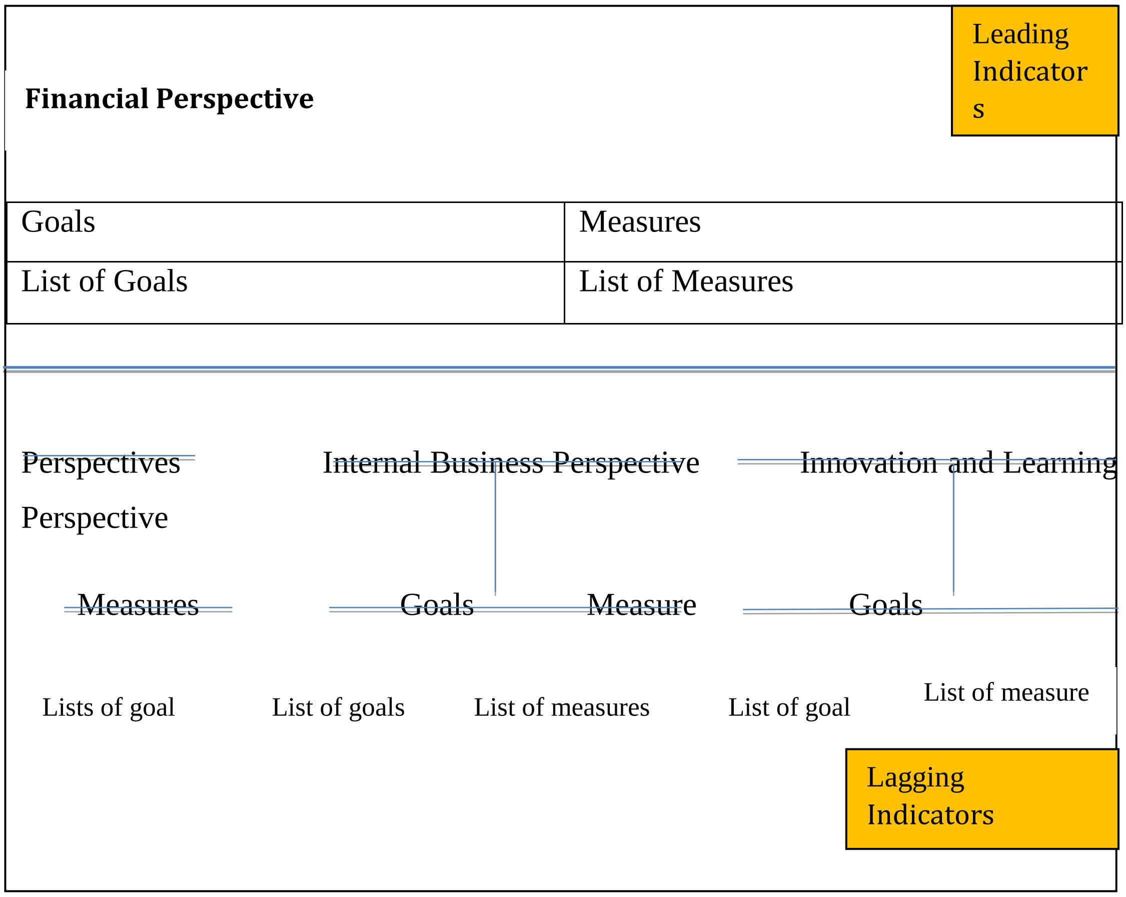

Figure 2.4: Illustration of Lagging and Leading Indicators (Source: Kagioglou, 2001)

Tian *et al.*, (2021), however, state that the drive to evaluate and measure the building construction performance is to ensure that builders achieve a high-performance building that stands the test of time. This measurement should be standardized and predictable. Data should inform performance benchmarked on quality delivered (Suprayitno & Soemitro, 2019). There has been a shift from the traditional method of performance management to modern techniques such as balance scorecards, performance metrics, and performance process frameworks. Each of them has advantages and drawbacks that affect measuring the performance (Kagioglou, 2001).

It is not the iron triangle (time, cost, and quality) alone that affects the construction performance. Son and George (2002) emphasized that in buildings, performance can be measured from other four requirements namely functional requirements, performance requirements, legality requirements, and user requirements. The performance management needs the involvement of the project stakeholders and consideration of the non-financial measures. The performance dimensions can have more than one indicator and could be influenced by various project characteristics (Ingle & Mahesh, 2020).

2.2.1 Balance Scorecard

The balanced scorecard is a performance management system devised by Professor Robert Kaplan of Harvard Business School and David Norton, the President of Renaissance Solution. It is representative of corporate strategy, competitive demand, and business objectives. It is a very fast and easy model that most senior managers use to measure their performance in construction. What is expected in Balance Scorecard is the tracking of the resulting metric as it clearly shows the cause and effect, this enables it to measure financial and non-financial KPIs. Kaplan and Norton (1996), emphasized on the indicators used in BSC measured the present and future compared to the traditional method of financial measure which measured the present only.

The business scorecard measures its performance with the main indicators listed below. If any of these indicators has an issue, the financial status of the company may be affected. The indicators are customer service, internal and business processes, learning and growth, and financial performance. Each of these indicators has potential sub measures (Kaviya and Hema, 2015).

2.2.1.1 Financial Perspective

This deals with where the company currently is in terms of finance and where do you want it to be in the next five years.

2.2.1.2 Customer Service Perspective

This deals with the end-users of your product and services. They determine the success or failure of a business.

2.2.1.3 Internal and Business Processes Perspective

It deals with the improvement of the business day to day activities.

2.2.1.4 Learning and Growth Perspectives

It deals with training and implementing the corporate culture within a company to ensure that a growth culture is inculcated into employees from one generation to another to ensure the company's legacy holds.

Therefore, the balanced scorecard (BSC) is an all-around approach considering the internal and external indicators. These four main indicators are of weight since they promote rigor in purpose, rigor in measurement, and rigor in the application (Kaplan & Norton, 1996). The due further promoted the importance of the Balanced Scorecard since it offers to the managers easy identification of the performance indicators and predicts the establishment of corporate wealth and health (Letza, 1996). The BSC provides relations of balanced financial perspective with other important factors; provides improvement of the company strategy, visions and turn them into actions (Kim *et al.*, 2007). The successful implementation of the balanced scorecard further encourages a strong human relation aspect (Roest, 1997).

According to Kaplan and Norton (1996), other performance measurement system focuses on controlling behaviors, but the BSC provides opportunities to motivate organizational members to achieve and review goals. However, the BSC does not show relationships of the indicators used in measurement; BSC is in-determined, to means that each company has to come up with their business scorecard allowing for their vision, mission, goals, and objectives to be considered. This leads to a model that each company cannot apply. BSC also has limited indicators hence one cannot fully rely on BSC as their tools for a performance measure, it needs to be part of a bigger strategy for the company's growth (Kim *et al.*, 2007).

2.2.2 The Performance Metrics

According to the Oxford Dictionary, the word metric means a standard of measurement by which efficiency, progress, performance, productivity, quality of a deliverable, process, project or product can be assessed. One assesses against schedule, cost, and profitability.

The performance metric is designed to relate directly to the various perspective that an organization decides to adopt. This means the company has to have KPIs and measure against them. The company KPIs depend on the culture, goals, objectives, mission, vision, and many more. Therefore, some companies may have many indicators and other few and also others none. It should be noted that is not the number of KPIs that makes it effective, it is the relevance of the indicators to the company's success (Mauritio *et al.* 2013).

Mallory-Hill *et al.*, (2012) utilization of performance indicators promotes the usability and sustainability of buildings however, indicators should be measurable, quantifiable, and have a milestone track. One should be able to calculate, disseminate information on KPIs. In some countries, there is usually a group and research on the same and set guidelines such as UK. They have professionals who help in data gathering, analyzing, and calculating. According to Mauritio *et al.*, (2013), the company can rank the KPIs according to the company goals, vision, and mission. Based on the performance matrices, there are 4 key indicators one might use to develop a measurement index for the building construction projects.

2.2.2.1 Financial

This could easily be dismissed by other different sectors, but one might argue due to construction needs that is labor and materials, the construction needs finance before the commencement of the project. There is a need to control the financial flow such as gross margin of the project, earning before taxes, depreciation, and amortization.

2.2.2.2 Safety

In case of accidents, the project can be delayed or closed down, hence the company must insist on safety garments and training. Good examples to inform on safety:

number of incidents, training, types of incidents.

2.2.2.3. Productivity

It goes hand in hand with proper management and commitment. One should be able to measure the productivity of both the employees and the equipment. Good examples to inform on productivity: number of resources, scheduled overrun on time, and schedule.

2.2.2.4 Quality

Getting it right the first time saves money and time. This eventually determines the profits of the project. Good examples to inform on quality is the number of defects, cost of rework, and cost of quality (Kagioglou, 2001).

Altan, Padovani and Hashemi (2016) conducted a study using a descriptive survey and found that performance metrics would help in identifying the problem and resolving it. For instance, if there have been many incidents of accidents within the site, then the problem is lack of safety and this leads to coming up with indicators, that is, training, number of incidents, number of safety garments. Further, the performance metrics identify cost-saving techniques and help in preventing losses soon, and identify the strength of the organization, this can be through identifying a post-project review with a high score. However, some of the shortcomings of performance matrices are those of encouraging the organization to have some rigid behavior, barring creativity, and also the capturing of every aspect is time-consuming for projects (Seminara *et al.*, 2022).

2.2.3 The Performance Process Conceptual Framework

Kaviya and Hema (2015) defines the performance process conceptual framework (PPCF) as a framework that has been derived from the balanced scorecard and has identified and improved its limitation in the implementation. Different from the balanced scorecard, the PPCF presents the complete performance management process that is, it also gives the suppliers and project perspective too and it represents all stages in the construction: the input, process, and the output.

2.2.3.1 Input

It is the development of organization strategy. It shows what the future wants in the long and short term. An organization needs to have a strategy so one can measure the results against the initial organization strategy (Kaviya & Hema, 2015).

2.2.3.2 Process

It is any group activity that takes input and adds value to it and provides output to an internal or external customer. It deploys the strategy into several goals and development of measures to measure the goal (Kaviya & Hema,2015).

2.2.3.3 Output

According to Kaviya and Hema (2015), it can be either quantitative or qualitative. The results form an indication of the extent to which an organization has achieved its goal.

The advantage of PPCF is that it gives the relationship between the measurements hence providing indicators for performance management. Not only can it be adapted in the construction industry but also in all the industrial sectors. However, the PPCF lacks validation from empirical evidence though it is a good framework that can be used to measure performance management. The PPCF is further illustrated in Table 2.1 below.

Table 2.1: An Example of Performance Metrics as per PPCF (Source: Kagioglou, 2001)

Vision and Strategy Perspective and goals derived from vision and structure								
Performance Metrics	**Measurement methods**	**Financial**	**Customer**	**Internal Business**	**Innovation & Learning**	**Project**	**Supporter**	**Measurement Results**

Defects	Parts out of 100	3	4	6	**12%**

1-low importance to 5-high importance

Metric importance in terms of perspective interdependency

In an industry that incorporates many people including the suppliers, contractors and consortia, performance management might be a tricky situation and many more forego to consider other perspective. For instance, the supplier does not consider the contractor's perspective. Hence most time people do not get the right indicator to measure the performance. The PPCF helps in crossing such a bridge (Kaviya & Hema, 2015).

2.2.4 Project Success Indicators

According to (Cooke, 2002), different stakeholders value different indicators depending on their interests in the project. Key performance indicators are meant to be objective and can easily be measured. For this research, a few of the indicators and their satisfaction weight formulae will be discussed in detail. This study will focus on the first determinant of project success that focuses on the period between project execution and right after project completion (Shenhar *et al.*, 1997). However, this does not mean the pre-implementation phase has no implication on the implementation phase.

2.2.4.1 Client and User Satisfaction

According to Chan *et al.*, (2002), satisfaction describes the level of 'happiness' of people affected by a project. Atkinson (1999) cites that end-user will not be happy if the end-product does not meet their requirements in terms of functionality and quality of service. According to Parviz, (2003), client satisfaction can be based on responsiveness, proper communication. It is recommended that the identification of the client-specified criteria and weightings be requested in pre-tender qualifications. This is because customer satisfaction is defined as subjective, and as a consequence, is influenced by the individual customer's requirements.

2.2.4.2 Quality

Quality in the construction project is defined as the totality of features required by a product or service to satisfy a given need; fitness for purpose (Parfitt & Sanvido, 1993). According to Freeman and Beale (1992), meeting technical specifications is meeting 'quality'. El-Mashaleh *et al.*, (2007) opined that getting the rework factor could give quality of services. Rework is the unnecessary effort needed to redo a task that was previously done because of a defect or was incorrectly implemented (Palaneeswaran, 2006). Rework factor is the total direct cost of field rework expressed as a fraction of actual construction phase cost multiplied by 100.

2.2.4.3 Time

According to Chan (1997), time can be measured in terms of construction time, speed of construction, and time overrun. Construction Time is the absolute time that is calculated as the number of days/weeks from the start on site to practical completion of the project (Mwangi, 2016). Construction time = Practical Completion Date - Project Commencement Date (Mwangi, 2016). Rankin *et al.*, (2008) formulate that time efficiency is the calculation of actual time-anticipated time as a fraction of anticipated time multiplied by 100.

2.2.4.4 Cost

Bubashait and Almohawis (1994) define 'Cost' as the degree to which the general conditions promote the completion of a project within the estimated budget. Cost is not only confined to the tender sum only, but also the overall cost that a project incurs from inception to completion, so it includes any costs that arise from variations, modification during the construction period, and the cost created by the legal claims, such as litigation and arbitration. According to Rankin *et al.*, (2008) Change in cost factor = Total cost of change in works/ Actual total cost of works. Effectiveness of predictability in cost planning = (Actual cost less Anticipated cost expressed as a fraction of Anticipated cost multiplied by 100.

2.2.4.5 Safety

Bubshait and Almohawis (1994) defines 'Health and safety' as the degree to which the general conditions promote the completion of a project without major accidents or injuries. Sousa and Texeira (2004) suggest that construction works are well known as the most dangerous and risky activities throughout the world because a large number of people are being killed and injured every year. According to Construction Industry Review Committee (2001), calculating the annual accident rate on construction sites forms the base for calculating the accident rate in a specific project. Accident rate equals to total no. of construction site accidents multiplied by 100 expressed as a fraction of the total number of workers employed on a specific project.

2.2.4.6 Environmental Performance

According to Shen *et al.*, (2000), construction projects affect the environment in numerous ways across the life cycle. The Environmental Impact Assessment (EIA) is the statutory framework to determine the impact of the project on the environment. Kamaruzzaman *et al.*, (2016) note that energy, sustainable sites, material, water, and waste should be included when considering environmentally sustainable measures. According to Mickaityte *et al*., (2008) there are several indicators on environmental performance including environmental protection measures, energy savings, extended building life cycle, increased user comfort, waste management (Sezer, 2016)

2.2.4.7 Project Leadership

People management drives the success of a project more than the technical issues (Young & Samson, 2004). According to Nyangilio (2014), the indicators on project leadership include a leader's professional qualification, leadership style, technical skills, managerial skills, and high employee relationship. The most used measure for project leadership in project performance measurement is the extensiveness of the leaders attaining the goals of the project. The goals should be given initially before the project commencement (Simbolon, Wiguna & Adi, 2020).

2.2.4.8 Team Satisfaction

Teamwork is a characteristic of the construction industry where construction projects are delivered by various professionals as a team (Winch, 2009). According to Egan (2002), process and team integration are the key drivers of the changes in the construction industry to become more successful. He also added that lack of organization, misunderstanding, poor communication, and inadequate participation from the team are issues that can challenge the success of construction. There are several factors however that can affect team satisfaction as posited by various authors. These include clear goals, knowledge leadership, appropriate management of internal conflicts, effective communication, matching employees to the area of expertise, and a clear organizational structure (Parker, 2011; Juli, 2010 & Pratt, 2010).

2.2.4.9 Productivity

According to Sezer (2016), productivity is an important performance measurement based on relations to economic growth. The low productivity in the construction industry can be explained by either lack of a clear definition of the industry and its boundaries or mismeasurement of productivity. In the construction industry, partial measures used by firms include labor productivity, machine productivity, and materials consumption (Sezer, 2016).

2.2.4.10 Proper Training and Recruitment

According to Mwangi (2016), other factors that might measure construction include training and skill up-gradation within the construction firms. The author emphasizes on the establishment of more middle-level technical colleges that will increase and improve the availability of skilled manpower. Valen and Lohne (2016) decried that even though there could be established performance indices in the building construction industry, there is the need to ensure commitment to assessment. This is can only be achieved through training and recruiting those with sufficient skills to honor and implement these indices as developed by this research and other existing literature.

2.3 Critique of the Existing Literature

Several scholars have conducted research around the area of building construction management and performance management. Even though there are several parameters and indicators, as portrayed in the study to facilitate performance management, there are no universally agreed on indices for measuring building construction performance. Each country is left to design its performance matrices to suit the environment and quality required. Valen and Lohne (2016) examined assessment tools for strategic performance evaluation of buildings and the Norwegian practice in light of international practice. The authors found several interesting methods for assessment of building performance especially feed-forward loop from Steinke, which was developed for BSC, soft landings framework, and the Norwegian multi-map method.

Aigbavboa and Thwala (2012) grouped different matrices and indicators into physical and social that warrants customer satisfaction. Some of these matrices and indicators included safety, lighting, waste disposal, drainage, accessibility, amenities, and the neighborhood to arrive at user satisfaction. According to Daniel and Edward (2008), in determining building construction performance variables and sub-variables, different countries use certain approaches and perspectives under the objectives to be achieved by building operators in the country or region. Even though there tends to be a universal consensus among different scholars on the importance of developing performance measurement indicators, Tian *et al.*, (2021) asserts that previous simulation-based building performance determinants are being questioned due to the performance gaps between simulated and measured values. As much many countries strive to develop building performance data which makes it possible to analyze and design buildings with data-driven methods, in countries such as Kenya, literature points to the non-existence of such.

Seminara *et al.*, (2022) agree that there is a growing intertest in building performance evaluation as an essential practice to design sustainable buildings, the performance is however influenced by other various terms irrespective of the existence of models such as the EFQM, BSC, PPCF, Performance Metrics among others. These other factors include but are not limited to building envelope, airtightness, energy technologies with or without micro-generations. How well a building performs is determined by several pre, during, and post-building indicators. The reviewed literature has captured several of these indicators across the build process where some have indicated strength in some areas and weaknesses in other areas. There is a need to improve on this, by developing key performance indices for measuring a building's performance at all stages across the process of construction.

2.4 Summary of the Literature Reviewed and Research Gap

There are several performance measurements tools and indicators that the literature has reviewed. The review demonstrated various project performance measurement frameworks used around the world, their advantages and disadvantages. These frameworks included balance scorecard, performance metrics, and Performance Process Conceptual Framework. The literature also reviewed an overview of what Key Performance Indicators are, the types, and the examples. The section explained the viewpoints of past and present scholars on management performance and what they considered as key performance indicators. It also identified the KPIs that informed the KPIs used in the study, and they include the external and internal factors and are process oriented.

From the literature reviewed, it emerged that there is no universally agreed on measurement scale or indices that engineers, procurement, and contractors use to measure the performance of building construction. Some scholars pointed out that each country is left to find what is suitable for their measurements based on the objective to be attained. This is more so particular in the Kenya context, where all stakeholders engaged in building construction lack standardized, reliable, and acceptable measurement indices for the delivery of quality buildings. There was a need therefore to fill this gap and develop key performance indicators and performance indexes that would contribute to the delivery of quality building construction in Kenya.

Borrowing from these reviewed studies and the existing literature in the domain of building construction performance, the study was able to come up with ten key performance indicators which were sued to develop their indices. These indices were developed using rankings, priority weight, satisfaction weight which led to tabulation of each of the key performance indicators performance index. This goes to say that most professionals in building construction know of the construction iron triangle as a standard of measuring the performance of a construction project in Kenya. This research contributes to the improved awareness of key performance indicators that would improve the performance building construction industry in Kenya. The result should be a construction performance framework with standardized measures for construction projects in Kenya.

2.5 Conceptual Framework

The Conceptual Framework gives an illustration of the relationships between the different types of variables. The type of variable distinct in this study is the independent, dependent, and moderating variable. Independent variable affects and determines the effect of another variable. (Mwangi, 2016). The independent variables in this study were the key performance indicators and the performance index. The dependent variable was the building construction performance. This relationship is further shown in Figure 2.5.

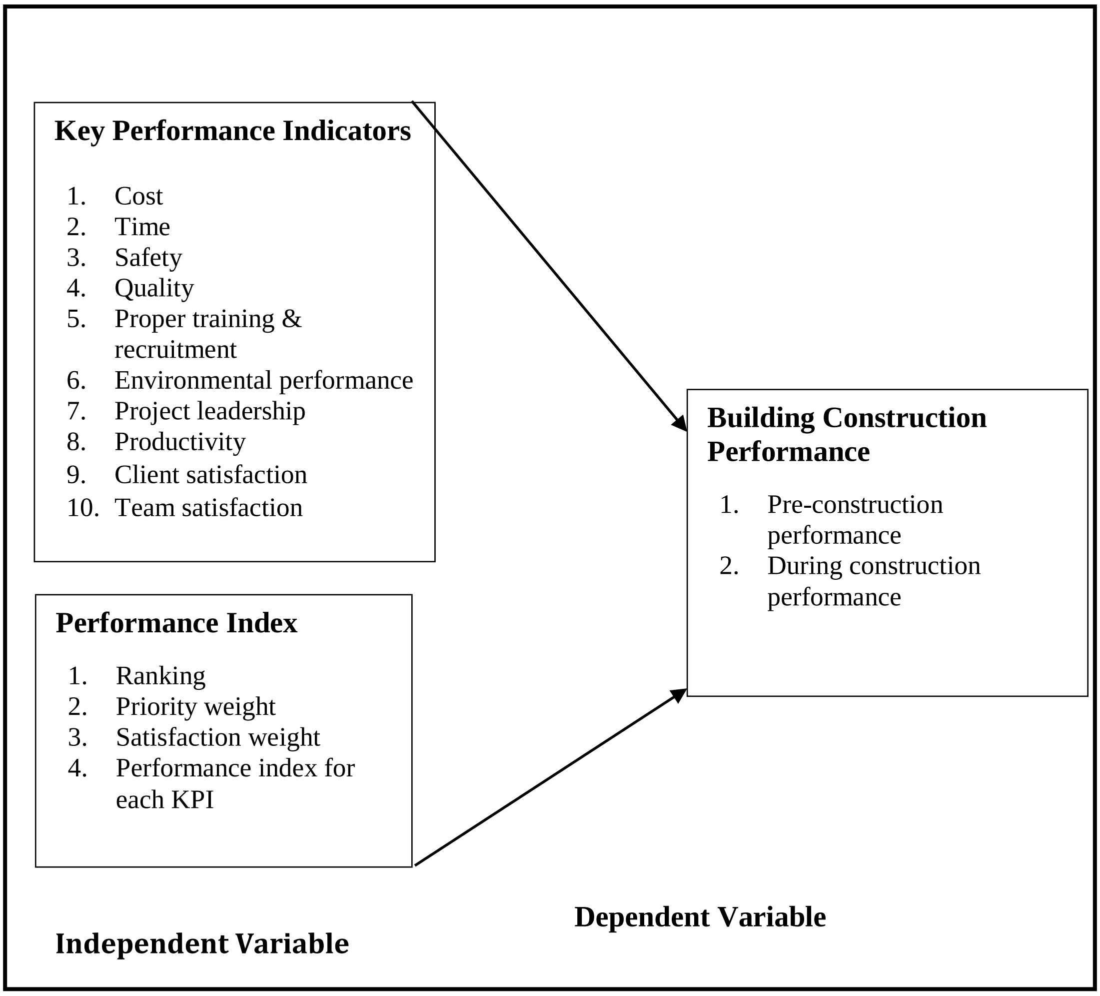

Figure 2.5: Conceptual Framework

Source: Author

CHAPTER THREE:

MATERIALS AND METHODS

3.1 Introduction

This chapter describes the research methodology used in undertaking the study. This study is sought to assess and rank the key performance indicators in the building construction projects and to come up with a performance index. This chapter starts by explaining the research design, sampling techniques, data collection procedures, pilot study, data processing, and analysis.

3.2 Research Design

This study employed a descriptive survey research design. Mugenda and Mugenda (2003) gave the purpose of descriptive research design as determining and reporting the way things are. It is intended to produce statistical information that can interest policy makers and educators.

The descriptive research design involves both quantitative and qualitative approaches (Soro & Wayoro, 2018). The quantitative in this research was through questionnaires and a face-to-face interview. The qualitative was through a review of the previous literature from which the KPIs were generated with their applications and importance.

Questionnaires were the best fit for the first objective since the respondents were only required to select and prioritize presented performance indicators. However, based on their response and priorities the gathered information was then used to rank the priorities, set priority weight, satisfaction weight, and calculate key performance index for each key indicator.

3.3 Study Target Population

Population refers to any group of any institution, people, or objects that have the same characteristics (Ogula, 2005). According to Abas *et al.*, (2020) construction project involves clients, contractors, consultants, and sub-contractors. The target population for this study was contractors, consultants who included engineers, architects, quantity surveyors, construction managers, and landscape architects and developers. In this research, a developer is a company or individuals who develop land through residential and commercial construction and sells it for a profit. Kothari (2004) defines a sample as a unit from the universe to represent a larger population from which true inferences can be made about that population. The target population for the study was distributed along the stakeholders' strata as described in Table 3.1.

Table 3.1: Study Target Population

Stakeholders	**Total Number**	**Source**
Registered building contractors	12,906	NCA, 2018 official website
Registered Quantity surveyors	421	BORAQS, 2018 official website
Registered Architect	745	BORAQS, 2018 official website
Registered construction managers	74	ACMK, 2018 official website
Registered engineers	2129	EBK, 2018 official website
Registered landscape architects	<300	AAK, 2021 official website
Registered Consortium	3669	Various Sources
Developers	75 property development company	Kenya Property Development Association, 2018
Total	**16650**	

Source: Research (2022)

3.3 Sampling Technique and Illustrations

The study used random and stratified probability sampling techniques.

3.3.1 Sample Size

A stratified sampling technique was used to sample different target groups which gave respondents equal chance for representation in the target population and provided greater precision as per Table 3.1. The sample size was determined using Glenn Israel Table (Singh & Masuku, 2014) and as per Table 3.2 below.

Table 3.2: Sample Size

Size of Population	Sample size for±5% precision	Sample size for±10% precision
500	222	**83**
1,000	286	**91**
2,000	333	**95**
3,000	353	**97**
4,000	364	**98**
3,000	353	**97**
4,000	364	**98**
5,000	370	**98**
7,000	378	**99**
9,000	383	**99**
9,000	385	[illegible]
10,000	385	[illegible]
15,000	390	[illegible]
120,000	**392**	**100**
25,000	394	**100**
50.000	397	**100**
100,000	398	**100**
>100,000	400	**100**

Level chosen due to population size

Source: Research (2022)

Using the target population as 16,650 for this study, at a confidence level of 95% and a precision of 10% the sample size was found to be 100 from Table 3.2. The proportionate stratum sampling was used. This was achieved through:

(Sample size/ Target population) * stratum size (Arnab, 2017).

The stratum size was as follows: contractors 77%, Consultants 22%, and developer 0.45%

This led to the use of disproportionate stratum sampling. This meant that each stratum was not proportional to its representation in the total population. This was because with the proportionate stratum representation, the developer stratum would not be fully represented at the strata sample and the sample would be small in size and would not collect enough data hence the small stratum was oversampled (Law, 2009).

Table 3.3: Sampling of Strata

Stratum	Sample Size for Stratum (n)
Building Contractors	40 (40% of the sample size)
Registered consortium	40 (40% of the sample size)
Developer	20 (20% of the sample size)
Total	100 (100%)

Source: Research (2022)

3.4 Research Instrument

The study adopted the use of a questionnaire. The questionnaire's purpose was to identify the existing performance measurement methods used in Kenya and rank the performance indicators to be included in the performance index model in order of importance. A questionnaire consists of several questions printed or typed in a definite order on a form or set of forms (Kothari, 2004). Each question in the questionnaire was developed to address a specific objective or research question of the study (Kombo & Tromp, 2006). For the results to have been effective the characteristics of the respondents were restricted to those the respondents with 5 years' experience in construction, have worked for more than 3 years in Kenya, was then working in a construction firm, had been involved in more than one project within the study period in Kenya, and held a senior position in the construction firm (Nguyen & Watanabe, 2017).

The questionnaire, as per the attached appendix one, was divided into 3 sections; the first section was aimed at collecting the description of the respondent such as the type of organization he or she works for, the position in the company, the experience they have within the construction sector. The second section collected the demographic characteristics and description of features in the project. The third and final sector collected the KPIs and priority weights in the variables for the research model based on Linear Saaty Scale on KPIs as shown in Table 3.4.

Table 3.4: Definition of Linear Saaty Scale Importance

Intensity of importance	Definition	Illustration/ Example
1	Equal importance	element *a* and *b* are equally favored
3	Moderate importance of one over the other	slightly favor element *a* over *b*
5	Essential importance	strongly favor element *a* over *b*
7	Demonstrated importance	element *a* is favored very strongly over *b*
9	Absolute importance	the evidence favoring element *a* over *b* is of the highest possible order of importance

3.3.1 Pilot Testing

Blessing and Chakrabarti (2009) explains that a pilot study is carried out for the following reasons: to assess whether the research protocol is realistic and workable, to estimate variability in outcomes to help determine the sample size, and to determine what resources are needed for the planned study. In this study, the reliability was tested in the pilot study. With the help of the supervisor, research experts, and peer review the initial questionnaire was ascertained of its relevance and appropriateness. It also reduced the number of questions due to its relevance to the study.

This study randomly selected 10 respondents, of who 6 were contractors, 2 were a developer and 2 were quantity surveyors. The first questionnaire was on MS word, two called asking for an online questionnaire and only one responded to the questionnaire. They found it challenging that they had to download it first and start editing. It consumed time and they were always busy. The second trial was an online questionnaire that was sent to the same respondents. The response was positive, three responded out of the five respondents. It was decided that the online questionnaire was the most effective instrument to collect data for the study. However, if the respondent was not tech-savvy, a printed questionnaire was used. The questionnaire was adjusted from the results obtained from the validation exercise to minimize errors and ambiguity.

3.4 Data Collection Procedure

Data was collected from various respondents through the process of identification of the respondent who included consultants, contractors, and developers. The respondents were distributed along the strata where contractors were 40%, the developers 20%, and the consultants 40%. The keywords that were used in the data collection were the project, measurement, performance, manager, and indicators. (Cooper and Schindler, 2008). The respondents were expected to answer the questions based on the most recent completed projects that they were involved in. There was face to face interviews and emails for collecting information. Telephone calls to the respondents acted as a follow-up to remind and urge them to fill in the questionnaires (Chan, 2007). According to Mugenda and Mugenda, 2003, the response of the questionnaire should be more than 30% for it to give substantial data. The minimum response rate is 27.2%.

3.5 Data Processing and Analysis

The first objective of the study was to determine the key performance indicators in the building construction industry. To achieve this objective, the questionnaire was analyzed using the Analytical Hierarchical Process, and the pairwise comparison to analyze and compare the KPIs against each other (Atanasova-Pacemska, 2014). AHP uses pairwise comparison methods to generate weightings for criteria instead of listing and ranking the level of importance. Analytical Hierarchical Process (AHP) was used in this study to prioritize the key performance indicators of this research.

After the prioritization, the Geometric Mean Method formula was used to calculate the weights of each of the performance indicators based on the responses received. The weights in each of the indices were then adopted as the performance index for each of the indicators under the study. This AHP process, therefore, covered the analysis for both the first and the second objectives of the study. The Geometric Mean Method formula adopted, and the calculations sample was attached to appendix two.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter focuses on the results of the data analysis of the data collected that was carried out through the questionnaire that was sent to the stakeholders in construction. The results and discussion of the study are presented regarding the main objective of the study which is to develop the performance index for building construction projects in Kenya.

The first specific objective of the study was to determine and assess the key performance indicators (KPIs) in the Kenya building construction industry. The second specific objective was to develop a performance model for the Kenyan building construction Industry.

4.2 Data Presentation

Data from the study were presented in charts, tables, and figures under the reverent subheading throughout the chapter.

4.2.1 Response Rate

Out of the 100 distributed questionnaires, 62 respondents fully completed the questionnaire. For most academic studies involving top management or business representatives, a response rate of approximately 35 percent is reasonable (Baruch, 2013). Saunders *et al.,* (2007) suggest that an average response rate of 30% to 40% is reasonable. While Sekaran and Bougier (2009) recommends that a response rate of approximately 60% for most research should be the goal of researchers. There was an incomplete pairwise comparison as some of the respondents missed a comparison or stopped filling when they were almost done. This did not affect the study as the

Monte-Carlo Simulation study led by Carmone, Kara and Zanakis, (1997) proved that one can delete 50% of comparisons and it won't significantly reduce the results. The initially proposed distribution of the respondents was contractors 40%, the developer 20% and the consultants 40%. The actual distribution was Contractor 58.26%, Consultants 29.57%, and Developer 12.17%.

4.2.2 Position in the Firm

To achieve the first objective, results were obtained from only qualified respondents. The first section of the questionnaire gathered information about the respondent's profile, experience, and experience with the building construction involved. As shown in Table 4.1 majority of the respondents were contractors at 58.26%, consultants at 29.57%, and developers at 12.17%. The majority of the respondents were well suited to respond to the surveys for reasons of their knowledge and their level of experience.

Table 4.1: Distribution of Positions in the Firm

Type of respondents	Frequency	Distribution Percentage
Consultant	19	29.57%
Contractor	33	58.26%
Developer	10	12.17%

4.2.3 Organizational Distribution

The respondents were requested to report on which organization within the industry do they belong. From the gathered data, the majority of the respondents 83.19% worked in a private firm, followed by non-government 7.96%, with government and others taking 5.31% and 3.54% respectively as shown in Table 4.2 below.

Table 4.2: The Type of the Organization of the Respondent's Firm

Name of organization	Frequency	Percentage
Government	6	5.31%
Non-government Organization	9	7.96%
Private firm	94	83.19%
Other	4	3.54%

4.2.4 Construction Experience

The respondents were asked to choose the number of years of experience in the construction industry. The intent was to eliminate those with less than 2, between 2 to 5, and can't remember as our respondents needed to have been involved in more than 5 building projects.

Table 4.3: The Number of Construction Projects Involved In

Construction Project involved in	Frequency	Percentage
Less than 2	8	7.48%
Between 2 to 5	28	26.17%
Above 5 to 10	31	28.97%
More than 10	36	33.64%
Can't remember	4	3.74%

4.1.5 Construction Completion within the Proposed Time and Amount

The respondents were asked to agree or disagree whether the projects they are involved in were completed in time and within the amount proposed. Of the responses received, 46 said yes, 58 said no and 3 respondents could not remember as shown in Table 4.4.

Table 4.4: The Number of Projects Completed within the Time and Amount Proposed

Were the construction building projects completed within the time and amount proposed?	Frequency	Percentage
Yes	46	42.99%
No	58	54.21%
Can't remember	3	2.80%

4.2.6 Building Construction Projects Completed within Contracted Time and Amount

The researcher sought to understand the number of building construction projects completed within the contract duration and within the amount agreed on. From the responses, 31.73% accounted for between 75% and 100% completion within contracted time and amount; 24.04% accounted for between 50% and 75% and less than 25% completion within contracted time and amount respectively; and 20.19% accounted for between 25% and 50% completion withing contracted time and amount as shown in Table 4.5.

Table 4.5: The Percentage of Building Construction Projects Completed within The Contracted Time and Amount

Percentage of projects completed within the contract period and amount	No. of Projects	Percentage
Less than 25%	25	24.04%
Between 25 to 50%	21	20.19%
Between 50 to 75%	25	24.04%
Between 75 to 100%	33	31.73%
Can't remember	0	0.00%

4.2.6 Construction Performance Tools

Table 4.6 was a response on whether the construction professionals had any method in measuring the construction performance of their building projects. Of the responses, 59.22% said yes, they had performance measurement methods and 40.78% said that they did not have any construction measurement method.

Table 4.6: The Percentage of Construction Professionals Who Have Construction Performance Measurement Methods

Response	Frequency	Percentage
Yes	61	59.22%
No	42	40.78%

The respondents who said yes, they have some building construction measurement methods were further asked to state some of the methods they used. The methods mentioned included, proposed work done vis a vis actual work done, proposed contractual cost vis a vis actual cost, proposed contractual time vis a vis actual time, earned value-based management, construction management software, client compliment, and experience.

4.2.7 Key Performance Indicators

The study sought to understand from the building construction stakeholders the hierarchical importance of the study key performance indicators as set out in the conceptual framework. Table 4.7 shows that the majority of the respondents chose 19.54% safety, 14.72% time effective, 12.25% client satisfaction, 11.62% quality, 9.46% productivity, 8.63% cost-effective, 7.95% team satisfaction, 6.24% project leadership, 5.37% proper training and 4.22% environmental performance.

Table 4.7: Key Performance Indicators Hierarchical Importance

Key Performance Indicators	Percentage
Safety	19.54%
Time Effectiveness	14.72%
Client Satisfaction	12.25%
Quality	11.62%
Productivity	9.46%
Cost Effective	8.63%
Team Satisfaction	7.95%
Project Leadership	6.24%
Proper training	5.37%
Environmental Performance	4.22%
Total	**100%**

4.2.8 Comparison Matrix for 10 Key Performance Indicators

The questionnaire had 10 different key performance indicators that were compared to each other in terms of which was more important within a construction building project. The value of the priority of key performance indicators was informed by the aggregation of individual judgment. Aguaron, Escobar and Turon (2019) defines the aggregation of individual judgment as aggregation on the individual pairwise comparisons to obtain a new judgment matrix as shown in Table 4.6. The aggregation of individual judgment was achieved through the geometric mean method of what each respondent selected as Aczel and Saaty (1983) suggest. This assisted in the group's systematic decision-making with a holistic vision of reality and subjacent ideas of literal thinking (Aguaron, Escobar & Turon 2019). A pairwise comparison matrix that holds the value preference was created in Table 4.8 and total column summation was done for normalization of the indices.

Table 4.8: A Comparison Matrix of 10 Key Performance Indices

	Quality	Cost Effective	Time Effective	Safety	Project Leadership	Environmental performance	Productivity	Team satisfaction	Client satisfaction	Proper Training
Quality	1	1.3445	1.5188	0.6936	1.0998	1.3542	1.268	1.3514	0.8593	0.9766
Cost Effective	0.7438	1	0.9209	0.8996	0.5223	1.9982	1.1443	0.484	0.8191	1.2153
Time Effective	1.9275	1.0859	1	1.0805	1.6763	1.8709	1.1068	1.7076	0.7883	0.6357
Safety	1.4418	1.1116	0.9255	1	1.82	2.1419	2.364	2.8962	1.696	1.6144
Project Leadership	0.9093	1.9146	0.5966	0.5495	1	0.8717	0.5293	0.646	1.1795	1.1236
Environmental Performance	0.7384	0.5005	0.5345	0.4668	1.1472	1	0.7497	0.938	0.5861	1.0508
Productivity	0.7886	0.8739	0.9035	0.423	1.8893	1.3339	1	1.7797	0.8599	1.9461
Team Satisfaction	0.74	2.0661	0.5856	0.3453	1.548	1.0661	0.5619	1	0.6791	1.0993
Client Satisfaction	1.1637	1.2209	1.2686	0.5896	0.8478	1.7062	1.1629	1.4725	1	1.6303
Proper Training	1.024	0.8228	1.5731	0.6194	0.89	0.9517	0.5138	0.9097	0.6134	1
Total	**10.4771**	**11.9408**	**9.8271**	**6.6673**	**12.4407**	**14.2948**	**10.4007**	**13.1851**	**9.0807**	**12.2921**

4.2.9 Normalization Matrix for 10 Key Performance Indicators

Normalization of the matrix was done by total summation of each column with judgment values in Table 4.8. Then each judgment value was divided by the summation. This yielded the normalized score in Table 4.9. The Eigen Vector which is also the priority weight was derived from adding the numbers in each row and dividing it with the numbers of the rows which is the average. When all the averages are added up, the summation is 1. Using the Eigen Value, ranking of the key performance indicator is achieved with the highest value being the most prioritized key performance indicator and the lowest value being the least prioritized as shown in Table 4.9. The consistency index for this study was 0.04 which was according to Saaty's Model indicated the acceptable consistency index should be less than 0.1.

Table 4.9: A Normalization Matrix of 10 Key Performance Indices

	Quality	**CE**	**TE**	**Saf**	**PL**	**EP**	**Prod**	**TS**	**CS**	**PT**	**Total**	**Avg**
Quality	0.095	0.113	0.155	0.104	0.088	0.095	0.122	0.102	0.095	0.079	1.048	0.105
Cost Effective	0.071	0.084	0.094	0.135	0.042	0.140	0.110	0.037	0.090	0.099	0.901	0.090
Time Effective	0.184	0.091	0.102	0.162	0.135	0.131	0.106	0.130	0.087	0.052	1.179	0.118
Safety	0.138	0.093	0.094	0.150	0.146	0.150	0.227	0.220	0.187	0.131	1.536	0.154
Project Leadership	0.087	0.160	0.061	0.082	0.080	0.061	0.051	0.049	0.130	0.091	0.853	0.085
Environmental Performance	0.070	0.042	0.054	0.070	0.092	0.070	0.072	0.071	0.065	0.085	0.692	0.069
Productivity	0.075	0.073	0.092	0.063	0.152	0.093	0.096	0.135	0.095	0.158	1.033	0.103
Team Satisfaction	0.071	0.173	0.060	0.052	0.124	0.075	0.054	0.076	0.075	0.089	0.848	0.085
Client Satisfaction	0.111	0.102	0.129	0.088	0.068	0.119	0.112	0.112	0.110	0.133	1.085	0.108
Proper Training	0.098	0.069	0.160	0.093	0.072	0.067	0.049	0.069	0.068	0.081	0.825	0.083
Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	10.00	1.000

Q: quality, **CE**: cost-effective, **TE**: time effective, **Saf**: safety, **PL**: project leadership, **EP**: environmental performance, **Prod**: productivity, **TS**: Team satisfaction, **CS**: client satisfaction, **PT**: proper training and recruitment, **Avg**: average

Source: Research (2022)

4.2.10 Ranking of 10 Key Performance Indices

From the normalization of the matrix of the 10 key performance indicators, the average is the Eigen Value which is also known as the priority weight of each key performance indicator. Using the Eigen value, ranking of the key performance indicator was done with the highest value being the most prioritized key performance indicator and the lowest value being the least prioritized as shown in Table 4.10.

Table 4.10: Ranking of 10 Key Performance Indices

Key performance indicator	Ranking	Priority weight
Safety	1	0.154
Time Effective	2	0.118
Client Satisfaction	3	0.108
Quality	4	0.105
Productivity	5	0.103
Cost Effective	6	0.090
Team Satisfaction	7	0.085
Project Leadership	8	0.085
Proper Training	9	0.083
Environmental Performance	10	0.069
Total		1.000

4.2.11 Development of Performance Index

From the findings of the study, safety, time effectiveness, and client satisfaction were most important to most professionals, this was different from traditional performance measurement which focusses only on the financial measure as important KPIs. There was a combination of financial and non-financial measures at the top, this supports the need to explore modern performance measures compared to the traditional one that focuses on financial measures only and lagging indicators. Quality being in the iron triangle was ranked 4th being below client satisfaction and safety. This provided a different perspective of performance measurement based on the findings of the study.

Proper training and Environmental performance were among the KPIs ranked least. These KPIs are social factors compared to the rest of the KPIs. They affect the community and society at large. This research aimed its focus on coming up with a performance index for construction building projects in Kenya. With the priority weights of the Key Performance Indicators, a performance index can now be tabulated. This is further illustrated in Table 4.11.

Table 4.11: Performance Index

Key Performance Indicator	**Ranking**	**Priority Weight**	**Satisfaction Weight in %**	**Performance index for each KPI**
Safety	1	0.154	*0*	0
Time Effective	2	0.118	*0*	0
Client Satisfaction	3	0.108	*0*	0
Quality	4	0.105	*0*	0
Productivity	5	0.103	*0*	0
Cost Effective	6	0.090	*0*	0
Team Satisfaction	7	0.085	*0*	0
Project Leadership	8	0.085	*0*	0
Proper Training	9	0.083	*0*	0
Environmental Performance	10	0.069	*0*	0
Total		**1.000**		
			Performance Index in General for the construction building site	**0**

4.2.12 Rating of Performance Index

The satisfaction weight is based on measurements of the KPIs as discussed in the literature review. This makes the performance index objective, quantified, and not biased. The satisfaction weight is in percentage which ensures that the performance index is in percentage. The priority weight of the KPI is multiplied with the satisfaction weight of the same KPI to get the performance for the particular KPIs. To get the general performance, a summation of all the KPIs' performance was conducted. The performance, therefore, can be rated as shown in Table 4.12.

Table 4.12: Rating of Performance Index

PI Range	Rate
0-20%	Poor performance
21- 30%	Below target
31-50%	Within Target
51-70%	Exceeds Target
71-100%	Outstanding Performance

4.3 Discussion of the Findings

4.3.1 Determination of the Key Performance Indicators (KPIs) for the Building Construction Industry in Kenya

The first objective was achieved through the responses received from the construction professionals aided by the study instrument. These responses enabled the researcher to identify firsthand, key performance indicators by the industry, which are considered as important critical or success factors for building projects. The study found that the majority of the stakeholders viewed safety as the most key performance indicator for the building construction projects in Kenya. This was then followed by time effectiveness, client satisfaction, quality, productivity, cost-effectiveness, team satisfaction, project leadership, proper training, and environmental performance in that order. This to some extent was in agreement with Ibem *et al.*, (2013) that many performance indicators can be attributed to the performance of building construction projects including user satisfaction. Aigbavboa and Thwala (2012), however, noted that there are many other attributes to a building that often is left out when thinking of performance indicators. These include safety, productivity, and quality. However, from the respondent's perspective, time is effective, productive, and cost-effective as some of the highly prioritized keep performance indicators. Li *et al.,* (2019), generally agreed that prioritizing and quantifying the building construction performance using key performance indicators is an essential step in the construction goals for both the new and existing buildings.

4.3.2 Development of the Performance Index for the Building Construction Industry in Kenya

The second objective was achieved through the analysis of data gained from the respondents. This data enabled the researcher to set priorities using statistical formulae and models. The priority weight was determined in the first objective using AHP Model. The summation of the priority weights of the KPIs is 1. The performance index aim is to be objective thus the satisfaction weight was quantifiable and measurable. Simbolon, Wiguna and Adi (2020) weighted their indicators using the Pairwise Comparison Model method based on the opinion of experts who were competent in the field of building.

Using the AHP model, Pairwise Comparison Model, Linear Saaty Scale, and Geometric Mean Model, the study found that the most weight was 0.154 for safety and the least weight was 0.069 for environmental performance. The others ranged between 0.118 and 0.083. The majority of the stakeholders are not concerned with the environmental performance as a factor that measures the building construction projects' performance. Performance indicators such as project leadership, proper training, and team satisfaction weighted least in the cadre as compared to time effectiveness, client satisfaction, quality, productivity, and cost-effectiveness. To answer to the need for ranking in order of importance, Atanasova *et al.,* (2014) agreed that the solution to this challenge could be obtained through the application of the Analytical Hierarchical Process (AHP) since it has a strong mathematical base.

The AHP process enabled the study to effectively develop the Key Performance Index which then could be adopted and used to facilitate the delivery of quality building construction projects in Kenya.

4.4 Summary of the Findings

The first specific objective of the study was to determine the key performance indicators for the building construction industry in Kenya. Data was collected from various stakeholders in the building construction industry including building contractors, quantity surveyors, architects, construction managers, engineers, landscape architects, consortium, and developers. Ten Key Performance Indicators were determined by the stakeholders in order of their importance whereby safety, time effectiveness, client satisfaction, quality, productivity, cost-effectiveness, team satisfaction, project leadership, proper training, and environmental performance were prioritized in that order.

The secondary literature reviewed pointed to the existence of performance indicators that are currently used by the engineering, procurement, and construction stakeholders to measure the performance of building construction. These included balance scorecards, EFQM, and performance matrices. The existence of these enabled the study to determine the performance indicators which were then subjected to the study instrument to elicit responses from those with expertise in the field of building construction. The top five key performance indicators chosen by the respondents were safety, time effectiveness, client satisfaction, quality, and productivity.

The second specific objective was to develop a performance index for the building construction projects in Kenya. Using the data collected on key performance indicators from various building construction stakeholders; Analytical Hierarchical Process, Pairwise Comparison, Linear Saaty Scale, and Geometric Mean Method were used to prioritize, to weight, and to rank each of the key performance indicators. This process led to the development of the Key Performance Index.

Secondary literature was used to identify, adopt, and action a process, formula, and matrix that would be suitable for the prioritization, weighting, and ranking of each of the key performance indicators. Based on the weights, safety had a weight of 0.115, time-effective 0.118, client satisfaction 0.108, quality 0.105, productivity 0.103, cost-effective 0.090, team satisfaction 0.085, project leadership 0.085, proper training 0.083, and environmental performance 0.069.

CHAPTER FIVE:

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

Based on the various sources of literature reviewed and borrowing from the existing building construction performance models the study confirmed that most construction professionals based the performance of the building projects on their opinions which was subjective, biased, and varied across all the professionals in the same project. To this extent, the study intervened through the identification, prioritization of key performance indicators found across the building construction industry, and development of the Key Performance Index which then could guide the building and construction, industry stakeholders.

5.1.1 Key Performance Indicators

Safety, time effectiveness, and client satisfaction were most important to most professionals, this was different from traditional performance measurement which focusses only on the financial measure as important KPIs. There was a combination of financial and non-financial measures at the top, this supports the need to explore modern performance measures compared to the traditional one that focuses on financial measures only and lagging indicators. Quality being in the iron triangle was ranked 4th being below client satisfaction and safety. This provided a different perspective on performance measurement. Proper training and Environmental performance were among the KPIs ranked least. These KPIs are social factors compared to the rest of the KPIs. They affect the community and society at large.

5.1.2 Development of Performance Index

Most construction professionals have ways of measuring their performance (59%). These are more of personal indices. Though the ratio is big, the remainder percentage

(41%) is almost equally larger who need to be able to measure their performance. A performance that cannot be measured, cannot be improved.

5.2 Recommendation

Poor performance in the construction sector can be very costly and this might affect business profits, community, and the environment. For this reason, construction firms and professionals need to have performance measures for their building projects. This can help in decision-making and strategies for improving performance. Setting achievable targets can be easier than it has always been.

5.2.1 Recommendation from the Study

National Construction Authority (NCA), the regulatory board for contractors in Kenya, has different categories of contractors based on the cost of the project the contractors as accomplished. The lowest cost is NCA grade 8 while the highest cost is NCA grade 1. Based on the study findings, this could present an opportunity for the NCA to improve on their proficiency by grading contractors based on their performance during the building construction process, rather than on the value of their completed projects. This would lead to fair and healthier competition among contractors while giving better value for money to their clients.

5.2.2 Recommendation for Future Research

From the study objectives which were to determine the key performance indicators and to develop a key performance index, the findings of the study showed that stakeholders in the building construction industry do not have standardized and acceptable performance measurements. The study has identified ten key performance indicators and developed their index based on their weights and ranked priority. The study, therefore, recommends that further research could be conducted on the adoption mechanisms of the Key Performance Index as a model for stakeholders in the building construction industry in Kenya.

REFERENCES

Abas, M., Khattak, S. B., Habib, T., & Nadir, U. (2020). Assessment of critical risk and success factors in construction supply chain: a case of Pakistan. *International Journal of Construction Management*, 1-9.

Aczel, J., & Saaty, T. (1983). Procedure for synthesizing ratio judgements. *Journal of the Mathematical Psychology, 27*(1), 93-102.

Aguarón, J., Escobar, M. T., Moreno-Jiménez, J. M., & Turón, A. (2019). AHP-Group Decision Making Based on Consistency. *Mathematics*, *7*(3), 1-15.

Altan, Haşim & Padovani, Roberto & Hashemi, Arman. (2016). Building Performance and Simulation. 10.1007/978-3-319-31967-4_11.

Anindhagyuna, A., Anidya, P., Talkah, W., & Wibisono, D. (2016). Developed Balance Scorecard from KPI in Construction Companies: Casestudy: State Owned Enterprise. *1st International Conference of Advanced Business and Social Science.* Bandung, Indonesia: Institute Technology of Bandung.

Assaf, S. A., Bubshait, A., Atiyah, S., & AlShahri, M. (2001). The Management of Construction Company Overhead Costs. *International Journal of Project Management*, *19*, 295-303.

Atanasova-Pacemska, Tatjana & Pachemska, – & Lapevski, Martin & Timovski, Riste. (2014). Analytical Hierarchical Process (Ahp) Method Application In The Process Of Selection And Evaluation.

Atkinson, R. (1999). Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. *International Journal of Project Management, 17*(6), 337-342.

Baldwin, A., McCaffer, R., & Osman, I. (2001). Project Performance in a Contracting Organisation: Analysis, Evaluation and Development. *CIB World Building Congress.* Wellington.

Bassioni, H. A., Price, A. D., & Hassan, T. M. (2004). Performance measurement in construction. *Journal of management in engineering, 20*(2), 42-50.

Beatham, S., Anumba, C., Thorpe, T., & Hedges, I. (2004). KPis: a critical appraisal of their use in construction. *Benchmarking: An International Journal,, 11*(1), 93-117.

Blessing, M., Chakrabati, A., & Blessings, M. (2009). *DRM, A Design Research Methodology.* Dordrecht: Springer.

Bubshait, A. A., & Almohawis, S. A. (1994). Evaluating the general conditions of a construction contract. *International Journal of Project Management, 12*(3), 133-136.

Carmon, F. J., Kara, A., & Zanakis, S. G. (1997). A Monte Carlo Investigation of inc omplete pairwise comparison matrices in AHP. *European Journal of Operational Research, 102*(3), 538-553.

Chan, A. P., Ho, D. C., & Tam, C. M. (2001). Design and build project success factors: multivariate analysis. *Journal of construction engineering and management, 127*(2), 93-100.

Chan, C., & Chan, L. (2004). Key Performance Indicator for Measuring Construction Process: Benchmarking. *An International Journal, 11*(2), 203-211.

Chan, D., & Chan, J. (2012). Developing a Performance Measurement Index (PMI) for Target Cost Contract in Construction: A Delphi Study. *Construction Law Journal, 28*(8), 590 -613.

Choi, J. H. (2002). *Framework of developing performance-related specifications at WisDOT.* The University of Wisconsin-Madison.

Chonge, M. (2017). An Investigation of the Performance of Local. *International Journal of Soft Computing and Engineering (IJSCE), 7*(7), 2231-2307.

Construction Industry Review Commitee. (2002). *Construct for Excellence.* Constructon Industry Review Commitee.

Cooke_Davis, T. (2002). The 'real' success factors on projects. *International Journal of Project Management 20*(3), 185-190.

Cooper, R., & Schindler, S. (2008). *Business Research Methods* (10 ed.). Newyork: Mcgraw-Hill.

Dalkir, K. (2011). *Knowledge Management in Theory and Practice.* Cambridge, Massachusetts: the MIT Press

Ho, D. C. W., Lo, S. M., & Yiu, E. C. Y. (2008). The first guide to prepare a Building Maintenance Manual (BMM) in Hong Kong. In *22nd Building Surveyors Conference* Hongkong.

De Wit, A. (1988). Measurement of Project success. *International Journal of Project Management, 6*, 164-170.

Eccles, R., Newquest, S., & Schatz, R. (2007). Reputation and its Risk. *Harvard Business Review*.

EFQM. (2003). EFQM: Introducing EFQM. Brussels, Belgium , *EFQM*.

EFQM. (2006). *The EFQM Excellence Model*. Retrieved 2017, from European Foundation for Quality Management: http://www.efqm.org/Default.aspx?tabid=35

EFQM. (2013). EFQM. *An Overview of EFQM*. Brussels, Belgium , *EFQM*.

Egan, J. (1998). *Rethinking Construction: Report of the Construction Task Force on the Scope for Improving the Quality and Effeciency of UK Construction.* London: Department of the Environment, Transport and the Region.

Egan, J. (2002). *Accelerating change, rethinking* London. .unfpa

El-Mashaleh, M. S., Edward Minchin Jr, R., & O'Brien, W. J. (2007). Management of construction firm performance using benchmarking. *Journal of management in engineering*, *23*(1), 10-17.

Evangelidis, K. ,. (1992). Performance measured is performance gained. *The Treasurer*, 45-47.

Flapper, S., Fortuin, L., & Stoop, M. (1996). Towards consistent performance management systems. *International Journal Operations and Production Management*, *7*, 27-37.

Freeman, M., & Beale, P. (1992). Measuring Project success. *Project management journal*, *23*(1), 8-17.

Ghalayini, A., & Noble, J. (1996). The Changing? Basis Performance of Measurement. *Interanational Journal Operation and Production Management*, *16*(8), 63-80.

Githenya, M., & Ngugi, K. (2014). Assessment of the Determinants of Implementation of Housing Projects in Kenya. *European Journal of Business Management*, *1*(11), 230-253.

Gwaya, A., Munguti, S., & Odhiambo, W. (2014). Development of a Benchmarking Model for Construction Projects in Kenya. *International Journal of Soft Computing and Engineering (IJSCE)*, *4*(5), 13-37

Ingle, P. V., & Mahesh, G. (2020). Construction project performance areas for Indian construction projects. *International Journal of Construction Management*, 1-12.

Jha, K., & Iyer, K. (2006). Critical actors Affecting Quality Performance in Construction Projects. *Routledge Taylor and Francis Group Journal*, *9*(17), 1155-1170.

Juli, T. (2010). *Leadership principle for project success.* Boca Raton: CRC Press, Taylor and Francis.

Kagioglou, M., Cooper, R., & Aouad, G. (2001). Performance Management in Construction: A Conceptual Framework. *Construction Management and economic Journal*, 85-95.

Kamaruzzaman, S. N., Salleh, H., Lou, E. C. W., Edwards, R., & Wong, P. F. (2016). Assessment Schemes for Sustainability Design through BIM: Lessons Learnt. In *MATEC Web of Conferences* (Vol. 66, p. 00080). EDP Sciences.

Kaplan, S., & Norton, P. (1996). The Balance Scorecard: Measures that Drive Performance. *Harvard Business Review*, *74*(1), 75-85.

Kaviya, B., & Hema, C. (2008). Performance Management in *Construction.conferenc paper presented* Conference: International Conference on Advances in Materials, Design Systems and *Manufacturing* (ICMDSM 2017)

Kerzner, H., & Saldis, F. (2009). *Value driven project managemenr*. New Jersey: Wiley.

Kesik, T. (2015). Vital signs: towards meaningful building performance indicators. *University of Toronto, Toronto*.

Kibuchu, N., & Muchungu, P. (2012). *The Contribution of Human Factors in the Performance of Construction Projects in Kenya: A case study of construction project team participants in Nairobi.* Nairobi: University of Nairobi.

Kihoro, M., & Waiganjo, E. (2015). Factors Affecting Performance Of Projects In The Construction Industry In Kenya. *The Strategic Journal of Business and Change Management*, *2*(50), 37-66.

Kim Jun Lee, S., & Yu, K. (2004). Corporate culture and organizational performance. *Journal of Managerial Psychology,, 19*(4), 340-359.

Kim, N., Park, M., Lee, H., & Roh, S. (2007). Performance Management Method for Construction Companies. *24th International Symposium on Automation and Robotics in Construction*

Companies, (pp. 523-529).

Kombo, K., & Tromp, D. (2006). *Proposal and Thesis Writing: An Introduction.* Nairobi, Kenya: Pauline's Publication Africa.

Kothari, C. (2004). *Research Methodology, New Delhi*. New Delhi: New Age International Publisher.

Lavy, Sarel. (2011). A Literature Review on Measuring Building Performance by Using Key performance Indicators. AEI 2011: Building Integrated Solutions - Proceedings of the AEI 2011 Conference. 406-417. 10.1061/41168(399)48.

Law, J. (2009). *Dictionary of Business and Management* (5 ed.). Oxford University Press.

Leite, Francisco & Alves Volse, Renan & Roman, H.R. & Saffaro, Fernanda. (2020). Building condition assessment: adjustments of the Building Performance Indicator (BPI) for university buildings in Brazil. Ambiente Construído. 20. 215-230. 10.1590/s1678-86212020000100370.

Lepartobiko, W. (2012). *Factors that Influence Success in Large Construction Projects: The Case of Kenya Urban Roads Authority Projects.* Nairobi: University of Nairobu.

Letza, S. R. (1996). The design and implementation of the balanced business scorecard: An analysis of three companies in practice. *Business Process Re-engineering & Management Journal, 2*(3), 54-76.

Li, Han & Hong, Tianzhen & Lee, Sang Hoon & Sofos, Marina. (2019). System-level Key Performance Indicators for Building Performance Evaluation. Energy and Buildings. 209. 10.1016/j.enbuild.2019.109703.

Liu, M., & Walker, A. (1998). Evaluation of Project Outcomes. *Construction Management and Economics, 16*(3), 209-219.

Longo, M. (1991). Development of In house Project Evaluation Checklist. *Journal of Management in Engineering*, *7*(2), 153-165.

Luu, V. T., Kim, S., & Huyah, T. (2008). Improving Project management using benchmarking project. *International Journal of Project Management, 26*, 758-765.

Mallory-Hill, Shauna & Preiser, Wolfgang & Watson, Christopher. (2012). Enhancing Building Performance.

Mandisa, S., Aigbavboa, C., & Thwala, W. (2015). Construction Projects' Key Performance Indicators: A Case of the South African Construction Industry. *2015 International Conference on Construction and Real Estate Management.* Johannesberg: ICCREM.

Mansour, H., Aminudin, E., Omar, B., & Al-Sarayreh, A. (2020). Development of an impact-on-performance index (IPI) for construction projects in Malaysia. A delphi stydy. *International Journal of Construction Management*.

Maskell, B. H., & Baggaley, B. (2004). Practical lean Accounting: a proven system for. *New York: Productivity Press, 2004*.

Mauritio, S., Ezcurdia, A., Maricela, M., & Gimena, F. (2013). Performance Measurement in Project Management: A Casestudy of Public sector in Colombia. *F.A.C.E*, 34-54.

Mbaluka, H., & Bwisa, H. (2013). Delay factors in Construction Projects implementation in the Public. Sector: A case study of the Kenya Agriculture Research Institute Construction Projects. *International Journal of Programme Management*, 200-205.

Mickaiyte, A., Zavadkas, E., Kaklauskas, A., & Tupenaite, L. (2008). the concept model of sustainable building refurbishment. *International Journal of Strategic Property Management, 12*(1), 53-64.

Mugenda, A., & Mugenda, O. (2003). *Research methods: quantitative and qualitative approacg.* Africa centre for Technology studies.

Muguchu, M. (2012). *Access to Credit and financial performance in projects.* Merriam Webster dictionary.

Mwangi, J. (2016). *Factors Influencing Performance of Contractors in the Road Construction Sector: Case of Selected Contractors in Kenya.* Nairobi: University of Nairobi.

Nasser, K. (2009). *An Integrated Framework for Evaluation of Performance of Construction Project.* Retrieved from Project Management Institute.

National Institute of Standard and Technology (NIST). (2011). *Criteria for Performance Excellence.* Baldrige Performance Excellence Program.

Neely, A., Mills, J., Gregory, M., Richards, H., Platts, K., & Bourne, M. (1996). *Getting the Measure of Your Business.* Cambridge: Works Management.

Ngacho, C., & Das, D. (2017). Critical success factors influencing the performance of development projects: An empirical study of Constituency Development Fund projects in Kenya. *Science Direct*, 276-293.

Nguyen, L. H., & Watanabe, T. (2017). The impact of project organizational culture on the performance of construction project. *Suatainability, MDPI, 9*(5), 1-21.

Nyangilo, A. (2014). *An assessment of the organization structure and leadership effecton construction project performance in Kenya: A case study of public building projects within Nairobi region.* Nairobi: University of Nairobi.

Nyangwara , P., & Datche, E. (2015). Factors Affecting the Performance of Construction Projects: A Survey of Construction Projects in the Coastal Region of Kenya. *International Journal of Scientific and Research Publications*, *5*(10), 2250-3153.

Oakland, J., & Marosszecky, M. (2006). *Top Quality in Construction Supply Chain.* Great Britain: Elsevier Limited.

Ofori, G. (2000). Challenges of Construction Industries in Developing Countries: Lesson from Various Countries. *International Conference on Construction in Developing Countries,* (pp. 15-17). Gaborone, Botswana.

Ogula, P. A. (2005). *Research methods.* Nairobi: Catholic University of Eastern Africa.

Parfitt, M. K., & Sanvido, V. E. (1993). Checklist of critical success factors for building projects. *Journal of Management in Engineering, 9*(3), 243-249.

Parker, G. (2011). *The Parker team series.* Amherst, Massachusetts: HRD Press.

Parviz, F. (2003). Project success attribute. *Journal of Cost Engineering, 45*(4), 23-28.

Pinto, J. K., & Slevin, D. P. (1988). Critical Success Factors across the project life cycle. *Project Management Journal*, 67-75.

Pratt, D. (2010). *Fundamental of construction estimating* (3 ed.). delmar: Cengage Learning.

Rankin, J., Fayek, A., Meade, G., Heas, C., & Manseau, A. (2008). Initial metrics and pilot program results for measuring the performance if the Canadian construction industry. *Canadian Journal Civil Engineering, 35*, 894-907.

Roest, P. (1997). The golden rule for implementing balance business scorecard. *Information Management and Computer Security*, 163-165.

Saaty, T. (1980). *The Analytic Hierarchy Process.* New York: McGraw-Hill International Book Company.

Sekaran, U., & Bougie, R. (2010). *Research Methods for Business: A Skill Building Approach* (5 ed.). West Susses: Chichester.

Seminara, Paola & Vand, Behrang & Sajjadian, Seyed & Tupenaite, Laura. (2022). Assessing and Monitoring of Building Performance by Diverse Methods. Sustainability. 14. 1242. 10.3390/su14031242.

Seshadhri, Gopikrishnan & Paul, Virendra. (2018). User Satisfaction Index: An Indicator on Building Performance. Journal of Civil Engineering and Structures. 2. 14-33. 10.21859/jces-02012.

Sezer, A. (2016). *Construction performance measurement: site managers in refurbishing projects.* (C. U. Technology, Ed.) Sweden: Department of technology Management and Economics.

Shen, L., Hao, L., Tam, V., & Yao, H. (2007). A checklist for assessing SP of construction projecrs. *Journal of cCvil Engineering and Management, 13*(4), 273-281.

Shenhar, A., Dvir, D., & Sadeh, A. (2000). The Role of Contract Type in the Success of R7D Defence Projects Under Increasing Uncertainity. *Project Management Journal, 31*(3), 14-21.

Shenhar, A., Levy, O., & Dvir, D. (1996). Towards a Typological Theory of Project Management. *Research Policy Journal, 25*(4), 607-632.

Simbolon, L & Wiguna, I & Adi, Tri. (2020). Weighting variables for building performance evaluation. IOP Conference Series: Materials Science and Engineering. 930. 012018. 10.1088/1757-899X/930/1/012018.

Singh , A. S., & Masuku, M. B. (2014). Sampling techniques & determination of sample size in applied statistics research: an overview. *International Journal of Economics, Commerce and Management, II*(11).

Singh, A. S., & Masuku, M. B. (2014). Sampling techniques and determination of sample size in applied statistic research: An overview. *International Journal of Economics and Management, 2*(11).

Son L H & George C S Y 2002 Building Maintenance Technology (Hong Kong).

Sonson, S. J., Kulatunga, U., & Pathenge, C. (2017). Performance measurement and management in construction. A construction framework. *University of Salford, Manchester.* Manchester.

Sousa, S., & Teixeira, J. (2004). Prevention measure to reduce risk of falling from height. In P. Porto (Ed.), *IX National SYmposium of ISMAI.*

Suprayitno H & Soemitro R A A 2019 Reflection on basic view of public infrastructure for infrastructure asset management in Indonesia J. of Infrastructure & Facilities Asset Management 3 Supplement 1 15-23.

Takim, R., & Akintoye, A. (2002). Performance Indicators for Successful Construction project Performance. *18th Annual ARCOM Conference. 2*, pp. 545-555. In U. of Northumbria (Ed.).

Tennant, S., & Lanford, D. (2008). The Construction Project Balance Scorecard. *24th Annual ARCOM Conference,* (pp. 361-370). Cardiff, UK.

Tian, Zhichao & Zhang, Xinkai & Wei, Shen & Du, Sihong & Shi, Xing. (2021). A review of data-driven building performance analysis and design on big on-site building performance data. Journal of Building Engineering. 41. 102706. 10.1016/j.jobe.2021.102706.

Toor, S., & Ogulana, S. (2010). Beyond the 'iron triangle': stakeholder perception of key performance indicators (KPIs) for largescale public sector development projects. *International Journal Project Management*, *28*, 228-236.

Valence, Gerard. (2005). Production theory and construction productivity. 13th International Group for Lean Construction Conference: Proceedings. 135-141.

Valence, Gerard. (2013). Construction management strategies: a theory of construction management By Milan Radosavljevic and John Bennett. Construction Management and Economics. 31. 10.1080/01446193.2012.736025.

Võsa, K., Ferrantelli, A., Tzanev, D., Simeonov, K., Carnero, P., Espigares, C., Escudero, M., Quiles, P., Andrieu, T., Battezzati, F., Cordeiro, K., Allard, F., Magyar, Z., Turturiello, G., Piterà, L., D'Oca, S., Willems, E., Litiu, A., & Kurnitski, J., (2021). Building performance indicators and IEQ assessment procedure for the next generation of EPC-s. E3S Web of Conferences. 246. 13003. 10.1051/e3sconf/202124613003.

Vukomanovic, M., Rajud, M., & Nahod, M. (2010). Leading, Lagging and Perceptive Measures in the Construction Industry. *An Organization, Technology and Management: An International Journal*, *2*(1), 103-111.

Wesley, N. (2014). *Evaluation of Success Indicators of Building Construction Projects in Kenya.* Nairobi: University of Nairobi.

What is Project Success: A Literature Review. (n.d.). Retrieved August 27, 2018, from Research gate: https://www.researchgate.net/publication/41891079_What_is_Project_Success_A_Literature_Review

Winch, G. (2009). *Managing Construction Project* (2 ed.). Wiley-Blackwell Publishers.

Young, C., & Samson, D. (2004). Project Success and Project Team Human Resource Management. *PMI, Research Conference.* London: Project Management Institute.

Zawdie, G., & Langford, D. (2000). Challenges Facing the Construction Industry in Developing Countries: The State of Construction and Infrastructure in Sub Saharan Africa and Strategies for a Sustainable Way Forward. *2nd International Conference on Construction in Developing Countries*, (p. 18). Gaborone, Botswana.

Zawdie, G., & Langford, D. A. (2010). Influence of construction-based infrastructure on the development process in Sub-Saharan Africa. *Building Research and Information*, 160-170.

APPENDICES

Appendix I: Sample Questionnaire

This questionnaire aims to collect information related to ‘construction projects success indicators and performance framework’. The study is being undertaken by Magdaline Mbugua for a Master of Construction Engineering and Management. The research is about considerations (success and failure indicators) that have an important impact on perceptions of project success. This will help in developing a performance index framework for construction projects in Kenya. The information given is for academic purposes only and will be treated confidentially.

Please answer the questions according to the instructions.

Section A: Respondent Profile

. Respondents’ Position in the firm

Consultant [ ] Contractor [ ] Developer [ ]

2. In which organization do you work?

Government [ ] Non- Government Organization [ ] Private Firms [ ]

Others (specify)…………………………………………….

3. Which one best describes your age bracket?

20 – 29 years [ ] 30 – 39 years [ ] 40– 49 years [ ] Over 50 years [ ]

4. How long have you been involved in the construction projects?

Less than 5 years [ ] between 5 to 20 years [ ] above 20 years [ ] I don’t remember [ ]

Section B: Respondent's performance

How many construction projects have you or your firm been involved in? Less than 2 [ ] Between 2 and 5 [ ] Between 5 and 10 [ ] More than 10 [ ] Can't remember [ ]

Were these construction projects completed within the initial contract period? Yes [ ] No [ ] Can't remember [ ]

On average, what percentage of projects was completed within the initial contract period? Less than 25% [ ] Between 25-50% [ ] Between 50-75% [ ] Between 75- 100% [ ] Can't remember [ ]

Do you have any method of measuring the construction performance of your project? Yes [ ] No[ ] If yes, which method is it?...
....
....

Section C: Ranking of Key Performance Indicator

To what extent do the following factors affect performance management in comparison to each other in construction? React on the items provided by using the scale given.

Intensity of importance	**Definition**	**Illustration/ example**
1	Equal importance (equal)	element *a* and *b* is equally favored
3	Moderate importance of one over the other (slightly favors)	slightly favor element *a* over *b*

5	Essential importance (strongly favors)	strongly favor element *a* over *b*
7	Demonstrated importance (very strong favors)	element *a* is favored very strongly over *b*
9	Absolute importance (extreme favor)	the evidence favoring element *a* over *b* is of the highest possible order of importance

Example: **QUALITY** (9) (7) (5) (3) (1) (3) (5) (7) (9) COST **EFFECTIVE**

Quality is very strongly favored compared to cost effective

TIME EFFECTIVE (9) (7) (5) (3) (1) (3) (5) (7) (9) QUALITY

Quality is slightly favored compared to time effective

QUALITY (9) (7) (5) (3) (1) (3) (5) (7) (9) **COST EFFECTIVE**

QUALITY (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROFITABILITY**

QUALITY (9) (7) (5) (3) (1) (3) (5) (7) (9) **TIME EFFECTIVE**

QUALITY (9) (7) (5) (3) (1) (3) (5) (7) (9) **SAFETY**

QUALITY (9) (7) (5) (3) (1) (3) (5) (7) (9) **TEAM SATISFACTION**

QUALITY (9) (7) (5) (3) (1) (3) (5) (7) (9) **CLIENT SATISFACTION**

QUALITY (9) (7) (5) (3) (1) (3) (5) (7) (9) **ENVIRONMENTAL PERFORMANCE**

QUALITY (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROJECT LEADERSHIP**

QUALITY (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROPER TRAINING**

COST EFFECTIVE (9) (7) (5) (3) (1) (3) (5) (7) (9) **TIME EFFECTIVE**

COST EFFECTIVE (9) (7) (5) (3) (1) (3) (5) (7) (9) **ENVIRONMENTAL PERFORMANCE**

COST EFFECTIVE (9) (7) (5) (3) (1) (3) (5) (7) (9) **CLIENT SATISFACTION**

COST EFFECTIVE (9) (7) (5) (3) (1) (3) (5) (7) (9) **TEAM SATISFACTION**

COST EFFECTIVE (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROJECT LEADERSHIP**

COST EFFECTIVE (9) (7) (5) (3) (1) (3) (5) (7) (9) **SAFETY**

COST EFFECTIVE (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROFITABILITY**

COST EFFECTIVE (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROPER TRAINING**

TIME EFFECTIVE (9) (7) (5) (3) (1) (3) (5) (7) (9) **SAFETY**

TIME EFFECTIVE (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROJECT LEADERSHIP**

TIME EFFECTIVE (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROFITABILITY**

TIME EFFECTIVE (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROPER TRAINING**

TIME EFFECTIVE (9) (7) (5) (3) (1) (3) (5) (7) (9) **ENVIRONMENTAL PERFORMANCE**

TIME EFFECTIVE (9) (7) (5) (3) (1) (3) (5) (7) (9) **CLIENT SATISFACTION**

TIME EFFECTIVE (9) (7) (5) (3) (1) (3) (5) (7) (9) **TEAM SATISFACTION**

SAFETY (9) (7) (5) (3) (1) (3) (5) (7) (9) **TEAM SATISFACTION**

SAFETY (9) (7) (5) (3) (1) (3) (5) (7) (9) **CLIENT SATISFACTION**

SAFETY (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROPER TRAINING**

SAFETY (9) (7) (5) (3) (1) (3) (5) (7) (9) **ENVIRONMENTAL PERFORMANCE**

SAFETY (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROJECT LEADERSHIP**

SAFETY (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROFITABILITY**

PROJECT LEADERSHIP (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROFITABILITY**

PROJECT LEADERSHIP (9) (7) (5) (3) (1) (3) (5) (7) (9) **CLIENT SATISFACTION**

PROJECT LEADERSHIP (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROPER TRAINING**

PROJECT LEADERSHIP (9) (7) (5) (3) (1) (3) (5) (7) (9) **ENVIRONMENTAL PERFORMANCE**

PROJECT LEADERSHIP (9) (7) (5) (3) (1) (3) (5) (7) (9) **TEAM SATISFACTION**

ENVIRONMENTAL PERFORMANCE (9) (7) (5) (3) (1) (3) (5) (7) (9) **PRODUCTIVITY**

ENVIRONMENTAL PERFORMANCE (9) (7) (5) (3) (1) (3) (5) (7) (9) **CLIENT SATISFACTION**

ENVIRONMENTAL PERFORMANCE (9) (7) (5) (3) (1) (3) (5) (7) (9) **TEAM SATISFACTION**

ENVIRONMENTAL PERFORMANCE (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROPER TRAINING**

PRODUCTIVITY (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROPER TRAINING**

PRODUCTIVITY (9) (7) (5) (3) (1) (3) (5) (7) (9) **CLIENT SATISFACTION**

PRODUCTIVITY (9) (7) (5) (3) (1) (3) (5) (7) (9) **TEAM SATISFACTION**

TEAM SATISFACTION (9) (7) (5) (3) (1) (3) (5) (7) (9) **CLIENT SATISFACTION**

TEAM SATISFACTION (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROPER TRAINING**

CLIENT SATISFACTION (9) (7) (5) (3) (1) (3) (5) (7) (9) **PROPER TRAINING**

Appendix II: AHP Calculations

Geometric mean method formula:

This is the formula used to aggregate the pairwise comparisons of the KPIs as shown in table 4.7

$$\left(\prod_{i=1}^{n} X_i^{w_i}\right)^{1/\sum_{i=1}^{n} w_i}$$

π= the uppercase Greek letter pi used to indicate that a product id being computed

X_i= A single element in the sample or population

W_i= the weight of element Xi

$\sum_{i=1}^{n} w_i$ = the sum of the weights w_1, w_2, …… w_n

Eigen Value		**Principle Eigen Value**
Average	Assist to get consistent Measure	Consistency Measure
0.105	1.118	10.66977307
0.090	0.946	10.50056763
0.118	1.253	10.63211243
0.154	1.624	10.57565213
0.085	0.898	10.53314623
0.069	0.732	10.56798835
0.103	1.094	10.59291804
0.085	0.899	10.59755312
0.108	1.150	10.60767401
0.083	0.883	10.70377899

Eigen value was calculated as shown in table 4.8

The assist consistency measure row was calculated multiply each row of the ranked

KPI’s as shown in table 4.9 with the column of eigen value and summing up

=MMULT (B2: K2,M17:M26)

B2: K2 = the values (row) of each KPI pairwise comparison

M17:M26= the eigen values of each KPI

The principal consistency index was retrieved from dividing the assist consistency measure by the eigen value of each KPI.

Principle eigen value = Consistency measure/eigen value

Consistency Index

(CI) = (λmax — n) ⁄ (n—1)

λmax = Average of the principal eigen value

n = The number of key performance indices

10.6-10/10-1=0.0665

Consistency Ratio

(CR) = CI / RCI

CI=Consistency Index; RCI = Random Consistency Index

The values of the RCI are:

n	Random Index (RCI)
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.25
7	1.32
8	1.42
9	1.45
10	1.49

Source: Saaty, (1980)

n= number of KPI's in the pairwise comparison.

Consistency Index = 0.0665/1.49 =0.0446

Summary of the Calculations

Average Principal eigen value = 10.6

Consistency Index =0.0665

Consistency ratio = 0.0446