DEVELOPMENT OF A PROJECT MANAGEMENT EVALUATION MODEL FOR THE CONSTRUCTION INDUSTRY IN KENYA

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2015

Development of a Project Management Evaluation Model for the Construction Industry in Kenya

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A Thesis Submitted in fulfilment for the degree of Doctor of Philosophy in Construction Engineering and Management in the Jomo Kenyatta University of Agriculture and Technology

2015

DECLARATION

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

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DEDICATION

With Special appreciation to two ladies, two girls, two boys and one gentleman namely; Mary Nyanchama, Linet Simion, Esther Nyachama, Mary Kwamboka, Joseph Gwaya Abednego, Simon Arasa Abednego and Joseph Gwaya Ondieki, respectively.

ACKNOWLEDGEMENTS

I would like to first and foremost thank the Almighty Father in Heaven for seeing me through and providing me with the necessary energy and good health while carrying out this research.

I am grateful to my supervisors Dr. Githae Wanyona, Prof. Walter Oyawa and Prof. Sylvester Munguti Masu for their invaluable guidance, encouragement and positive criticism while undertaking the research for this thesis. I thank you all for your time and devotion throughout the duration of this research, with an express desire and commitment to ensure the successful completion of this thesis. Special thanks go to the Director SMARTEC – Eng Kabubo - for not only offering useful academic comments but also for facilitating the PhD seminars and all the necessary support including registration into the programme. I would like to thank the rest of the academic staff in the SMARTEC and in the Construction Management Department for their moral support. I am also grateful to Jomo Kenyatta University of Agriculture and Technology for offering me the opportunity to study at this great institution.

I would like to thank the industry participants for providing me with the necessary data. I acknowledge that as blood is essential for life, so is data for a researcher. On behalf of industry participants, I take special recognition of the late Mr Norman Mururu of Mururu & Associates, for the special comments and counsel he gave me while I was undertaking this study. On the same note, I would like to extend my gratitude to Mr Kithinji N. Boore of Costwise Consultants, for his invaluable input in the model validation process.

I would like to thank the PhD seminar panelists comprising Prof Zachary Abiero Gariy, Dr Stephen Diang'a, Dr Githae Wanyona, Prof. Sylvester M. Masu, Dr Titus Kivaa, Prof James Wambua and Eng C. Kabubo for their consistency in attending the seminars and giving useful comments. Without you all, this thesis would not have been what it is.

I wish to thank my family particularly my five brothers and my only sister for providing a loving and supportive environment. I am grateful to my parents who not only cared for me but also shaped me up. Thanks a lot to my wife Linet, for her patience, love and encouragement. Finally I would like to thank my four children - Esther Nyanchama, Mary Kwamboka, Joseph Gwaya and Simon Arasa - for their persistent but important concerns. Once again; to my wife and children, you are such a treasure!

Finally, to those not mentioned expressly, but contributed in this study in one way or the other, kindly accept my sincere appreciation for your contribution. I have endeavoured to present the facts as accurately as possible. However, in the event of any errors, I hereby take full responsibility.

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LIST OF ACRONYMS

AACE :	Association for the Advancement of Cost Engineering
CIOB:	Chartered Institute of Building
CPM:	Critical Path Method
CS:	Construction Site Management
GDP:	Gross Domestic Product
ICPMK:	Institution of Construction Project Managers of Kenya.
IPMA:	International Project Management Association.
JKUAT:	Jomo Kenyatta University of Agriculture and Technology
PC:	Project Cost Management
PCA:	Principal Components Analysis
Pe:	Projection Execution Efficiency
PERT:	Program Evaluation and Review Technique
PH:	Project Human Resource Management
PI:	Project Integration Management
PIM:	Project Information management
PMBOK:	Project Management Body of Knowledge.
PMI:	Project Management Institute
PMM:	Consultant and Contractor Contribution component towards projects performance.
PMct:	Is the Client's contribution to Project Performance
PP:	Project Performance Management
PQ:	Project Quality Management
PS:	Project Scope Management
PT:	Project Time Management
RSA:	Republic of South Africa
SMARTEC:	Sustainable Materials Research and Technology Centre
UCT:	University of Cape Town
UK:	United Kingdom
U.O.N:	University of Nairobi
USA:	United States of America
TUK:	Technical University of Kenya

VE: Value Engineering

WBS: Work Breakdown Structure

ABSTRACT

There is a problem in the construction industry in Kenya in terms of ineffective monitoring and evaluation of construction projects. Previous researchers have argued for different approaches to the way activities in the construction industry should be treated for efficiency to be realized in the execution of construction projects. However, none of these researchers has undertaken an exhaustive and eclectic modeling of project management evaluation as a solution to the challenges facing the construction industry. Low efficiency and effectiveness in terms of frequent delays, cost overruns, deficient quality and inadequate safety are still serious challenges to the construction process and execution of projects in Kenya. These challenges could be addressed by use of models. This study therefore, addresses the challenges by developing a project management evaluation model for a more effective and efficient construction industry in Kenya.

From review of the related literature, three key observations were made regarding the practice of project evaluation. Firstly, projects should ideally produce project *health reports* with leading performance measures, instead of producing project *autopsy reports* with lagging performance measures. However, most of the existing project management models emphasize the use of lagging measures of project performance. Secondly, the models do not emphasize continual assessment of the project performance from the very onset of the project execution. Finally, the models do not pay attention to needs of the clients as initiators of the project. These practices render the project management function rather inefficient in the delivery of construction projects. For that reason, this research study was undertaken.

A multi-strategy research approach involving a survey and interview research designs were adopted to actualize the research objectives. A sample size of 580 members was selected, out of which 344 member were responsive. The variables in the study and their relationships were conceptualized from literature review. They comprise the traditional measures of project *cost*, project *quality* and project *time*, and were observed to account for only 57% of projects' performance. Consequently, another set of three variables - *human resource* management, *scope* management, and project process *performance* management - was added, and was observed to account for 42%

of the performance of projects. The data analysis procedures adopted were: statistical descriptive frequencies, correlation analysis, principal component analysis (PCA), analysis of variance (ANOVA) and multiple regression analysis. They were done using the Statistical Program for Social Sciences (SPSS for Windows, Version 20).

From the data analysis results, a project evaluation model was synthesized and validated. In the model, 82% of a project's performance is attributed to consultants and contractors together, while 18% of the performance is attributed to clients, making a total of 100%. The project evaluation model is stated as follows: -

$$P_e = 82\%\ PME_{Cs\&Cr} + 18\%\ PME_{Ct} + e$$

Where:-

P_e is the overall project execution efficiency.

$PME_{Cs\&Cr}$ is the consultant and contractor contribution component.

PME_{Ct} is the Client's contribution to project performance.

e is an error which is a function of the operating environment, political situation and any other external factors that can influence the project.

The model was reduced to a software model which can predict performance of a project within an error margin of 0.5%. It received an acceptance rating of 88% from the field.

The model can be applied to any project situation irrespective of procurement method used, and it encourages measurements to be done using a shared perspective between a client and his project team, regarding the performance of a project. It also encourages coordination between the client, consultants and contractors, with elimination of conflicts amongst them. Use of the model should make monitoring and evaluation of construction projects, which have hitherto been rather elusive in the construction industry in Kenya, to be more proactive and effective.

Finally, it is concluded that continual project evaluation during the project execution process improves project performance, and recommended that the project management evaluation model developed in this study be adopted in the mainstream construction industry in Kenya, to foster delivery of construction projects.

CHAPTER ONE: INTRODUCTION TO THE STUDY

1.1 BACKGROUND TO THE PROBLEM

The construction industry is a crucial sector for the growth of any economy. It is the sector involved with erection, repair and demolition of buildings and civil engineering structures in the economy, and contributes a noteworthy portion of Gross Domestic Product (GDP) nationally and internationally (Hillebrandt, 2000). As shown in the Kenya National Bureau of Statistics (KNBS, 2012), the construction industry in Kenya, for example, contributed 3.8%, 4.1%, 4.3% and 4.1% towards the GDP of the country, in the years 2008, 2009, 2010 and 2011, respectively. This contribution is an average of 4.1%, but is lower than the average contribution found in developed economies, which Hildebrandt (2000) observes to be 10%. These statistics imply that timely and realistic evaluations of the managerial effectiveness of construction projects and, by implication the construction industry, are actions that should improve the performance of the national economy of Kenya.

In the world, construction agencies are experiencing unprecedented pressure to deliver projects for constituents including increasing congestion to open up more roads, reduced works periods for construction, workforce issues, intense public interest and involvement, and severe revenue pressures. Agencies are seeking ways to deliver projects in the most efficient and expeditious manner possible (Lock, 2007). However, a number of projects have caused problems. In the UK for instance, the Eurotunnel project, finished with a debt burden of £2.05 Billion, an 80% cost overrun which made the project's final account stand at £4.65 Billion against an original contract sum of £2.60 Billion (Sherif, 2002). Another example is the new Wembley Stadium project which finished late and cost twice its original budget. All the same, in the USA there is continued project management improvement including project management surveys to come up with new projects delivery strategies including on highways. Also, in Malaysia there is Vision 2020 encompassing construction management and projects delivery improvements. The aforementioned examples demonstrate that project execution challenges do exist globally but developing economies are faced with more enormous challenges as opposed to developed economies. It is therefore important that a structured project management evaluation model is adopted in Kenya, as done in developed economies, to aid in improving the delivery of construction projects.

If the construction industry is to realize its full potential as an important sector to the general economy, there is need to identify specific actions and good practices, which would help achieve timelines in project execution and value for money. In the UK Egan, (1998) states that construction industry fails to satisfy the majority of customers, who want their projects delivered quickly, cost effectively and without defects. Failing to achieve a satisfactory level of performance may result in confrontation leading to expensive litigation. This need for improving construction performance and the efficiency of the construction industry in Kenya formed the motivation for this research study.

In recent years, there has been a great concern by the Government of Kenya over the performance of the construction industry in Kenya. For instance, there have been a number of accidents on construction sites. Buildings have been reported to have collapsed in Nairobi and Kiambu among other counties (Charagu, 2013). However, the observed challenges are not unique to the Kenyan Situation. Sherif, (2002) has indicated similar challenges in the UK, as stated before. This has led to many reports being published there criticizing construction, stating that it is characterized by low achievement and low productivity and offering no solutions to overcome some of the stated problems. According to the reports of Latham (1994) and (Egan, 1998), the UK is still suffering from under achievements and low productivity and has made clients to criticize the industry for not always delivering what they need and the majority of them are not satisfied with the quality of the construction industry.

The concept of *management by projects* offers solutions to the sub-optimal performance of construction projects, but its adoption has hitherto been rather slow and inefficient in the mainstream construction industry. In brief, *project management in construction* is a professional and scientific specialization that differs from traditional/general management by the generally limited, temporary, innovative, unique and multidisciplinary nature of projects; it is widely recognized that project management requires its own tools and techniques (Munns & Bjeirmi, 1996).

According to the PMI (2013), *project management* is the application of knowledge, skills, tools and techniques to project activities to meet projects requirements within constraints of time, cost and quality by using planning, control, and monitoring and evaluation management functions. From these definitions, a definition for a *project management evaluation model* can be inferred as a ***formula which project managers employ in project planning, design and implementation, to successfully achieve the set project objectives***. Project management needs a well structured evaluation model for assessing the effectiveness of its adoption. It is for this reason that a project management evaluation model was developed in this study, for the purpose of increasing the chances of success in the implementation of construction projects in Kenya.

Successful project execution is about getting a quality project done on time and on budget and more often, taking a life cycle approach to make sure that the built asset is maintained over the long term. Success of a construction project is influenced by many factors, one of the major factors being the procurement approach adopted. According to KPMG international, (2010) project procurement strategies can be placed into one of the following four categories, namely: traditional, collaborative, integrative and partnership. Their attributes and influence on project success may briefly be explained as follows: -

1.1.1 Traditional Approach: The traditional method of project execution assumes that the project client has completely and accurately defined the scope of the work through its design consultant and that a qualified contractor will be hired to construct the work. This method is characterized with fragmentation where designers are separated from implementers, occasioning conflicts at times. The only link is usually through supervision and due to different project expectations by participants; the process is not usually seamless. It also requires substantial completion of designs before the contractor is brought on board; it also breeds an adversarial culture if there is insufficient coordination of team members. But (Murdoch & Hughes, 2008) argue that there is no superior or inferior procurement method; only an appropriate or inappropriate one. This traditional method is the one mostly used construction procurement method in Kenya, despite the aforementioned challenges.

1.1.2 Collaborative Method: The collaborative model involves construction professionals in the early planning and design phases of the project and eases the barriers to communication that existed previously between the project owner and the main contractor. One of the most well-known collaborative project delivery approaches is the design and build approach and involves the design consultant and the main contractor joining forces. By joining forces, the two parties can offer a "one-stop shop" to the project owner for delivering a large capital project under a single contractual agreement.

1.1.3 Integrative Method: The integrative model of project execution is a relatively new approach with risk sharing features, unlike either the traditional or the collaborative models. In the integrative model, the project owner, the design consultant, and the contractor work as one team to develop, define and deliver the project. Examples include alliancing, partnering and integrated project delivery.

1.1.4 Partnership Method: The partnership model is a form of project execution strategy where the design, construction and operation of a building, highway, hospital plant or other facility is completed by one of the contracting parties for the benefit and use of another, including the general public. Typically the party responsible for executing the project is also responsible for financing the project in whole or in part and most significantly, maintains the responsibility for the quality of the infrastructure over the long term. Examples include build-operate-transfer, build-own-operate, build-own-operate-transfer, concession, design–build-finance-and-operate, private finance initiative and public private partnerships. All these approaches are in their formative stages in Kenya.

Research and practice in construction project management has for decades focused on *project scheduling* problems as well as *project planning* techniques such as the program evaluation and review technique (PERT) and critical path method (CPM). Researchers and practitioners appear to have shared a deep conviction that development and adoption of better scheduling techniques could lead to better project management and project success (Belassi & Tukel, 1996). However, scheduling techniques seem to have failed to effectively address the challenges continually encountered in project execution. This suggests that further management tools are required to complement project scheduling.

In the last three decades, construction research in Kenya has focused on the entities that constitute the construction industry – particularly, projects, contractors and human resources - deducing the performance of the industry as a whole from the observations made on its parts. Key areas of research have been procurement methods (Mbaya 1984, Kithinji, 1988 & Mbatha 1993); project execution – cost overruns & time overruns and human resources (Wachira 1996, Talukhaba 1999; Gichunge, 2000; Wanyona, 2005; Masu 2006 & Muchungu, 2012); and indigenous contractors and marketing (Magare, 1987 & Gitangi, 1992). No research has specifically focused on a continual and structured evaluation of the performance of construction projects.

1.2 ARGUMENTS LEADING TO STATEMENT OF THE PROBLEM

Ineffective evaluation of construction projects remains an intractable problem in construction industry in Kenya. In practice, project participants produce *project autopsy reports* using lagging measures of project performance, and as a result make rather belated corrective measures which eventually lead to sub-optimal project management performance. Consequently, project delays, cost overruns and dissatisfied clients remain the norm rather than the exception, in the construction industry in Kenya, as noted by previous researchers, notably Mbatha (1993), (Talukhaba, 1999; Gichuge (2000) and Masu (2006).

The previous researchers examined this matter and made observations and recommendations, which may briefly be presented as follows: -

(a) Mbatha, (1993) did an analysis of building procurement systems' features and conception of an appropriate project management system in Kenya. He explored the applicability of project management in Kenya. He for instance observed that public clients were skeptical to employ a project manager. He attempted to prescribe a solution for the persistent cost, quality and time overruns in the construction industry in Kenya, in way of adopting a more structured approach to project management in the public sector. Later on, the public sector adopted project management but only changing the title of

"Departmental Representative" to "Project Manager" without a structured process on how to go about measuring the project management results. This leaves different project managers to go about actualizing project objectives on an *ad hoc* basis. Despite the solutions he prescribed, cost and time overruns are still prevalent, pointing to the need for a different approach. Hence the current study.

(b) Talukhaba, (1999) concentrated on causes of project delays. He argued that despite the high level of competence in terms of technical skills of construction professionals involved in projects, the goals of project management such as cost, quality, time, environmental safety and client satisfaction were rarely achieved. This suggests the need to investigate and or apply other methods to foster the performance of construction projects in Kenya. Later on, (Wanyona, 2005), citing a number of construction projects, observed that both private and public building clients continued to experience cost overruns on set budgets which was – and still remains - a serious and costly matter.

(c) Gichunge, (2000), observed that the most serious source of cost and time risks in building projects during the construction period was 'extra work' - technically termed as variations- and normally occurred in 73.50% of the building projects studied. Additionally, defective materials accounted for 38.20%. Earlier, Mbatha (1986), Mbeche & Mwandali, 1996;Talukhaba, 1988) had established that time and cost performance of projects in Kenya were unacceptable to the extent that over 70% of the projects initiated were likely to escalate in time with a magnitude of over 50%, while over 50% of the projects were likely to escalate in cost with a magnitude of over 20%. This state of affairs appears not to have changed in a significant way.

(d) Masu (2006) observed that cost and time overruns were still a major problem in the construction industry in Kenya. He dealt with causes of this poor state of affairs, as a follow up on Mbatha's (1986) and (Talukhaba, 1988) work on performance of construction firms who are responsible for projects execution. He investigated the causes and impact of resource mix practices in the performance of construction firms in Kenya.

The four aforementioned research studies have clearly pointed out that there are major challenges in the construction industry in Kenya, which lead to poor project execution results in Kenya. This calls for further project management tools, one of which is timely and accurate evaluation of the project management performance throughout the project duration.

As stated before, undesirable project performance results are problems affecting construction industries worldwide, but more seriously in developing countries. In developed countries, efforts are being made to use project performance evaluations to monitor and control projects to ensure more favourable outcomes. In developing countries, there has been less research activity aimed at improving in project performance, particularly through continuous evaluations. There is therefore the need to emulate developed countries' approaches of ensuring timely improvements in project performance. All the same, in order to determine the most effective and realistic application of the existing models in a developing country, it is imperative that a study be done to determine the extent to which the models are relevant in the country. It is for this reason that the researcher undertakes to develop an evaluation model to aid project management application in the execution of construction projects in Kenya.

The problem of poor project management in construction projects in Kenya can be addressed by adopting project management modeling, as done in the developed economies. As stated before, none of the previous researchers has dwelt on project management modeling as a way of solving project performance problems. Yet models can prove useful in the execution of projects, according to Beatham *et al* (2004). In their study, Beatham *et al* (2004) investigated problems of existing models focusing on the measurement criteria.

The subject matter of this thesis is evaluating construction project performance. The focus is on how to determine, through performance measurement, that an on-going project is succeeding or failing to achieve the objectives for which they are being implemented. This is borne out of the global quest for the improvement, in the performance of the construction industry in general and project performance in particular. The subject of performance measurement or evaluation has become a matter of concern to several countries at different levels of socio-economic development which have realized the need to improve the performance of their construction industry (Beatham et al., 2004). Discontent with the state of their construction industries, governments in developed countries are supporting various initiatives for improvements (Ofori, 2000). Following the Latham (1994) and Egan, (1998) Reports, the UK construction industry in particular has resorted to using several performance measures to address improvement concerns of the various aspect of the industry (Beatham et al., 2004). With regard to the global concern of the development of the construction industry, the use of performance measures to achieve this aim by most developed countries has been underscored. In the quest for improvements in the construction industry performance by these countries, this research posits that improvements in the performance of the project as a key component of the construction industry should be given due attention.

The research focuses on the project and its performance evaluation. Undesirable project performance results across several countries have been well documented in the literature review. Identified in various forms as low productivity, delays, cost overrun and poor quality, unsatisfactory project performance has been noted as the bane of construction industries of several countries, particularly, developing countries (Mutijwaa & Rwelamila, 2007; Le-Hoai et al., 2008). Developed countries also have their fair share of the problem, though, as indicated by Klakegg et al. (2005) and "Benchmarking the Government Client stage 2 study (1999)". In addressing the problem, most developed countries have resorted to the use of measures to evaluate project performance. This has led to the modelling of indicators and criteria in which performance could be measured as well as the factors that influence performance (Shenhar *et al*., 1997, Shenhar, 2002; Atkinson, 1999; Belassi & Tukel, 1996). This development is seen as encouraging because performance evaluation in the form of monitoring and controlling is central to effective project management (PMI, 2013). Studies on these models show that each of them is designed to address different aspects of project performance; for example, strategy, people, design, process, project, project manager and organizational culture (Beatham *et al*, 2004; Shenhar *et al*, 1997; Ankrah, 2007; Ahadzie, 2007). This result is rooted in the central position of construction project within the industry. Being at the centre of the construction industry, project performance is affected by all aspects of the industry in the same way that the industry is affected by project performance. Thus, issues bothering on project performance are expected to have diverse focus. As Neely,et al., (2000) note, all the various models add value. In the developing countries, however, little evidence exists to show that concerted efforts are being made by governments in this regard despite acknowledgement by several countries of the existence of project performance inefficiencies. It is for this reason that the World Bank (1994) advises that it is time developing countries did things differently, to reverse the inefficiencies within their construction industries.

However, in the developed countries where these various models are developed, there are growing fears that the various models designed to evaluate the performance of projects cannot help to accomplish the performance improvements for which they were intended (Shenhar *et al*., 2002; Atkinson, 1999; Beatham *et al*., 2004). This is proven by the fact that undesirable project performance results continue to plague even the construction industry of countries where project performance assessment has received prominent attention since the past two decades, for example, in UK, (Benchmarking the Government Client stage 2 study, 1999). In addition, a key feature of the models is that they attempt to measure the success or failure of project and hence most of their assessment measures are "lagging" indicators, reporting performance after they have occurred. Yet, there is still a disagreement between project management researchers as to what constitute project success and how it is to be measured (Murray, et al., 2002; Klakegg *et al*., 2005). Still, it has been acknowledged that most of the existing models are not usually made to be part of a complete evaluation system (Dvir, et al., 1998; Beatham *et al*., 2004; Takim and Akintoye, 2002). Finally, most of these models address only client satisfaction as a criterion among the rest and not the perspective of the client as an important stakeholder (Takim and Akintoye, 2002). This is limiting in its recognition of the important role of the client in ensuring best practice and improvements as underscored by Latham (1994). These issues are comprehensively addressed in this study.

In this study, focus is made on both the pre-contract and the post contract stages of a construction project, up to handing over of the project, which are often referred to as the "pre-contract and post-contract construction phases". Many individuals within the construction industry believe that planning efforts during the early stages of a project’s life cycle maximizes the chances of a project being successful (Ahuja, 1994; Gibson & Dumont, 1996)). The pre-contract phase is considered to be the most significant phase of the construction project since it provides valuable input to the forthcoming phases. Although there are numerous views that have been put forward about the importance of pre-contract, few models that focus on this phase have been developed, with the exception of the work of the Construction Industry Institute [CII] (Sherif, 2002). In addition, existing models do not provide an integrative framework for improvement, for instance, the CII model was developed and tested on industrial projects and also lacks the tools that facilitate communication among project participants. Even in post contract there are very few models developed in developing countries, Kenya in particular.

Finally, this research emphasizes the importance of the project management function and stresses that improved project management in construction leads to improved construction performance and achievement of project objectives, eventually leading to greater client satisfaction.

1.3 STATEMENT OF THE PROBLEM

Undesirable project performance result is one of the main problems affecting construction industries everywhere and mostly developing countries. In developed countries efforts are being made to use project performance evaluations to monitor and control projects to ensure successful outcomes. Yet, to date, there has been little, if any, research in developing countries aimed at promoting improvements in project performance through continuous evaluations. There is therefore the need to emulate developed countries’ approaches of ensuring improvements in project performance. However, in order to determine the most effective and realistic application of the existing models in any developing country, it is imperative that a study be done to determine to what extent these models are relevant in each country. In addition it is important to determine to what extent these models can be useful in addressing the specific problems confronting the construction industry of each country. It is for this reason that the researcher undertakes to develop an evaluation model to aid project management application in the execution of construction projects in Kenya.

Based on the different studies cited in the background there are persistent problems in the construction industry in Kenya in terms of quality issues, cost overruns and project delays. The problem in Kenya can be solved possibly by adoption of project management modelling as done in the developed economies. None of the aforementioned researchers has dwelt on project management modeling as one way of solving project performance problems. Yet models can prove useful in the execution of projects; Beatham *et al* (2004). Beatham *et al* (2004) investigated about problems of existing project management structures specializing on measurement criteria. Lack of efficiency and effectiveness in terms of frequent delays, cost over-runs, deficient quality and inadequate safety are still serious challenges to construction project execution in Kenya. It is for this reason that we need to evaluate the project management practice in the delivery of projects. Lack of continuous evaluations in project management objectives may be one of the causes of unacceptable project delivery results. This study is therefore on the development of a suitable project management evaluation model in the performance of construction projects.

1.4 STUDY OBJECTIVES

The main objective of this study is to develop a project management evaluation model for the construction industry in Kenya.

The specific objectives of the study are: -

(i) To identify project management shortcomings in Kenya requiring management interventions.

(ii) To establish relevant project management indicators in the performance of construction projects.

(iii) To develop a project management evaluation model for Kenya by regressing identified project management indicators.

(iv) To assess the effectiveness of the developed project management evaluation model on performance of construction projects in Kenya.

1.5 AIM

The aim of this research is to create a means by which construction project performance can be evaluated at any stage of the project execution with measures that reflect the perspectives of the clients, practitioners and contractors, as well as the particular circumstances of the project within different socio-economic settings. The model that will help clients and consultants improve execution of construction projects, by establishing a structured project management process and providing a mechanism and tools to guide this process.

The importance of continual evaluation is underscored by the PMI (2013); continual monitoring of projects provides the project team with insights into the health of the projects and highlights areas that require attention. Addressing the perspective of clients alongside those of the practitioners and contractors is aimed at promoting a shared perspective and responsibility between them and reduce, if not eliminate, the frequent disputes that exist between clients and practitioners on the state of the projects. This the research focuses on building measures of project management factors for project performance evaluation, which are to be of relevance to the construction industry in Kenya.

In a nutshell, the study endeavours to advance the application of the project management body of knowledge (PMBOK) to the Kenyan situation. An analysis of the construction project management as currently practiced in the industry provides insight into the existing knowledge gaps in the application of the PMBOK, with a view of identifying the improvements necessary.

1.6 HYPOTHESIS

The research hypothesis in this study is that application of a project management evaluation model in construction will increase project management effectiveness in the construction industry in Kenya. The hypothesis can be stated mathematically as follows: -

$$y = \beta_0 + \beta_1 X_1 + \cdots + \beta_p X_p + \epsilon_i$$

Where:

y = Project performance efficiency

β = Coefficient Estimates

$X_{i...p}$ = Project management performance factors

ϵ = Error term

The null hypothesis is that

$H_0 : \beta_1 = \beta_2 = \cdots = \beta_p = 0$ …………………………………………………. *(1.1)*

and posits that 'application of a project management evaluation model in construction will not increase project management effectiveness in the construction industry in Kenya.

The research hypothesis is that:-

$H_1 : \beta_j \neq 0$ For at least one j, j = 1, . . . , p …………………………………..(1.2)

Rejection of null hypothesis implies that at least one of the explanatory variables, x1, x2, . . . , xp, contributes significantly to project management effectiveness . We will use a generalization of the F-test in regression to test this hypothesis at $\alpha = 0.05$.

Does the addition of some group of independent variables of interest add significantly to the prediction of y obtained through other independent variables already in the model? This is the research question. In this study, we are interested to know whether addition of extra explanatory variables to the 'traditional' ones – project cost, project quality and project time – does increase project management performance significantly.

1.7 JUSTIFICATION

This research is focused on providing a clear understanding of current project management processes that characterizes the construction industry to determine the key activities performed and the key project management issues involved. It examines how project management is approached by construction professionals, determines and identifies the factors that inhibit project management improvement. This thesis; therefore, fills the existing academic gap through development of a project management evaluation model that shall be used to continuously monitor and evaluate performance of construction projects till completion. The model can also be used for decision making at any stage of the project. Finally, there is need for a change of how the practice of project management is carried out in Kenya. By suggesting and recommending leading measures instead of lagging measures there is a contribution in knowledge by bringing in a new dimension of health projects (health reports) and not autopsy reports (lagging measures). Finally by ensuring the clients are rated and a new scoping process emphasized; there is a contribution to knowledge by coming up with new methods of establishing and evaluating the project performance measures.

The findings of this study will undoubtedly help in the following ways:

- The clients, consultants and contractors will benefit from the research by understanding the role of project management in the construction industry in Kenya and by knowing areas in need of improvement to make the industry more competitive. It will also prove useful in terms of quality and value management and/or engineering as part of roles of a project manager.
- Students pursuing professional courses like civil engineering, architecture, quantity surveying and construction management leading to the construction industry will benefit from the research findings not only in the academic line but also in the industry by offering solutions to the impediments in the application of project management in the industry.
- The study will give a contribution in terms of other important Construction Project Management indicators in the construction industry other than the traditional measures of cost, quality and time.
- A project management model to guide the practice of project management in the construction industry in Kenya is developed.

1.8 SIGNIFICANCE

In current models of the design and construction process; pre-contract has been given less attention compared to later stages of a project (Sherif, 2002). In addition, most of the literature related to pre-contract does not directly deal with the process, only referring to it through general discussions and highlighting various management aspects relating to it.

Many of the problems encountered in the design and construction phase of projects originate from the pre-contract phase. The main problems are frequently attributed to poor planning and poor identification of client needs, which act as contributory factors to poor project performance. This research contributes to the body of knowledge by establishing a link between improved project modelling and project performance. The rationale for undertaking this research stems from a number of factors:-

- The need to improve construction projects performance in Kenya through a structured project management evaluation application;
- Project management is perceived to play a crucial role in the success of the project and accomplishing the project objectives in Kenya;
- The research should prove extremely useful to construction clients for better approaching pre-contract and post-contract phases of the project life cycle;
- The lack of a structured and well recognized project management model to aid the project execution process in Kenya;
- The model provides the link among clients, consultants and industry and is a very important tool to provide success and ultimate client satisfactions.

1.9 SCOPE AND DELIMITATION

In Kenya both the private and public sector are involved in construction. A study covering the entire country could have been ideal. However, following a pilot survey carried out by the researcher; the results indicated that of the targeted population of consultants and contractors; 77% have offices in Nairobi. In addition, the consultants in Nairobi do engage in projects throughout the country frequently travelling all over the country offering their services as and when required. The other reason is because of 60% of the Kenyan economy is generated in Nairobi County (Muchungu, 2012). Finally challenges facing the construction industry in Nairobi are similar to those faced on upcountry projects.

Theoretical delimitation was limited to the existing project management theory and development, the review of Project Management Institute's PMBOK as published in 2013 as the source of Key Project Management objectives to be actualized in a project. Relevant variables were extracted but the mode of application and measurement process was changed; an evaluation model was developed via this research mainly to provide a model cognizant to the local situation in Kenya; a developing country.

1.10 THEORETICAL FRAMEWORK

The theoretical framework for this study may be summarized as follows: -

1.10.1 Project Performance Evaluation

The research alludes to the concept of the project as a temporary organization and adopts it as a nascent theory of project management, that is being regulated by *action, expectation and learning*. For efficiency in performance evaluation and management, the project environment is separated into internal and external environments. This concept is illustrated in Figure 1.1.

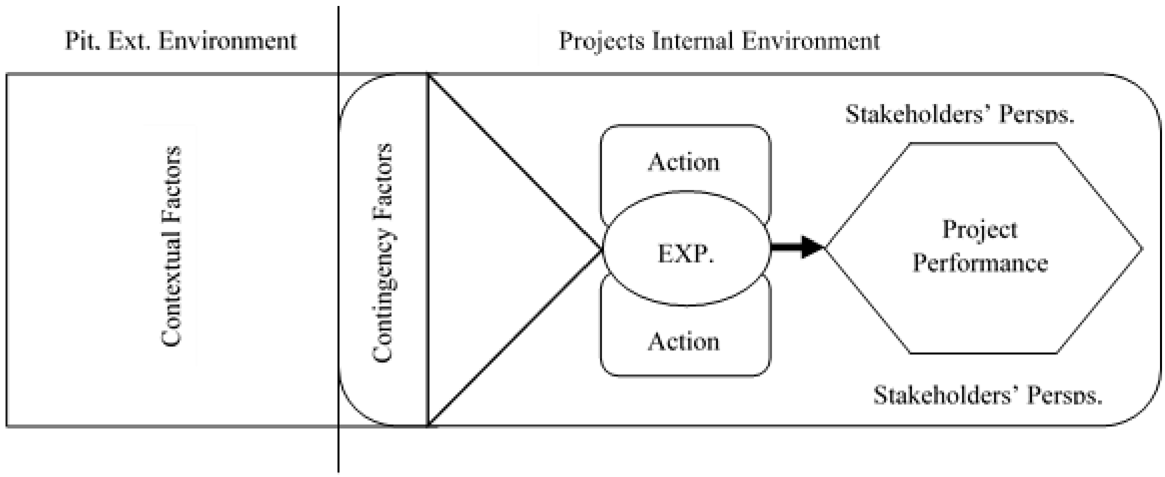


Fig 1.1 Environments of a Project as a temporary Organization

Source: Own formulation, 2013

The external environment is affected by contextual factors. Therefore, the research posits that the project situation should be considered within a context with all the relevant contextual factors well acknowledged. These factors including *socio-cultural, socioeconomic* and *political, institutional*, define the external environment of the project. The internal environment of the project is affected directly by factors which affect the implementation process and hence the project performance. These are essentially contingency factors in nature and have been classified into factors related to: *the project, the project manager/consultant, the project team, the client's organization*. These factors impact directly on the *action*, *expectation* and *learning* which shape the management of the project. Focusing on the performance of the project thus means that the research is emphasizing the *expectation* variable as it interacts with *action* and *learning.* This is expressed in terms of the *criteria* in which performance could be measured or evaluated. The research is based on the fact that even when the same external environment (contextual factors) exists over time within the same country, the project's internal environment varies due to contingency factors defined by client types and their expectation, project location, project team, design and site conditions. Hence, the research also posits that project performance evaluation measures should be considered within the contingency theory as it applies to the project as a temporary organization. In the case of construction project in particular where there are several stakeholders, the *expectations* (represented by 'perspectives') will vary for each, at least in terms of the priority, given the same measures. This means that the perspective of each stakeholder is paramount within the action, expectation and learning theories of project management.

Review of related literature – amplified in Chapter II later - shows that issues relating to project performance should be placed in a context defined by both the internal and external environments of the project. Considering the project as a temporary organization, it is possible to develop a theoretical framework based on the theory of action, expectation and learning. This position allows other concepts that relate to the permanent organizations and business to be applied to the project situation. In particular, best practices in business performance measurements could be learnt and applied to the construction project situation to ensure improvements. This implies a paradigm shift in project performance evaluation in which the assessment of a project should lead to improvements and learning. It calls for using leading, instead of lagging measures, considering the results of project performance not as a dichotomous situation of success and failure but a continuum of several levels of performance, and considering the specific context in which the project is being implemented.

1.10.2 The Background to the Research Framework

This research considers the issue of project performance within the context of the construction industry. It is considered in the light of the effect of the interactions between the various relevant organizations on the project as shaped by project management factors. The perspectives of three key stakeholders in project execution in Kenya are considered. The premise is that to determine the true state of a project by evaluation, it requires the identification and clear definition of the *expectations* of these stakeholders before commencement if smooth execution and absence of conflict is the goal. The perspectives of these stakeholders are influenced by several factors within the context of the construction industry in Kenya. PMI, (2013) has developed ten key knowledge areas and five processes in the area of project management to ensure project objectives are met. The ten knowledge areas form a key anchorage in the development of the evaluation model in this research. In addition, these stakeholders may also have their means of attributing project performance to different factors at play –factors that may have positive, negative or mixed effects on project performance. These distinguish not only individuals, but a group of people from one country to the other. Even though only the project team and organizational core factors were measured, it takes an implicit cognizance of the project management core factors at play. These formed an important basis on which clients', practitioners' and contractors' perspectives were analyzed. The factors of project management in the performance of projects were evaluated under two key perspectives from the project clients' perspective and from the project team perspective.

(a) Practitioners' and contractors perspectives

(1) Factors that affect performance: The measures affecting performance were carried out within the PMI (2013) PMBOK. The purpose of the PMBOK Guide is to assist a project manager and other stakeholders in the application of knowledge, skills, processes, techniques and tools to ensure maximum chances of success of a project. It identifies the subset of project management knowledge being recognized as good practice, that is to say, that there is a broad consensus on the fact that their application, and the associated skills, techniques and tools significantly improve the chances of a successful project.

This does not however, mean that all these elements must be implemented systematically and indiscriminately in their entirety. It is the specificity of the project that determines the selection of items to be incorporated and placed under the responsibility of the management team and other project stakeholders.

The life cycle of a project is divided into five process groups:

i. *Initiating:* allows to define a new project or new phase of a project in progress, to obtain authorization for its execution and if accepted, to identify stakeholders.
ii. *Planning*: allows to develop the project scope, develop goals and define the subsequent actions to achieve the objectives for which the project is undertaken.
iii. *Executing*: brings together the work to be done according to the established project management plan, respecting the system and project specifications.
iv. *Monitoring & controlling:* allows the monitoring, control and adjustments necessary for the advancement of the project and its performance. An important part of this group is to identify faulty elements that require changes to the plan and undertake the necessary changes within the executing processes.
v. *Closing:* allows for completion of all activities in an orderly way and formally close the project.

Although the order of these groups suggests a process which is conducted in systematic sequence of activities included in each group, this is not the case. During the project, these activities overlap and frequently inter-link and many processes are repeated in an iterative manner. It is the know-how and the skills of the project management team that determine the course by following this guide.

The total of all the project management activities consists of 42 processes, which are spread across ten knowledge areas:

The ten knowledge areas are: -

1. Project Integration Management : Project Integration Management includes the processes and activities needed to identify, define, combine, unify, and coordinate the various processes and project management activities within the Project Management Process Groups.
2. Project Scope Management : Project Scope Management includes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully.

3. Project Time Management : Project Time Management includes the processes required to manage the timely completion of the project.
4. Project Cost Management : Project Cost Management includes the processes involved in planning, estimating, budgeting, financing, funding, managing, and controlling costs so that the project can be completed within the approved budget.
5. Project Quality Management : Project Quality Management includes the processes and activities of the performing organization that determine quality policies, objectives, and responsibilities so that the project will satisfy the needs for which it was undertaken.
6. Project Human Resource Management : Project Human Resource Management includes the processes that organize, manage, and lead the project team.
7. Project Communications Management : Project Communications Management includes the processes that are required to ensure timely and appropriate planning, collection, creation, distribution, storage, retrieval, management, control, monitoring, and the ultimate disposition of project information.
8. Project Risk Management : Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, and controlling risk on a project.
9. Project Procurement Management : Project Procurement Management includes the processes necessary to purchase or acquire products, services, or results needed from outside the project team
10. Project Stakeholders Management : Project Stakeholder Management includes the processes required to identify all people or organizations impacted by the project, analyzing stakeholder expectations and impact on the project, and developing appropriate management strategies for effectively engaging stakeholders in project decisions and execution.

(2) Measures for assessing performance: Conceptualizing the necessary model for factors that affect the performance of construction project performance, the research drew heavily on works by PMI's Project performance factors. As discussed in the PMBOK guide; the factors are interrelated. In this research the interactions of the key variables were taken into consideration and using Principal Component Analysis the Key variables were established. After establishment of key variables regressions were used to develop the Project Management evaluation model.

(b) Clients' Perspective

The satisfaction of clients regarding the procurement process is taken to be the perceived performance of the service providers during the implementation period; whilst those of the needs satisfaction are measured with the criteria representing both the observable and the latent needs (Mbachu, 2003). Figure 1.2 shows the perspectives of assessing development satisfaction of the various clients. In addition to meeting specific design goals (cost, time, quality and stakeholders satisfaction), they are taken to represent the perspective of clients on project performance in this research. In the process, the needs and motivation criteria of each client were identified. Table 1.1 summarizes the needs/ motivation of various clients and service providers who must meet their expectations. This initial approach gave a global picture of how all clients in general view project performance, especially, during the development and commissioning phases.

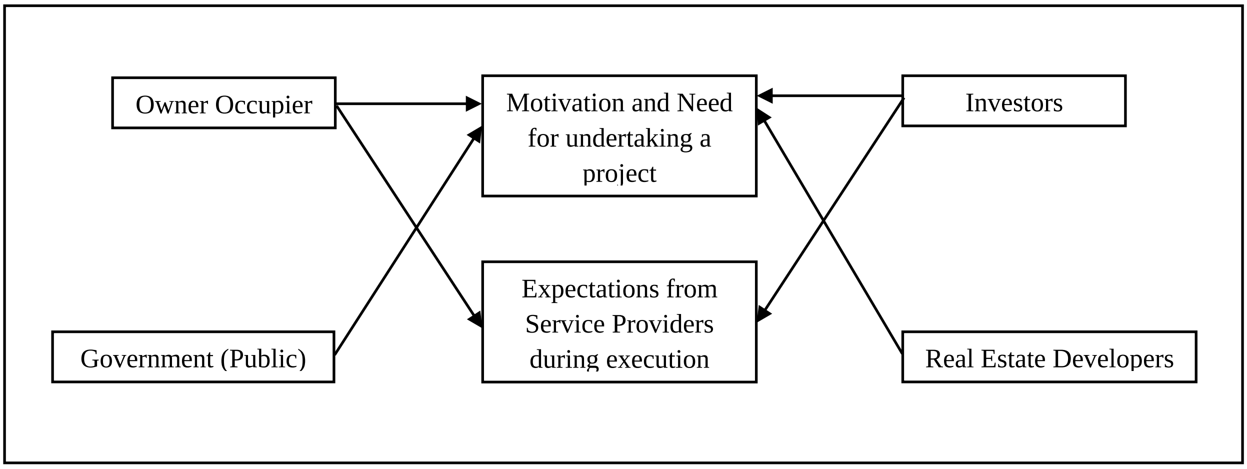


Figure 1.2 Clients' perspective of project performance Based on (Mbachu, 2003)

Table 1.1 Identifying Clients Perspectives by Type (Mbachu, 2003)

Client Type	Need/Motivation	Expectations of these Services Providers must be met
Owner Occupier	For business expansion, to minimize rental cost in the long-term leasehold, to improve capital assets, to enhance corporate image, to extend infrastructural facilities	Quantity Surveyors
Investors	For business expansion/market share, for diversification, to match fund liability with property asset base, to minimize investment risks and stable investment vehicles, to achieve capital growth/long-term retention of funds against inflation, to achieve desired returns on investment/profitability level, speculative purposes.	Architect Project Manager/Lead Consultant
Real Estate Developers	For profit, speculative purposes, to maintain/profitability level, speculative purposes	Engineers
Government (Public)	To satisfy social need, to regulate economy, to generate income, for prestige/national pride, to satisfy international objective	Contractors

1.10.3 The Framework: Linking the Research Variables

Figure 1.3 shows how key elements of the theoretical framework relate and interact with the stakeholders and their focus. It demonstrates how each stakeholder takes *action* and *expects* results from the other and thereby provides a means by which *learning* can take place through *understanding complexities, aspiration* and *reflective conversation*. Figure 1.4 illustrates the key concepts used in the empirical investigation and how they relate to each other. Within this framework, a clear distinction is made between the two perspectives being researched into: clients on one hand and Practitioners and contractors as the other criteria. Within each category, further distinctions were made. In the case of clients, four types of major clients (Owner Occupiers, Investors, Government and Real estate developers) were initially distinguished (Mbachu, 2003). This allows inquiry to be made into their individual views. But the other general way of classification is either public or private clients. The research was done on the broad basis of either public or private clients. In the case of the practitioners and contractors, the framework allowed the inquiry to be made from four main practitioners in the construction industry in Kenya (consulting Civil Engineers, Architects, Quantity Surveyors and Project Managers). This provided a general view of practitioners about the subject under consideration. Contractors under Categories of NCA1-NCA3 were also included in the survey because they have necessary expertise in the construction industry crucial for this research. The research conceives that the responses that would be provided across board will be influenced by contextual factors and human experiences based on the number of years of practice, organizations they have worked with, projects they have worked on and other features that define the particular sociocultural, socio-economic, institutional and Political and other external environmental factors. Finally, the main objective of the research is to establish what will represent the perspectives of each of the stakeholders (clients, practitioners and contractors) as well as the resulting shared perspective. After the initial model was developed a validation process was carried as discussed in Chapter Five where the actual model scores were compared with industry participants' scores on three projects per consultant for five consultants.

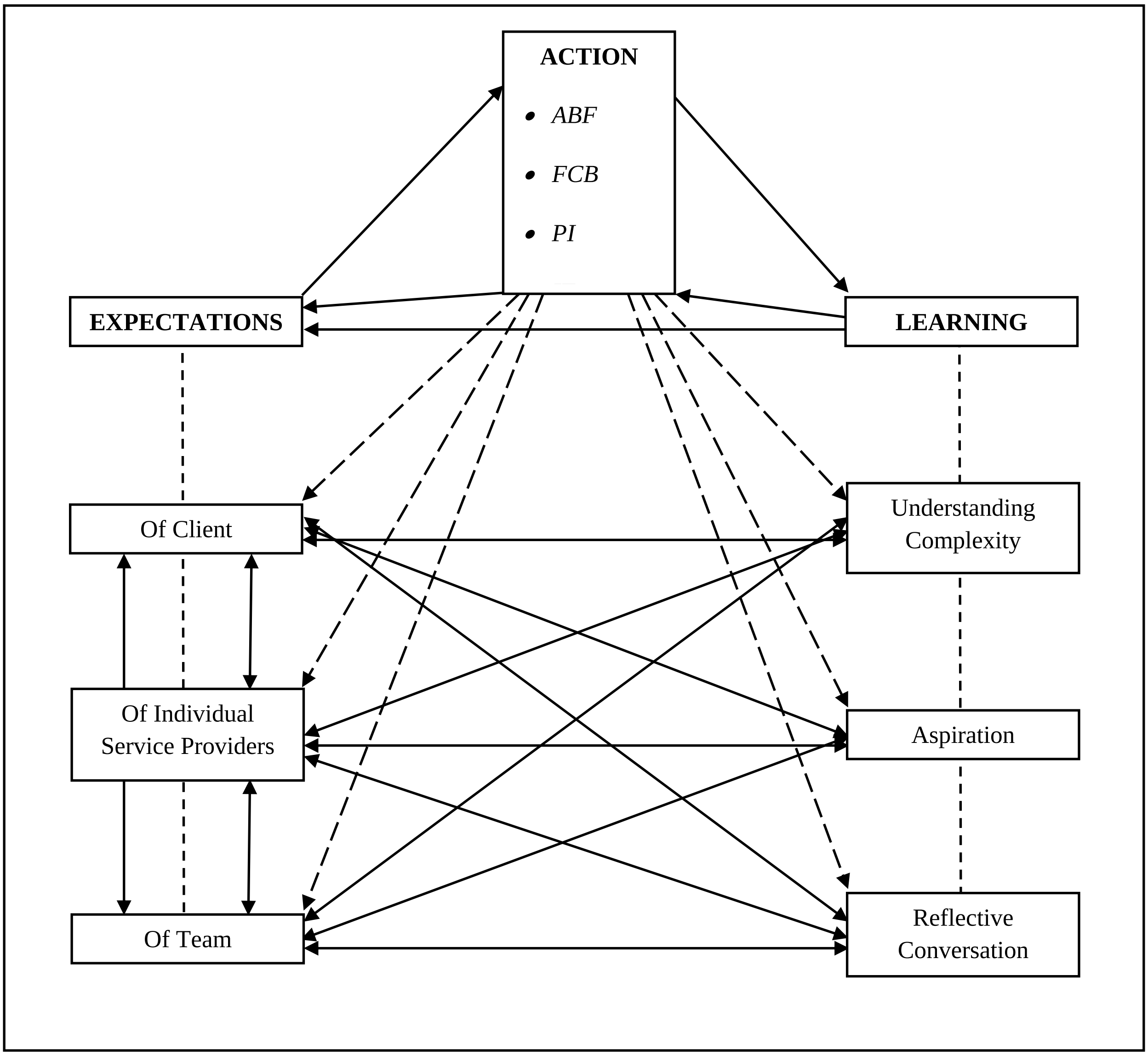


Figure 1.3: Action, Expectations and Learning as related to the stakeholders.

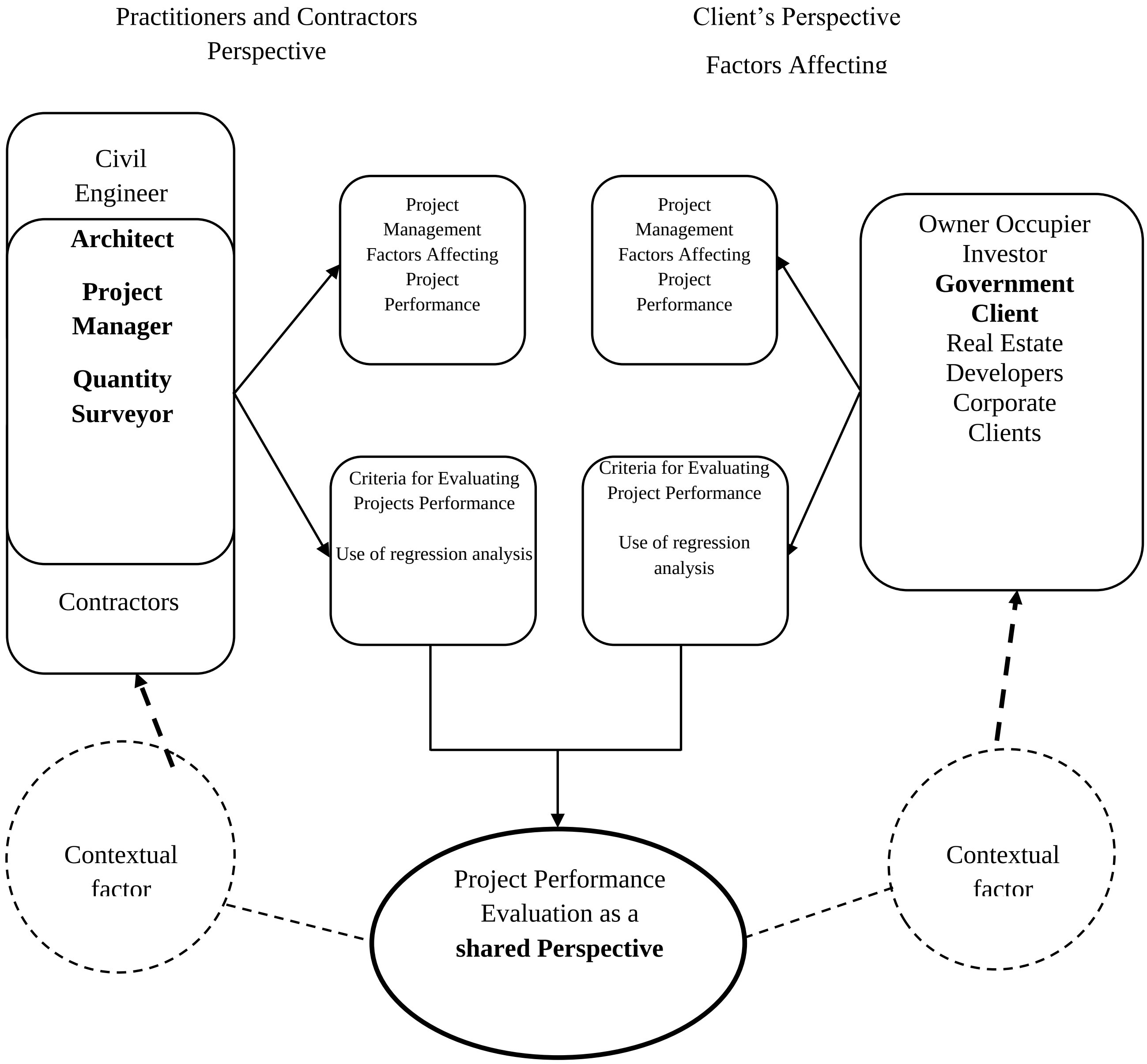


Fig 1.4 The research theoretical framework

1.11 CONCEPTUAL FRAMEWORK

Based on the above research framework the following conceptual frameworks were operationalized for the research. The following is the conceptual framework adopted for this study:

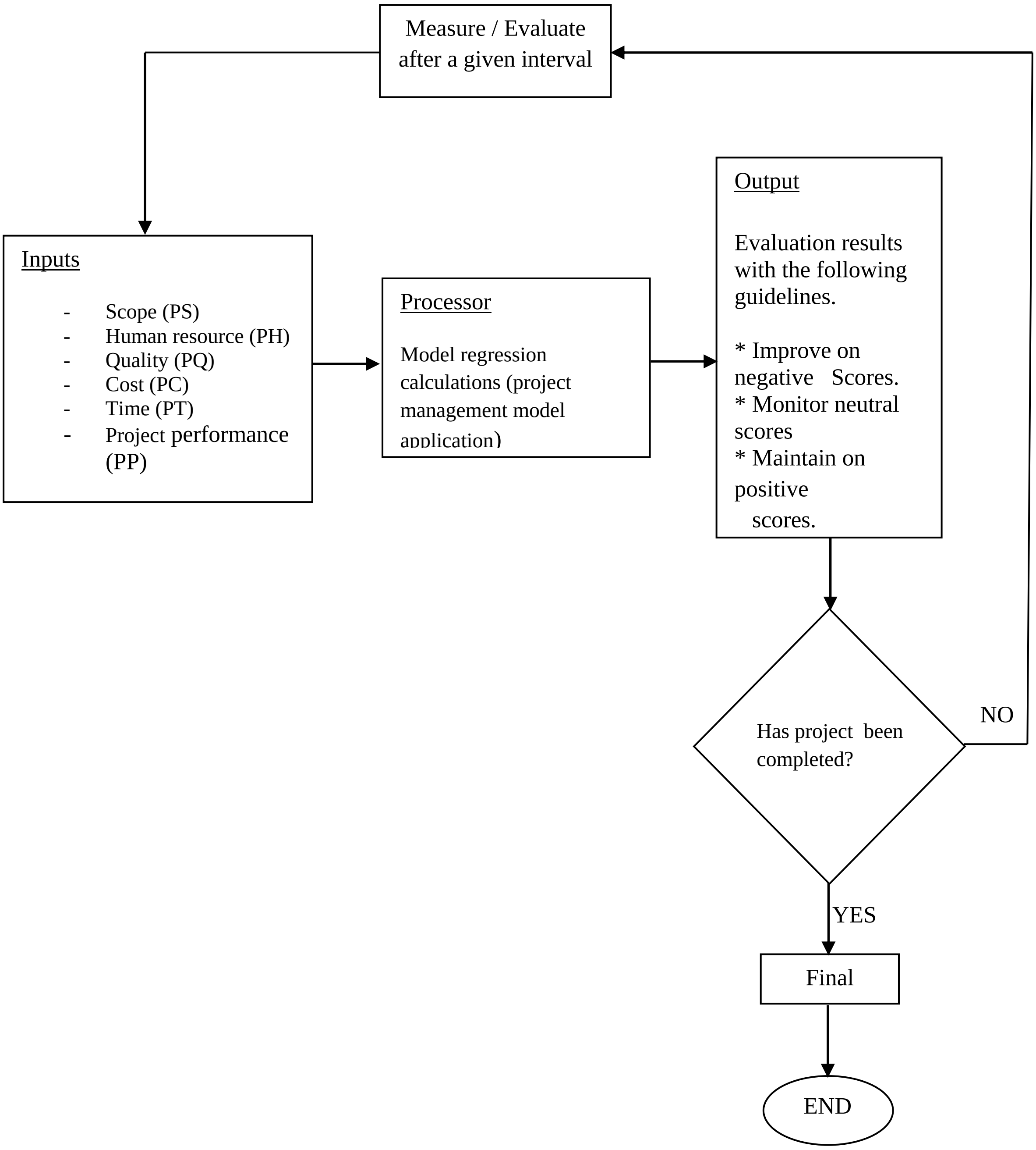


Fig 1.5: Conceptual model 1; Consultant and contractor contributions

Source: Own formulation; 2013

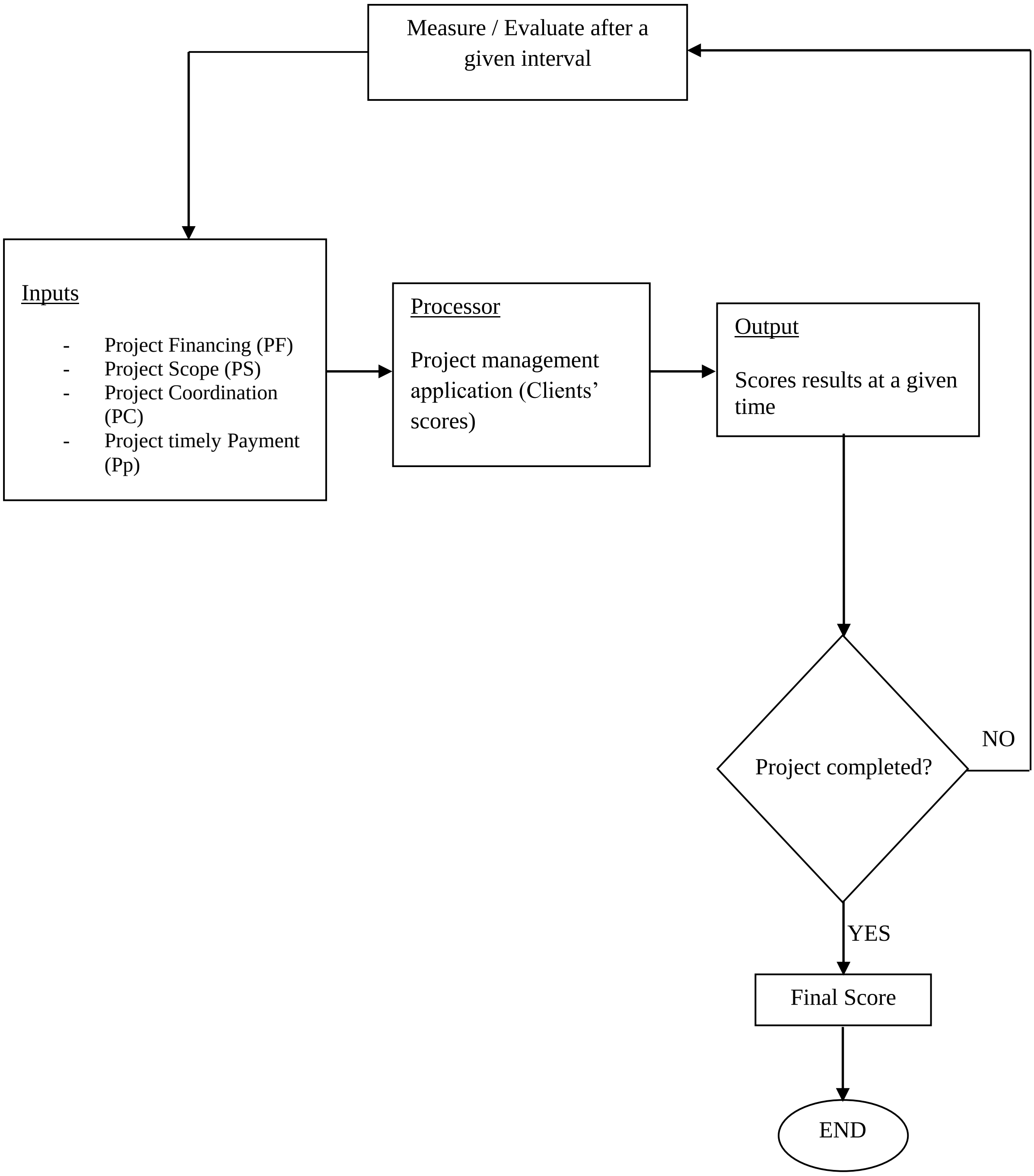


Fig 1.6: Conceptual model 2; Client's Assessment

Source: Own formulations; 2013

Effective project management application is then application of both conceptual flow diagram 1 and 2 to give the following combined equation.

$P_e = 82\% \ PME_{cs\&cr} + 18\% \ PME_{ct} \pm e.$

Whereby:-

P_e is the overall project execution efficiency.

$PME_{cs\&cr}$ is the consultant and contractor contribution component.

PME_{ct} is the Client's contribution to project performance.

e is an error which is a function of the operating environment, political situation and any other external factors that can influence the project.

1.12 METHODOLOGY

The research strategy adopted in this study is of a mixed approach with a larger extent of positivist (quantitative), which implies that the research process is largely deductive. Within this general positivist framework, elements of the phenomenological (qualitative) approach are also incorporated to provide alternative insight into the role of project management in the construction industry. Starting with basic observations and theoretical insights derived from literature, conceptual models and research hypotheses are developed and tested with the progress of the research. To meet the requirements of the objectives, the research process proceeded as follows:-

1 Comprehensive literature review to establish the relevant indicators
2 Questionnaire survey on the indicators in respect to Kenya
3 Data analysis
4 Model development
5 Feedback from the field on the performance of the model
6 Model validation

Data analysis is undertaken using descriptive statistics (particularly, means, frequencies), correlation analysis, Principal Component Analysis, ANOVA, and multiple regression using the statistical package (SPSS for Windows, Version 20). These analysis procedures show the nature and extent to which project management influences construction project performance.

Finally, the project evaluation model is created from the data analysis results. The research methodology is discussed in more detail in Chapter 3 later.

1.13 LIMITATIONS OF THE STUDY

A number of important limitations are identifiable with the current study. The first one has to do with the responses during the survey. It is not possible to ascertain that all the respondents answered the questions with the same level of honesty and openness. In addition, we estimate that no matter how candid respondents may be, the quality of their responses is limited by their ability to recollect from experience and also influenced by their present conditions. The effect of these potential deficiencies, however, is minimized by the multiple research methods used in the investigations and by use of check questions in the questionnaire.

Secondly, even though it has been suggested in literature that factors of project performance interact with each other as well as with indicators to impact on performance (Belassi & Tukel, 1996), the scope of this research could not allow this aspect to be included in the empirical investigation. This leaves an information gap that is needed to expedite the monitoring and control aspect of the model. This is because, in spite of the fact that the assessment model operates on contingency principles and that these interactions are addressed as they occur, such a knowledge base will be a resource that will guide the Project Manager and those responding to assessment questions, thereby expediting actions.

Finally, the focus of the research limited it to only the planning and construction phases of the project. After completion the views and satisfaction of facility users is not included. The research on performance of the projects that use this model and those that do not use as far as facility users are concerned is an area for future research.

1.14 DEFINITION OF TERMS

1. **Research** is the practice of discovering information that was not previously available by using a scientific approach. It is the procedure by which we

attempt to find systematically and with the support of demonstrable fact, the answer to a question or the resolution of a problem (Leedy, 2012).

2. **Project management** is the application of knowledge, skills, tools and techniques to project activities to meet project requirements within constraints of time, cost and quality by using planning, control, monitoring and evaluation management functions ((PMI, 2013)).

3. **A process** is a set of interrelated actions and activities that are performed to achieve a pre-specified set of products, results or services (Kerzner, 2013).

4. **Project integration management** knowledge area includes the processes and activities needed to identify, define, combine, unify and co-ordinate the various processes and project activities within the project management process group (PMI, 2013).

5. **Project scope management** includes the processes required to ensure that the project includes all the work required and only the work required, to complete the project successfully. Project scope management is primarily concerned with defining and controlling what is and is not included in the project (Burke, 2007).

6. **Project time management** includes the processes required to accomplish timely completion of the project (Lock, 2007)

7. **Project cost management** includes the processes involved in planning, estimating, budgeting and controlling costs so that the project can be completed within the approved budget (PMI, 2010).
8. **Project quality management** processes include all the activities of the performing organization that determine quality policies, objectives and responsibilities so that the project will satisfy the needs for which it was undertaken (Kerzner, 2013).
9. **Project human resource management** includes the processes that organize and manage the project team (PMI, 2013).
10. **Project information management** is the knowledge area that employs the processes required to ensure timely and appropriate generation, collection,

distribution, storage, retrieval and ultimate disposition of project information (Lock, 2007).

11. **Project risk management** includes the processes concerned with conducting risk management planning, identification, analysis, responses, monitoring and control on a project (PMI, 2013).

12. **Project procurement management** includes the processes to purchase or acquire the products, services or results needed from outside the project team to perform the work (PMI, 2013).
13. **Value engineering** is the organized approach to the identification and elimination of unnecessary cost (Kerzner, 2013).
14. **Project Management Evaluation Model** is a methodology which project managers employ in the design, planning, implementation and achievement of set project objectives.

1.15 ORGANISATION OF THE THESIS

The thesis comprises of six chapters and these have been organized as follows: Chapter one deals with the background to the research including justification, the statement of the problem, research hypothesis, aims and objectives, research methodology and the associated contribution to knowledge emanating from the research.

Chapter two addresses project management approaches, project performance indicators, project success factors; client's roles and expectations in projects and the role of project management in ensuring effective and efficient execution of projects. This chapter further discusses the construction performance and highlights the factors contributing to poor performance of the construction industry. Tools that deal with these issues are also discussed. The major project management models are evaluated with a view of ensuring their relevance or otherwise to the Kenyan situation; a developing economy. Existing project management models are also reviewed with lagging and leading measures discussed.

Chapter three addresses the research methodology adopted. The research methodology is described including the design of the research instrument and methods for collecting the relevant data. The research instruments, philosophical underpinnings for this research, sample selection criteria and data analysis methods adopted for this research are discussed.

Chapter four addresses the data analysis and presentation. This includes descriptive analysis of collected data and the use of appropriate statistical methods namely, one sample t-test and factor analysis on the dependent variables. Factor analysis and principal component analysis were used to help reduce the independent variables to a manageable size for the subsequent development of the model. The application of multiple regression analysis, analysis of variance (ANOVA), multicollinearity test and residual analysis are presented here. An in-depth discussion of the theoretical convergence and significance of the findings is also presented in this chapter. Finally model development is handled under this chapter.

Chapter five describes the functionality and measurement process and the methodology adopted in the validation procedure. The evaluation processes are discussed in terms of the key variables; intervals of measurements, key measurement scales and application procedures are discussed. It is devoted exclusively to the validation of the substantive model including discussions of the findings and the potential recommended application. The model measurement criteria and validation process are discussed under this chapter. The analysis of interview validation findings for the model from the field perspective based on fifteen projects and five senior consultants are also discussed. An alternative model based on logistic regression is also presented but the final model product realizes similar results as for multiple linear regressions. After the validation process this chapter leads to chapter six which is dedicated to conclusions and recommendations.

Finally, in chapter six; conclusions drawn from the work are presented and recommendations are made. Further areas of research are also suggested.

1.16 CONCLUSION

This chapter has provided an introduction into the research. Significance and justification of undertaking this research is further discussed and a conceptual model for the study is developed. To date, research has been mainly directed towards construction delays and cost overruns in the construction industry in Kenya. Particularly there has been no deliberate effort to model empirically the role of project management in Kenya. Research has mainly centred on the lagging measures and not on leading measures of construction performance. Also project management evaluation criteria has been mainly on traditional measures of quality, time and cost which have been indicated to account for only 57% of the performance of projects. This explains why despite several studies on the subject; little change has been noticed in the industry in Kenya. There have been very few structured models on the performance of construction projects at pre-contract and post-contract phases in Kenya. However, these models lack the tools to facilitate communication and deal with the problems that occur during the pre-project planning and project execution processes in Kenya. The development of a project management model for improving projects execution is aimed at ensuring effective and efficient construction process in Kenya. In the next chapter a comprehensive literature review covering existing researches on the area, construction performance indicators, approaches and construction project management modeling are covered.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

This chapter presents review of the literature related to project monitoring evaluation. It begins by highlighting some key concepts which provide the basis for the required change in paradigm. On the basis of considering the project as a temporary organization, the relationship between project performance and the performance of other organizations is explored. Eventually, the case for construction project performance as a business issue is made. This provides a reason for which lessons can be drawn from performance measurement concepts in the business world.

In the literature review process, four key performance measurement frameworks from business organizations were identified and related to the project situation as a ‘temporary organization’. Next, the theory of the project as a temporary organization was explored in detail. In combination with other theories of the organization a theoretical framework was developed which guided empirical investigation into the measurement of project performance in Kenya. Use of project performance evaluation for purposes of improvements as a means of influencing a country’s construction industry development agenda was investigated. Some notable models were analyzed and key problems with approaches being used were identified. Finally, the Kenyan construction industry was scrutinized in the light of the foregoing.

In this chapter, the quest by construction industries everywhere to improve their performance and the need for developing economies to emulate developed economies in project management modeling is addressed, and then the role of project evaluation in the development of construction industry discussed. The use of project performance evaluation as a managerial means of addressing project execution challenges is explained. In conclusion, it is pointed out that Kenya needs to follow the path of developed countries and address the numerous problems confronting her industry via a paradigm shift *from use of lagging measures* of project evaluation *to use of leading measures* of project evaluation.

2.2 CURRENT PRACTICE OF PROJECT MANAGEMENT

Ofori, (2001) posits that the absence of measurable targets in the development programmes to guide and assess, at intervals, the success of their implementation is a possible reason for lack of progress and the persistence of problems in the construction industry. Following a deliberate process of continuously monitoring the performance of the construction industry everywhere based on relevant indicators is, thus, at the core of the quest to develop, improve and sustain the industry. This research sees this as an important aspect of the global agenda for construction industry development and its sustainability. More importantly, this goal could be better achieved if the approach takes into consideration the very peculiar nature of the industry as outlined by (Hillebrandt, 2000):

(i) the nature of the final product,
(ii) the structure of the industry and the organization of the construction process,
(iii) the determinant of demand,
(iv) method of price determination. Koskela (2000a) summarized it as: "one-of-a-kind production, site production and temporary product organization".

This peculiarity in itself poses the first challenge regarding the quest of its development. However, in the industry's quest for development through performance assessment, the research notes a central problem. In the majority of cases, attempts at using indicators to track and monitor the improvements in the construction industry have been to address the problem en bloc. Beatham *et al* (2004) notes five problems with this approach in relation to construction companies: -

1. They focus on post-event lagging key performance outcomes at a very high level that offered little opportunity to change and were not used by businesses to influence managerial decisions.
2. The key performance indicators were not aligned to the strategy or business objectives of construction companies.
3. They were designed for cross industry benchmarking purposes, but due to a lack of certainty in the data, problems with different procurement routes and lack of validation of results, this level of benchmarking is not thought to be viable.
4. The key performance indicators do not provide a holistic, company-wide representation of the business.

5. They are not incorporated into a Performance Measurement system (PMS). It is the position of this research that the objective of improvement in the construction industry would be better achieved if the industry is rightly divided into its major component parts, that is, *clients*, *construction firms*, *practitioners* (consultants, project managers), *products, the material suppliers* and *consumers/the publics* and the other *stakeholders*. These will need specific indicators of measurement for monitoring and evaluation to accomplish specific purposes of interest. Consequently, the performance of the construction industry of any country will be the aggregation of the performance of its components. Thus, the improvements in the construction industry of any country as measured by its performance at any time should be represented by the aggregation of the improvement of its components; and that the overall development of the construction industry of any country at any time should be represented by the aggregation of the developments of its components. Towards these end, the critical issues to address are: -

1 How to assess the performance of each of these components for their effective management over time through continuous evaluations.

2 How to assess and manage the performance of the construction industry on the basis of the results of the performance of its components as a shared perspective.

One characteristic of construction projects is their continuous growth in size and complexity as technology advances. Another characteristic is the involvement of different people in the development of the project and their different roles and responsibilities. There are many types and sizes of projects; they range from small domestic projects which may only take minimum effort and time to prepare to the large international projects which involve much higher cost and effort (Sherif, 2002). However, although many organizations allocate appropriate managerial resources for their large projects, they fail to do so for their smaller projects, which in turn make proportionally greater losses. Each project has its own characteristics, but they also have a common life cycle, which needs to be defined. Projects have a beginning and an end, are made up of a large number of tasks and demand resources to execute them. Most projects have the following features;

- A start and finish
- A life cycle
- A budget with an associated cash flow
- Activities that are essentially unique and repetitive
- A team of people
- Use of resources, which may be from different departments and which need coordination
- A single point of responsibility (the project manager)

Before discussing what needs to be done to improve construction project management performance via project modelling, it is essential to shed some light on the problems that cause poor performance and identify those factors that affect construction performance. The construction industry faces many barriers to achieving high quality performance, as a result of the complicated nature of the industry.

Literature reveals that productivity, value for money and overall client satisfaction in the construction industry is low compared to other industries. There appears to be no single factor that is responsible for this. This view was expressed by Cox & Townsend, (1998) who argued that "a range of factors is more realistic conclusion to the factors contributing to the inefficiency of the construction industry". They identified some of the problems and barriers to achieving value for money, they include;

- Low and discontinuous demand
- Frequent changes in specifications (variations)
- Inappropriate contractors/consultant selection criteria
- Inappropriate allocation of risk
- Poor management
- Inadequate investment

- An adversarial culture
- Fragmented industry structure

It is by understanding these problems that an appropriate model can be developed. In his report, Latham (1994) reaffirmed the conclusion of several previous studies on the subject. The Latham report focused on the fragmented nature of the industry as a major factor that contributes to poor communication between all parties working on a construction project. The main recommendation within the Latham report was the need for significant cost savings by utilizing the formulation of effective construction processes, which will in turn lead to increased project performance.

The Kenya Government has developed various strategies to address construction challenges such as the establishment of National Construction Authority (NCA) to enforce construction standards for contractors, Public Private Partnerships in training, more polytechnics in the country and training of more artisans. But there is still a gap in projects performance despite the aforementioned intervention strategies hence this study. The fragmentation of construction has resulted in several problems such as the lack of adequate co-ordination of the project participants involved in the construction activities. This results in rework and changes in design, which lead to extra cost and time and consequently disputes and litigation (Ashworth, 2010).

According to Bennett et al (1988), Latham (1994), (Atkin & Pothecary, 1994), CIT (1996) and (Egan, 1998), the underachievement of the construction industry, is reflected in the following:

- Little investment in research
- Unreliable rates of profitability
- Poor training and shortage of skills
- Inadequate selection of designers and contractors by clients on the basis of tendered price

The increased awareness of the present position has been driven by the Latham review report published in 1994 and the reports of the construction task force undertaken by Egan at the request of the Development of Trade and Regions (DETR);

in the UK. The previous discussion has shown that poor construction performance can be attributed to two main aspects, namely;

- People issues or soft issues that deal with people and cultural aspects
- Process issues, which deals with tools, techniques, procedures

Gibson & Griffith, (1997); and Muchungu, (2012), emphasized that people are the most important asset in construction, therefore managing people is important in any attempt to improve the performance of construction industry. However, the theme of the people is more difficult to measure and define due to various reasons. Among these reasons are that people usually perceive things differently. These different objectives are seen as a main cause of conflict by many researchers. It is often difficult to bring together adverse relationships and in a co-operative environment because each party involved have their own objective.

The process issues include tools, techniques and procedures. It is important to adopt effective processes that lead to improved performance. Low (1998); and (Tucker & Ambrose, 1998) emphasized that insufficient construction process is the cause of the underachievement of the construction industry.

To achieve client satisfaction, minimize the risk of any changes during the construction period and ensure project success, the early phase in the project life cycle is recognized as being very important. During this phase, the involvement of the client is critical in order to ensure that all of the requirements are taken into consideration.

A review of literature on project success has demonstrated that project success has been the focus of many studies. But noticeably, much of the research concerning project success focused on identifying the critical success factors that lead to the project success, mainly cost, schedule and time performance (Ashley et al., 1987); (Pinto & Slevin, 1988). Many other studies related project success to teamwork and emphasized the importance of teams to the success of a project. Larson, (1995) stated that project success could only be achieved if owners and contractors work as a team and establish common achievable objectives.

The success of a project can be measured in terms of different variables such as, cost, time, quality and safety (Turner, 2007; Ashley et al., 1987; Sanvido, et al., 1992)).

Further, (Beale & Freeman, 1992) outlined that success can be measured in three ways, “sponsor (customer or user) measure, project manager measures and sponsor internal project manager measure”.

Businesses within the construction industry have, for many years, been implementing new initiatives to improve productivity and attain quality gains (Sarshar, 1998), (British Quality Foundation, 1996). Despite the attempts to improve productivity, the targets are not often being met yet. In UK, Egan (1998) called for productivity improvement and urged the industry to focus in particular on construction process. Productivity is an extremely important measurement tool within the construction industry, as well as the economy as a whole.

Wild, (1995) defined productivity as “a relationship between the output generated by a production or service system and the input provided to create this output”. This is referred to as total productivity. Olomolaiye, et al., (1998) define productivity as “ a measure of the output of the factors of productivity over a defined time period, a measure of how well the resources are utilized as well as the factors behind the production itself”. This can meaningfully be evaluated during project implementation.

Productivity is widely known as a relationship between the inputs and the outputs, often expressed as the outputs divided by the inputs. The basic level of productivity is that of the consumption of resources on the project such as labour, money, time, materials and plant (Sanvido 1988; Barrie & Paulson, 1992; Fox, 1993). The measurement of productivity varies depending on the purpose of measurement. For example, time and cost are the measurement of productivity in the project level (Ireland, 1992; Jaggar & Martin, 1994).

Quality is meeting the needs and satisfaction of the ultimate end user of the project, the owner (Oberlender, 2014). It is the responsibility of all the project team. Quality is about meeting the general customer requirements both now and in the future. Quality is the ratio of what is offered versus of what is expected (Thiry, 1997).

Total Quality Management was founded on the principles advocated by Deming, Juran and Crosby. Deming was famous for his role for turning Japan into a giant and dominant economic power after the end of the war. Figure 2.1 illustrates the evolution of the philosophy, practices and techniques of TQM.

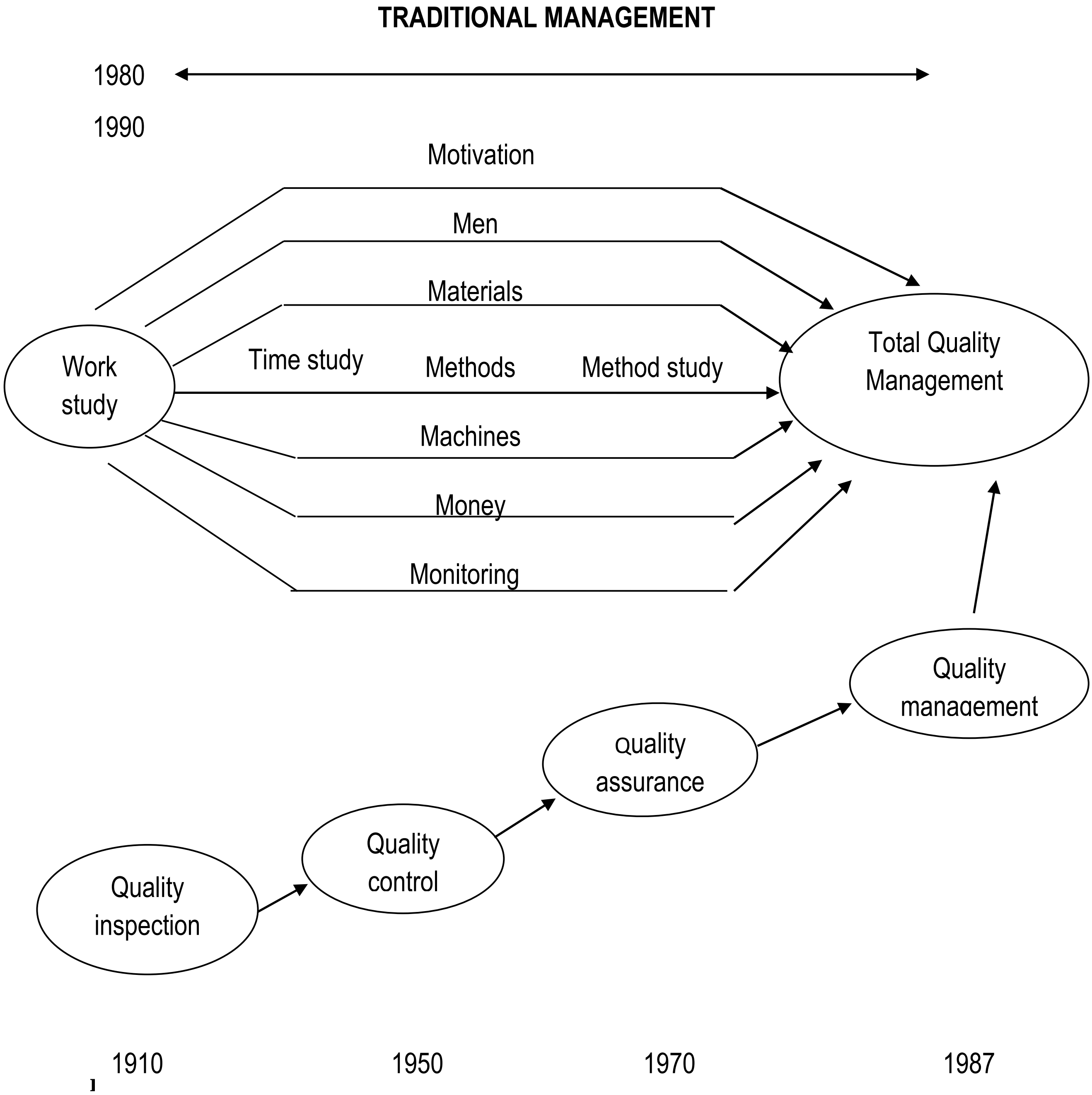


Fig: 2.1 The Evolution of Techniques and Philosophy Leading to Total Quality Management (Adopted from: Hearld 1993)

TQM management includes ideas that participants should work together for a common goal that includes partnership with suppliers and customers (Oakland, 2003). Saylor, (1996) stressed that TQM principles are based on the following: orientation, customer satisfaction, emphasis, continuous improvement of quality, measurement, establish priorities and quantification, human resources, respect for employees and their ability to improve the quality of business process, teamwork and leadership and organization issues, company wide support of TQM principles, starting at top cross functional approach to managing business process.

2.3 MEASUREMENT OF PROJECT SUCCESS

The success of a project would normally be measured by the extent to which the predetermined targets set by the Client have been met, whether it performs the function it was intended to meet satisfactorily and if it solves an identified problem within the stipulated time, cost and quality standards. To meet the objectives, the project will require effective planning control through the application of project management systems as argued by Muchungu, (2012) in his research.

Projects have an element of risk and the tasks leading to their completion may not be described with accuracy in advance. The function of project management is, therefore to predict as many of the risks and problems as possible and to plan, organize and control activities so that the project is completed successfully. This process must start before any resources are committed and continue until the project is completed to the satisfaction of the Client, within the promised timescale, without exceeding the financial allocation and to the highest quality standards achievable (Kerzner, 2013). Developed countries have made use of project management models to ensure effective and efficient projects execution; the current research is an attempt to replicate the same in Kenya.

There is need for developing countries to emulate the approaches of developed economies. Problems identified with the existing models prompted a discussion on the need to reconfigure the measurement process and the measures used. In addition, it is argued that research into the industry should consider the industry as a system. Kenya needs to follow the path being taken by the developed countries and address the numerous problems confronting its industry via project management modelling.

Khosravi & Afshari, (2011), discuss a success measurement model for construction projects in Singapore. The aim of their journal paper was: to develop a success measurement model for construction projects to fulfill two main objectives: to provide a project success index for finished projects in order to compare them with each other and to establish a benchmark for future improvements in success of construction projects execution. The model's output is a project success index which is calculated based on five project success criteria. According to them, the project success index will be calculated by using the following equation:

$$PSI = 0.209PTP + 0.233PCP + 0.199PQP + 0.173PHP + 0.186PCP \quad \ldots\ldots.. \quad (2.1)$$

Where: PSI: Project Success Index; PTP: Project time performance; PCP: Project cost performance PQP: Project quality performance, PHP Project Health and Safety Performance and PCP is Project Clients' Performance. All five success criteria should be measured based on an approach applied by each project-based organizations. It is therefore the argument in this research that that Clients' contribution to the performance of construction projects can be set at 18% while the rest of the team members contribute to 82%; an argument advanced in this research.

A construction project is one where the objective is to build, extend or refurbish a visible and tangible facility that is of sufficiently large size that requires engineering analyses and design to ensure that the facility will be fit for purpose and be able to safely withstand the physical forces that will be applied to the facility during its life. A facility that is constructed as such is called a *constructed facility*. Project management is the professional discipline which separates the management function of a project from the design and execution functions. Management and design may still be combined on smaller projects and performed by the leader of the design team. For larger or more complex projects the need for separate management has resulted in the evolution of project management (Lock, 2007).

Project Management is a specialized management technique necessary for the planning, organization and control of industrial and commercial projects under one strong point of responsibility. Modern project management emerged some fifty years ago in the United States and has been evolving ever since particularly in connection with the defence and aerospace industry, process engineering and development of computers (Massie 1998). Project management may be defined as "the overall planning, coordination and control of a project from inception to completion aimed at meeting a client's requirements in order to produce a functionally and financially viable project that will be completed on time within authorized cost and to the required quality standards." It is the discipline of planning, organizing, securing and managing resources to achieve specific goals. A project is a temporary endeavor with a defined beginning and end (usually time-constrained, and often constrained by funding or deliverables) undertaken to meet unique goals and objectives, typically to bring about beneficial change or added value. The temporary nature of projects stands in contrast with business as usual (or operations), which are repetitive, permanent, or semi-permanent functional activities to produce products or services. In practice, the management of these two systems is often quite different, and as such requires the development of distinct technical skills and management strategies (Kerzner, 2013).

For purposes of this study the definition of project management shall be taken as the overall planning, coordination, directing, organizing and controlling of a project from inception to completion aimed at meeting a client's requirements in order to produce a functionally and financially viable project that will be completed on time, within authorized cost, approved scope and to the required quality standards.

Project management in construction has evolved to plan, coordinate and control the complex and diverse activities of modern industrial, construction, commercial and civil engineering projects. All projects share one common characteristic- the projection of ideas and activities into new endeavours. The ever-present element of risk and uncertainty means that the events and tasks leading to completion can never be foretold with absolute accuracy (Ritz & Levy, 2013). Project management in construction aims at minimizing some of the effects leading to project failures and or challenges by introducing a structured approach to projects execution. With deregulation and privatization, large companies and government departments have been forced to become more competitive and more customer focused. One way of achieving this is to package their work as small projects (Karamaju, 2010). Combine this with projects becoming more technically complex, with shorter durations and tighter budgets, hence there is need for companies to adopt appropriate construction project management to plan and control their scope of work. This thesis analyzes the effectiveness and impacts of construction project management as a method and strategy in Kenya to execute projects within time, cost and of the specified quality so as to develop an appropriate project management evaluation model for the construction industry in Kenya.

Successful project management can then be defined as having achieved the project objectives:

- Within the allocated time period
- Within the budgeted cost
- At the proper performance or specification level
- With acceptance by the Client and or user
- When you can use the Client's name as a reference
- With minimum or mutually agreed upon scope changes
- Without disturbing the main work flow of the organization
- Without changing the corporate culture
- While utilizing the assigned resources effectively and efficiently

2.4 DISTINCTION BETWEEN GENERAL MANAGEMENT AND PROJECT MANAGEMENT

The management of construction projects requires knowledge of modern management as well as an understanding of the design and construction process. Construction projects have a specific set of objectives and constraints such as a required time frame for completion. While the relevant technology, institutional arrangements or processes will differ, the management of such projects has much in common with the management of similar types of projects in other specialty or technology domains such as aerospace, pharmaceutical and energy developments (Barrie & Boyd, 2014).

Generally, project management differs from the general management of corporations by the mission-oriented nature of a project. A project organization terminates when the mission is accomplished (Kerzner, 2013).

The basic ingredients for a project management framework are represented schematically in Figure 2.2. A working knowledge of general management and familiarity with the special knowledge domain related to the project are indispensable. Supporting disciplines such as computer science and decision science may also play an important role. In fact, modern management practices and various special knowledge domains have absorbed various techniques or tools which were once identified only with the supporting disciplines.

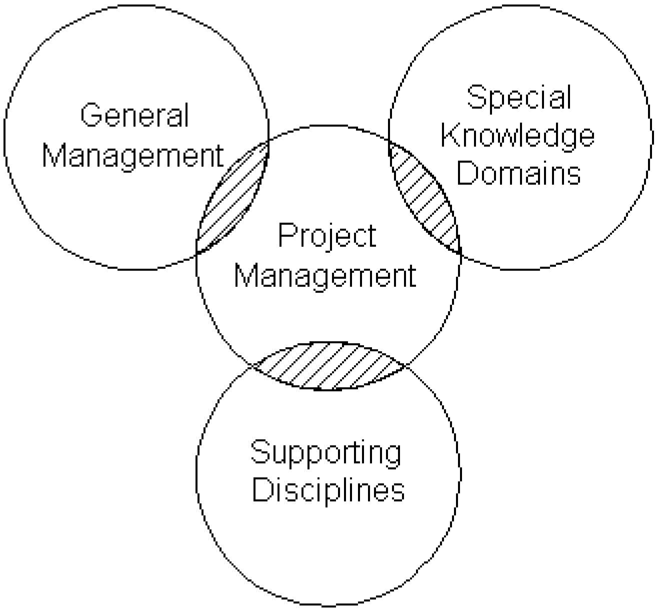


Figure 2.2: Basic Ingredients in Project Management (Source: (PMI, 2013)

Specifically, project management in construction encompasses a set of objectives which may be accomplished by implementing a series of operations subject to resource constraints. There are potential conflicts between the stated objectives with regard to scope, cost, time and quality, and the constraints imposed on human, material and financial resources. These conflicts should be resolved at the onset of a project by making the necessary tradeoffs or creating new alternatives. Subsequently, the functions of project management for construction generally include the following (PMI, 2013):

1. Specification of project objectives and plans including delineation of scope, budgeting, scheduling, setting performance requirements and selecting project participants.
2. Maximization of efficient resource utilization through procurement of labour, materials and equipment according to prescribed schedule and plan.
3. Implementation of various operations; through proper coordination and control of planning, design, estimating, contracting and construction in the entire process.
4. Development of effective communications and mechanisms for resolving conflicts among the various participants.

2.5 REVIEW OF CONCEPTS LEADING TO A PARADIGM SHIFT IN PROJECT MANAGEMENT MODELLING

Performance theorists are propagating the need to use multidimensional criteria or a balance scorecard to assess the project management performance of a business or a project (Kaplan & Norton, 1996; Shenhar *et al*, 1997; Van develde *et al*, 2002). Atkinson, (1999) calls for a break from the 50-year old tradition of measuring project performance (success and failure) in terms of the "iron triangle" that is cost, time, and quality. The use of multi-dimensions or multi-criteria in assessing project has been well acknowledged in project management literature (Cooper & Kleinsmidcht, 1987; Pinto & Slevin, 1988; Pinto & Mantel, 1990; Beale & Freeman, 1992; Dvir & Shenhar, 1992; Lipovetsky, et al., 1997). In particular, (Pinto & Mantel, 1990) provided an empirical justification for a multidimensional construct of project failure, encompassing both internal efficiency and external effectiveness aspects. They established that critical factors associated with failure depend on how failure is defined and also how organizations make judgment on the matter. They suggested that future research on project failure must take into account a variety of contingency variables, such as the type of project, and the stage of the project in its life cycle. The strength in using multi-measures to assess project is also rooted in the fact that several factors often combine together to result in the performance or non-performance of a project. Ojiako, et al.,(2008) confirmed that: "there is no single project factor that will, in its entirety, influence the chances of a project failing or succeeding; rather, project failure or success occurs through a combination of events occurring on a continuous basis". It is therefore necessary to keep evaluating project performance throughout its lifecycle; a key concern for this research.

In the business world, this has also been noted. Writing under the topic "performance measurement manifesto", (Eccles, 1991) submitted that "the leading indicators of business performance cannot be found in financial data alone. Quality, customer satisfaction, innovation, market share –metrics like these often reflect a company's economic condition and growth prospects better than its reported earnings do. Depending on an accounting department to reveal a company's future will leave it hopelessly mired in the past". The paradigm shift that occurred thereafter is that most managers began "changing their company's performance measurement systems to track non-financial measures and reinforce new competitive strategies”. According to (Eccles, 1991), this has been made possible and economically feasible by new technologies and sophisticated databases. “Industry and trade associations, consulting firms, and public accounting firms that already have well-developed methods for assessing market share and other performance metrics can add to the revolution's momentum –as well as profit from the business opportunities it presents”. Eccles, (1991) hopes that when one leading company can demonstrate the long-term advantage of its superior performance on quality or innovation or any other non-financial measure, it will change the rules for all its rivals forever.

2.6 PROJECT MANGEMENT MODELLING: MOVING FROM “AUTOPSY” REPORTS TO “HEALTH” REPORTS

According to (Beatham, et al., 2004) the present practice of project success/failure measurement encourages the measurement of project performance with “lagging indicators” and leads us to expect project “autopsy reports”. This, however, does not offer opportunity for change and improvements as expected from evaluation in the first place. If the concept of organizational learning, as explained by Senge (2006), could be of benefit to the on-going project, and if lessons learnt from a completed project could provide a guide for future projects, then in this case the assessment should cover its entire “life story”. The question here is, whether the success or failure of a project is of any relevance to the project after they had occurred? To correct these, such measurements should always be aimed at giving opportunities to change and, always leading to improvements in performance. This suggests, then, that the assessment of a typical construction project should be done:

i. throughout its life cycle,
ii. with the intention of declaring the true state at any point in time,
iii. in order to ensure that the necessary objectives are achieved,
iv. to ensure improvements in those areas where success is not being achieved.

This calls for the determination of what is happening to the project in all its aspects throughout its life cycle and be able to predict performance based on real-time information (Russel et al., 1997). Indeed, Mian, et al., (2004) noted that as human health is maintained by identifying and monitoring those factors which have the potential of influencing it, so must those critical factors be monitored which have the potential of influencing the project's health; and "this approach", they argued, "is applicable to all phases of the construction projects and many construction procurement methods". In that article "project health" was said to be synonymous to "project performance". In a related article (Humphreys, et al., 2004) identified some parallels between construction project health and human health:

- State of health influences performance;
- Health often has associated symptoms;
- Symptoms can be used as a starting point to quickly assess health;
- Symptoms of poor health are not always present or obvious;
- State of health can be assessed by measuring key areas and comparing these values to established norms;
- Health changes temporally;
- Remedies can often be prescribed to return to good health; and
- Correct, accurate and timely diagnosis of poor health can avoid *(prevent)* small problems becoming large.

Willard, (2005) proposes that projects could be declared "challenged", "failed", "successful". Within this framework, it is possible to describe a project's "health" in several ways depending on the conditions of its "health": *frustrated, disturbed, paralyzed, distressed* towards the undesirable end; and then, expressions like *healthy, improved, progressing, and satisfactory,* towards the desirable end. Success itself could be qualified, for example, *very, quite, extremely, somewhat successful* and so on, based on technical definitions ascribed to them. Hence project management writers have used the term "project performance" interchangeably with success/failure and "performance measurement modelling" with "success/failure measurement" (De wit, 1988; Mian et al., 2004; Beatham et al., 2004). This has been followed by the use of such terms as "performance Indicators" or "Performance measures". The term "Performance" is thus the key word in this research used to represent how a project is succeeding in achieving its set goals and objectives by continuous assessment. This research, focusing on construction projects within its life cycle and appreciating the required continuous monitoring and evaluation during the implementation period, prefer the use of the expression "project performance" to represent the overall state of the project based on the degrees of success or failure at any stage. Ojiako et al., (2008) also prefer to use the same expression. By this consideration, performance will be assessed in multi-criteria; and in various degrees on a continuum ranging from excellent performance (very successful) to poor performance (overall failure) in specific criteria or dimensions. This calls for the identification of the key sets of principles, measures, indicators as would be necessary for the measurement of the performance of projects. The quest towards what constitute a successful project is, thus, directly linked with the greater quest for improvements in project performance.

2.7 PROJECT SUCCESS AND FAILURE CONSIDERED WITHIN THE "TWO-FACTOR" THEORY

One of the causes of the difficulty in reaching consensus on the definition of project success or failure lies in the fact that these two have been treated as a dichotomy. This research takes the view that the two are not mutually exclusive and that they could, in fact, exist together across the stages of the project life cycle. Also called the 'Hertzberg's Hygiene-motivation' factor, the 'Two-factor' theory can be used to explain the relationship between project success and failure from the point of view of their underlying factors. Proposed by Hertzberg *et al*. in 1959, this theory indicates that the factors leading to 'satisfaction' are separate and distinct from the factors that lead to 'dissatisfaction'. Hence satisfaction and dissatisfaction can exist independently and simultaneously so long as the factors producing them exist. It postulates that the opposite of "Satisfaction" is not "Dissatisfaction" but "No Satisfaction", and the opposite of "Dissatisfaction" is not "Satisfaction" but "No Dissatisfaction" (Robbins, 2005). Applying this theory to the project situation then puts the success and failure question into a dual continuum, rather than a dichotomous, situation. We can speak of "success", "no success", "failure" and no "failure" of aspect of a typical project within the phases of its life cycle based on the influencing factors. With regard to the influencing factors, (De wit, 1988) posits thus: "factors affecting project success or failure are usually good indicators of preconditions of success or failure". He considered them to be analogous to Hertzberg's hygiene/ motivation factors in that the presence of success factors does not guarantee success but not identifying them (their absence) is likely to lead to failure. Therefore in the project situation, the factors that lead to success could, sometimes, be separate and distinct from the factors that lead to failure that is the absence of those success factors should not always be seen as the only causes of failure. Hence there could be a condition for a project in which evaluation will result in "no success" without necessarily implying "failure". In practice, this is realized by using multi-measures to assess projects. In such a situation a project could fail in some criteria but perform very well in others. In assessing a construction project thus, a fundamental theory to embrace is that the absence of success does not necessarily indicate a failure and vice versa. This position is explained by considering the various interest groups (stakeholders) within a typical construction project with diverse focus, expectations and what is of essence to them across the project life cycle.

2.8 CONTINGENCY THEORY

An impression created by project management practitioners and underscored by the Project Management Body of Knowledge (PMBOK, 2013) is that project management knowledge is applicable to all sorts of industries and environments (Engwall, 1992; Packendorff, 1995). Packendorff, (1995) contends that such a view positions project management as a field of study which is held together by conceptions of process rationality in which differences in outcome and process are disregarded in favour of alleged similarities. This difference clearly does not only exist between industries but also within the same industry, in the case of projects. Indeed, the lack of agreement as to what factors affect project success as acknowledged by project management researchers (for example, (Pinto & Slevin, 1987) has been blamed on the assumption by project management researchers that "a universal theory of project management can be applied to all projects (Dvir et al., 1998). Classical contingency theory suggests that different external conditions to an organization require different organizational characteristics, and that the effectiveness of the organization is contingent upon the goodness of fit between structural and environmental variables (Shenhar, et al., 2001). This class of behavioural theories posit that there is no one best way to organize a corporation, to lead a company or to make decisions (Vroom & Yetton, 1973). Alluding to this, (Shenhar et al., 2001) posits that "one size does not fit all", and talks of an organization concept project management. This falls in line with the philosophy of the project as a "temporary organization" (Packendorff, 1995;Lundin & Söderholm, 1995), and so on.

Consequently, due to the realization of the several "non-constants" surrounding project situations and its procurements, the research chose as it primary theoretical drive, the contingency theory as applied to project management, particularly, regarding performance measures and an evaluation model is developed.

2.9 CONSTRUCTION PROJECT AND BUSINESS MODELS DISCUSSED

This section further explains the relationship between construction project and business organization as a means by which best practice performance could be studied. Further, it highlights some key performance measurement models in the business world which are of relevance to this research. Defining performance as being on-time, on-budget, and meeting quality expectations, (Kashiwati, 2002) concluded that construction is a business issue and not an engineering technical issue: "a layman can identify whether the contractor finished on time, on-budget, and whether the owner's expectations were met". Thus, he argued that solving a business issue with technical specifications will not lead to performance. Further, he suggested that performance specification should include owner's requirement, and the *method* of identifying the best performance. The concept of project performance as a business issue was given a further support by (Dinsmore, 1999) in his book "Winning in Business with Enterprise Project Management". He explains that business prosperity depends on the efficient management of projects. According to him, this is achieved by adding value to the business and that "value is added by systematically implementing new projects –projects of all types, across the organization". He referred to this as Managing Organizations By Projects (MOBP) and later *Enterprise Project Management* (EPM) in which all business endeavours need to be well focused and result-oriented. This will enable organizations to apply project management to target strategic corporate needs, rather than merely accomplishing specific, isolated projects (Dinsmore, 1999). He outlines reasons why organizations are becoming "project-oriented", the relevant ones (to this research) of which are listed below: -

- This allows organizations to perceive themselves as dynamic composed of countless projects simultaneously being managed to completion.
- An organization's success depends on new projects, as opposed to excessive concentration on "business as usual".

- The time-to-market squeeze; companies experience demands that projects be completed on time, within budget, and meet the required quality standards and customer requirements.
- Quantum leaps in bottom-line effectiveness come from new initiatives, and that calls for project management.
- With project management in place, companies tend to improve customer satisfaction, market penetration, and financial results. Projects, thus, are seen by businesses as product lines or portfolios.

2.10 SOME RELEVANT BUSINESS PERFORMANCE MODELS

In addressing the issue of construction project assessment, the research also draws from business performance measurements, especially, those which provide measures that resonate with the construction project situation. Four of such relevant models are discussed. The first one is the "Results and Determinant model (Fritzgerald et al.,1991)" which deals with performance measurement of the service sector and it is based on the premises that there are two types of performance measures in any organization: those which relate to the results (*competitiveness and financial performance*) and those which relate to the determinants of the results (*quality, flexibility, resource utilization and innovation)*. The strength of this distinction by the model lies in its emphasis that results obtained are a function of past business performance with regard to specific determinants. Results, they explain, are 'lagging' indicators whereas determinants are 'leading' indicators. The second one is the "Strategic Measurement Analysis and Reporting Technique (SMART)" by (Lynch & Cross, 1991). Also called the "Performance Pyramid", a key feature of this model is that it makes explicit the difference between measures that are of interest to external parties –*customer satisfaction*, *quality* and *delivery* and those that are of primary interest within the organization –*productivity, cycle time and waste* (Neely et al., 2000). This model satisfies an important requirement of performance measurement system (PMS) in that it "links the performance measures at the different hierarchical levels in a company, so that each function or department strives towards the same goals" .The third is "the Balanced Scorecard (BSC) by Kaplan and Norton (1992)". The BSC is probably the most popular PMS among the emerging models for performance measurement in business and other organizations. This model allows top management to take a quick but comprehensive view of the business from four important perspectives which provide answers to the following (Kaplan and Norton, 1992):

- How do we look to our shareholders (*Financial Perspective*)?
- What must we excel at (*internal business perspective*)?
- How do our customers see us (*the customer perspective*)?
- How can we continue to improve and create value (*innovation and learning*)?

By combining financial measures and non-financial measures in a single report (it emphasizes that both must be part of the information system for employees at all levels of the organization), the BSC aims to provide managers with richer and more relevant information about activities they are managing than is provided by financial measures alone. The BSC provides managers with the instrumentation they need to navigate to future success (Kaplan & Norton, 1996). It provides them with a comprehensive model that translates a company's vision and strategy into a coherent set of performance measures (Kaplan & Norton, 1996). The BSC, exhibits the following four characteristics which provide a footing for the approach to assessing performance of projects contemplated in this research as shown on Table 2.1.

The last model to consider is the Performance Prism (PP) by Neely, et al., 2002)). The PP is underpinned by three fundamental premises (Neely et al., 2002):

- It is no longer acceptable (or feasible) for organizations to focus solely on the needs of one or two of their stakeholders –typically shareholders and customers –if they wish to survive and prosper in the long term;

Table 2.1: Mapping the characteristics of the BSC to the project performance measurement characteristics

The BSC (Kaplan & Norton, 1996)	**Useful application in the project situation**
It translates an organization's mission and strategy into a comprehensive set of performance measures that provides the framework for strategic measurement and management system.	To translate the expectations of the stakeholders (Clients and practitioners) of a project into a comprehensive set of performance measures that provides the framework for strategic measurement and management system.
It retains an emphasis on financial measures as well as including the performance drivers of these financial objectives.	To use all the relevant contingency measures (including financial ones) that will reflect the strategies, visions and expectations of the stakeholders.
It measures organizational performance across four balanced perspectives: financial, customers, internal business processes, learning and growth.	To measure the performance of the project across all relevant measures including financial, internal business process, environmental and social impacts in the perspectives of key stakeholders, in this case Clients and practitioners; and to use the assessment process to provide learning and growth.
It enables companies to track financial results while simultaneously monitoring the intangible assets they need for future growth (Kaplan & Norton, 1996).	To enable the project management team to monitor and control all aspects of the project through the relevant contingency.

- An organization's strategies processes and capabilities have to be aligned and integrated with one another if the organization is to be best positioned to deliver real value to all of its stakeholders;
- Organizations and their stakeholders have to recognize that their relationships are reciprocal. Stakeholders have to contribute to organizations, as well as expect something from them.

It is a three dimensional model made into a prism shape, with the top and bottom facets as *stakeholder satisfaction* and *stakeholder contribution* respectively. The three sides are *Strategies, Processes and Capabilities*. Thus, the PP consists of five interrelated perspectives on performance that pose specific vital questions: -

- Stakeholder Satisfaction –who are our key stakeholders and what do they want and need?
- Stakeholder Contribution –what do we want and need from our stakeholders on a reciprocal basis?
- Strategies –what strategies do we need to put in place to satisfy the wants and needs of our stakeholders while satisfying our own requirements too?
- Processes –what processes do we need to put in place to enable us to execute our strategies?
- Capabilities –what capabilities do we need to put in place to allow us to operate our processes?

The model, according to Neely et al., (2002)), has been designed to be highly flexible so that it can provide both a broad and a narrow focus as required. If only a part of the aspects of the performance management is required, such as a single stakeholder focus or a particular business process agenda, then the PP can be applied to designing a measurement system and appropriate measures (and their attendance metrics) that address that context. It is also, equally, capable of supporting broad corporate or business unit performance management improvement initiatives too (Neely *et al*, 2002). Unlike the Balanced scorecard, the Performance Prism starts with stakeholder satisfaction not strategy. Organizations stakeholders are likely to be a combination of a number of the following (Neely, et al., 2002):

- Investors (principally shareholders, but other capital providers too);
- Customers and intermediaries;
- Employees and labour unions;
- Suppliers and alliance partners;
- Regulators, pressure groups and communities.

The PP takes the view that these and their satisfaction criteria should form the basis of performance measures designs. "To derive measures from strategy", posit Neely *et al* (2002), "is to misunderstand fundamentally the purpose of measurement and the role of strategy". Significantly, they opined that performance measures are designed to help people track whether they are moving in the direction of their intended destination and to help them establish whether they will indeed reach their set destination. Strategy, however, is not about destination; but about the route you choose to take. Essentially, it is about how to reach the desired destination (Neely *et al*, 2002). They, thus, conclude that the starting point for deciding what measure to be used should not be "what is the organization's strategy?" But instead: "who are the organization's stakeholders and what do they need?" Hence in the PP, the first perspective on performance is that of the stakeholder satisfaction. The PP model has the most appeal to project management in general and this research in particular. Applying the PP concept to the project situation, there will be *quid pro quo* relationship through which the management of a project will be effectively enhanced in the following ways:

i. Clients' contribution to the project performance will be as equally important as their satisfaction. Therefore, clients will be expected to live up to their roles.

ii. Practitioners' maximum contribution and commitment to the project will be seen as the necessary means for ensuring good performance and thus, merit their fees and satisfaction.

iii. All other stakeholders on the project such as employees, contractors, end users and beneficiary community will recognize this relationship. This relationship in the project situation is illustrated in Figure 2.3 with the client at the centre dealing with a number of stakeholders.

Significantly, the BSC and the PP in particular touches on three key aspects which relate very much with the basis of the theoretical framework of this research. These are:

i. Strategies: this relates to motivation, expectation and culture;

ii. Capabilities (knowledge): this relates to people, learning, technology, practice, and infrastructure;

iii. Processes: this relates to actions.

The trend shows that the concepts of measurement, whether in the project situation specific (as a temporary organization) or in business enterprises (as a permanent organization) are adopting multiple measures to address several dimensions. On the grounds that performance measurement (whether for projects or organization) is a business issue, and that the project is a temporary organization, it is practicable to adopt and adapt some of the concepts and even measures from the other organizations to the construction project situation.

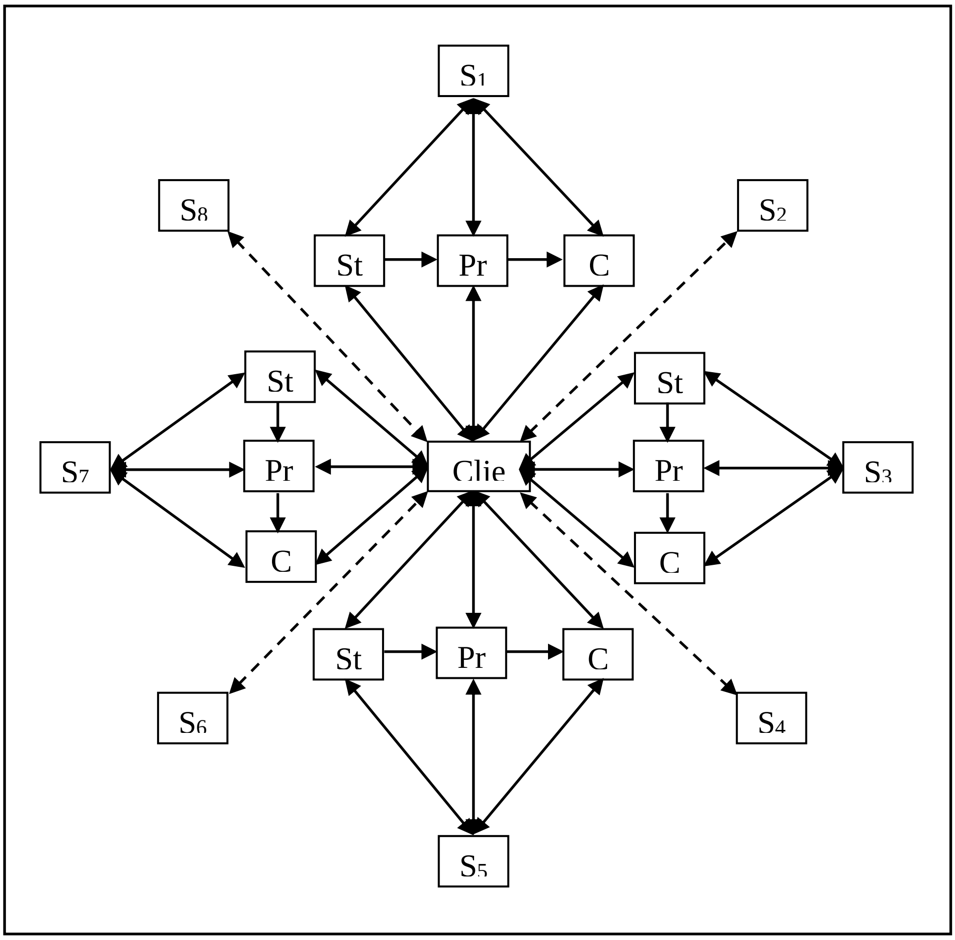


Fig: 2.3 Performance Prism adopted from Neely et al (2002)

[NB: S_1, S_2,............S_8 : Other stakeholders; St: strategy; Pr: processes; Cp: Capabilities]

More importantly, the concepts and philosophies behind these models hold a lot of promise to the construction projects (especially, in the case of the balanced scorecard and the performance prism). Neely *et al* (2002) believe that there is no one "holy grail" or one "best way" to view business performance. And that all the various models "can exist because they add value" (Neely *et al.*, 2002). Regarding the adoption and adaptation of best practices to the construction industry, (Mohamed, 1996) notes that the industry lacks consistent methods of measuring performance and data for benchmarking and therefore suggests that before some of these best practices could be applicable to construction, the benchmarking form being applied in the manufacturing sector should be re-dimensioned as:

i. **Internal benchmarking**: this has to do with the firm level performance assessment

ii. **Project benchmarking:** This has to do with the project level performance assessment

iii. **External benchmarking:** Industry level performance assessment

This research is focused on the internal and project benchmarking levels. It is the position of this research that such adaptations should also take place within the broader consideration of the construction project as a temporary organization. The main distinction that needs to be clarified should, of course, be between the production management aspect and the project management aspect of the project being implemented (Koskela & Howell, 2002c).

2.11 TOWARDS A THEORY FOR PROJECT MANAGEMENT

Evidence from literature indicates no sound theoretical basis of project management (Koskela & Howell, 2002c). In relation to this, (Anagnostopoulos, 2004) attributes the difficulty of most universities to recognize project management as an “autonomous scientific discipline” to its lack of a good theoretical base. He observes that instead of an underlying theory defining a discipline, in its state of maturing, Project Management has a peculiar situation in that establishing standards of the profession has preceded the development of its theory. In a related observation, Söderlund (2002a) observes that the rationale underlying most texts and articles in the *project management journal* considers project management as “a method” for solving complex organizational problems. In addition, the fact that there are diverse schools of thought (Söderlund, 2002b) argues, suggests apparently a discipline yet to define its overall focus and answer the key scientific questions. In his submission, (Packendorff, 1995) classified projects as a “tool” when it is underpinned by the concepts of *planning, control* and *evaluation*. Hence Koskella and Howell (2002a) conclude that “the underlying theory of project management is obsolete”.

Therefore, Judgev (2008) framed the importance of collaboration between academics and practitioners in developing a “good theory” for project management. This, he believes, will prevent the risk of running the discipline in a ‘theoretical’ and ‘ascientific’ way. However, Söderlund (2004) observes that this should not be seen as a sign of confusion. In reality, he saw it as an indication of a discipline that has a potential of continuously evolving into one that would be all embracing and linking to others, and the one that can possibly connect all. Söderlund, (2004) particularly observes the illumination of the cross-disciplinary character of project management research through the combination of different fields of inquiry, as featured in five consecutive research conferences of the *IRNOP* (International Research Network for Organizing a Project). He concludes that: “project management seems to be a research field with potential of bringing different disciplines to focus on a focal phenomenon of study, that is projects” This is supported by the diversity of theories and perspectives that would define project and project management (Packendorff, 1995). In developing a theoretical base for this research, the nascent theory of the temporary organization and its potential as theoretical foundation for project management in general and construction project management in particular was reviewed. In the process the key elements of this nascent theory was adopted as one of the foundations of the theoretical model of this research.

2.11.1 Towards a Theory of the Temporary Organization

(Lundin & Söderholm, 1995; Packendorff, 1995) propose theories of the temporary organization (project) within the model of organization theory. They argue around the notion that in the temporary organization, *action* (not decision) plays a leading role. Söderlund (2004) supports this view when he argues that a project theory should focus on “action” and “temporariness”. He argues that

(i) theories of projects are conceptualizations and models that explain and predict the structure and behaviour of projects (or temporary organizations), and

(ii) that a number of such theories –some complementary and some competing – are necessary and, will further develop the project management field of study. In support of this quest, he proposes that each attempt should address the following key questions:

a) Why do project organizations exist?

b) Why do project organizations differ?
c) How do project organizations behave?
d) What is the function of, or value added by, the project management unit?
e) What determines the success or failure of project organizations?

Koskela & Howell, (2002a) also derived a theory of project management by augmenting the existing ones with the relevant production and management theories. The theoretical framework of this study is developed following these contemporary conceptualizations and models of the project management alongside the existing project management schools of thought (Sönderlund, 2002). Three main works by (Lundin & Söderholm, 1995; Packendorff, 1995; Koskela & Howell, 2002a) formed the basis of the adoption of this position as discussed hereunder:

(a) Lundin and Söderholm's (1995) Model

In structuring their theory, (Lundin & Söderholm, 1995) emphasized on "action" (not decision-making) as a predominant factor in "explaining" the nature of the temporary organization. They adopted this view based on both theoretical and empirical reasons. The theoretical aspect is based on the fact that literature criticizes the assumption that decisions cause action (citing such authors as (March & Olsen, 1976; Cyert & March, 1992). They propose an alternative theory where decision could come after action, legitimizing it, that solutions may be implemented even without there being any problem attached to them. Depending heavily on previous researchers, they concluded that temporary organizations are almost always motivated by a need to perform specific *actions* aimed at achieving immediate goals (Goodman & Goodman, 1976). Putting the action-decision debate within the perspective of construction project specifically, this study sees a direct cyclical connection between the two. The existence of this connection is much more relevant than the order in which they should be considered. Either of them may, thus, come before the other or follows immediately after it. However, the fact should be appreciated that to begin with either of them has its own implication on the execution of a typical construction project. With *action* at the centre of their theory, they outline four basic concepts in a theory of the temporary organization: *Time, Task, Team and Transition.* Following the four basic phases of a project life cycle (that is concept, development, implementation and termination as contained in PMI, (2013), and outlined four sequential actions within these phases, called “action demarcations”:

(i) *Action-Based Entrepreneurialism (ABE)*: This highlights the action needed by an entrepreneur (a client) to initiate and provide the impetus for a temporary organization at the first phase. This is done through what they referred to as “mapping by rhetoric” which is the way in which a particular situation is made to appear real, tangible, and less ambiguous to the "listeners". Usually, it is difficult to have opposing views at this stage; otherwise it will mean that the existence of the temporary organization itself is being called into question. The ability to handle the temporary organization's rhetoric is thus of prime importance for anyone trying to influence or govern it. In construction industry, for example, these approaches are institutionalized, governed by “action” and “time” and they imply costs.

(ii) *Fragmentation for Commitment-Building (FCB)*: Where the action to key project parameters is specified, that is duration, scope, task and definitions and termination criteria, as well as commitment among team members. This also means “de-coupling by bracketing” detaching the temporary organization from its surrounding, and re-attaching it after termination; and “task definition by partitioning”.

(iii) *Planned Isolation (PI)*: This is the phase where predetermined action according to plans is executed. This is to isolate the temporary organization, and guarding it in order to avoid disturbances to its plans or other threats. “Once the temporary organization enters this phase it must be managed according to popular opinion, in accordance with action plans, which requires control.

(iv) *Institutionalized Termination(IT):* This is the final sequencing concept and is about the action taken in the dissolution of the temporary organization. The PMI (2013) only speaks of *initial, intermediate* and *final phases* (with the intermediate phase being divisible into sub-phases) of a project. Therefore it is possible to have part of sequence fragmentation for commitment in the initial phase, with the rest in the intermediate phases. Key features of this model are (Lundin & Söderholm, 1995)**:**

i. It refers to the Project management body of knowledge (PMBOK)

ii. It explicitly refers to the distinctive features of the temporary organization (project) and provides a structure for analyzing such organization phenomenon in its entirety.

iii. It aspires to embrace the temporary organization phenomenon in its entirety

iv. By placing action at the heart of a theory of the temporary organization, the theory provides a means for the alternative (inaction) by setting boundaries in time, space, scope and tasks. Hence, they showed that these theory can as well be concerned with cases "where *inertia,* rather than action, is invoked as a result of an effort to create and execute a project, and when these attacks on the project itself has been successful". In the model of this theory, asking why things happened or not happened are both equally justifiable, demonstrating that the theory lends itself to empirical research. This model is depicted in Figure 2.4. According to the authors, they have been able to apply the framework in their studies of empirical cases of temporary organizations and thus have face validity.

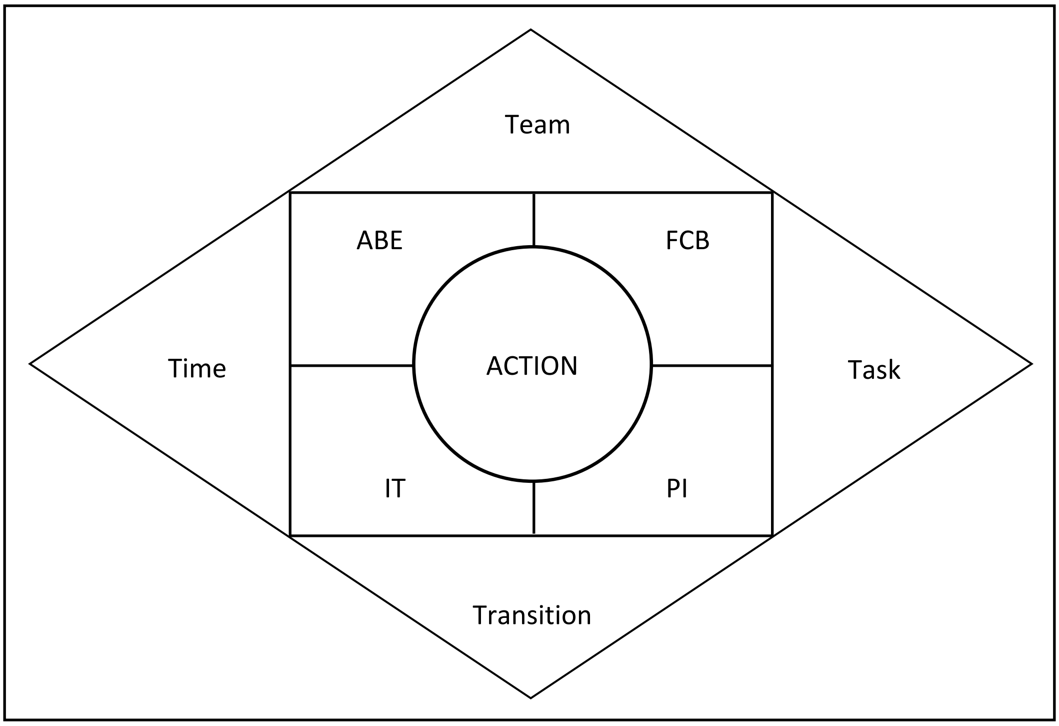


Fig 2.4. Amodel of theory of the Temporary organisation (based on Lundin & Söderholm, 1995).

Key: ABE: Action-Based Entreprenuerilsm; FCB: Fragmentation for Commitment-Building; PI:Planned Isolation; IT:Inistitutionalized Termination).

(b) Packendorff's (1995) Framework of the Theory

Considering the theoretical base of project management, (Packendorff, 1995) proposes two metaphorical theoretical approach to the project management situation along the *development, implementation and termination* stages: the project as a "tool" (the typical traditional project management theory), and the project as a "temporary organization"

(Table.2.2). The "tool" implies the perspectives of the "user" only (example the owner and the manager of the project) while the "temporary organization" are viewed from several different perspectives. Expatiating on the latter as a point of departure, he identifies some theoretical areas of further research identified with the following common denominators:

(i) that different types of projects will require different theories

(ii) that extensive empirical fieldwork is required in order to build these theories, and

(iii) that a diversity of theories and perspectives will enhance our understanding of projects as compared to the single viewpoint of rational management.

By changing the metaphor from "project" to "a temporary organization", (Packendorff, 1995) effectively proposes a reduction in emphasis on project management concepts such as "planning", or "structure, and a focus on the study of temporary organization processes, that is, "the deliberate social interaction occurring between people working together to accomplish a certain, inter-subjectively determined task". The development phase of a project is structured into controllable parts with task specifications. Simultaneously, *expectations* concerning the nature of the project are formed among the project team members, based on their previous experiences or on the rhetoric (including plans and budgets) of the project to come. During the life of the project, this expectations action-learning "loop" is repeated many times.

Table 2.2: Packendorff's metaphorical systems of project management

Research Focus	**Project Metaphor**	
	The project as tool	**The project as a temporary organization**
Development	Plan	Expectation
Implementation	Control	Action
Termination	Evaluation	Learning

Source: Adopted from (Packendorff, 1995)

The assumption made by this theory is for a new research proposal, whereby the project is seen as the temporary organization. At the end of the project "learning" is said to have occurred, both at the organizational level and at the individual level. This "alternative assumptions" call for studying organized *action* on a basis of "individuals' conceptions" rather than of the structural features of projects. The present study sees in this model and the underlying assumptions as a bridge that links researches in construction project performance management and business (organization) performance management. This is because a key feature of this research is its emphasis on stakeholders (individuals) *conceptions, perceptions, perspectives, expectations* and *actions* as a means of assessing and regulating construction project performance.

(c) Koskela and Howell's (2002c) Framework of the Theory

On their part, (Koskela & Howell, 2002c) declare that the underlying theory of project management (based on the theories of *planning, execution,* and *control*) is not only obsolete but also the cause of the problems of project management. They identified such problems with Project Management as: frequent project failures (as in Kharabanda and Pinto, 1996), lack of commitment towards project management methods (as pointed out by Forsberg et al., 1996) and slow rate of methodological renewal (as found in Morris, 1994)). (Koskela & Howell, 2002a) indicate that "customer requirements are poorly investigated at the outset, and the process of requirement clarification and change leads to disruption in the progress of the project". In particular, they showed that these underlying theories are based on wrong assumptions and that it is based only on the transformation model of production. Following this, they proposed that the ingredients of a theoretical foundation of project management should be separated into the theory of the project and the theory of management (Table 2.3 below). The former relates to the production aspect of the project and is governed by the "transformation", "flow" and "value generation theories". The latter, which addresses the project management aspect and which is the relevant part of this research, highlights three complementary theories.

(i) *Management-as-organizing*: This is seen as a counterpart to management-as-planning. Management-as-organizing, which assumes that human activity is inherently situated, that is a response to the situation in question. This means that the agents involved consist of interacting sub-units and are capable of sensing, planning and acting. This allows the structure of the environment to contribute to purposeful acting.

(ii) *Language/Action Perspective*: This states that project execution is facilitated by "two-way communication" not the hierarchical one-way communication in which action is thought to flow from authorization of a task. The language/action perspective, argues that work in organizations is coordinated through making and keeping commitment. In this view, "orders are

Table 2.3 Koskela and Howell's Ingredients of a new theoretical foundation of project management

Subject of theory		Relevant theories	Contributions Provided
		Transformation	Production is conceptualized as transformation of inputs to output (Starr, 1996; Morris, 1994)
Project		Flow	*Considerations of time and change (Koskela, 2000)*
		Value generation	*Consideration of the customer (* Cook, 1997*;* Koskela, 2000*; Suh, 2001)*
	Planning	Management-as-planning	Assumes that the organization consists of a management part and an effect or part
		Management-as-organizing	*Idea of inherent human (Johnson and Koskela, 2000)*
		Classical communication theory	One-way communication of the classical communication theory
Management	Execution	*Language/action perspective*	*Conceptualizes two-way communication and commitment (Winograd and Flores, 1986;* Lundin & Söderholm, 1995)
		Thermostat model	Identification and correction of variances to brig performance to standard (Hofstede, 1978)
	Control	*Scientific experimentation model*	*Learning, Finding causes of deviations and acting on those causes instead of only changing the performance level for achieving a predetermined goal in case of deviation This thus adds the aspect of learning and improvements to control.*

Source: Koskela and Howell, 2002c

understood as strong requests and even here, commitments arise from the promise to follow it".

(iii) In addition to the thermostat model, they believe that there should be the *"scientific experimental model"* which addresses learning and improvement. Generally, this treats all operations as a hypothesis testing, rather than those specified as experiments in advance. In this regard, every operation must be specified, that is, hypothesis must be made explicit. When this is done, it becomes easy to be able to identify root causes of problems during execution.

(d) Söderlund (2002b)

Söderlund (2002b) reviewed the history of project management together with recent developments as found in literature and concludes that there are seven, strands or schools of thought of project management research. He posits that a typical research under project management can be categorized under one or more of the following schools of thought: *Optimization, Behavioural, Critical success factor, Contingency, Transaction cost, Marketing and Decision schools* (table 2.4).

By relating control to implementation in his work, Packendorff has effectively considered *execution* as part of *control* with both of them being regulated by "action" as a concept of the temporary organization. He separated evaluation as a key part of the termination process. Koskela and Howard on the other hand believe that execution and control as an important part of project implementation should each be governed by different concepts: the former being regulated by "language/action perspective" and the latter by "the scientific experimentation model". Significantly, Koskella and Howard's concept of *controlling* also involves *evaluation* as provided by Packendorff. Another similarity is that both approaches emphasize "action" and "learning" within the model of project management as a human activity. By integrating (Lundin & Söderholm, 1995) and Söderholm's (1995), Packendorff's, (1995) and the relevant part of (Koskela & Howell, 2002a) models, one can see a possible nascent project management theory which has the potential of governing researches in project and project management.

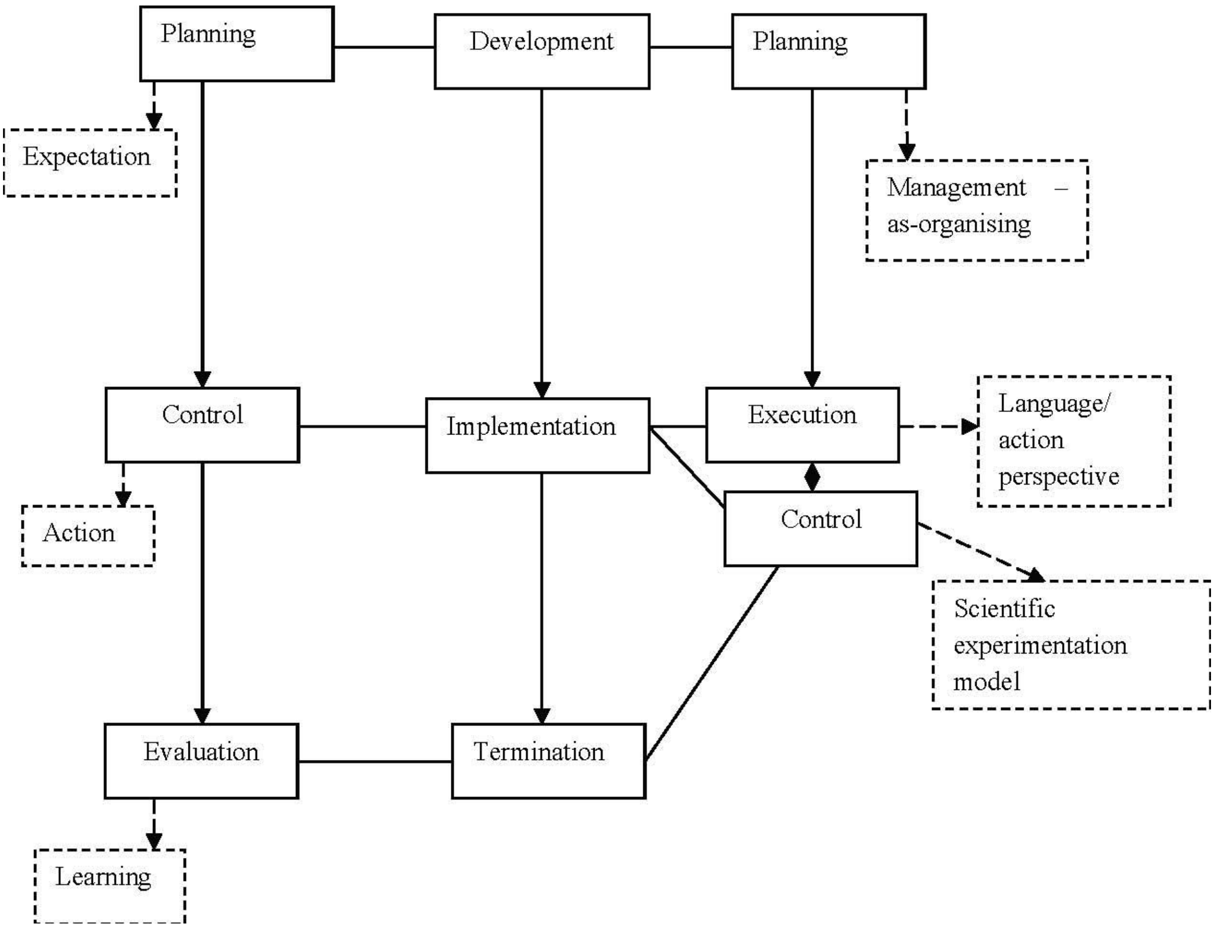
Table 2.4 Soderlund's Seven Schools of thought in Project Management *(based on Soderlund, 2002)*

Schools of Thought	**Common advocacy**	**Major objective**	**Contributors**
Optimization school	Considers project as analyzable task requiring methodical approaches and structured techniques, development of various "work breakdowns techniques".	Efficiency, low cost and optimal solution.	(Morris, 1994; Packendorff, 1995; Engwall, 1995; Turner 1999).
Critical Success Factor School.	The identification of genetic factors, in multidimensional and multi-criteria, will greatly improve the project implementation process in practice.	Determination of project success/failure through generic criteria and factors.	(Pinto & Slevin, 1987; Pinto & Prescott, 1990)
Contingency School	<u>Posit</u> that the differentiation of project type, strategic problems and managerial concerns should be acknowledged in existing project management research.	Treating each project according to their peculiarities and differences.	(Shenhar,et al., 1996); (Wheelwright & Clark, 1992)
Behavioral School	Treats projects as a "temporary organization" and focus on the various behavioral aspects of projects.	Extending the interpretation of project management within organization theory.	(Packendorff, 1995; Lundin & Söderholm, 1995)
Transaction cost School	Conceptualizes project as characterized by uncertainty, asset specificity and transaction frequency, discourages continuous relations and routine engagement in favor of the "decoupling principle".	Analyzing the existing form of projects and determining the appropriate governing mechanisms of project transactions (*contract types).*	(Eccles, 1991; Winch G., 1989); O'Brien et al (1995);
Marketing School	Devoted to the investigation into the management of the early phases of project, the identification of Client needs and the formation of project organizations,	Investigating "Strategic behaviors" of companies dealing with projects and to propose a model for supplier-based adaptation strategies in project marketing.	(Bansard, et al., 1993; Cova & Holstius, 1993); Gunter and Bonaccorsi (1996).

One which allows all the emerging schools of thoughts to be researched within its model, that is, "expectation of the individual team members (management-as organizing), “Action” at the heart of it all, and “Learning”. These three aspects in essence provide the theoretical base of the project as a temporary organization for project management modeling.

2.11.2 Packendorff (1995) and Koskela and Howell (2002c) Compared

A comparison between (Packendorff, 1995) and Koskela and Howell's (2002) models reveals that whereas the former considers *planning, control,* and *evaluation* as relating to the project management research focus of *development, implementation* and *termination* respectively, the latter separated the project (production) aspect from the management (of the project). They considered the project aspects within the production management theories of "transformation", "flow" and "value" generating. This aspect relates to the production of the construction product as related to the contractor's activities. In the management aspect, they considered it in the three stages of *planning, execution* and *controlling*. These relationships are illustrated in Figure 2.5.



Research Focus in (Koskela and Howard 2002c; Packendorff, 1995) Project Management (2002b)

Fig. 2.5 Comparing the Models of (Packendorff, 1995) and Koskela and Howard (2002c)

By relating control to implementation in his work, Packendorff has effectively considered *execution* as part of *control* with both of them being regulated by “action” as a concept of the temporary organisation. He separated evaluation as a key part of the termination process. Koskela and Howard on the other hand believe that execution and control as an important part of project implementation should each be governed by different concepts: the former being regulated by “language/action perspective” and the latter by “the scientific experimentation model”. Significantly, Koskella and Howard’s concept of *controlling* also involves *evaluation* as provided by Packendorff. Another similarity is that both approaches emphasise “action” and “learning” within the framework of project management as a human activity. [Note:in Figure 3.3 the aspects of the proposed frameworks are in doted boxes.] By integrating (Lundin & Söderholm, 1995), Pankendorff’s (1995) and the relevant part of Koskela & Howell’s (2002) models, one can see a possible nascent project management theory which has the potential of governing researches in project and project management. One which allows all the emerging schools of thoughts to be researched within its framework, that is, “expectation of the individual team members (management-asorganising), “Action” at the heart of it all, and “Learning”. These three aspects in essence provide the theoretical base of the project as a temporary organisation for this research as explained below.

2.12 THE ELEMENTS OF THE NASCENT THEORY OF PROJECTS: EXPECTATION, ACTION AND LEARNING

(a) Expectation

This is the “expectations” of project clients, key individuals and team members that emanates from organization of the project at the initial stages. Packendorff, (1995) explains that projects are associated with conceptions (usually based on past experiences of a similar kind) of the nature of their own implementation, conceptions about the task to be solved. In the organization situation the following have been demarcated in literature: -

(i) at leadership level: *Profit/financial target, quality and efficiency*, *strong* *individuals/ strong team* (Grové, 2008)

(ii) at team level: *clear roles /responsibilities, guidance /leadership, goal setting, rewards, mutual understanding, sound communication, dependency/synergy, a need for team skills, decision making authority, resources, organizational support* (Grové,2008; Carr, 1992, Robbins, 1998; Brower, 1995; Margulies and Kleiner, 1995; Wilson, 1996; Field and Swift, 1996; Bettenhousen, 1991), and

(iii) at individual level: *culture of support as defined by 'participation, respect, aspirations, opportunity and caring', fun and humour, empowerment/trust, work-life balance* (Grové, 2008).This expectation, when supported by commitment and motivation, evokes action (Brunsson, 1985).

(b) Action

This is the "language/action" described by the coordination of the work, making and keeping promises, performance and declaration of completion, and to address all unforeseen eventualities during execution. *Action* is placed at the centre of project management. This is demarcated into the four sequences in the project life cycles: ABE at the conception phase, FCB, for the development phase, PI for the implementation phase and IT for the termination phase. Wherever, there is an action (or activity) in the project life cycle (especially, construction), it is characterized by the basic concepts of *time, team, task and transition*. Within the macro level of the project, it is also possible to see each of these basic concepts being dominant at one phase or the other: *time* (more prominent at the conception and termination stages), *team* (more prominent at the conception and development phases), *task* (more prominent at the development and implementation phases) and *transition* (more prominent at the implementation and termination phases).

(c) Learning

The "learning" aspect from the whole exercise by the individual participants is made evident when the evaluation aspect is considered more as "scientific experimentation model" rather than a "thermostat model". At the organization level, (Senge, 2006) provides five disciplines of the learning organization, which represent approaches (theories and methods) on which he develops the three core learning capabilities in this case (the disciplines are in italics):

(i) Fostering aspiration (*personal mastery, shared vision*),

(ii) Developing reflective conversation (*mental models, dialogue*), and

(iii) Understanding complexity (*systems thinking*). He built these on the idea that the fundamental learning units in an organisation are working teams "(people who need one another to produce an outcome".

2.13 INTEGRATING THE THREE ELEMENTS FOR A THEORETICAL BASIS FOR THIS RESEARCH

This research draws from the on-going debate and carefully adopts the above integrated nascent theory of project management modelling as one of its bases for developing a theoretical framework. It also considers it in the lights of the project management schools of thought as provided by Söderlund (2002). These schools of thought are considered the "principal" lines of research focus of project management as a discipline based on the nascent theoretical model. This research observes that the model opens itself unto other schools of thought, over time. This research however, worked within the *Critical success factor, Behavioural, Contingency and Decision* schools of thought. In Figure 2.6, *action* is placed at the centre of project management. This is demarcated into the four sequences in the project life cycles: ABE at the conception phase, FCB, for the development phase, PI for the implementation phase and IT for the termination phase. Wherever, there is an action (or activity) in the project life cycle, it is characterized by the basic concepts of *time, team, task and transition*.

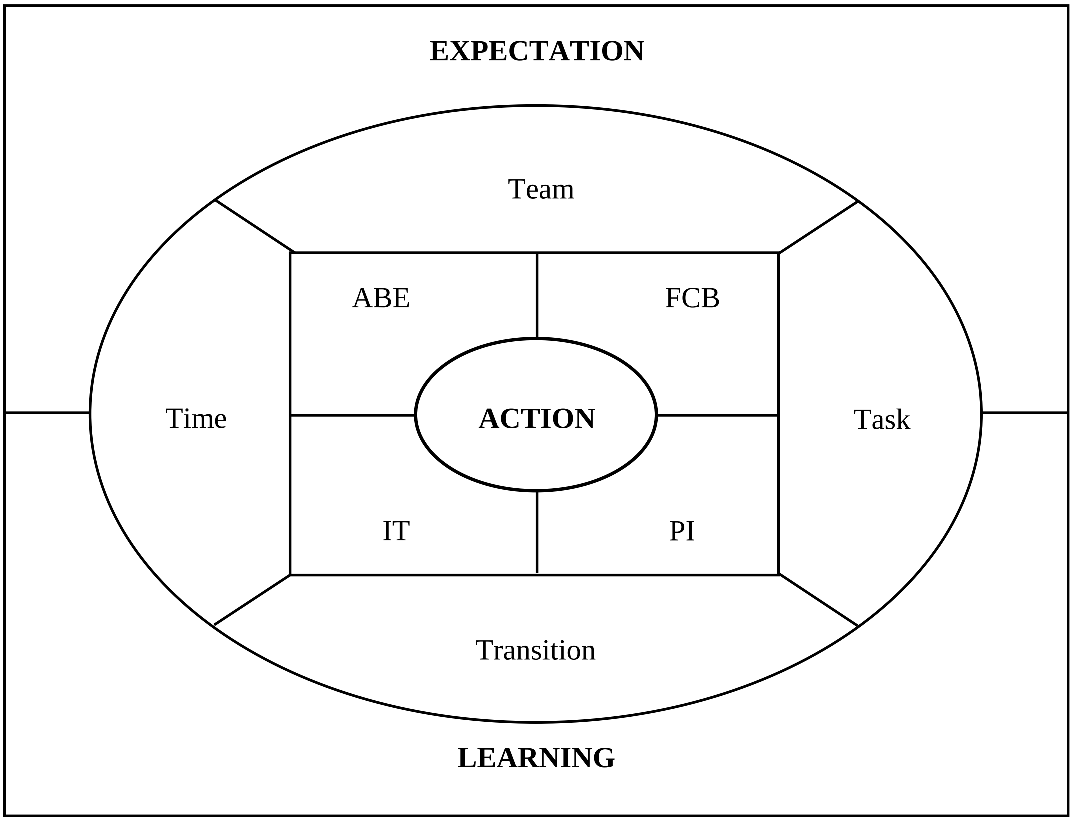


Fig. 2.6 Integrated "Nascent" Theory of the Project for the Research [based on (Lundin & Söderholm, 1995; Pankendorff, 1995; Koskela and Howell, 2002]

(NB: ABE: *Action-Based Entrepreneurialism; FCB: Fragmentation for Commitment-Building; PI: Planned Isolation; IT: Institutionalized Termination).*

2.14 A THEORETICAL MODEL FOR PROJECT MANAGEMENT

This research alludes to the concept of the project as a temporary organization and adopts it as a nascent theory of project management, that is being regulated by *action, expectation and learning*. For efficiency in performance measurement and management, the project environment is separated into internal and external environments. The external environment is affected by contextual factors. Therefore, the research posits that the project situation should be considered within a context with all the relevant contextual factors well acknowledged. These factors include *socio-cultural, socioeconomic* and *political, institutional,* defines the external environment of the project. The internal environment of the project is affected directly by factors which affect the implementation process and hence the project performance. These are essentially contingency factors in nature and have been classified into factors related to: *the project, the project manager/consultant, the project team, the client's organization*. These factors impact directly on the *action*, *expectation* and *learning* which shape the management of the project. Focusing on the performance of the project thus means that the research is emphasizing the *expectation* variable as it interacts with *action* and *learning*. This is expressed in terms of the *criteria* in which performance could be measured or assessed.

The research is based on the fact that even when the same external environment (contextual factors) exists over time within the same country, the project's internal environment varies due to contingency factors defined by client types and their expectation, project location, project team, design and site conditions. Hence, the research also posits that project performance assessment measures should be considered within the contingency theory as it applies to the project as a temporary organization. In the case of construction project in particular where there are several stakeholders, the *expectations* (represented by 'perspectives') will vary for each, at least in terms of the priority, given the same measures. This means that the perspective of each stakeholder is paramount within the action, expectation and learning theories of project management modelling.

2.15 GLOBAL QUEST FOR CONSTRUCTION PROJECT MANAGEMENT IMPROVEMENT

Generally, the built environment is known to constitute more than half of the national capital investment, account for the consumption of more than half of all the raw materials taken and, and consumes between 40% and 50% of a country's energy (Du Plessis, 2002). According to the (World Bank., 1994), developing countries invest $200 billion a year in new infrastructure -4 percent of their national output and a fifth of their total investment. Regarding its socio-economic significance, the industry contributes about 50 per cent of all investments in capital goods in many countries (Zawdie & Langford, 2000). Even though the precise linkage between infrastructure and development is still open to debate, the (World Bank., 1994) the report asserts that infrastructure capacity grows in tandem with economic output: "a one percent increase in stock of infrastructure is associated with a one per cent increase in gross domestic product (GDP) across all countries". Contributing to the debate, Lopes et al. (2000) provided evidence, based on a study on data from 15 countries spanning 22 years, that "there is a critical level of construction value added (CVA)/GDP (at 4-5%) below which a relative decrease in construction volume corresponds directly to a decreasing growth in GDP per capita”. Commenting on the socio-economic significance of infrastructure projects, (Zawdie & Langford, 2000) observes that good infrastructure projects can help enhance growth process by raising productivity, alleviate poverty by responding to the needs of the poor for better health, education, housing, transport and water and power supply services. Against this background, several countries at various levels of socio-economic development have recognized the need and importance of taking measures to improve the performance of their construction industry in order to meet the aspirations of its developmental goals (Ofori, 2000). This is in line with the agreements reached and reported by the (CIB Task Group 29, 1999).

According to Ofori, (2000), the report agreed that “construction industry development is a *deliberate process* to improve the capacity and effectiveness of the construction industry in order to meet the demand for building and civil engineering products, and to support sustained national economic and social development objectives (CIB Task Group 29, 1999). At that meeting, the report continued, it was agreed that construction industry development promotes:

(a) increased value for money to industry clients as well as environmental responsibility in the delivery process;

(b) the viability and competitiveness of domestic construction enterprises.

This has become necessary because of the poor performance of the construction industry due to problems and challenges including those having to do with its structure characterized by fragmentation, institutional weakness and resource shortages (Latham, 1994; (Egan, 1998), (Beatham et al., 2004). In the developing countries these problems are even bigger, compounded by lack of adequate resource and institutions to address them. These, together with the threat on the environment, have led to the call by various countries to work towards improvements in, and sustainability of, the construction industry. Where, sustainable development has been defined as the “development that meets the needs of the present without compromising the ability of the future generations to meet their needs” (Rio + 20 Conference, 2012).

2.16 CONSTRUCTION INDUSTRIES IN DEVELOPING COUNTRIES

Considering the investments levels of the construction industry and the development needs of most developing countries, the time is overdue for construction matters to be given prominence. This is also because, despite the relatively high investment in infrastructure in developing countries, the World Development report (1994) highlights the less corresponding impact these have had on the people in these countries. Hence, the report indicated that the infrastructure's future challenges should be dealt with by tackling inefficiency and waste –both in investment and delivering services. The report indicated that the poor performance of those managing the delivery and maintenance of these infrastructures provides strong reasons for doing things differently. Indeed, Agenda 21 for sustainable construction in developing countries puts construction at the centre of how the future is to be shaped, and the sustainability of this future (Du Plessis, 2002). In particular, developing countries were well advised to avoid the development mistakes of the developed world and to take steps to intervene on behalf of sustainability today than to wait and change things after they have occurred (Du Plessis, 2002). Even though the research does not cover sustainable construction, this advice is seen as another reason why developing countries should make efforts to deliberately address the many problems that confront their construction industry, particularly, in the area of project performance and project management modelling.

2.17 THE PROJECT AS A TEMPORARY ORGANISATION

Turner, (2007) defines a project as *"an endeavour in which human, material and financial resources are organized in a novel, to undertake a unique scope of work, of given specification, within constraints of cost and time, so as to achieve beneficial change defined by quantitative and qualitative objectives".* His definition emphasizes "organization of resources" and "uniqueness" of the scope of work". The PMI (2013) defines a project as *"temporary endeavour undertaken to create a unique product, service, or result".* It highlights the word 'temporary' in three aspects: (i) every project has a definite beginning and a definite end; (ii) the opportunity or market window is usually temporary; and (iii) the project team, a working unit, seldom outlives the project –usually disbanded after the project. Another key word from this definition is that a project creates a unique product, service or results. In addition, it acknowledges that a project is characterized by "progressive elaboration", that is, it develops in steps. Referring to Cleland and Kerzner's (2013) definition of a project as "a combination of human and non-human resources pulled together into a temporary organization to achieve a specified purpose", this definition addresses the project both as a *temporary organization,* and a *production function* and an *agency of assigning resources*. Reviewing Turner's (1999) definition, (Turner & Müller, 2003a) observe that a project has three essential features: it is unique, it is a novel process and it is transient. These features, they note, create three pressures:

(i) they are subject to *uncertainty*: there is no guarantee that plans will deliver the required project outcomes or desired beneficial change;

(ii) they create a need for *integration* of the resources to do the project, between different parts of the project and of the project into the business;

(iii) they are undertaken subject to *urgency* of delivery within the desired timescales.

Quoting from Turner's (1999), they suggest that "it is these three pressures that are special to project management, not the management of *time, cost* and *quality*, which is shared with routine operations management". They note the need to consider other relevant dimension to the project, that is, *as agency of change, agency of resource utilization* and *agency for uncertainty management* as contained in the definitions of other authors (for example: (Anderson, et al., 1987; Barnes, 1989; Turner, 2007). Consequently, they define a project as: *"a temporary organization to which resources are assigned to undertake a unique, transient endeavour managing the inherent uncertainty and need for integration in order to deliver beneficial objectives of change".*

In a related development, (Shenhar & Wideman, 1996) concluded that there is lack of consensus among practitioners on terms "Project" and "Project Management". However, (Anagnostopoulos, 2004) reviewing works by several authors in this regard concluded that it is fruitful to consider projects as "temporary organizations" (referring to (Packendorff, 1995; Lundin & Söderholm, 1995; Turner & Müller, 2003b; Söderlund, 2004). The research agrees with (Turner & Müller, 2003b) and considers the project as a temporary organization. This allows the project to be analyzed from the perspective of organizational theory. It also calls for a focus on the '*organizing'* aspect of the project as it relates to human endeavour. The focus is mainly on ensuring good performance throughout the *process*. This thesis posits that managing the project successfully depends largely on actions and inactions of the key stakeholders within this temporary organization.

2.18 PROBLEMS IN PROJECT EXECUTION

The unique characteristic of the construction industry is epitomized in the project. This has meant that every project is different, a situation which emanates from the project's own characteristics, that is, its type, its size, its geographic location, personnel involved in the project, those emanating from the other subsystems within the industry, and also those from the super-system as argued in PMI, (2013). Hence according to PMI's PMBOK Guide (2013); project execution is inherently risky and the lack of appropriate approach to addressing these risks has led to a lot of undesirable results in project execution in the construction industry of most developing countries. Beatham et al., (2004) while supporting this argument indicate that most of the problems militating against the achievement of the desired effect on the construction industry of any country have to do with the project execution challenges, namely, the difficulty in achieving the main objectives of the project. Traditionally, this is seen in the failure of the project to achieve its cost, time, quality and other targets due to inefficiencies in the execution process. This ultimately, causes client dissatisfaction

2.18.1 The problems of Low productivity, Delays and Cost Overruns in Project Execution

A common problem that affects project performance in the industry is low productivity. For example, (Makulwasawatudom, et al., 2003) identifies 23 critical factors influencing the construction productivity in Thailand. Ten of these were found to be critical: lack of materials, incomplete drawings, incompetent supervisors, lack of tools and equipment, absenteeism, poor communication, instruction time, poor site layout, inspection delays, and reworks. A research by Mutijwaa & Rwelamila, (2007) showed that the South Africa Infrastructural Department (SAID) is under pressure to improve performance, that is, to deliver projects on time, on budget and to higher standard of quality. They attributed the problem to lack of skilled workers in these infrastructure departments (ID) and called for the need for a project manager in all these offices to coordinate the many on-going projects. Further, they observe that the infrastructural departments do not know whether they are:

(i) Achieving desired results

(ii) Meeting their customer's success criteria and

(iii) Achieving their desired return on investment. Hence, they propose a means of assessment to evaluate progress as a means of addressing these questions.

Secondly, they recommend such IDs to be Project-Oriented Organizations (POO). Other project-related challenges have to do with the twin chronic problems of cost and time overruns. These problems are not limited to developing countries alone. According to "Benchmarking the Government Client stage 2 study (1999)", UK, benchmarking study conducted in 1999 of 66 central government departments' construction projects with a total value of £500 million showed that three quarters of the projects exceeded their budgets by up to 50% and two thirds had exceeded their original completion date by 63%. According to Yisa & Edwards, (2002) despite the development of new alternative and less adversarial contractual arrangements, the industry continues to be affected by problems of project time and cost overruns and consequently, client dissatisfaction (drawing from Latham, 1994; (Egan, 1998)). Different countries identify different factors as critical in this regard. In Botswana, Chimwaso, (2000) investigated the factors of cost overrun and came up with four related factors: *variations, re-measurement of provisional works, fluctuation in the cost of labour and materials and contractual claims, that is, claims for extension of time with cost.* In the case of time overruns, (Zhang & Zhang, 2003) identify 8 factors that cause delay in project executions in China: *factors related to the contractor, the design team, the project, labour, client, material, equipment, and other factors.* In the midst of the booming infrastructure development and urbanization in Vietnam, Le-Hoai et al (2008) established that cost and time overruns top the list of problems of project implementation. Using factor analysis techniques, they obtained 5 main factors out of a list of 21, namely: *poor site management and supervision, poor project management assistance, financial difficulties of owner, financial difficulties of contractor, design changes. The foregoing indicates that both developed and developing economies face project execution challenges.*

Table 2.5 Comparison of factors causing time and cost overruns from ten countries

Countries	Major causes				
	1	2	3	4	5
Vietnam (Le-Hoai et al, 2007) (1)	Poor site management and supervision	Poor project management assistance	Financial difficulties of owner	Financial difficulties of contractor	Design changes
Malaysia (Sambasi and Soon, 2007) (2)	Improper planning	Site management	Inadequate contractor experience	Finance and payments of completed work	Subcontractors
South Korea (Acharya et al., 2006) (2)	Public interruptions	Changed site conditions	Failure to provide site	Unrealistic time estimation	Design errors
Hong Kong (lo et al., 2006 (2)	Inadequate resources due to contractor/lack of capital	Unforeseen ground conditions	Exceptionally low bids	Inexperienced contractor	Works in conflict with existing utilities
UAE (Faridi and El-Sayegh, 2006) (2)	Preparation and approval of drawings	Inadequate early planning of the project	Slowness of the owner's decision-making process	Shortage of manpower	Poor supervision and poor site management
Jordan (Sweis et al., 2007) (2)	Financial difficulties faced by the contractor	Too many change orders from owner	Poor planning and scheduling of the project by the contractor	Presence of unskilled labour	Shortage of technical professionals in the contractor's organization
Kuwait (Koushki et al., 2005) (2)	Change orders	Financial constraints	Owner's lack of experience	Materials	Weather
(3)	Contractor	Materials	Financial constraints	Change orders	Weather
Ghana (Frimpong et al., 2003) (1)	Monthly payment difficulties	Poor contract management	Material procurement	Inflation	Contractor's financial difficulties
Nigeria (Aibinu and Odeyinka, 2006) (2)	Contractors' financial difficulties	Client's cash flow problem	Architects' incomplete drawings	Subcontractor's slow mobilization	Equipment breakdown and maintenance problem
(Kenya) (Talukhaba, 1999)(1)	Client's payment problem (61.7%)	Architect's instructions (7.91%)	Poor resource management	Inadequate attention to project risks	Coordination challenges

Source: Le-Hoai et al, 2008; with modifications

In Kenya (Talukhaba, 1999) has identified the major causes of delays as Clients' payments and Architect's instructions whereas Masu, (2006) has identified poor resource mixes.

(1): Delay and cost overruns; (2): Delay only; (3): Cost overrun only. These results are corroborated by other results from West and South African studies as shown by Rwelamila, et al., (2000). Significantly, (Kaliba, et al., 2009) studied 13 ongoing projects in Zambia and found out that 5 of them went beyond schedule and budget, 4 went beyond schedule, 1 exceeded the cost and was still incomplete after 10 years, 1 had exceeded the scheduled completion time by 5 years and is still incomplete, and 2 have failed to commence since 2001. This scenario is a common feature in most developing countries, especially in Africa. The same issues are also prevalent in some developed countries too, as shown by (Klakegg, et al., 2005) for the construction industry in Norway. The foregoing suggests that most of the factors that cause delay also cause cost overruns. In addition, it is also found that the same factors were ranked differently in different countries. In a related development, (Faniran, 1999) provided another dimension to the delay factor issue. He carried out his study in Nigeria, and found out that depending on whether a contractor is using quantitative techniques (for example, bar chart, Critical Path Network or Pert analysis) or not, different rankings of the same identifiable delay factors emerged, that is, from the contractors' point of view. These differences in the rankings of the same factors in different countries, and even in the same country, shows that these factors are themselves, influenced by other factors. It suggests that the factors that affect the efficient execution of construction project everywhere are themselves impacted on by other external and, sometimes, intermediate factors prevailing in those countries and during the course of project implementation. It also shows that each factor should be taken seriously and treated as of equal relevance. They are, thus, contingency factors and what may be the most important factor today may not necessary be a critical one on the next project or in the near future. Therefore, the perceived importance attached to a factor by contractors, consultants, clients or even the public should be considered in such a way as to reflect the specific circumstances of the project.

2.18.2 The Effect of Human Risk Factors

Muchungu, (2012) argues that human resource management is a critical factor in the performance of construction projects. According to his study human factors are key to meeting construction project goals both at design and construction level. Human factors influence cost, quality, time, environmental sustainability and client satisfaction. He recommends appreciation of employees and simplification of organization structures for improved productivity. (Thevedran & Mawdesley, 2003), define human factors as follows: "Individual, project team and organizational factors, which influence the behaviour of people and the climate at work, in a way which can increase or decrease the efficiency of a construction project". They divided human factors into 13 major categories which are labelled core factors. These were further grouped as Positive, Negative and Mixed Factors. They classify human factors affecting construction into three distinct groups:

i. Individual core factors: Capability; Knowledge; Stress; Motivation; Emotional; Culture

ii. Project team core factors: Management; Supervision; Task; Communication and Coordination

iii. Organizational core factors: Policies; Standards; Systems & Procedures. According to (Thevedran & Mawdesley, 2003), there is a generic acknowledgement that human factors are unequivocally the single most important element that can affect project performance. Quoting from other sources, they attributed most construction industry disasters to human risk factors, for example, the collapse of the Quebec Bridge (Schaub & Dickison, 1982) and the collapse of Heathrow Express Tunnel (Masurier, 2002). They concluded from (Oldfield & Ocock, 1997) that about 80% of all project risks may be human related, noting that even the minor effects of human factors can have a substantial contribution to or influence on the implementation of construction projects on a day-to-day basis. This research observes that apart from issues bothering the natural environment, for example, 'weather', all the above factors that cause low productivity, cost and time overruns, can be related to human risk factors. It is thus imperative that any approach to addressing the problems of project performance and its improvement be related to the human elements.

2.19 PROJECT MANAGEMENT FOR THE CONSTRUCTION INDUSTRY IN KENYA

In Kenya, despite the need for Project Management services; it is yet to take a structured and recognized approach. Most of the professionals including Architects, Engineers, Quantity Surveyors and Construction Managers are doubling as construction project managers albeit without proper rules and regulations. It is only in 2009 that the Institution of Construction Project Managers of Kenya (ICPMK) was formed. The objects of the institution include: promote the general advancement of the practice of construction project management and its application in Kenya including facilitating the exchange of information of the Institution and otherwise; develop and advance a standardized body of knowledge for Construction Project Management; set and develop qualification and registration criteria for Construction Project Managers; set regulation and control standards of Construction Project Management Practice; pursue the incorporation of practice objectives into legal framework through an Act of Parliament.; keep and maintain a register of members and cooperate with universities, in the furtherance of education and training in construction project management.

Interestingly, according to ICPMK, (2009) a project manager is supposed to be a degree holder in Architecture, Civil or Structural Engineering, Quantity Surveying/Building Economics, Property Valuation/Land Economics, Facilities Management, Construction Management/Construction Project Management and Building Technology. It is worth noting that each of the above disciplines other than the latter two have other organizations. While it is a useful indication for separating Construction Project Management from other types of management by way of registration under the auspices of the aforementioned criteria; it is also important to modify the qualification by demanding that Construction Project Managers be subjected to a further examination, legislation and/or vetting process to ensure that only the qualified people are allowed to practice as Construction Project Managers. The criteria should; therefore, take cognizance of basic qualification in the construction industry and a further qualification in Project Management.

Project management in the construction industry in Kenya still remains rudimentary. A study done in Kenya for public building projects established that out of one hundred (100) of the projects, seventy three (73) experienced time overruns compared to thirty eight (38) out of one hundred (100), which suffered cost overruns (Mbatha, 1986). Another study undertaken for both public and private building projects came up with a similar conclusion (Talukhaba, 1988). The overall implication is that national resources are significantly wasted. The observations also do imply that project risks are not adequately examined prior to the award of contracts (Gichunge, 2000).

According to (Gichunge, 2000) the most serious source of cost and time risks in building projects during the construction period is ‘extra work’ (technically termed as variations), which normally occurs in 73.50% of the building projects in the population whereas defective materials accounted for 38.20% for observed unacceptable quality work cases. There is evidence that construction projects performance in Kenya is inadequate. Time and Cost performance of projects in Kenya are poor to the extent that, over 70% of the projects initiated are likely to escalate in time with a magnitude of over 50%. In addition over 50% of the projects are likely to escalate in cost with a magnitude of over 20%. Studies have shown that, although cost performance was not better, time performance was comparatively the worst (Masu, 2006). The latter recommended that efforts should be directed to the training of the key participants in construction resource management. Work-studies on construction resources, application of resource optimization techniques, Just-in-time philosophy and project information management strategies should be embraced.

Wanyona, (2005) explored financial risk management in cost planning and control of building projects in Kenya. His research findings indicated that intuition/judgement/experience was the only method of risk analysis currently used to identify and quantify risk impacts during risk assessment in budget prediction in Kenya. He further observed that the most important risk factors considered in risk management at the prediction stage were bills of quantities, quality of design information, brief uncertainty, completion of design and conditions of contract. Yet use of intuition to support budget prediction with the Bills of Quantities method was limited by inadequate pricing, incomplete design and lack of project information causing poor budget prediction.

Citing a number of projects; (Wanyona, 2005) has argued that in Kenya; both private and public building Clients continue to experience cost overruns on set budgets which has proved to be a serious and costly problem as cited by Omondi, (2000). Projects such as Kenyatta International Conference Centre *(KICC building),* a landmark building in Nairobi, was initially estimated at Kshs. 22 Million in 1970 but this figure had risen nearly fourfold to Kshs. 80 Million by the time it was completed in 1973 (Wanyona, 2005)*citing* (Opala, 1999)*).* The National Social Security fund *(N.S.S.F)* Building, Loita House (Kisero, 2001) and the Weithaga Coffee Co-operative Society Building (Wamwati, 2001) exceeded their original budgets by 140 percent, 156 percent and 70 percent respectively. He mainly dwelt on financial risk management procedures as practiced by Quantity Surveyors in Kenya. His conclusion is that the absence of risk indicators in risk assessment procedures demands an effective evaluation of building risks in order to guide the quantity surveyor to manage final building costs. The research made a contribution in form of risk profiles and clusters for risk management of building projects in Kenya; however, there still exists a gap in form of how effective application of project management can aid the process of scope change management, quality management, budget management and project scheduling. No study has specifically focused on the role of construction project management in form of a real-time study *(projects in progress)* with a view to gaining a greater understanding of the effects of the various processes interacting in budget prediction. What is however appreciated is that projects in Kenya have continued to incur time and cost overruns. The study presented the use of risk indicators proactively derived from very limited project information, to streamline the budget process and facilitate risk management in cost planning and control of building projects.

Mbatha, (1993) has argued that Project Management was in Kenya to stay albeit inconsistencies in application. He for instance indicates that Public Clients are skeptical to employ a project manager. However, contrary to his assertions, project management is firmly entrenched in the public sector for reasons of ensuring effective and efficient delivery of projects. He has analyzed the various project management approaches as applied in developed countries including Germany, United Kingdom and United States with a view of developing an appropriate construction Project Management model. However, the models he has developed in 3 No. versions are mere generalizations without clear measurable facts and they just look like other contractual networks or just but suggestions for establishment of project Management in Kenya. For example he has suggested the obliteration and or optional practice of Quantity Surveying profession as established in Kenya because it is not being practiced in Germany. He acknowledges the fact that Quantity Surveying functions are being executed by Project Managers in Germany.

(Mbatha, 1993), obtained views about relevance of Project Managers in Kenya from two project managers, five Clients, two Architects, Four Engineers and Nine Quantity Surveyors. According to his findings, Clients were totally opposed to Project Managers. Engineers gave mixed reactions with two Engineers supporting while two Engineers did not support. Only two Architects responded to his questionnaires whereby one Architect appreciated the management role in construction projects. All in all, 27 % *(9 No. out of 45)* Quantity Surveyors, 27 % *(4 No. out of 11)* Engineers, 13% *(2 No. out of 13)* architects responded to his questionnaires. This translates to 15 respondents or 15 percent response rate; given his target sample size of 100 members. Clearly, apart from the questionable response rate on generalization on findings; his study dwelt on technology transfer; there still remains a gap in the role of construction project management in ensuring effective and efficient delivery of projects in Kenya.
Masu 2006; has argued that cost and time overruns are still a major problem in the construction industry in Kenya. He investigated the causes and impact of resource mix practices in the performance of construction firms in Kenya. He addressed inappropriate resource mix as a major contributor to poor project performance in Kenyan construction projects in terms of time and cost overruns.

In all the above studies it is argued that time, quality and cost issues are still major problems in the construction industry. Addressing them requires a holistic approach via construction project management. In construction project management both Client's perspective and contractor's perspective are addressed. This study therefore has attempted to develop an appropriate project management model for an effective and efficient construction industry in Kenya.

(Mbatha, 1993), has argued that the Kenyan poor project performance is nothing more than a re-allocation of resources and re-assigning of risk. He has concentrated on the applicability of the modern construction project management approaches in Kenya, thus contributing to a controlled technology transfer. His suggested model is inapplicable implying underlying gaps in his study. The role of construction managers in the effective and efficient delivery of projects in Kenya has not been covered adequately to date. The solution to the aforementioned project delivery challenges lies in a structured application of construction project management. This research serves as an attempt to fill the existing gap in this area.

Typically, a construction industry of any country could be seen as having two main sets of features which make it unique from all others. The first one is the peculiarity of the construction industry which distinguishes it from other industries as argued by (Hillebrandt, 2000). The second being the peculiarities of each country's construction industry as defined by its socio-economic level, technological level, culture, institutional and legal frameworks as presented by (Ojiako et al., 2008). The first one has been generally addressed in the preceding sections. This section, therefore, focuses on the second aspect. It discusses the set-up of the industry, its project execution situations and how efforts are required at improving performance through systematic measurement and management.

Construction projects are widely accepted as complex in nature. This complexity is evidenced in a number of different ways, such as; size of the project; technical complexity; contractual arrangements used; and the range of client-consultant-contractor relationships (Lock, 2007).

The construction industry is also characterized by the involvement of different parties such as clients, contractors, subcontractors and consultants. The interactions of these parties, who have their own objectives differ from the others in the same supply chain and consequently often lead to conflict and litigation. Their performance has a great impact of the outcome of the project. Disparities between project objectives and the objectives of the participating organizations play an important role in this. This is attributed to the fragmentation of the construction industry (Latham, 1994).

2.20 REVIEW OF CURRENT PROJECT MANAGEMENT TOOLS

Project management tools played significant roles and contributed to performance improvement in manufacturing and business sector. Although all these practices may not be directly applicable to the construction industry, many construction practitioners have reported some degree of success.

Increased interest in tools and techniques for improving efficiency and quality learned from other industries, including benchmarking, value management, and total quality management. There are several tools that have been developed in the construction industry. They have been proved as important tools for improving project performance and teamwork. Gibson & Griffith, (1997) identified the following tools;

- Risk management and control software
- Historical information regarding lessons learnt
- Partnering agreement with outside supplier or contractor
- Scope definition checklists
- Project team in progress
- Work process flow diagram
- Constructability, concurrent engineering and design and build

2.20.1 Risk Management

No construction project is risk free; in fact all construction projects carry with them to a certain extent an element of risk. Risk and uncertainty are inherent in all construction projects irrespective of project size. This risk encompasses time, cost and quality as well as risk allocation. Any attempt to manage or reduce risk has to take into account the trade- off between these performance measures. Risk management plays an important role in construction as it can be used as a tool for solving the problems associated with risk.

According to Gould & Joyce, (2008) the general risks that occur on any project are classified as follows:

- Financial risk where the cost of the project exceeds the money that has been allocated for the project
- Time risk where the project is not completed on the time originally planned
- Design risk where the project will not perform the function for which it was intended
- Quality risk where poor quality materials or workmanship or work will be incomplete in someway

2.20.2 Partnering

Partnering can best be defined as a way of doing business with a contractor or customer that recognizes that common goals exist which can be achieved through cooperation and open communication. The concept of partnering involves developing a cooperative management team with key players from the organizations involved in the construction process. Partnering is defined as "teambuilding effort when parties build a cooperation relationship to develop a project" (Groton, 1997).

Fisk, (2009) identified the following as the key elements of partnering, they include;

- Commitment to partnering from top management
- All of the parties interests need to be considered in creating mutual goals
- Trust
- Development of mutual goals and objectives
- Develop strategies for implementing mutual goals as well as mechanism for solving problems
- Timely responsiveness

The concept of partnering is based on a long-term relationship. Fisk, (2009)defined partnering as "a relationship between two or more companies or organizations which is formed with the express intent of improving performance in the delivery of projects". It is designed to achieve specific business objectives and improve the performance of the people involved through a set of processes and procedures to use their resources and experience more efficiently.

2.20.3 Constructability

Constructability or build-ability has been widely adopted as means to increase cost efficiency. In Kenya various attempts have been made but there is no universal constructability report yet. The concept of constructability evolved from studies into how improvement can be achieved to increase cost efficiency and quality in the construction industry. It is basically an approach that links the design and construction process.

Many definitions have been given to constructability, the most widely accepted being the one produced by the American Construction Industry Institute (CII, 1990) which defined constructability as "the optimum use of construction knowledge and experience in planning, design, procurements and field operation to achieve overall project objectives and promote potential cost savings. Constructability which can also be termed as project performance is therefore an important project management tool and it will be appropriate to include it in the final model.

2.20.4 Benchmarking

Benchmarking is a tool that has been applied to many industries with notable success. It is about companies and organizations comparing their practices and performance in key activities. It is a useful tool based on the belief that it is possible to identify and examine the best practices of other organizations and then make constructive changes in one's own organization. Lema & Price, (1996), stressed that benchmarking is the practice of comparing business and performance levels between divisions, competitors or world best, as part of continuous change and improvement. One advantage of benchmarking is that it can be applied in construction to both the product and the process with reference to time, quality and cost.

(a) Types of Benchmarking

Benchmarking is classified into various types depending on the company's strategy. Benchmarking can be divided into the following:-

1.0 Internal benchmarking compares performance between departments, units within an organization

2.0 External benchmarking identifies the competitor's product and then compare with own product.

(b) Benefits of Benchmarking

Benchmarking has noticeable benefits and can be summarized into the following (CIB 1997);

- Provides better understanding of customers' needs and their competitor's activities
- More customer's satisfaction
- Reduction in waste, quality problems and rework
- Faster awareness of important innovations and guides on how to apply to achieve profitability
- Provides strong reputation with their markets
- Increased profits and turnover

It can be observed that benchmarking is a powerful and useful tool to promote process changes and improvement that has been proved to be successful and could be used in construction industry to improve overall performance.

2.20.5 Value Management

Value management is a structured, systematic and analytical process which seeks to achieve value for money by providing all the necessary functions at the lowest total cost consistent with required levels of quality and performance (Burke, 2007). Value management is not to reduce costs but to establish balance of performance with cost. Therefore, value can be reached when balance is achieved between quality and resources (Thiry, 1997).

Value management addresses the overall project objectives, questioning the need for the project in the first place and seeking to clarify the client's priorities in achieving the project (Hayden & Parsole, 1996). Value management is defined as "an organized function oriented team approach directed at analyzing the functions of a product, system or supply for the purpose of enhancing its value by identifying and eliminating unnecessary costs and achieving the required performance at the lowest project life cycle cost”. It can assist in creating a culture, which enhances project performance by reducing risks.

(a) Customer Value

Value like many other concepts is subjective, however it can be measured. (Thiry, 1997), provided a formula where customer value can be measured as follows:

$$\textbf{Customer value} = \frac{\textbf{Needs + Objectives + Targets}}{\textbf{Maximum overall resources expected}}$$

There are many types of values and their importance varies depending on the objectives of the client. (Thiry, 1997) identified the following types of values.

1. **Use value** – The amount of resources spent to realize a finished product as it was intended
2. **Esteem value** – The amount of present resources a user is willing to spend for a function attributable to pleasing rather than performing.
3. **Exchange value** – The amount of present resources for which a product can be traded.
4. **Cost value** – The amount of present resources spent to achieve a function measured in money value (currency example Kenya Shillings).
5. **Function value** – The relationship of function with function cost.

(b) Benefits of Value Management

The principles of value management are important to the improvement of the construction performance. Hayden & Parsole, (1996) outlined the following benefits:

- Improved communication and team working
- A shared understanding among the people involved

- Better quality project definition and design briefing
- Increased innovation

2.20.6 Project Definition

Arguably, if any aspect of a project is more responsible for project failure than any other, it is the lack of an adequate project definition. Clear and accurate definition of a project is one of the most important actions to be taken to ensure any project's success. The definition of a project involves a process of selecting and reducing of the ideas and perspectives of those involved into a set of clearly defined objectives and evaluated risks. The project definition document should be approved at various stages in order to allocate resources for the construction activities. According to (Karamaju, 2010), inadequate project definition is responsible for many project failures in recent years.

2.20.7 Project Organization

In dealing with construction projects, planning and control are the key issues, but project management also involves attitudes and behaviour. Organizations are complex systems with certain characteristics (Schlesinger, 1992). The cultural (soft) issues such as value and behaviour must be taken into account when dealing with construction projects. It goes without saying that improved construction performance requires better processes and new technology; however, this could not be achieved without motivated and valued people working in a culture of cooperation, teamwork and continuous improvement.

2.20.8 Culture and People

The human factor has been proven to be an important issue affecting quality (Hamza, 1995; (Muchungu, 2012)). Cultural issues such as attitudes, values, trust, behaviour, and environment are important factors affecting the alignment of teams toward the same objectives ((CII, 1997). People are the most valuable asset of an organization and it follows that the control of projects starts with the team development. The performance of the team determines the success or failure of a project.

Teams and leadership has become a concern on the formation of teams. In fact the construction of the pyramids could only be accomplished through teamwork. A team must be assembled that will work in harmony and efficiently.

(a) The Relationship between Client and Project Team

The relationship between the client and project team is a complex one. A successful relationship between the client and project team depends largely on the level of trust and commitment. There may be different views between client and others involved in the team, as a result each has a different viewpoint. This leads to the need for a method to facilitate communication to enable each member in the team to work towards the same set of objectives. One method to facilitate communication is developing a project plan. This will help communicate project objectives more effectively between the project team.

(b) The Importance of Teamwork

Teamwork has been regarded as a key factor leading to productivity in the construction industry (Menndelsohn, 1998). The capability of teams in planning a team building and communication has a positive relationship with construction time performance (Walker, 1994). Ahuja, (1994) stated that interpersonal relationships are important because they allow teams to work with high productivity. Teamwork is important in achieving success. Leadership is vital in securing the success of teamwork; it provides effectiveness (Mendelsohn, 1998). Furthermore, Romanik, (1995) added that the effectiveness of teamwork depends on many things such as communication. Allen, (1984) explained that project teams are important and beneficial and that the team should adopt a positive and creative strategy when defining the client needs.

(c) Teamwork and Project Success

Most construction project teams comprise three primary participants; the client, with the need of the project; the designer and the contractor. The objectives of each are understandably different. But the success of the project lies on the comprehensiveness of the stakeholders to manage the objectives and any conflict. The basic assumption of teamwork is that the whole is better than the sum of parts. Teams can produce more if there is cooperation and coordination. Teams are an important factor and can contribute to project success. Ashely et al (1987) demonstrated in their study that project success is achievable when there is a team satisfaction. (Potter & Sanvido, 1995) explained that project success depends on a cohesive team contributing to successful projects. These characteristics include people oriented as shown in Figure 2.7.

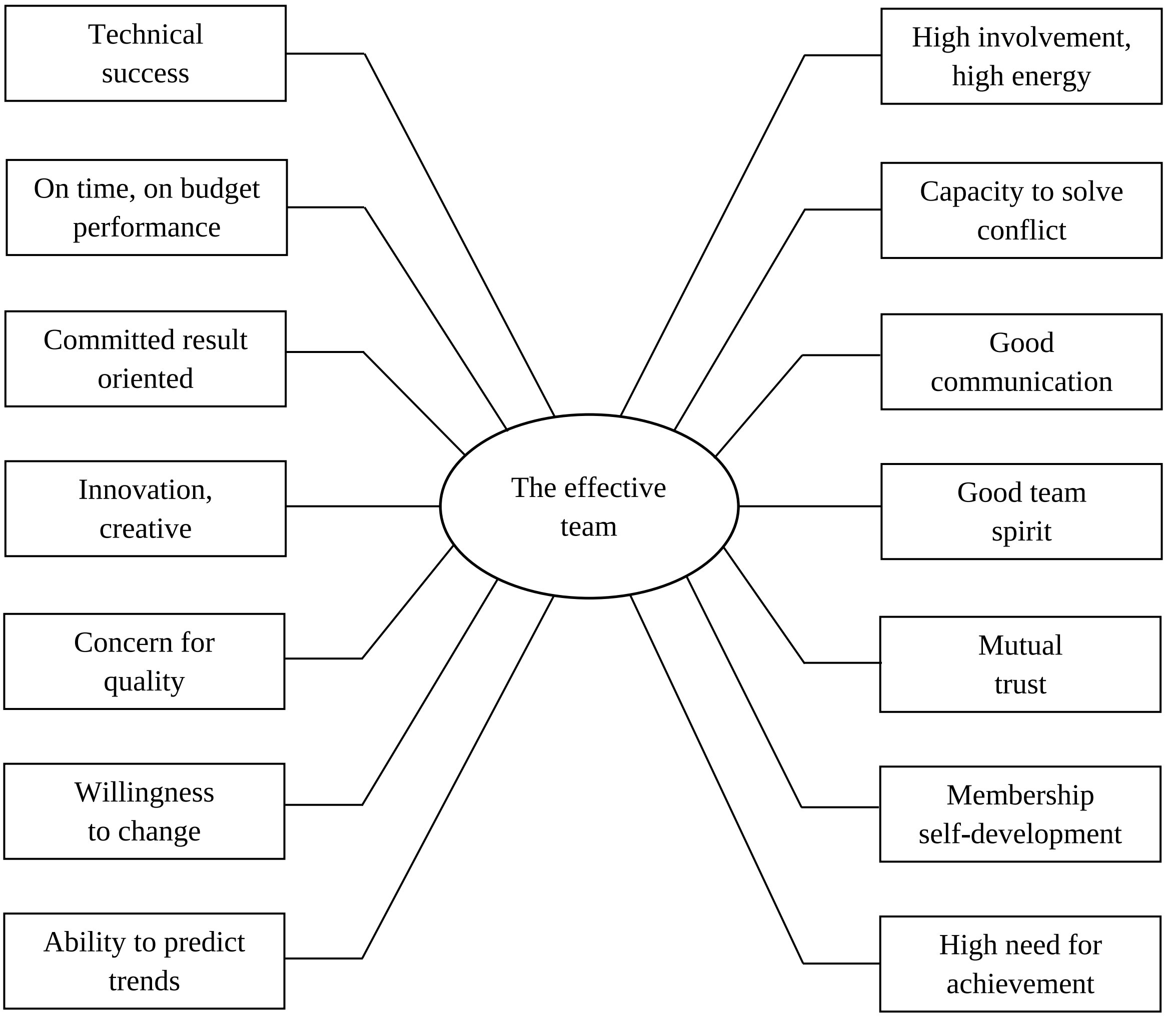


Figure 2.7 Characteristics of an Effective Team

(Adopted from Tucker et al 1997)

2.20.9 Alignment

The (CII, 1996)defined alignment as "the condition where appropriate project participants are working within acceptable tolerance to develop and meet a uniformly defined and understood set of project objectives".

In the project environment, alignment exists in three dimensions. The first dimension, vertical, involves top-to-top alignment within an organization. The second, horizontal, involves the cross-organizational alignment between functional groups within organizations. The third dimension, longitudinal, involves alignment of objectives and priorities throughout the project life cycle.

(a) Factors affecting Alignment

Issues that affect alignment during project planning can be divided into the following five categories (CII 1997).

Cultural: includes attitudes, values, behaviour and environment of the government and the project planning team

Execution process: procedures, processes and project systems

Information: business objectives used to define project objectives and scope of the project

Project planning tools: software programme, checklists, and flow diagrams used to develop and manage projects.

Barriers: the obstacles that inhibit maintaining alignment

(b) The Importance of Alignment

Alignment is critical to effective project planning and can be used to ensure that team members contribute their experience and knowledge. Appropriate alignment helps decision-makers focus their attention on the project objectives (Gibson & Griffith, 1997). Alignment is also closely related to the project success. Albanese, (1993) revealed that among the reasons that contribute to the success of any team is their commitment to work well as the shared goals they have. Gibson & Griffith, (1997) identified several performance models that focus on the topic of organizational alignment. The following is a brief description of these models.

An alignment Matrix is a model that emphasizes the need for daily work to be focused and aligned with the organizational aim. This requires open communications between all project participants. The alignment matrix is proposed to assist in improving communication and achieving alignment within the organization.

A strategic and cultural path is a model based on the belief that the condition of alignment is divided into two branches, strategic path and cultural path.

Organizational alignment takes place when strategic goals and cultural values are mutually supportive.

Hierarchical and lateral alignment is divided into hierarchical and lateral alignment. Hierarchical alignment involves vision, generic code, talent and environment. All of these elements must support each other and be compatible to achieve alignment (Hamilton & Gibson, 1996). Lateral alignment involves customers, organizations and teams serving the customer.

In this model, alignment is viewed in terms of aligning the five aspects of organizational life; purpose, objectives, strategy, structure and culture. This model recognizes that culture influences each of the other elements.

Organizational effectiveness variables is a model that describes alignment as a part of fundamental shift of mind to a new paradigm that places primary emphasis (purpose, vision, alignment,) on the elements underlying organizations and placing secondary emphasis on more traditional variables, solution to problems, agreement. The model draws a clear distinction between alignment and agreement. Alignment deals with a more inspirational aspect of purpose and vision while agreement deals with the mechanics of goals and objectives.

(c) Teamwork and Alignment

Alignment is defined as "the condition where appropriate project participants are working with acceptable tolerance to develop and meet a uniformly defined and understood set of objectives" (CII, 1997). The keys to alignment are that the team may have different objectives and goals, but these must be aligned and not contradict each other.

2.21 SCOPE DEFINITION

Scope definition is defined as "the process by which projects are defined and prepared for execution" (Gibson & Dumont, 1996). The information identified during this process is usually presented in a form of a project definition package. A project definition package is a detailed formulation of a continuous systematic strategy to be used during the evaluation phase of a project to accomplish the project objectives. This package should include sufficient information to permit effective and efficient detailed engineering to succeed (Gibson, et al., 1993)

According to Burke, (2007), the scope definition; outlines the content of the subject details, how it will be approached and explains how it will solve the client's needs and problems. Scope definition is a formulation and documentation of the methods and resources an owner of a company can use to perform pre-project planning. It comprises the following:-

- Statement of need
- Outline of known alternatives
- Defined schedule for pre-project planning
- Defined pre-project planning resources in detail
- Defined information available and needs
- Contract strategy
- Defined deliverables
- Defined tasks for minimizing risks
- Define responsibilities for pre-project planning team members

2.21.1 Scope Definition and Success

The review of literature concerning scope definition revealed that the quality of scope definition is closely related to the success of a project. The scope definition developed during the early stage of a project has a significant effect on schedule and cost features at completion (Gibson & Griffith, 1997). Gibson and Dumont (1996) reported then the study by Smith and Tucker (1989) that the lack of scope definition is the most problematic cause of rework and lower productivity as well as delay to project being completed on time. Proper scope definition is a critical factor that contributes to project success (Songer. & Molenar, 1997).

Scope definition can affect the quality of design. Gibson & Dumont, (1996)reported a study by Buddus (1993) that scope definition is the highest-ranking input for construction projects. The study also showed that scope definition was found to be the most important variable affecting the quality of design and overall project success. In addition to the previous studies, Construction Industry Institute research has shown that increased efforts of scope definition during the early stages of project can improve the accuracy and estimates of a project as well as meeting the project objectives (Griffith & Gibson, 2001).

2.21.2 Previous Attempts to Define Scope Definition

John Hackney Definition Rating Index

Hackney, (1992) published the first definition rating index checklist (Gibson & Dumont, 1996). This was a tool designed to quantify the degree of scope definition for industrial projects. He classified the items for a good scope definition under six main items. In his view, the most important item in the project definition package that if well-defined should minimize the potential cost overrun of a project. However, his checklist was not well accepted and consequently did not receive recognition (Gibson & Dumont, 1996). Hackney, (1992) classified the items of the scope definition under six major items namely;

- General project basis
- Process design status
- Site information
- Engineering design status
- Detailed design
- Field performance status

The checklist of John Hackney was developed in such a way that items are assigned maximum weights in his checklist. The weights represent the relative ability of an item to affect the degree of uncertainty in the project estimate scores for each item. For example, complete definition is given a score zero and the scores increase up to the maximum possible weight as the level of definition decreases.

2.21.3 Project Definition Rating Index (PDRI)

The previous section described that information regarding defining the scope of a project should be represented in a form of package containing the details. This is important because it allows the project to be executed in an effective way, since all the critical elements are identified. The tool that identifies and describes these critical elements in the scope definition is called project definition rating index (PDRI). The PDRI is an easy to use tool that enables the project planning team to evaluate the likelihood of achieving project objectives (Griffith & Gibson, 2001). The weighing is the same as the one performed by John Hackney.

2.21.4 The Benefits of PDRI

The (CII, 1996) identified the following benefits:

- A checklist to enable project team evaluate the completion of scope definition
- A tool to guide in communication between owners and contractors
- A method to help teams reconcile differences
- A way to monitor progress during project planning
- A training tool for companies
- A benchmarking tool for companies to evaluate the completion of scope definition versus the performance of past projects

2.22 CLIENT SATISFACTION MEASURES

The inability of the construction industry to consistently satisfy its clients is a major concern. One way to overcome this problem is to adopt new approaches and techniques have to increase the efficiency and client satisfaction. The possibility of improving client's satisfaction is by meeting its needs. According to (Love, 1996), there are several factors that contribute to client dissatisfaction, they include the following:

- Project not completed on time nor in budget
- Project not completed according to the required technical specification and quality
- Lack of feedback from participants
- Lack of involvement throughout the project

The Latham Report (1994) reviewed procurement and contractual arrangements in the construction industry in the UK and gave emphasis to the importance of clients, good briefing and the essential need to the experts and professions and industry in a team approach to satisfy client requirements. Research by (Atkin & Flanagan, 1995) identified the need for clients and their advisors to be aware of the importance of decision making (business case, development of the design and management of the project) at the strategic level.

Davenport & Smith, (1995) examined the relative level of client satisfaction and involvement with all of procurement types. They concluded that it was more difficult to satisfy private clients than public ones; however, they did not give evidence to the reasons of whether it was that public clients have more understanding of the capability of contractors than private clients and therefore find satisfaction more easily. Table 2.6 presents reports from different authors of the measures of client satisfaction.

Table 2.6 Client Satisfaction Measures Source: Own formulation, 2013

Author	**Measure of Satisfaction**
(Walker, 1994)	Quality, cost and time
(Bitici, 1994)	Quality, reliability, on time deliveries, high service levels and minimum cost of ownership
(Kometa, et al., 1994)	Function, safety, economy, running costs, flexibility, time and quality
(Harvey & Ashworth, 1997)	Trust, cost, performance and management
Chinyio et al 1998	Economy, functionality, quality, timeliness, lack of surprise and safety

It can be seen from the above stated definitions that time, cost and quality (Walker, 1994), are not the only measures of client satisfaction, but they also expand to include other factors such as working relationships and other factors which are people related factors such as stakeholders and business partners. With such considerable evidence linking people's relationships cannot be ignored as a main contributor to client satisfaction.

2.23 PROJECT MANAGEMENT MODELLING

There have been a number of attempts to clarify the complex subject of project management by means of modeling on a global perspective. However, in Kenya there has been little activity on project management modeling.

A model is some form of representation designed to aid in visualizing a thing that cannot be observed directly, either because it has not yet been constructed or because it is abstract. There are different types of models including mental models, physical models, mathematical models and diagrammatic models. Mental models relate to the images that form in people's minds when some subjects are discussed. The physical models relate to the three dimensional models that may or may not be working mechanically but do demonstrate shape and physical relationships, such as in structural and architectural models. The mathematical types are expressed as formulae such as cost models. Whereas the diagrammatical models include bar charts and figures that present information by visual impression. Most of the developed project management models are diagrammatic. For example the International Project Management Association (IPMA) developed a sun wheel model based on the major tasks of a project management in 1997 as represented in figure 2.4 below.

According to IPMA, 1997, a good project management model should do the following things:

i. Clarify the overall scope and extent of comprehensive project management body of knowledge
ii. Break up the body of knowledge into logical and understandable categories or divisions
iii. Utilize and build on the work accomplished by the Project Management Institute
iv. Indicate the interrelationships between the various categories into which the project management body of knowledge can be subdivided
v. Take into account the complexities of project management and the integrating nature of the project manager's job and of his or her supporting team

vi. Provide a breakdown of the project management body of knowledge which can readily be utilized for storage and retrieval of all elements of project management that is functions, processes, activities, tools and techniques
vii. Be sufficiently simple and understandable to be useful to present and potential project management practitioners
viii. Be consistent with the course content of project management educational programmes.

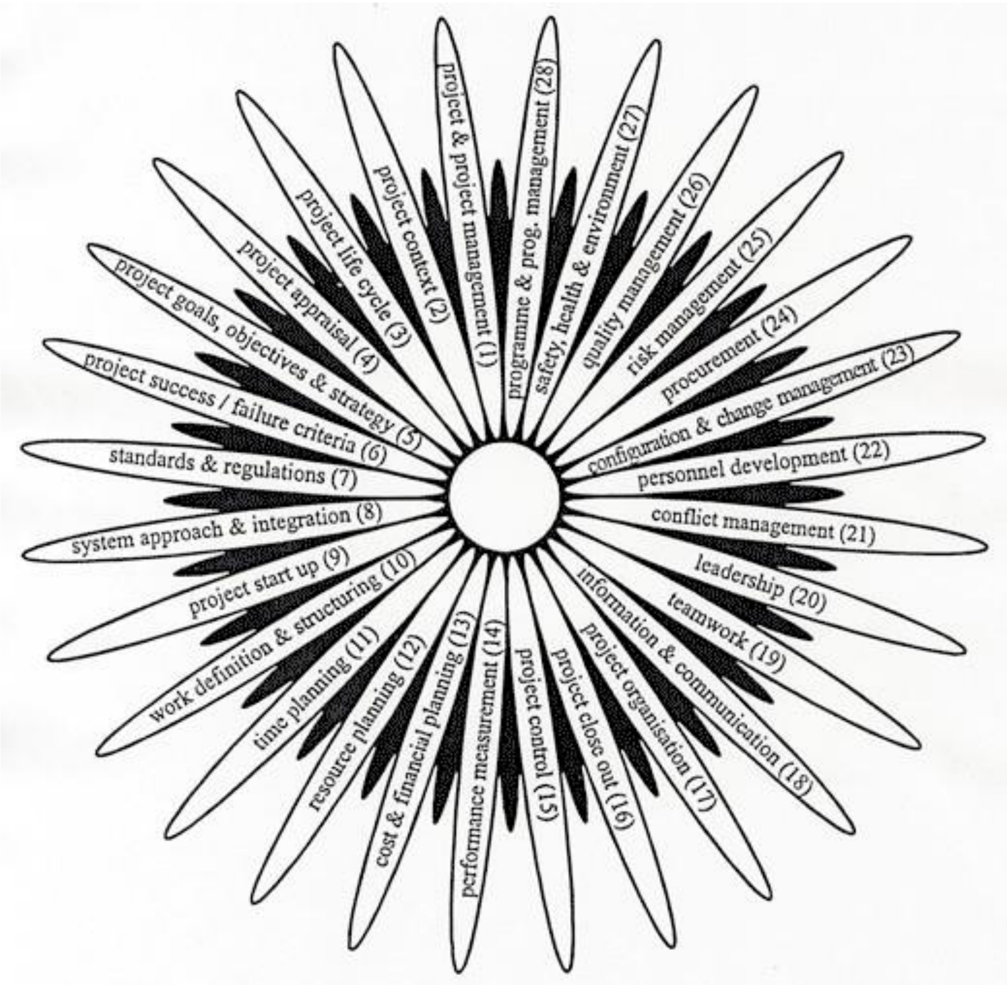


Fig 2.4 The IPMA sun wheel model, 1997

2.24 A DISCUSSION ON EXISTING PROJECT MANAGEMENT MODELS

There are a number of Project management models in use in the world today the major ones being the PMI's Project Management Body of Knowledge in use in USA and CIOB's in use in UK. Project Management has a standard and recognized corpus of knowledge. Indeed, in America there is a standardized Body of Knowledge, the PMBOK (Project Management Institute, 2013) -so standardized that a practitioner seeking to become accredited as a "Project Management Professional" (PMP) has to sit a multiple choice exam on the PMBOK. The Project Management model is predicated on a number of assumptions. The PMI model is yet to take a structured adoption in the construction industry in Kenya.

The PMI (2013) recommends five distinct but interrelated project management process groups: *initiation, planning, execution, monitoring* and *closing process groups.* Significantly, the body of knowledge acknowledges that "the integrative nature of the project management requires the monitoring and controlling process group interaction with every other process group". In other words, monitoring and controlling is central to project management processes. Monitoring and controlling is "the process necessary for collecting, measuring, and disseminating performance information, and assessing measurements and trends to effect process improvement". When this is done continuously, the body of knowledge suggests, it will provide the project team insight into the health of the project and highlights any areas that require additional attention. The main activities in monitoring and control, according to the guide, include:

- Monitoring the ongoing project activities against the project management plan and the project performance baseline
- Influencing the factors that could circumvent integrated change control so that only approved changes are implemented.

In particular, the measurement and evaluation of performance are central to control posing four basic questions (Shaw, 1999):

- What has happened?
- Why has it happened?
- Is it going to continue?
- What are we going to do about it?

The first question can be answered by performance measurement. The remaining ones will depend on the information from assessing the performance of the project for management to take decisions and actions. The information about what is really happening is vital for the project management team and other stakeholders to determine with considerable certainty what to do. Thus, assessing the performance of project throughout its life cycle is one of the major ways of achieving the objectives of the project and to ensure better performance. In addition, it is a means of ensuring improvements in executions. Improvements in project execution within a construction industry will then be one of the key indicators of a construction industry of a country. Within the construction sector, mostly in the developed countries, various frameworks exist for the measurement of project success or failure. This also includes which factors are influencing the performance of the projects.

In UK the argument is that construction and development projects involve the coordinated actions of many different professionals and specialists to achieve defined objectives. The task of project management is to bring the professionals and specialists into the project team at the right time to enable them make their best possible contribution, efficiently as indicated by The Chartered Institute of Building (Chartered Institute of Building, 2010). The UK model structures a project into different stages from inception to project closure.

Projects begin with the inception stage that results from business decisions by the client which suggest a new construction or development project may be required. Essentially, the inception stage consists of commissioning a project manager to undertake the next stage, which is the test of the feasibility of the project. The Feasibility Stage is a crucial stage in which all kinds of professionals and specialists may be required to bring many kinds of knowledge and experience into a broad ranging evaluation of feasibility. It establishes the broad objectives for the project and so exerts an influence throughout the subsequent stages. The UK model has also not been fully embraced in Kenya.

The other developed model is that of Germany suggested for Kenya by (Mbatha, 1993); whereby the QS is not recognized. This model was not taken up and it does not have a tangible measurement criteria. There is therefore a need to develop an appropriate model for the construction industry in Kenya. This has been necessitated more by the fact that many practicing architects, quantity surveyors and civil engineers are calling themselves project managers without proper criteria for their performance evaluation. Currently there are no formally approved project management models in use in Kenya hence the need for the current study.

2.24.1 PRINCE2

PRINCE2 (an acronym for **Pr**ojects **In c**ontrolled **E**nvironments, version **2**) is a project management methodology. It was developed by the UK government agency Office of Government Commerce (OGC) and is used extensively within the UK government as the de facto project management standard for its public projects. The methodology encompasses the management, control and organization of a project. PRINCE2 is also used to refer to the training and accreditation of authorized practitioners of the methodology who must undertake accredited qualifications to obtain certification (Office of Government Commerce; (OGC, 2009; The APM Group Ltd, 2010).

Since 2006, the method has been revised. It launched as "PRINCE2:2009 Refresh" in 2009. The name "PRINCE2" (instead of "PRINCE3" or similar) remains to indicate that the method remains faithful to its principles. Nevertheless, it is a fundamental revision of the method from 1996 to adapt it to the changed business environment, to make the method simpler and lighter, to address current weaknesses or misunderstandings, and to better integrate it with others. The main difference between the 2009 version and earlier versions is that there are two manuals:

1. 'Managing Successful Projects with PRINCE2 - 2009 Edition',
2. 'Directing Successful Projects with PRINCE2 - 2009 Edition'

(a) The Structure of PRINCE2

PRINCE2 extracts and focuses on key elements (Themes) which it identifies as being crucial to the successful assessment and completion of all projects. It contains a structured Process to tie those elements together to reduce overall project risk, with several useful techniques to support them. In its publication, PMI; (Feb. 2013) the Project Management Institute (PMI®) says: "…the PMBOK® Guide is intended to help practitioners recognize the general process of project management practice and the associated input and outputs," and "due to its general nature and generic application, the PMBOK® Guide is neither a textbook, nor a step-by-step or 'how-to' type of reference." The PMBOK® GUIDE calls on the practitioner to apply a project management methodology (as a tool), and PRINCE2 provides a reliable and practical one. That is the reason why Kenya also needs to develop and or adapt the guide to suit its conditions.

PRINCE2 Principles, Themes and Processes are consistent with the PMBOK® GUIDE, but PRINCE2 does not include all the knowledge areas and details specified in the PMBOK® GUIDE. PRINCE2 focuses on critical areas, so a Project Manager still may need to draw on the depth and range of the PMBOK® GUIDE and other sources to complete some areas of project management work. The intention of PRINCE2 is to organize and focus project management knowledge in a manner adaptable to a wide range of project environments. It assumes that those learning and working with this methodology have a level of experience that enables them to fill in the details that PRINCE2 omits. In PRINCE2 the scale and content of its Processes and Themes must be tailored to the size and nature of the project, and the characteristics of the organization in which it operates.

(b) Principles

The PRINCE2 methodology has as its framework seven Principles – guiding obligations which determine whether a project is being managed using PRINCE2. Unless all of them are being applied in a project, it is not a PRINCE2 project. The methodology emphasizes that the Principles define a project – not filling out forms, or following the methodology word-for word. The emphasis is on information and communication.

The seven Principles are:

(i) Continued Business Justification – exemplified by the Business Case Theme; ensures that the project remains aligned to the business objectives, strategy and benefits being sought.

(ii) Learn from Experience – lessons are sought, recorded and acted upon throughout the project's life cycle.

(iii) Defined Roles and Responsibilities – ensures that the right people are involved, and that all parties understand what is expected of them.

(iv) Manage by Stages – as planning can only be done to a level that is manageable and foreseeable, projects are planned, monitored and controlled on a stage-by-stage basis, providing control points at major intervals throughout the project.

(v) Manage by Exception – PRINCE2 projects establish distinct limits of authority for each level of the project management team, based on the performance objectives of time, cost, scope (the classic triple constraints) – adding in quality, risk and benefits to provide a full and truer picture of a project's success factors.

(vi) Focus on Products – as successful projects are output (rather than activity) oriented, a PRINCE2 project has a particular emphasis on the definition, production and approval – to agreed expectations – of deliverables (which PRINCE2 refers to as products).

(vii) Tailor to Suit the Project Environment – recognizing that projects cannot be managed to strict (rigid) formulas, Processes and Themes must be shaped to reflect the particular circumstances of each project (to avoid "robotic" project management).

(c) Performance Measurements

The classic project constraints that define the performance objectives of a project (identified in the PMBOK® GUIDE as time, cost, scope and quality) have been expanded in PRINCE2 to recognize the additional two factors of benefits (the value being delivered) and risk (the limit of the project's risk exposure; also recognized in the PMBOK GUIDE® as "risk tolerance"). PRINCE2 identifies all six of these as the factors that shape the project plan, whose variances must be monitored, and the (control) measure of the project's progress. They are used during the project to determine whether or not the project is being delivered to meet Acceptance Criteria, or if it is wandering beyond limits of authority established by the commissioning body or PRINCE2's Project Board.

(d) PRINCE2 Themes

PRINCE2 is built on seven elements, or Themes: Business Case, Organization, Plans, Progress, Risk, Quality, and Change (comprising configuration management and change control). They roughly map against the nine PMBOK® GUIDE Areas of Knowledge as follows:

Table 2.7: Comparison of PMBOK® GUIDE Areas of Knowledge and PRINCE2 Themes.

PMBOK GUIDE Knowledge Area	**Comparable PRINCE2 Themes**
Integration	Combined Processes and Themes, Change
Scope, Time, Cost	Plans, Business Case, Progress
Quality	Quality, Change (Configuration Management)
Risk	Risk
Communications	Progress
Human Resources Project stakeholders management	Organization (Limited)
Procurement	Not Covered

These Themes are not as comprehensively defined as the Areas of Knowledge. For example, PRINCE2 covers PMBOK® GUIDE's Time and Cost Management within its discussion of Plans - but only insofar as the development of time and cost information is necessary at the relevant plan level. The following summarizes the PRINCE2 Themes:

(i) *Business Case:*

The existence of a viable Business Case (project justification) is the main driver of – and a requirement for – a PRINCE2 project. The Business Case – representing the expected benefits to be achieved through the project's deliverables – is verified by the Project Board before a project begins and at every major decision point throughout the project.

(ii) *Organization:*

Since the Project Manager often has to direct staff who report to other management structures, some senior management oversight organization is needed to assure that those diverse resources are committed to the project. In addition, viability decisions need to be made by management with an investment in the project, and accountability for delivering it through the Project Manager. This oversight is provided by the Project Board.

(iii)*Plans:*

Plans are the backbone of the management information system required for any project, and require the approval and commitment of the appropriate levels of the project organization. The “Plans” Theme emphasizes the core concepts of planning, and outlines the major steps to produce plans, which are ultimately derived from the project’s expected deliverables (products).

(iv) *Progress:*

Progress is about monitoring and controlling against plans, and decision making. Its purpose is to ensure that the project:-

(a) generates the required products which meet defined quality criteria;

(b) is carried out in accordance with its schedule and cost plans;

(c) remains viable against its Business Case, and;

(d) operates at an acceptable level of risk.

(v) Risk:

As project work is inherently less predictable than non-project work, management of the risks is an essential part of project management. To contain risks during the project, they must be managed in a disciplined manner, through risk analysis and risk management (as in the PMBOK® GUIDE), guided by a Risk Management Strategy.

(vi) *Quality:*

Quality management ensures that the quality expected by the customer is defined and achieved through a quality system (similar to the PMBOK® GUIDE). Quality requirements of the project’s deliverables (“products”) are based in Product Descriptions, created by the Project Manager and approved by the Project Board. They are a subset of a Project Product Description which clearly specifies what the overall project is expected to deliver.

(vii) *Change:*

Controlling scope change means assessing the impact of potential changes, their importance, cost, impact on the Business Case, and a decision by management on whether or not to include them. But “change control” has no meaning unless requests for change are referenced against a fixed baseline. To do that, PRINCE2 integrates change control with configuration management. Configuration management gives the project management team control over the project’s assets (the products that it develops), and is vital to any quality system. It provides mechanisms for tracking and controlling the project’s deliverables and additionally includes procedures for managing project issues.

(e) Adoption

PRINCE2, as a method and a certification, is adopted in many countries worldwide, including the UK, Western Europe and Australia. The PMI and its certification, the PMP, is popular in the UK, USA and the rest of the world although as pointed out by the PRINCE2 official website, these two methodologies can complement each other. In Kenya we can borrow some of its strengths and develop a methodology suitable for our use.

PRINCE2 is a structured approach to project management. It provides a method for managing projects within a clearly defined framework. PRINCE2 describes procedures to coordinate people and activities in a project, how to design and supervise the project, and what to do if the project has to be adjusted if it doesn’t develop as planned. In the method each process is specified with its key inputs and outputs and with specific goals and activities to be carried out, which gives an automatic control of any deviations from the plan.

Divided into manageable stages, the method enables an efficient control of resources. On the basis of close monitoring the project can be carried out in a controlled and organized way. Being a structured method widely recognized and understood PRINCE2 provides a common language for all participants in the project. The various management roles and responsibilities involved in a project are fully described and are adaptable to suit the complexity of the project and skills of the organization.

PRINCE2 is sometimes considered inappropriate for small projects or where requirements are expected to change, due to the work required in creating and maintaining documents, logs and lists. However, the OGC claim that the methodology is scalable and can be tailored to suit the specific requirements and constraints of the project and the environment.

2.24.2 Hermes Method

HERMES is a software development methodology. HERMES is a phase based method, where some phases can be repeated. HERMES can be extensively tailored, using the PowerUser tool. Sub-models describe the activities overlapping phases. HERMES is Results oriented and provides additional views about Roles and Procedure (The APM Group Ltd, 2010).

(a) Objectives and concept

Successful projects may require target-oriented management, execution and controlling. The purpose of HERMES is to offer support to all those involved in this complex challenge in the management of their particular tasks. HERMES proposes goal and results oriented project procedures. Accordingly, it takes into consideration those interests and tasks of the purchaser and project manager, as well as those of the project collaborator. It thus creates the right conditions for successful coordination between all participants, by providing a common language.

HERMES structures the development and execution of a project by specifying project results and phases, from which the required project activities and responsibilities are derived. The methods name and describe phase-specific activities and their nature, as well as overlapping and concomitant tasks required for the guaranteeing of the project’s success, as summed up in the sub-models (such as project management, quality assurance and risk management). The application of HERMES improves project transparency. It facilitates the monitoring of the project’s progress and enables more rapid and targeted corrections to be made during the course of the project, if the need should arise.

As a project guidance method HERMES has already existed since 1975 (with extensive revisions in the years 1986 and 1995) in public administration in

Switzerland and in numerous enterprises. The constantly increasing usage of HERMES, also outside the federal administration, has borne fruit and shown that the content of HERMES is largely formulated as federal administration-neutral and that references specific to an area, or abbreviations and the like coming from the federal administration environment are avoided as far as possible.

The dynamism and nature of construction industry in Kenya does not allow for this method to apply well to monitor performance of construction projects.

2.24.3 Project Management Body of Knowledge (PMBOK)

The PMI – Project Management Body of Knowledge (PMBOK) 5th edition is a global standard of best practices established by the suggestions and comments from thousands of professionals in project management worldwide, as well as criteria for project management excellence by a work group consisting of itself of hundreds of contributors. The fifth edition has been in force since 2013. It takes into account the changing commercial practices and the facts of globalization in recent years and provides corresponding recommendations for effective project management in harmony with them. It is not limited to computers and can be applied to any project in any domain, commercial, technical, industrial, and construction. As this is a standard of best practices, similar to the GMP (Good Manufacturing Practices) used in the pharmaceutical, medical devices and food industries, it can easily replace existing methods and methodologies. It is therefore, possible to complete a project using only the standard or combine it with other methods and methodologies, particularly if these are already in place within an organization (PMI, 2013).

The purpose of the PMBOK Guide is to assist a project manager and other stakeholders in the application of knowledge, skills, processes, techniques and tools to ensure maximum chances of success of a project. It identifies the subset of project management knowledge being recognized as good practice, that is to say, that there is a broad consensus on the fact that their application, and the associated skills, techniques and tools significantly improve the chances of a successful project.

This does not however, mean that all these elements must be implemented systematically and indiscriminately in their entirety. It is the specificity of the project that determines the selection of items to be incorporated and placed under the responsibility of the management team and other project stakeholders.

The life cycle of a project is divided into five process groups:

1. **Initiating:** allows to define a new project or new phase of a project in progress, to obtain authorization for its execution and if accepted, to identify stakeholders.
2. **Planning:** allows to develop the project scope, develop goals and define the subsequent actions to achieve the objectives for which the project is undertaken.
3. **Executing**: brings together the work to be done according to the established project management plan, respecting the system and project specifications.
4. **Monitoring & controlling:** allows the monitoring, control and adjustments necessary for the advancement of the project and its performance. An important part of this group is to identify faulty elements that require changes to the plan and undertake the necessary changes within the executing processes.
5. **Closing:** allows for completion of all activities in an orderly way and formally close the project.

Although the order of these groups suggests a process which is conducted in systematic sequence of activities included in each group, this is not the case. During the project, these activities overlap and frequently inter-link and many processes are repeated in an iterative manner. It is the know-how and the skills of the project management team that determine the course by following this guide.

The total of all the project management activities consists of 42 processes, which are spread across ten knowledge areas:

The ten knowledge areas are:

1. *Project Integration Management*: Project Integration Management includes the processes and activities needed to identify, define, combine, unify, and coordinate the various processes and project management activities within the Project Management Process Groups.

2. *Project Scope Management*: Project Scope Management includes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully.
3. *Project Time Management:* Project Time Management includes the processes required to manage the timely completion of the project.
4. *Project Cost Management:* Project Cost Management includes the processes involved in planning, estimating, budgeting, financing, funding, managing, and controlling costs so that the project can be completed within the approved budget.
5. *Project Quality Management:* Project Quality Management includes the processes and activities of the performing organization that determine quality policies, objectives, and responsibilities so that the project will satisfy the needs for which it was undertaken.
6. *Project Human Resource Management:* Project Human Resource Management includes the processes that organize, manage, and lead the project team.
7. *Project Communications Management:* Project Communications Management includes the processes that are required to ensure timely and appropriate planning, collection, creation, distribution, storage, retrieval, management, control, monitoring, and the ultimate disposition of project information.
8. *Project Risk Management:* Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, and controlling risk on a project.
9. *Project Procurement Management:* Project Procurement Management includes the processes necessary to purchase or acquire products, services, or results needed from outside the project team
10. *Project Stakeholders Management:* Project Stakeholder Management includes the processes required to identify all people or organizations impacted by the project, analyzing stakeholder expectations and impact on the project, and developing appropriate management strategies for effectively engaging stakeholders in project decisions and execution.

The PMBOK’s ten knowledge areas have been subjected to Principal Component Analysis (PCA) and the resultant reduced factors have been used to develop a project management evaluation model for Kenya. While, these models were developed independently, the overall objective is one that is achieving projects results as anticipated at project initiation.

2.24.4 Global Alliance for Project Performance Standards

The Global Alliance for Project Performance Standards' (GAPPS) is a nonprofit organization who provides *independent* reference benchmarks for project management standards and assessments (GAPPS, 2006). Driven entirely by volunteers, the GAPPS is an alliance of government, private industry, professional associations, and training and academic institutions working to develop globally applicable performance based competency standards for project management. The GAPPS produces standards, frameworks, and comparability maps (of other standards and frameworks) which are intended to facilitate mutual recognition of project management qualifications and are available for download, free of charge, from their website.

GAPPS membership is open to any organization (public or private) or government agency and maintains a listing of current members on its website.

Further, the GAPPS members are categorized into four distinct types:

- Standards and Qualifications Organizations
- Project Management Professional Associations
- Academic/Training Institutions
- Industry

(a) Objectives of GAPPS

According to the GAPPS website, their objectives are to:

1. *Facilitate, develop, approve, publish, promote, maintain and review:*
    1. *global project management standards*
    2. *usage guidelines for project management standards, but*
2. ***NOT** consult, advise, express opinion or develop products based upon standards and guidelines*
3. ***NOT** provide training, assessment, certifications or qualifications to individuals based upon standards and guidelines*

(b) Approach to Standards

The GAPPS "explicitly recognizes" that there are many different approaches to project management that can achieve satisfactory results and that there are many different ways for project managers to develop their competence. The GAPPS standards for qualifications of *Junior Project Manager* (known as *Global 1,* or "G1") and *Senior Project Manager* (known as *Global 2,* or "G2" are quite generic, though this is intentionally so, as they are written as a complement to project management standards including those of professional associations (example PMBOK®Guide, IPMA Competence Baseline and associated National Competence Baselines) as well as other standards such as BS6079 Guide to Project Management. All of these aforementioned documents can be used in association with the GAPPS to provide further detail, knowledge, and understanding of specific applications.

(c) Adoption of Standards

The GAPPS initiative encourages professional associations to consider adopting the standards to support existing standards and qualifications processes by adding and/or strengthening the performance based dimension. GAPPS also allows additions and modifications to be made to suit specific local and regulatory requirements.

(d) Design of the GAPPS Standard

Performance Based Competency Standards (PBCS) typically address at least the following two questions:

● What is usually done in this occupation, profession, or role by competent performers?

● What standard of performance is usually considered acceptable to infer competence?

In the GAPPS standards, these questions are answered by defining:

● *Units of Competency*

> A unit of competency defines a broad area of professional or occupational performance that is meaningful to practitioners and which is demonstrated by individuals in the workplace. The GAPPS Level 1 framework includes five Units of Competency while GAPPS Level 2 includes six.

● *Elements of Competency*

Elements of Competency describe the key components of work performance within a Unit. They describe *what* is done by individuals in the workplace but do *not* prescribe *how* the work is done. For example, project managers must "define risks and risk responses for the project," but they can do it themselves or delegate the work to others.

● *Performance Criteria*

Performance Criteria set out the type and/or level of performance required to demonstrate competence. They describe observable results and/or actions in the workplace from which competent performance can be inferred. In the GAPPS framework, Performance Criteria can be satisfied in many different ways; there are no mandatory approaches, tools, or methodologies.

● *Range Statements*

Range Statements help to ensure consistent interpretation of the Elements and the Performance Criteria by expanding on critical or significant aspects of them to enable consistent application in different contexts. Where the Range Statements contain lists, the lists are generally illustrative and not exhaustive.

(e) Application

The GAPPS framework explicitly recognizes that there are many different approaches to the management of projects, that there are many different ways to achieve satisfactory results, that there are many different paths for project managers to follow to develop their competence.

- *Use in Assessment*

When adopted as a standard, the GAPPS framework is intended to help an assessor infer whether an experienced, practicing project manager is likely to be able to perform competently on future projects. The assessment should include direct contact between the candidate and the assessor as well as examination of evidence supplied by the candidate and by other sources such as clients, supervisors, and team members. Assessment may also include direct observation of the candidate in a workplace environment.

As with most other performance based competency standards, GAPPS assumes that 100% of the Performance Criteria must be satisfied for a candidate to be assessed as competent in the role. As a result, Performance Criteria have generally not been repeated in different Units.

2.24.5 Business Enterprise Regulatory Reform (BERR) Guidelines

The purpose of the project management guidelines is to help organize, plan and control projects. They are designed to help maximize the potential for projects to succeed by helping address each element of project at the right time and to the right level of detail for the size and complexity of a project (BERR, 2007).

To be successful a project must:

- Deliver the outcomes and benefits required by the organization, its delivery partners and other stakeholder organizations;
- Create and implement deliverables that meet agreed requirements;
- Meet time targets;
- Stay within financial budgets;
- Involve all the right people;
- Make best use of resources in the organization and elsewhere;
- Take account of changes in the way the organization operates;
- Manage any risks that could jeopardize success;
- Take into account the needs of staff and other stakeholders who will be impacted by the changes brought about by the project.

(a) Classification of projects according to BERR guidelines

Projects are different from the normal operation of the organization in that they:

- Have specific objectives to deliver new benefits to, the taxpayer, companies, the general public government the sponsoring organization, stakeholders and/or delivery partners.
- May introduce significant changes to the way the business operates.
- Create new outputs/deliverables that will enable benefits to be realized.
- Have a specific, temporary management organization and governance arrangements set up for the duration of the project.

● Are susceptible to risks not usually encountered in the day to day operation at work of the organization.

● Involve a range of stakeholders from different parts of the organization and beyond.

● May use methods and approaches that are new or unfamiliar.

(b) Reasons for use of BERR guidelines

Unfortunately projects sometimes fail to deliver, for a variety of avoidable reasons, example:

● Failure to take into account the needs and influences of stakeholders;

● Failure to communicate and keep the stakeholders informed of developments;

● Lack of attention to the impact of project work on the normal business of the organization

● Producing expensive 'Gold plated' solutions when simple workable products would suffice

● Failure to identify and deal with the many risks that can affect achievement of project objectives;

● Insufficient attention to planning, monitoring and control of the project.

This guidance will help you manage these sorts of avoidable problems. However, it should not be regarded as set of standards to be followed slavishly in all circumstances. On the contrary, there are many decisions you must take about the degree of management rigour you feel is necessary to maximize the chances for success and minimize the likelihood of project failure. The guide helps you make those decisions.

(c) What the guidelines cover – and do not cover

To help manage your projects the guidance, which can be applied to any type of project in the organization and its delivery partners, provides:

● The 'what, why, who, when and how' of project management activities.

● Advice on scaling project management projects of different sizes, duration and criticality

● Flowcharts and checklists to steer you through key project management tasks

● Templates for essential project management documents/forms

The following are not addressed in the guide but are available from a variety of other sources:

- General project management theory
- The details of the PRINCE2 methodology (although the guide is fully consistent with PRINCE2)
- Instruction on how to apply generic project management techniques
- The soft skills necessary for effective project management.

However, these guidelines do not provide absolute measures to differentiate the performance of project managers on different projects; a fact appreciated that the skill and judgment of a project manager as key and therefore need for a measurement process to be developed. The thesis delves into this matter while appreciating what is provided in the guidelines.

2.25 CRITERIA FOR ASSESSING PROJECT PERFORMANCE BASED ON EXISTING PROJECT MANAGEMENT MODELS

The criteria in which project success/failure has often been assessed have also been called key performance indicators and even dimensions (Atkinson, 1999; Shenhar, 2002), Betham *et al.*, 2004; (Chan & Chan, 2004). These are used interchangeably at this stage of reviewing literature based on how the authors referred to them. Several authors, within the multidimensional construct of project performance have proposed different criteria or indicators based on empirical research. While some focused on using these measures as strategic weapons, others emphasized the proper delineation of the measures and groupings into classes that will make tracking and management reasonable. (Shenhar et al., 1996; Shenhar, et al., 1997) model is based on the principle that projects are undertaken to achieve business results and that they must be "perceived as powerful strategic weapons, initiated to create economic value and competitive advantage, and project managers must become the new strategic leaders, who must take responsibility for project business results.". In their opinion, "projects in future will no longer be just operational tools for executing strategy –they will become the engines that drive strategy into new directions." The second premise is about the existence of project typologies, on the slogan "one size does not fit all". They propose that project success should be considered in four dimensions: *project* *efficiency, Impact on the customer, Business success, and Preparing for the future.* These are to be assessed on the basis of four project types: *Low-tech, Medium-tech, High-tech, and Super-high tech projects.*

Vandevelde, et al., (2002) summarized various works on project performance measurement which are based on the multidimensional, multi-criteria concept. In all, they identified seven dimensions: *respect for time, respect for budget and technical specification, knowledge creation and transfer, contribution to business success, financial and commercial success*. They merged these seven dimensioned model into a **three-polar model** namely, *process, economic and indirect poles***.** Atkinson, (1999) separates success criteria into *delivery* and *post-delivery* stages and provides a "square route" to understanding success criteria*: iron triangle, information system, benefits (organizational) and benefit* (stakeholder community). The 'iron triangle', has *cost, time* and *quality* as its criteria (for the delivery stage). The post-delivery stages comprise:

(i) The Information system, with such criteria as *maintainability, reliability, validity, information quality* use;

(ii) Benefit (organizational): *improved efficiency, improved effectiveness, increased profits, strategic goals, organizational learning* and *reduced waste;*

(iii) Benefit (Stakeholder community): *satisfied users, Social and Environmental impact, personal development, professional learning, contractor's profits, capital suppliers, confident project team* and *economic impact to surrounding community*.

This model takes into consideration the entire project life cycle and even beyond. It thus lends itself for continuous assessment. Lim & Mohammed, (1999), as reviewed by (Chan & Chan, 2004), modelled project success measurement into '**micro viewpoint:** *completion time, completion cost, completion quality, completion performance, completion safety;* and **macro-viewp**oints: *completion time, completion satisfaction, completion utility, completion operation*. A key feature of this model is that it proposes only lagging indicators and gives no room for continuous assessment and monitoring. Below each view point are list of "factors" for measurement. Chan & Chan, (2004) concentrated on construction projects, and, based on previous works (particularly of (Shenhar et al., 1997; Atkinson, 1999); and Lim and Mohamed, 1999), proposed a 15 key project indicators, key performance indicators (KPIs), comprising both objective measures: *construction time, speed of construction, time variation, unit cost, percentage net variation over final cost, net present value, accident rate, Environmental Impact assessment (EIA) scores;* and subjective measures: *quality, functionality, end-user's satisfaction, client's satisfaction, design team's satisfaction, construction team's satisfaction.*

Patanakul & Milosevic, (2009) grouped their measurement criteria into three:

(i) criteria from organizational perspective: *Resource productivity, Organizational learning*

(ii) criteria from project perspective: *time-to-market, Customer satisfaction* and

(iii) criteria from personal perspective: *personal growth, personal satisfaction*.

Sadeh, et al., (2000) proposed a division of project success into four dimensions. These are: *Meeting design goals, benefit to end user, benefit to the development organization, benefit to the defence and national infrastructure*, in that order. Finally, Beale & Freeman, (1992) provided *technical success, efficiency of project execution, managerial and organizational success, personal growth, completeness, and technical innovation* as the main success criteria. In effect, these authors are emphasizing the need to strategically assess project in dimensions that will facilitate its management for good performance. Taking from the often quoted adage of performance management: "if you cannot measure, you cannot manage", it is also true that: "If you cannot measure appropriately, you cannot manage appropriately.

2.25.1 Factors that Influence Project Management Modelling

The factors that influence the success/failure of the project have received similar attention from a number of authors. Also referred to as critical success factors, the researchers have been focusing on the product, project or business unit level (Dvir et al., 1998). The classical proposition is that organizations must develop a set of strategic strength areas that are important to the environment and industry in which they operate. With reference to Pinto & Kharbanda (1996), Torp, et al., 2004) agrees that identifying critical success factors and potential pitfalls in project at the front-end (knowing beforehand as much as possible and how to respond) will help project teams to minimize firefighting, intuitive and *ad hoc* approach in managing uncertainties. Several others have developed various frameworks for success factors, mostly highlighting project management in general (Sayeles and Chandler, 1971; Martin, 1976; Baker, et al., 1983; Celand and King, 1983; Hughes, 1986; Morris & Hough, 1987); (Pinto & Slevin, 1987); (Tukel & Rom, 1995a), Pinto and Kharbanda, 1995; Belassi & Tukel, 1996). These works, together with Mengesha's, (2004) influenced Torp et al.'s (2004) observation that there is gradual shift in focus over time from purely technical issues towards organizational and management issues. Significantly, they identify progressive emphasis on such issues as *top management support, organizational issues, stakeholder management, coordination* and *human relations.* They established from the case study evidence that there is a relationship between critical success factors and potential pitfalls in the projects; that lack of critical success factors are considered potential pitfalls and vice versa. This is in line with (De wit, 1988) that "the presence of critical success factors does not guarantee success but their absence is likely to lead to failure". In Kenya, Muchungu, (2012) has argued on the importance of human factors on the performance of projects.

In their contribution Shenhar et al (2002) propose that "different factors influence the success of different kinds of projects and that future scholarship of project management must adapt a more project specific approach to identify the exact causes of project success and failure". Based on information collected on 127 projects executed in Israel, they identified three different types of success factors: *factors which are independent of the project characteristics, factors which are solely influenced by uncertainty* and *factors which are solely influenced by scope*. Belassi & Tukel, (1996) provided a framework for grouping project performance factors (they called them success factors) into factor groups under each of which are several other factors which are viewed as the indicators for measuring a particular factor group. These are: *factors related to the project, the project manager, the project team, the clients' organization* and *the external environment,* In addition, the provided an intermediate set of factors called *system response*. The strength of the model lies in the fact that it opens itself up to several other factors that could be relevant based on the context of the project. In addition, it shows that with the five factor groups appropriately distinguished, one can even expect an entirely different set of factors under the groups. This provides a means by which Shenhar et al's (2002) position of looking at success factors as contingency factors could be appropriately considered. Belassi & Tukel, (1996)) also argued of their model helping project managers to understand the intra- relationships between factors in different groups. Shenhar et al (2002) acknowledge this in their work with reference to (Murphy, et al., 1974), who, in their study of 646 projects, used path analysis to show that success factors influence each other. In relating to this position, the scope of this research covers the linkage between the identified factors and the indicators of assessment. In this regard, it could be possible to deploy effective project management through the project as a temporary organisation and also to ensure good monitoring and controlling of those critical factors that could impact on the project performance in identifiable criteria.

2.26 PROBLEMS WITH EXISTING PROJECT MANAGEMENT MODELS

Despite the existence of several project management models meant to ensure improvements in project performance, several authors have found some short comings with them and expressed the doubt whether the true objective of assessment would be achieved. This has got to do with the measures in use, the paradigm within which they are being considered, and the nature of the models.

2.26.1 Problems with the Success/Failure Definition

A major problem found with the present paradigms of project performance measurement is the lack of consensus on what constitutes success or failure of the project. Various authors have expressed concern about the definition of success and failure. Quoting from (Morris & Hough 1996; Murray et al., 2002) indicate that the definition of a success or failure of a project is not always an easy one. Project management theories have not always agreed on a universal definition of what is meant by a project success (Pinto & Slevin, 1988); (et al. Shenhar, 2002)). Consequently, the factors causing success (or failure) have been similarly defined in restricted dimensions by various authors. Murray et al., (2002) notes from literature that projects are often termed a technical success despite being behind schedule and over budget. Conversely, projects may be ahead of schedule and within budget but still be a technical failure. This position is corroborated by (Willard, 2005) who provided examples showing the various means by which success have been declared.

Within a certain context, Ludin and Söderholm (1995) comment that a project could be considered a success in the sense that it has successfully passed through all the sequences of the standard stages: *concepts, development, implementation and termination.* Notably, Murray et al., (2002) reiterated Morris and Hough's (1987) discussion as to whether one should study project successes and failure. "To some extent", they conclude, "it would seem that Murphy's Law is at work: *'what can go wrong will go wrong*".

In their contribution, (Klakegg et al., 2005) acknowledge this lack of consensus on what success is and how to measure it as a fundamental but often unresolved issue in investment projects. They opined that "success is to apply the right amount of resources to do the right things at the right time". Significantly, they admit that what the right thing may be, for government projects, is for the decision makers to agree, and should reflect relevant needs in society as expressed for instance in public international agreements. One of the results of this disagreement is the inherent assumption that the two are dichotomous. That a project either ends up successfully or it failed.

2.26.2 Problems with the Project Management Measurement Procedure

Despite the promise project management holds for improving project performance, certain problems have been identified with the present procedure being used. This has to do, especially, with the kinds of measures being used, the models not designed to be part of an assessment system and the minimum attention given to clients' input.

(a) Problem with the Kinds of Measures in use

A problem with the various models is that most of the measures are only capable of reporting on performance after they have occurred. According to (Beatham et al., 2004), a conference of leading representatives from an array of design and construction companies note that a major problem with the Key Performance Indicators (KPIs) of the Construction Best Practice Programme (CBPP) was that they do not offer the opportunity to change; and that they are designed as a post results, "lagging" KPIs. A closer observation of the other KPIs discussed reveals a similar situation (BQF/CPN, 2001). Beatham et al., (2004) describes two variants of KPIs as measures of assessment under "lagging" or "leading" measures: key performance outcomes (KPOs) and *perception measures*. KPOs could be used to assess sub-process and give indications for change in the next sub-process. In this way they could be considered as leading indicators. Perception measures can be used at any stage and can be leading or lagging measures. For example, if client satisfaction is measured after completion, it is considered a lagging measure. However, if client satisfaction is measured at various stages during the project, then it is a leading measure. Parmenter, (2007) chose to designate them as *key results indicators* (KRI): which tells you how you have done in perspective; *Performance indicators*: which tells you what to do; and *Key performance indicators* (KPI): which tells you what to do to increase performance dramatically. Of calling them *lagging* and *leading* measures he prefers to consider them as *past -, current* – and *future* measures.

Clearly, the nature of construction project execution indicates that little improvement can be obtained from measures that give "post- mortem" reports. This problem is directly linked with the lack of consensus on what project success is and when it should be determined. If current and leading measures are used, it indicates a continuous progressive assessment of project which offers opportunity for improvement. If lagging measures are used it indicates that the project is completed before we know of its status. Hence, (Pinto & Slevin, 1987) propose that because of the difficulty in accurately deciding when projects 'success' should be determined, the project manager would be advised to make periodic assessment throughout the project's life…. as a practical method to monitor project success". In related development, Van Egmond (1999) asks whether the "required targets of the construction output quantitatively and qualitatively are being reached in reality".

With regard to the success factors, Shenhar et al. (2002) argued that a major problem with research on critical success factors is the universalistic approach being used, assuming that all projects are made of a universal set of functions and activities. Further, their analysis indicated that the list of project success factors varies with project type, and that project managers must carefully identify those factors that are critical to their particular project. Hence they conclude that "project success factors are indeed contingent upon the specific project type –that is, the list of project success factors is far from universal". The fact that differences exist in the factors that causes delays and cost overruns across various countries, and the fact that where similar factors are found to exist they are known to impact differently on time and cost show the contingent nature of critical success factors. Shenhar et al. (2001) summarised this in the statement: "one size does not fit all". This also calls for a shift from the universal approach to project management evaluation to a contingency-based approach.

(b) The Models are often not a part of a Performance Measurement System

Another problem identified is the fact that performance measures are often treated in isolation by most of the models. Research has not linked the factors of "success/failure" to the criteria (Dvir et al., 1998; Shenhar et al., 2002, Takim & Akintoye, 2002)), hence it has not been easy determining, predicting or influencing project performance during the construction phase of the project. In particular, (Takim & Akintoye, 2002) highlights this as a gap in addition to the need to assessing performance of stakeholders throughout the project phases. In construction projects, this gap has prevented construction project performance measurement to be considered as a complete system. According to (Beatham et al., 2004) performance measurement must be part of a system, which reviews performance, decides on actions and changes the way in which business operates. A difficulty in effectively ensuring the required changes across the project stages may exist if the present state of indicators cannot be related to a specific factor or factors influencing them. Mian et al., (2004) with specific reference to construction, maintain that as the factors that affect the health of the human body needs to be monitored and controlled for good health, so must those critical success factors that affect the project "health" be treated. To do so requires an effective way of linking the factors to the "symptoms" (criteria and indicators) of the project health. There is thus the need to go beyond the development of stand-alone models of KPIs or CSFs into creating a holistic system of assessment in which the KPIs are linked with the CSFs.

(c) "Clients Satisfaction" Measurements is limited in scope and Function

Another problem is that most of the performance measurement models discussed above which referred to clients or customers refer only to client satisfaction, customer satisfaction or end-user satisfaction. Such measures render the client role in the project execution passive. This is in contrast to recent developments in construction where the client is seen as initiator of improvement, innovation and even, sustainable construction. However, the relative important role played by the client in the implementation process of a project has been well acknowledged (Bennet, et al., 1988; Latham, 1994; Yisa, et al., 1996). The performance of the project throughout the phases is to a large extent the function of the client's disposition towards it. This is because the client may, in the course of the project:

(a) ensure consistent funding

(b) delay funding

(c) divert funding or

(d) stop funding altogether, causing delay or abandonment of the project.

In other cases, the client could have inconsistent and erratic wishes authorizing variations here and there throughout the project life to the great frustration of consultants, the project manager and the contractor. The appointment of a consultant and subsequently, a contractor is, thus, by no means a foregone conclusion. With regard to improvements required in the industry, Latham (1994) emphasized the need of the government as a client to "deliberately set out to use their spending power…… to assist the productivity and competitiveness of the industry, in addition to obtaining value for money generally in the long term". In addition, he proposes that a government department "should take the lead to ensure best practice and drive for improvements are implemented throughout the public sector...", and also, that leading clients "have a substantial role to play in setting demanding standards and insisting upon improvements". " Ultimately", he continued, "they have the most to gain from ensuring the implementation of best practice". Yisa et al., (1996) note that public clients are gaining more autonomy in project execution and are placing emphasis on *speed, value-based services* and *cost-time-quality* performance for a particular project. This implies that clients are also concerned about development satisfaction, not completion or use satisfaction alone. This indicates that their involvement in the building process is increasing.

If such roles are attributable to the modern client, it calls for an assessment that goes beyond a mere client satisfaction as is being considered –it requires the assessment of a whole perspective of the client of project performance as represented by a number of criteria and indicators. In other words, client satisfaction, if it will have to be considered, should be a declaration by the clients after they have considered the achievements of all the criteria and indicators that represent their perspective of project performance at the appropriate stage of the project; not by practitioners or consultants. Another reason for having a different focus on clients in assessing performance has to do with the different types of clients existing in the construction industry. For example, Melville and Gordon, (1983) identified six kinds of clients. These are:

(i) the individual client

(ii) the committee cli*ent*: *For example, sports clubs, tenants associations, charitable or religious organizations*;

(iii) the company client: *the Lay and the Informed or Expert*;

(iv) the local authority client: acting for and on behalf of the government;

(v) the central government: *Most of the capital investments in a developing country are undertaken by the central government*; and

(vi) nationalized institutions of the government.

In another research, (Mbachu, 2003) categorizes clients into two broad bases. One is based on characteristics of the client system: nature of organizational entity, source of project finance, construction industry experience, level of knowledge of the construction industry, frequency of project development, complexity of client organization, type of business activities, purpose group of buildings mostly procured and procurement interests. He grouped these into three distinct classification based on the nature of clients: public, individual (Private), and Corporation clients. The second one is needs-based categorization of clients: similarity of overall needs preferences and development needs preferences. Mbachu, (2003) notes two categorization of clients' needs: observable (latent) and observable (stated and non-stated but expected) needs (Mbachu, 2003). By way of synthesis from the foregoing, it is possible to propose a model by which a typical client in the construction industry could be identified according to which of the parameters is applicable to them. This goes to prove that all clients are not to be treated the same way regarding what gives them satisfaction: a client is not just a client. A typical client in the industry can be identified according to their needs and characteristics. By this model it is also possible to appreciate that the client type could be categorized differently based on the present needs and characteristics. The obvious differences that distinguish one from the other inevitably will lead to each of them having a peculiar way of looking at project performance, have different expectations, and hence a different perspective. Identifying this perspectives and meeting the specific expectations is what can account for their true satisfaction.

The foregoing illustrates that the assessment of client satisfaction as a criteria is simply inadequate in reflecting their true needs, expectation and functionality. Supporting this view, (Ryd, 2004) pointed out that a "good understanding of the 'client's situation'" –"which demands effective means of working within the construction and management processes" –is the "basis for being able to satisfy the needs of the client". Hence (Hill, et al., 2007) proposed the creation of a "shared mind" or "shared vision". Applying this to the present situation would mean developing a "participatory model" (Kennedy, 2003) in which both the perspectives of the now "active-Client" and the Practitioners will be represented to ensure a better assessment of the performance of the project to facilitate comprehensive project management and real client satisfaction.

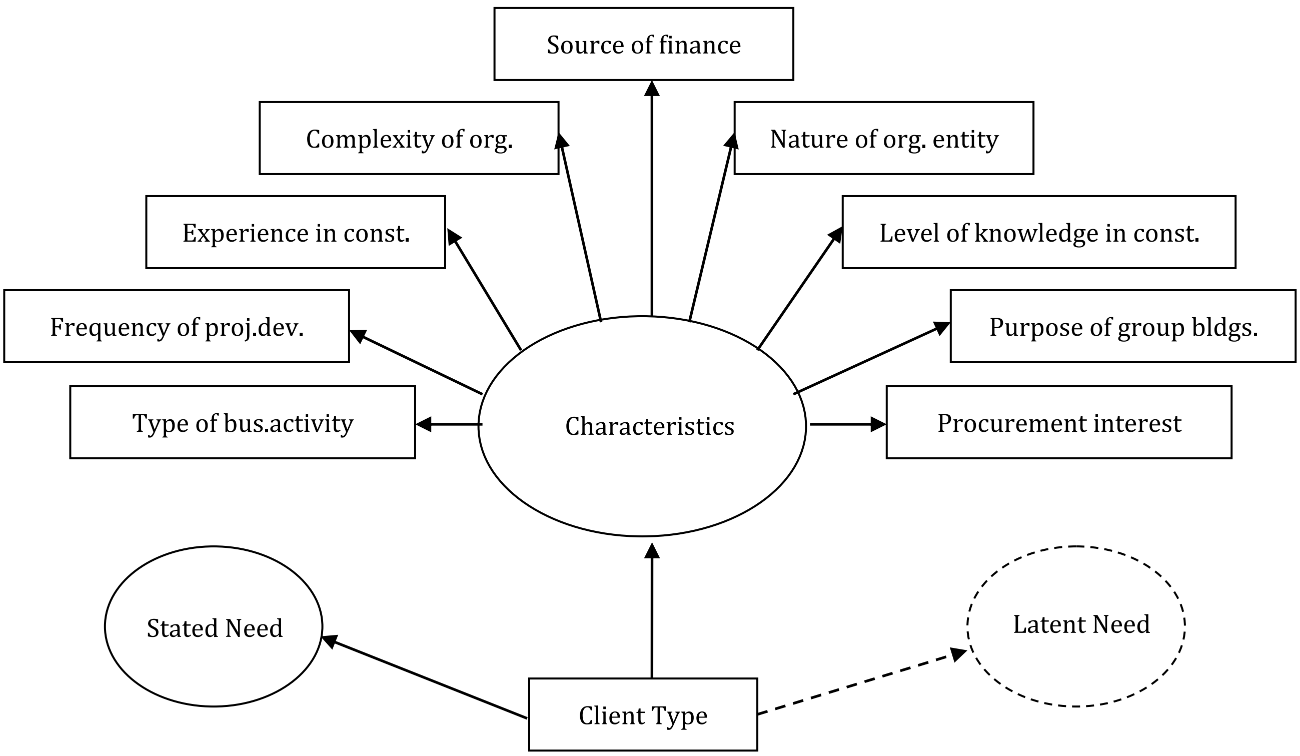


Fig. 2.5 A Model for Identification of clients according to Needs and Characteristics (Based on Melville and Gordon, 1983; (Mbachu, 2003)

2.27 CONCLUSION

This chapter has discussed the present practices of project management, the factors influencing the performance of project management and current challenges faced. It has been established that currently lagging measures, instead of leading measures, are used. Further, key variables to be investigated in the field for development of the model have been identified. Apart from the traditional measures of cost, quality and time, it is argued that scope, human resources and project performance under different environmental factors should be considered. Clients play a critical role in the performance of projects, and therefore they should also be considered. The considered factors have been incorporated in the methodology in the next chapter. A research instrument along these lines was used for the field research as discussed in chapter four.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 INTRODUCTION

The objective of this chapter is to explain the research design and methods that were used to conduct this research study. It discusses the philosophical assumptions underpinning the research strategy and design and describes in detail how the data collection and analyses were done. Discussed here are the research designs, target population, sampling techniques and what was used for this study, the research instruments, data collection procedures, the processing and analysis techniques used in the study.

The research employed both qualitative and quantitative research approaches, whereby standardized quantifiable information was collected from measurable observable phenomena using structured questionnaires based on a five-point Likert scale. Two other sections were included, the first section to capture background information and the last section being an open-ended question for clarification of facts based on qualitative analysis.

3.2 PHILOSOPHICAL UNDERPINNINGS

Research assumptions are philosophically grounded. They relate to a view or perception of philosophers towards reality. Two terms 'ontology' and 'epistemology' are used to explain philosophical assumption characteristics. According to (Easterby-Smith, et al., 2002) ontology is the science of being. It is the way researchers perceive and understand the nature of the 'real world'- for example from the perspective of an individual, an organization or an industry. Epistemology is the theory of knowledge and critical examination of assumptions of what is valid and what is the scope of that validity. This enables researchers to explore the real world as they define it. It is clear that research studies in science and social science have different positions on the nature of research philosophy (Bryman, 2011). The research philosophy adopted in this study is the ontological or positivist approach whereby the situation of project management as is are studied. There is no room for manipulation of research population. However, a question touching on epistemology is introduced in the last section on each research instrument on the views on modelling as provided by different professions and is analyzed qualitatively.

Based on different philosophical assumptions, both physical and social scientists can be categorized into positivist or social constructionist groups (Brindle, 2008). Positivists believe that the world is actually concrete and external and therefore their exploration can only be based upon observed and captured ‘facts’ through direct data or information (Bryman, 2011). On the other hand, social constructionists believe that the world is not objective and exterior, and they consider that the world is based on a social construction in which people create and interact. Therefore, the way people feel and behave is at least as important as the way they are observed or recorded to behave. Social constructionists argue that the real world is determined by people rather than by objective and external observable factors (Easterby-Smith et al., 2002). The social constructionists can also be called intepretivists. This theory shows the social world and natural world as very different. People who live in the social world are seen as unpredictable and are likely to behave in a variety of ways. They may be affected by stress or illness. The general view is that people are not objective at times but subjective and it is this subjectivity which may influence their thoughts, actions and behavior in relation to the research process.

Positivists’ theoretical framework purports that there is no difference between the natural world and the social world. The researchers believe they are collecting neutral facts from which they must stand back in order to be objective. Positivists tend to favour quantitative research arguing that quantitative techniques are much more scientific and reliable. This is the approach adopted for this study; although the constructionist is also used on one section for each research instrument to get facts more clearly.

Understanding philosophical assumptions can therefore, help researchers to plan a research method and design. (Easterby-Smith et al., 2002) provides a rationale for understanding the philosophy as follows. First, knowledge of philosophy helps researchers to design research questions and to gather and analyze a collection of evidence answering those questions. It does this by framing a point of view-the ontological position, for example, from an individual or group perspective. Second, it helps researchers to understand the limitations of each research design and to select the appropriate one-the epistemology that guides the rules that determines what is considered valid or not, given the ontological stance.

Although the line between positivist and social constructionist is clear at a philosophical level, (Kiggundu, et al., 1983) argued that this line may become blurred at a research design level when the researcher needs to understand the real situation from several perspectives. The researcher may decide to combine the way to obtain data using both qualitative and quantitative data to understand the nature of the real world as perceived by those interviewed and/or surveyed. For this research the researcher used a combined research approach by appropriately structuring the questionnaires.

Having considered the philosophical research assumptions, next the research design is discussed in detail. A range of data collection techniques is available and each has been designed to elicit certain types of information. Mugenda & Mugenda, (2004) explained that the techniques should be used to support and complement one another. Relevant literature concerning research strategy has revealed that there are several methodologies available for collecting data namely direct observation, survey questionnaire, personal interviews and case studies (Tucker et al 1997). According to Yin, (1998) there are five strategies that are available to pursue research questions, they include explanatory, descriptive, survey, archival analysis, history and case studies. Babbie (1992) identified five methods of collecting data, they include: -

- Experimental research, which involves taking action and observing the consequences of data collection. This method is usually related to physical science
- Field research involves the direct observation of social phenomena in natural settings
- Unobtrusive research involves investigation without the research intruding into whatever is being studied

- Evaluation research seeks to evaluate the impact of social intervention by using experimental and quasi-experimental methods
- Survey research involves collecting data by asking people questions. This method is usually associated with social science

The research design adopted in this research is survey. No controls were introduced over interacting variables. Initially relevant project management models were reviewed with a view of extracting relevant variables. These were then subjected to the field surveys study to reduce the many variables to a manageable number which was determined at six variables for consultants' measures and four for clients' measures to make a total of ten variables. A model was then developed which was subjected to the field the second time but via structured interviews with senior consultants having acquired more than twenty years' of experience as of the time of the interviews. After this process the model was developed further to a software application which is the knowledge gap addressed by this thesis and a key deliverable of the research.

3.3 RESEARCH METHODS

This study utilized a number of research methods. Primary data were collected and analyzed. From the review of the literature related to project management modeling, the relevant project management indicators were identified; they constituted the variables in the study. They were subjected to a pilot study using questionnaires and involving 14 respondents. The fourteen were arrived at on the basis of limited time and budget. Even after close scrutiny of the comments and responses from the 14 cases, it became apparent that the questionnaires were good to be subjected to the main study. Based on the observations made in the pilot study, corrections were made on the research instrument – the questionnaires. The questionnaires were then administered to the respondents. Consultants and contractors were subjected to the same research instrument while clients were subjected to a differently structured research instrument.

The data received from the field was analyzed and important project management indicators reduced to regressions and a General Linear Model (GLM) developed; which was subjected to a validation process.

The objectives of the study were formulated in such a way that they required a quantitative data to be collected to facilitate reduction of variables. The first research instrument was largely a Likert scale close-ended questionnaire formulation with two additional sections; one for background information and the other section for open-ended questions for obtaining qualitative data to reinforce observations on close-ended questions.

After model development, a validation process was carried out based on experienced consultants with 15 projects in number. The consultants for validation were randomly selected although they were required to have accumulated more than twenty years of experience as of the date of the interview. The validation process indicated that the developed model was indeed useful for Kenya and it was reduced to object based software for use in the construction industry in Kenya.

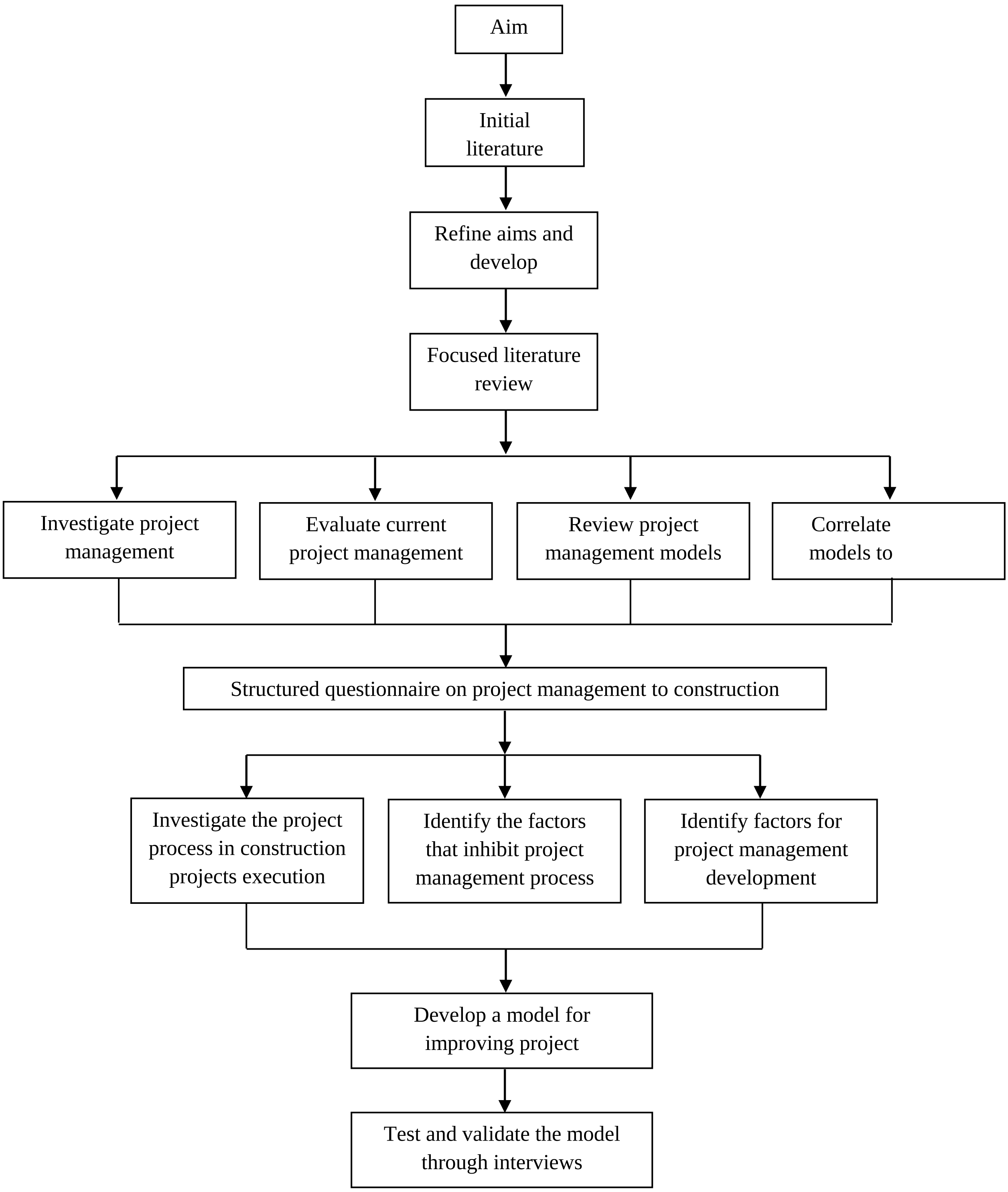


Figure 3.1: Research Design Diagram. Source: Own formulation, 2013

The research methodology for this study is to a large extent positivist (quantitative), which implies that the research process is largely deductive. Within this general positivist framework, elements of the phenomenological (qualitative) approach are also incorporated to provide alternative insight into the role of project management in the construction industry. Starting with basic observations and theoretical insights derived from literature, conceptual models and research hypotheses were developed and tested with the progress of the research. To meet the requirements of the objectives, the research process proceeded as follows:-

- Comprehensive literature review
- Questionnaire survey for consultants and contractors
- Questionnaire survey for clients
- Model development
- Validation using 15 projects and 5 senior consultants with over 20 years' experience
- Conclusions and recommendations

Data analysis was undertaken using descriptive statistics at the preliminary stages to provide useful insights, with more detailed analysis done using factor analysis, ANOVA, correlation analysis, and other statistical tests of significance. ANOVA was very useful particularly when comparing the results of model parameters using the traditional approach (cost, quality and time) against the parameters established from the research (10 number in total with cost, quality, time, scope, human resources and projects performance in one cluster of six variables as practitioners measures and four factors in cluster two for clients assessment comprising of project financing, project scope definition and management, promptness in payments and coordination with project participants. Appropriate statistical analysis comprising of SPSS and R are employed, where necessary, to aid analysis. Using a suitable modelling technique in the form of multiple regression analysis and principal component analysis (PCA); comprehensive model(s) depicting the nature and extent to which project management influences construction project performance are reviewed.

Table 3.1: Summary of research design and outcomes

Objectives	*Research Activities*	*Output*
(i). To assess the appropriate project management indicators for Kenya	(i) Evaluation of lagging and leading measures of projects performance	(i) Six number variables were extracted for project management model formulation for practitioners and contractors' evaluation. The factors include Scope, Time, Quality, Cost, Human Resources and Project Performance.
	(ii) Developed a conceptual framework.	(ii) Four number variables were extracted for Clients' evaluation comprising of Project Financing, Project Scope Definition and Management, Promptness in payments and Level of Clients' Coordination with project participants.
	(iii) Field survey based on a sample of 580 members consisting 100 each of Architects, Quantity Surveyors, Civil Engineers, Project Managers and Contractors respectively and 80 developers/clients.	
	(iv) Formulation of research instruments in form of Likert Scale close-ended questionnaires with a section of open questions for elaboration of ideas at the end.	
	(v) Use of Principal Components Analysis (PCA) to reduce variables to an appropriate number.	
(ii). To develop an appropriate Project Management Model for Kenya	(i). Data analysis and presentation to come up with regression equations for each variable.	(i). Shared perspective model development.
	(ii). Model validation using 15 number projects.	(ii). Project Management Model in form of a software application.

Table 3.1: Summary of research design and outcomes (Cont'd)

	(iii). Comparison between model scores and actual consultants' scores.	(iii)Useful in project monitoring and control.
(iii). To assess the effectiveness of the developed project management model on efficient and effective construction projects execution in Kenya.	(i) Field interviews	(i) Establishment of Clients' scores at a maximum of 18% and Consultants' at 82% towards projects performance.
	(ii) Establishment of monitoring and control procedures of projects.	(ii) Establishment of monitoring and control procedures for projects performance encompassing negative factors and their treatment, positive factors and their treatment and neutral factors and their treatment.
	(iii) Determining the relevant success criteria.	

Source: Own Formulation, 2013

PCA was particularly chosen because it reduces the dimensionality of a data set scientifically, it can also identify meaningful underlying variables and lastly Bartelett's Test of Sphericity for the significance of the sample was less than 0.05 which justifies use of this method (Peri, 2012). These models then form the basis for the development of a comprehensive project management simulation model for use in the construction industry in Kenya.

Research respondents were randomly selected based on BORAQS' register, ERB's Secretariat register, and Ministry of Public Works Register for Contractors under Categories A to C; for all categories as of end of 2012. However, for Contractors and through the Ministry of Public Works they are now updating the National Construction Authority's (NCA) register to handle contractors' issues. However, clients were issued with a differently structured questionnaire. A more detailed discussion on research strategy follows and it covers target population, sampling, research instruments and data analysis and presentation that were used for this study.

3.4 TARGET POPULATION

The target population was all professionals in the construction industry and contractors; a population size of more than 6890 people. Based on BORAQS register; 2012 it has over 1843 registered members of whom 731 are Quantity Surveyors while 1121 are Architects, ERB has 2,591 registered civil engineers and from the National Construction Authority 1990 contractors in the categories of NCA 1 to NCA 3 as of March 2013. Clients also play a critical role in the success or failure of projects. Clients were issued with a differently structured questionnaire targeting information on their roles in scope definition, projects performance, project performance indicators and expectations on executed or proposed projects. There overall rating was calculated at 18% towards the overall project performance rating and this shall be the weight contribution assigned towards the model development. The rating was obtained from the field study and supported from literature review.

Table 3.2: A Tabulation of Sample Population

	CATEGORY	SAMPLE POPULATION	SAMPLE SIZE
A	CONTRACTORS		
	CONTRACTORS NCA 1	643	33
	CONTRACTORS NCA 2	480	33
	CONTRACTORS NCA 3	867	34
	SUBTOTAL 1	1990	100
B	QUANTITY SURVEYORS	731	100
C	PROJECT MANAGERS	457	100
D	ARCHITECTS	1121	100
E	CIVIL ENGINEERS	2591	100
F	CLIENTS	N/D	80
	TOTAL	**6890**	**580**

The target populations were all registered professionals in the construction industry, clients and contractors; a population size of more than 6800 members as per table 3.2. Stratified random sampling was used to arrive at the sample size. Since it was difficult to determine the actual client numbers there population was Not Determined (N/D). The clients were therefore selected on the basis of referrals from consultants especially the construction elite clients. The sample size of 580 members was utilized based on reasons given hereunder. Masu, (2006), citing (Alreck & Settle, 1995) argues that there are maximum and minimum practical survey sample sizes that apply to all surveys. Ordinarily a sample less than about 30 respondents provides too little certainty to be practical. The minimum limit and maximum limits for experienced researchers are about 100 respondents and 1000 respondents respectively for large populations although there are exceptions. Masu, (2006), further argued that it is necessary to sample more than 10% of the population to obtain adequate confidence, providing the resulting sample size is less than 1000 units; the experienced researcher would probably consider a sample size of about 100 or so. For populations of about 5,000 units, the minimum practical sample size would be 100 or so and the maximum would be approximately 500 or 10%.

For populations of more than 10,000 a sample size between 200 and 1000 respondents would be adequate. (Mutai, 2000), as cited in (Masu, 2006), argues that the sample size depends on the level of precision required in the estimates, the intrinsic level of variability of the variable to the estimated and the sample design to be used. Thus the more precise the estimates are required to be the smaller the standard error, and the larger the sample size must be. (Hoinville & Jowell, 1978) argues that the decision on sample size is usually governed by the sample size required for the smallest sub-group as a rough guide. The smallest sub-group will need to have between fifty (50) and hundred members (100).

For this study experienced practitioners were selected from the fields of Architecture, Engineering, project management and Quantity Surveying with work experiences of more than five years each and Contractors from Ministry of works registered under categories of A-C. The stratification is informed of the specialized knowledge and work experiences of the targeted population groups. A differently structured questionnaire was administered to clients to get their views on project management modeling.

3.5 SAMPLE SELECTION

There are currently four clear distinctions of professions playing an active role in the construction industry namely: Architecture, Engineering (civil, structural, mechanical and electrical), Quantity surveying, Project/construction management; all the aforementioned constitute the Design team. Whereas, the project promoters/Clients and Contractors are the other key players. Other than the above mentioned we also have subcontractors and material suppliers.

The sampling frame refers to the source of the population. It is a means of representing the elements of the population (Mugenda & Mugenda, 2004). The sampling unit is the basic unit containing the elements of the population to be sampled. It may be the unit itself or the unit in which the element is contained.

This study covers the clients, design team and contractors as the sampling frame. Due to the difficulty of establishing the number of individual clients; they were surveyed subjectively through ongoing projects for this study. The questionnaires for the clients were designed for the most technical person in the clients' organizations. The sample population for the study comprises the following:-

- BORAQS (Board of Registration for Architects and Quantity Surveyors) register for Quantity Surveyors and Architects
- Engineers Registration Board
- Ministry of public works for the contractors' register in the formal sector.
- Secretariat for The Institution of Construction Project Managers of Kenya.
- Clients with ongoing projects in Nairobi as at the time of study (2013).

3.6 THE SAMPLE

The sample size comprises 580 members consisting of 100 Architects, 100 Quantity surveyors, 100 Civil Engineers, 100 project managers, 80 clients and 100 contractors. The data collection instrument for the practitioners was structured differently from the one administered to clients. All sample units were randomly selected to avoid a biased view of the study. The Architects, Civil Engineers, Quantity Surveyors, Project Managers and Contractors were subjected to the same research instrument while Clients were subjected to a different research instrument. Towards the proposed model all practitioners and contractors contribute 82% towards model formulation; in total (clients 18% and practitioners and contractors at 82% to make a total of 100%). It is on these criteria of the developed model that projects shall be evaluated in project management performance.

There is no minimum and maximum sample size in a case study research (Yin, 1998). According to Masu, (2006) studies on construction projects have in many cases worked with small sample sizes for various reasons. For instance Nkado, (1992) investigated information systems for the building industry with a sample of 29 cases; (Ogunlana, et al.,1996) investigated the causes of delay in projects in Thailand basing their research on a sample of 12 projects; Uher, (1996) investigated the cost of estimating practices in Australian construction industry using a sample of 10 projects, (Talukhaba, 1999) investigated causes of project delays in highrise buildings based on 38 projects, (Mbatha, 1993), analyzed building procurement systems features and conception of an appropriate project management system for Kenya based on 32 participants spread in seven categories, ranging from 2 to a maximum of 9 and (Walker, 1994) argues that sample sizes of 30 – 35 projects have been used for investigations in construction time performance.

Hamburg, (2001) as cited in (Masu, 2006); argues, that if an investigator wants to know how large a random sample is required in a research, he must answer two questions in order to specify the sample size. Namely, what degree of precision is required and what probability is attached to obtaining that desired precision. Clearly the greater the degree of desired precision, the larger will be the necessary sample size. Similarly the greater the probability specified for obtaining the desired precision, the larger will be the required sample size.

Masu, (2006); Leedy, (2012; Mugenda & Mugenda, (2004) all concur and who argue that the rule of thumb should be to obtain as big a sample as possible. However resources and time tend to be the major constraints in deciding on the sample size to use. However in social science research the following formula can be used to determine the sample size (Fisher, Laing and Sloeckel, 1983).

$$n = \frac{Z^2 Pq}{d^2}$$

Where n = desired sample size if the population is more than 10,000

Z = the standard normal deviate at the required confidence level

P = the proportion in the target population estimated to have characteristics being measured q =1 – P

d = the level of statistical significance

As with most other research, a confidence level of 95% was assumed (Munn and Drever, 1990; Creative Research Systems, 2003). For 95% confidence level (that is significance level of $\alpha = 0.05$), $z = 1.96$. Based on the need to find a balance between the level of precision, resources available and usefulness of the findings (Maisel and Persell, 1996), a confidence interval (d) of ±5% was also assumed for this research. According to Czaja and Blair (1996), when determining the sample size for a given level of accuracy, the worst case percentage picking a choice (p) should be assumed. This is given as 50% or 0.5.

Based on these assumptions and above formula, the sample size was computed as follows:

$$n = \frac{1.96^2 x 0.5 x 0.5}{.05^2}$$

= 384 items.

But given the method of Principal Component Analysis (PCA) which works best when items are above 300; and low response rates in survey research, this sample size was muiltiplied by 1.5 to give 580 members which were utilized in the main survey. However, (Leedy, 2012) argues that the researcher should consider three factors in making any decision as to the sample size that is; the degree of precision required between the sample population and the general population, what the variability of the population is (standard deviation) and what method of sampling should be deployed.

Rudestam & Newton, (2001) argue that a sample size is a function of the following:

(i) variability in the population

(ii) the precision or accuracy needed

(iii) the confidence level desired

(iv) type of sampling plan used (Random or Stratified and the size of the population used)

(v) Cost and time constraints.

Roscoe, (1975) proposes the following rules of thumb for determining sample size.

(i) Samples large than 30 and less than 500 are appropriate for most research

(ii) Where samples are to be broken into sub-samples (e.g. males/females/juniors/seniors); a minimum sample size of 30 for each category is necessary.

(iii) In multi-variety research (including multiple regression analysis, the sample size should be several times (preferably 10 times or more) as large as the number of variables in the study.

(iv) For simple experimental research with tight experimental controls (Matched pairs), successful research is possible with samples as small as 10 to 20 in size.

De Vaus, (2003) argues that the sample size varies and depends on the type of research undertaken. It is also argued that the sample size depends on funds, time, access to potential participants, planned method of analysis, and the degree of precision and accuracy required (de Vaus, 2003). In general the larger the sample the better, but beyond a certain point increasing the sample size has smaller and no more marginal benefits.

Fowler, Jr. (1993 pp. 33 – 35) and (de Vaus, 2003) argue that, there is rarely any particular sample size in any research study. However the size of a sample is a compromise between the funds available for conducting the research, time for the study; access to potential participants, the research design, techniques used, the degree of precision and accuracy required and finally the nature of the research study itself.

Based on (Yamane, 1967), respondents can also be randomly selected as sample size using the following formula; where the population is 10,000 members :

$$n = \frac{N}{1 + N(e)^2}$$

Substituting figures for N= 10,000

n=10,000/ (1+10000*0.05^2)= 384 items

Where n = Sample size

N = Population size

e = level of precision and for this case at 95% confidence level (Yamane, 1967).

Even when applying the aforementioned formula for a population of 10,000 still we arrive at 384 items as the sample size. Given the risk of nonresponsive and unreturned questionnaires the sample size was enhanced by 50% to give a total of 580 sample units. This was deliberately done to meet the requirements of Principal Component Analysis (PCA) as analysis method which requires at least 300 items to give best results. Out of the 580 sample size only 344 members or 59.31% responded of which 32 or 40% were clients and 312 or 62.4% were consultants and contractors as per analysis presented in the next chapter.

Given the aforementioned considerations the sample sizes in this study are justifiable.

3.7 DATA COLLECTION METHODS

A field study was undertaken for the purpose of obtaining data of a primary nature. The data were collected using questionnaires developed in this study. The questionnaires comprised of close-ended questions. A few open-ended questions were incorporated whose primary purpose was to get the details of the respondents and better insight on some of the study areas.

A Likert scale was used to formulate the questionnaire containing factors of 1-5; narration of 1. To a very low extent 2. To a low extent 3. Uncertain. 4. To a high extent & 5. To a very high extent; and finally in percentages on an appropriate interval. The structured questionnaire is easy to quantitatively capture the results and measure making data analysis and presentation easy and faster. 15 selected ongoing projects in Nairobi were used in data validation using five senior practitioners.

Interviews and case studies were utilized with a view of identifying what is being used in the construction process against set parameters. The selected consultants were taken through by the researcher on the model evaluation process and were also asked to rate the performance of some of their projects executed in under three years as at the date of carrying out the research. Then the model development was finalized; hypothesis tested and chapter on summary, conclusions and recommendations written.

3.8 DATA ANALYSIS METHODS

In the analysis of data, the following statistical procedures were used: descriptive statistics, correlation analysis, Principal Component Analysis (PCA), analysis of variance (ANOVA) and multiple regression analysis. The analysis was undertaken using a computer software package - Statistical Package for Social Sciences (SPSS for Windows, version 20). The descriptive statistics involve the central tendencies, spread of data and the distribution exhibited by the sample.

Tables, bar charts, line graphs and pie charts were employed to depict the data more clearly. The nature of distribution type was established using the Receiver Operating Characteristic for standardized residuals (ROC-Curve), Shapiro-Wilk test was used to test the normality of the data and finally a plot of standardized residuals compared on the best line of fit to indicate the nature of distribution type. Kaiser – Meyer – Olkin measure of sampling adequacy was carried out together with Bartlett's test of sphericity before subjecting the data to advanced analysis techniques such as principal component analysis, multiple-linear regressions and cross-tabulations to establish the key project management indicators to appear in the final project management model.

In this study, the PCA was considered suitable for two reasons. Firstly, it can be used to reduce the many variables subjected to the primary study in a meaningful manner. Secondly, it can be used to formulate a mathematical weighted model.

The Analysis of Variance (ANOVA) was used to establish whether there are any significant differences between projects with and projects without project management application in the construction industry in Kenya under the various categories of respondents.

A case study was carried out to validate the findings on existing projects based on 15 projects undertaken by senior consultants in Nairobi with an experience of more than 20 years. After model validation a section under Chapter V is dedicated to a discussion on the application and functionality of the model. How the various variables are measured using direct linear functions, inverse linear functions and regression models are discussed.

3.9 PRINCIPAL COMPONENT ANALYSIS

Principal component analysis (PCA) involves a mathematical procedure that transforms a number of (possibly) correlated variables into a (smaller) number of uncorrelated variables called *principal components*. The first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible.

3.9.1 Overview: The "what" and "why" of principal components analysis

Principal components analysis is a method of data reduction. Suppose that you have a dozen variables that are correlated. You might use principal components analysis to reduce your 12 measures to a few principal components. In this example, you may be most interested in obtaining the component scores (which are variables that are added to your data set) and/or to look at the dimensionality of the data. For example, if two components are extracted and those two components accounted for 68% of the total variance, then we would say that two dimensions in the component space account for 68% of the variance. Unlike factor analysis, principal components analysis is not usually used to identify underlying latent variables. Hence, the loadings onto the components are not interpreted as factors unlike in a factor analysis would be. Principal components analysis, like factor analysis, can be performed on raw data, or on a correlation or a covariance matrix. If raw data are used, the procedure will create the original correlation matrix or covariance matrix, as specified by the user. If the correlation matrix is used, the variables are standardized and the total variance will equal the number of variables used in the analysis (because each standardized variable has a variance equal to 1). If the covariance matrix is used, the variables will remain in their original metric. However, one must take care to use variables whose variances and scales are similar. Unlike factor analysis, which analyzes the common variance, the original matrix in a principal components analysis analyzes the total variance. Also, principal components analysis assumes that each original measure is collected without measurement error.

Principal components analysis is a technique that requires a large sample size. Principal components analysis is based on the correlation matrix of the variables involved, and correlations usually need a large sample size before they stabilize.

Tabachnick and Fidell (2001, page 588) cite Comrey and Lee's (1992) advice regarding sample size: 50 cases is very poor, 100 is poor, 200 is fair, 300 is good, 500 is very good, and 1000 or more is excellent. As a rule of thumb, a bare minimum of 10 observations per variable is necessary to avoid computational difficulties.
Usually the analysis will include the original and reproduced correlation matrices and scree plots; Tabachnick and Fidell (2001).

3.9.2 Varimax rotation and its application

In the PCA literature, definitions of *rotation* abound. R*otation is defined* as "performing arithmetic to obtain a new set of factor loadings (regression weights) from a given set," and Bryant and Yarnold (1995, p. 132) define it as "a procedure in which the eigenvectors (factors) are rotated in an attempt to achieve simple structure." "In factor or principal-components analysis, rotation of the factor axes (dimensions) identified in the initial extraction of factors, in order to obtain simple and interpretable factors." They then go on to explain and list some of the types of orthogonal and oblique procedures.

Rotation methods are either orthogonal or oblique. Simply put, *orthogonal rotation* methods assume that the factors in the analysis are *uncorrelated*. Gorsuch (1983, pp. 203-204) lists four different orthogonal methods: equamax, orthomax, quartimax, and varimax. In contrast, *oblique rotation* methods assume that the factors are *correlated*. Gorsuch (1983, pp. 203-204) lists 15 different oblique methods.
Version 20 of SPSS offers five rotation methods: varimax, direct oblimin, quartimax, equamax, and promax, in that order. Three of those are orthogonal (varimax, quartimax, & equimax), and two are oblique (direct oblimin & promax).

3.9.3 Objectives of Principal Component Analysis

The objectives are: -

- To discover or to reduce the dimensionality of the data set.
- To identify new meaningful underlying variables.

From above, **Principal component analysis (PCA)** is a mathematical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called **principal components**. The number of principal components is less than or equal to the number of original variables. This transformation is defined in such a way that the first principal component has the largest possible variance (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it be orthogonal to (that is uncorrelated with) the preceding components. Principal components are guaranteed to be independent if the data set is jointly normally distributed. PCA is sensitive to the relative scaling of the original variables.

PCA was invented in 1901 by Karl Pearson, as an analogue of the principal axes theorem in mechanics; it was later independently developed (and named) by Harold Hotelling in the 1930s. The method is mostly used as a tool in exploratory data analysis and for making predictive models. A project management model was a cardinal objective of this study. PCA can be done by eigenvalue decomposition of a data covariance (or correlation) matrix or singular value decomposition of a data matrix, usually after mean centering (and normalizing or using Z-scores) the data matrix for each attribute. The results of a PCA are usually discussed in terms of component scores, sometimes called factor scores (the transformed variable values corresponding to a particular data point), and loadings (the weight by which each standardized original variable should be multiplied to get the component score).

PCA is the simplest of the true eigenvector-based multivariate analyses. Often, its operation can be thought of as revealing the internal structure of the data in a way that best explains the variance in the data. If a multivariate dataset is visualized as a set of coordinates in a high-dimensional data space (1 axis per variable), PCA can supply the user with a lower-dimensional picture, a "shadow" of this object when viewed from its most informative viewpoint. This is done by using only the first few principal components so that the dimensionality of the transformed data is reduced.

3.9.4 Interpretation of the Principal Components

To interpret each component, we must compute the correlations between the original data for each variable and each principal component. Take, for example, the Places

Rated Almanac data (Boyer & Savageau, 1987) which rates 329 communities according to nine criteria namely; climate, housing, health, crime, transportation, education, arts, recreation and economy and analyze the same by the PCA method. These correlations are obtained using the correlation procedure. In the variable statement we will include the first three principal components, "prin1, prin2, and prin3", in addition to all nine of the original variables. We will use these correlations between the principal components and the original variables to interpret these principal components.

Because of standardization, all principal components will have mean 0. The standard deviation is also given for each of the components and these will be the square root of the eigenvalue. More important for our current purposes are the correlations between the principal components and the original variables. These have been copied into the following table. You will also note that if you look at the principal components themselves that there is zero correlation between the components.

Table 3.2a An illustration of PCA analysis

	Principal Component		
Variable (Factors)	**1**	**2**	**3**
Climate	0.190	0.017	0.207
Housing	**0.544**	0.020	0.204
Health	**0.782**	**-0.605**	0.144
Crime	0.365	0.294	**0.585**
Transportation	**0.585**	0.085	0.234
Education	0.394	-0.273	0.027
Arts	**0.985**	0.126	-0.111
Recreation	**0.520**	0.402	**0.519**
Economy	0.142	0.150	0.239

Source: Boyer and Savageau (1987)

Interpretation of the principal components is based on finding which variables are most strongly correlated with each component, that is., which of these numbers are large in magnitude, the farthest from zero in either positive or negative direction.

Which numbers we consider to be large or small is of course a subjective decision. You need to determine at what level the correlation value will be of importance. Here a correlation value above 0.5 is deemed important. These larger correlations are in boldface in the table 3.2a above:

We will now interpret the principal component results with respect to the value that we have deemed significant.

(a) First Principal Component Analysis - PCA1

The first principal component is strongly correlated with five of the original variables. The first principal component increases with increasing Arts, Health, Transportation, Housing and Recreation scores. This suggests that these five criteria vary together. If one increases, then the remaining four also increase. This component can be viewed as a measure of the quality of Arts, Health, Transportation, and Recreation, and the lack of quality in Housing (recall that high values for Housing are bad). Furthermore, we see that the first principal component correlates most strongly with the Arts. In fact, we could state that based on the correlation of 0.985 that this principal component is primarily a measure of the Arts. It would follow that communities with high values would tend to have a lot of arts available, in terms of theaters and orchestras; whereas communities with small values would have very few of these types of opportunities.

(b) Second Principal Component Analysis - PCA2

The second principal component increases with only one of the values, decreasing Health. This component can be viewed as a measure of how unhealthy the location is in terms of available health care including doctors, hospitals, nurses and hospitals.

(c) Third Principal Component Analysis - PCA3

The third principal component increases with increasing Crime and Recreation. This suggests that places with high crime also tend to have better recreation facilities.

3.9.5 A Discussion on Principal Component Analysis

Principal component analysis is a powerful tool for reducing a number of observed variables into a smaller number of artificial variables that account for most of the variance in the data set; that is, a variable reduction procedure. Technically, a **principal component** can be defined as a linear combination of optimally-weighted observed variables. It is useful when you have obtained data on a number of variables (possibly a large number of variables), and believe that there is some redundancy in those variables. In this case, redundancy means that some of the variables are correlated with one another, possibly because they are measuring the same construct. Because of this redundancy, you believe that it should be possible to reduce the observed variables into a smaller number of principal components (artificial variables) that will account for most of the variance in the observed variables.

Because it is a variable reduction procedure, principal component analysis is similar in many respects to exploratory factor analysis. In fact, the steps followed when conducting a principal component analysis are virtually identical to those followed when conducting an exploratory factor analysis. However, there are significant conceptual differences between the two procedures, and it is important that you do not mistakenly claim that you are performing factor analysis when you are actually performing principal component analysis. The difference between these two procedures PCA makes no assumptions concerning an underlying causal structure that is responsible for variation in the data. When it is possible to postulate the existence of such an underlying causal structure, it may be more appropriate to analyze the data using exploratory factor analysis.

Both principal component analysis and factor analysis are often used to construct multiple-item scales from the items that constitute questionnaires. Regardless of which method is used, once these scales have been developed it is often desirable to assess their reliability by computing Cronbach's **coefficient alpha.**

(a) Characteristics of principal components

The first component extracted in a principal component analysis accounts for a maximum amount of total variance in the observed variables. Under typical conditions, this means that the first component will be correlated with at least some of the observed variables. It may be correlated with many.

The second component extracted will have two important characteristics. First, this component will account for a maximum amount of variance in the data set that was not accounted for by the first component. Again under typical conditions, this means that the second component will be correlated with some of the observed variables that did not display strong correlations with component 1.

The second characteristic of the second component is that it will be *uncorrelated* with the first component. Literally, if you were to compute the correlation between components 1 and 2, that correlation would be zero.

The remaining components that are extracted in the analysis display the same two characteristics: each component accounts for a maximum amount of variance in the observed variables that was not accounted for by the preceding components, and is uncorrelated with all of the preceding components. A principal component analysis proceeds in this fashion, with each new component accounting for progressively smaller and smaller amounts of variance (this is why only the first few components are usually retained and interpreted). When the analysis is complete, the resulting components will display varying degrees of correlation with the observed variables, but are completely uncorrelated with one another.

(b) Sample size in PCA

Principal component analysis is a large-sample procedure. To obtain reliable results, the minimum number of subjects providing usable data for the analysis should be the larger of 100 subjects or five times the number of variables being analyzed.

(c) Key Terms in Principal Component Analysis

The "total variance" in the data set is simply the sum of the variances of these observed variables. An **orthogonal solution** is one in which the components remain uncorrelated (orthogonal means "uncorrelated").

A **communality** refers to the percentage of variance in an observation variable that is accounted for by the retained components (or factors). This is the proportion of each variable's variance that can be explained by the principal components. It is also denoted as h^2 and can be defined as the sum of squared factor loadings. A given variable will display a large communality if it loads heavily on at least one of the study's retained components. Although communalities are computed in both procedures, the *concept* of variable communality is more relevant in a factor analysis than in principal component analysis.

Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. A "high" value of alpha is often used (along with substantive arguments and possibly other statistical measures) as evidence that the items measure an underlying (or latent) construct. However, a high alpha does not imply that the measure is unidimensional. If, in addition to measuring internal consistency, you wish to provide evidence that the scale in question is unidimensional, additional analyses can be performed. Exploratory factor analysis is one method of checking dimensionality. Technically speaking, Cronbach's alpha is not a statistical test - it is a coefficient of reliability (or consistency)(Gardner, 1998).

KMO & Bartlett's Test of Sphericity is a measure of sampling adequacy that is recommended to check the case to variable ratio for the analysis being conducted. In most academic and business studies, KMO & Bartlett's test play an important role for accepting the sample adequacy. While the KMO ranges from 0 to 1, the world-over accepted index is over 0.6. Also, the Bartlett's Test of Sphericity relates to the significance of the study and thereby shows the validity and suitability of the responses collected to the problem being addressed through the study. For PCA/Factor Analysis to be recommended as suitable, the Bartlett's Test of Sphericity must be less than 0.05. (Peri, 2012)

Rotated Component Matrix - While deciding how many factors one would analyze is whether a variable might relate to more than one factor. Rotation maximizes high item loadings and minimizes low item loadings, thereby producing a more interpretable and simplified solution. There are two common rotation techniques - orthogonal rotation and oblique rotation. While orthogonal varimax rotation produces factor structures that are uncorrelated, oblique rotation produces factors that are correlated. Irrespective of the rotation method used, the primary objectives are to provide easier interpretation of results. (Peri, 2012)

3.9.6 Steps in conducting PCA

(a) Step 1: Initial Extraction of the Components

In principal component analysis, the number of components extracted is equal to the number of variables being analyzed. Because six variables are analyzed in the present study, six components will be extracted. The first component can be expected to account for a fairly large amount of the total variance. Each succeeding component will account for progressively smaller amounts of variance. Although a large number of components may be extracted in this way, only the first few components will be important enough to be retained for interpretation.

(b) Step 2: Determining the Number of "Meaningful" Components to Retain

Earlier it was stated that the number of components extracted is equal to the number of variables being analyzed, necessitating that you decide just how many of these components are truly meaningful and worthy of being retained for rotation and interpretation. In general, you expect that only the first few components will account for meaningful amounts of variance, and that the later components will tend to account for only trivial variance. The next step of the analysis, therefore, is to determine how many meaningful components should be retained for interpretation. This section will describe four criteria that may be used in making this decision: the eigenvalue-one criterion, the scree test, the proportion of variance accounted for, and the interpretability criterion.

(i) **The eigenvalue-one criterion**. In principal component analysis, one of the most commonly used criteria for solving the number-of-components problem is the eigenvalue-one criterion, also known as the Kaiser criterion (Kaiser, 1960). With this approach, you retain and interpret any component with an eigenvalue greater than 1.00.

(ii) **The scree test**. With the scree test (Cattell, 1966), you plot the eigenvalues associated with each component and look for a "break" between the components with relatively large eigenvalues and those with small eigenvalues. The components that appear *before* the break are assumed to be meaningful and are retained for rotation; those appearing *after* the break are assumed to be unimportant and are not retained. Sometimes a scree plot will display several large breaks. When this is the case, you should look for the *last* big break before the eigenvalues begin to level off. Only the components that appear before this last large break should be retained.

(iii) Proportion of variance accounted for. A third criterion in solving the number of factors problem involves retaining a component if it accounts for a specified proportion (or percentage) of variance in the data set. For example, you may decide to retain any component that accounts for at least 5% or 10% of the total variance. This proportion can be calculated with a simple formula: Proportion = Eigenvalue for the component of interest/Total eigenvalues of the correlation matrix. In principal component analysis, the "total eigenvalues of the correlation matrix" is equal to the total number of variables being analyzed (because each variable contributes one unit of variance to the analysis). Fortunately, it is not necessary to actually compute these percentages by hand, since they are provided in SPSS.

(iv) The interpretability criteria. Perhaps the most important criterion for solving the "number of-components" problem is the **interpretability criterion**: interpreting the substantive meaning of the retained components and verifying that this interpretation makes sense in terms of what is known about the constructs under investigation.

(c) Weighted PCA

This is interpreted PCA of weighted sum of data matrices. An important property of the PCA method is that, for fixed ***c*** scaled to unit item, Weighted PCA is equivalent to PCA of $\sum_{k=1}^{p} c_k X_k$ $\quad$ *Where c is a p – vector*

$k = 1,2,3.....p$

X = *percentage* (%) *in unit item*

(d) Cronbach's Alpha

SPSS Output for Cronbach's Alpha: SPSS produces many different tables. The first important table is the **Reliability Statistics** table that provides the actual value for **Cronbach's alpha**, as shown below:

Table 3.3 Realibility statistics output

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.805	.796	9

Source SPSS Inc., an IBM Company; 2013

From above table 3.3, we can see that Cronbach's alpha is **0.805**, which indicates a high level of internal consistency for this specific sample.

Item-Total Statistics: The **Item-Total Statistics** table presents the **Cronbach's Alpha if Item Deleted** in the final column , as shown in table 3.4 below:

Table 3.4 Illustration of Item-Total statistics

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Qu1	24.20	45.029	.633	.588	.767
Qu2	23.93	47.352	.520	.651	.783
Qu3	24.07	46.638	.654	.899	.767
Qu4	23.40	47.114	.551	.823	.779
Qu5	23.60	51.257	.389	.573	.799
Qu6	24.47	50.695	.372	.693	.802
Qu7	24.07	45.210	.615	.777	.770
Qu8	24.20	56.457	.128	.791	.823
Qu9	24.07	45.210	.589	.610	.774

Source: SPSS Inc., an IBM Company; 2013

This column presents the value that Cronbach's alpha would be if that particular item was deleted from the scale. We can see that removal of any question, except question

8, would result in a lower Cronbach's alpha. Therefore, we would not want to remove these questions. Removal of question 8 would lead to a small improvement in Cronbach's alpha, and we can also see that the **Corrected Item-Total Correlation** value was low (0.128) for this item. This might lead us to consider whether we should remove this item.

Cronbach's alpha simply provides you with an overall reliability coefficient for a set of variables (e.g., questions). If your questions reflect different underlying personal qualities (or other dimensions), for example, employee motivation and employee commitment, Cronbach's alpha will not be able to distinguish between these. In order to do this and then check their reliability (using Cronbach's alpha), you will first need to run a test such as a Principal Components Analysis (PCA).

(e) Parallel Analysis

Parallel analysis is a method for determining the number of components or factors to retain from PCA or factor analysis. Essentially, the program works by creating a random dataset with the same numbers of observations and variables as the original data. A correlation matrix is computed from the randomly generated dataset and then eigenvalues of the correlation matrix are computed. When the eigenvalues from the random data are larger than the eigenvalues from the PCA or factor analysis you know which components or factors are mostly random noise (Shiffman, 2011).

Example

```
Principal components/correlation          Number of obs    =      568
                                          Number of comp.  =        6
                                          Trace            =        6
   Rotation: (unrotated = principal)      Rho              =   1.0000

    --------------------------------------------------------------------------
      Component |   Eigenvalue   Difference        Proportion   Cumulative
    -------------+------------------------------------------------------------
          Comp1 |      1.70622      .303339            0.2844       0.2844
          Comp2 |      1.40288      .494225            0.2338       0.5182
          Comp3 |      .908652      .185673            0.1514       0.6696
          Comp4 |      .722979     .0560588            0.1205       0.7901
          Comp5 |       .66692      .074563            0.1112       0.9013
          Comp6 |      .592357            .            0.0987       1.0000
    --------------------------------------------------------------------------
```

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Unexplained
bg2cost1	0.2741	0.5302	-0.2712	-0.7468	-0.0104	-0.1111	0
bg2cost2	-0.3713	0.4428	-0.4974	0.2800	0.2996	0.5005	0
bg2cost3	-0.4077	0.4834	0.0656	0.2466	-0.5649	-0.4646	0
bg2cost4	-0.3766	0.2748	0.7266	-0.2213	0.4504	0.0538	0
bg2cost5	0.4776	0.3345	0.3829	0.1950	-0.3942	0.5657	0
bg2cost6	0.5009	0.3192	0.0144	0.4647	0.4824	-0.4453	0

(f) Comparison of Principal Component analysis and Parallel analysis

PA -- Parallel Analysis for Principal Components

PA Eigenvalues Averaged Over 10 Replications

	PCA	PA	Dif
c1	1.7062	1.1366	0.5696
c2	1.4029	1.0637	0.3392
c3	0.9087	1.0343	-0.1257
c4	0.7230	0.9707	-0.2477
c5	0.6669	0.9269	-0.2600
c6	0.5924	0.8677	-0.2754

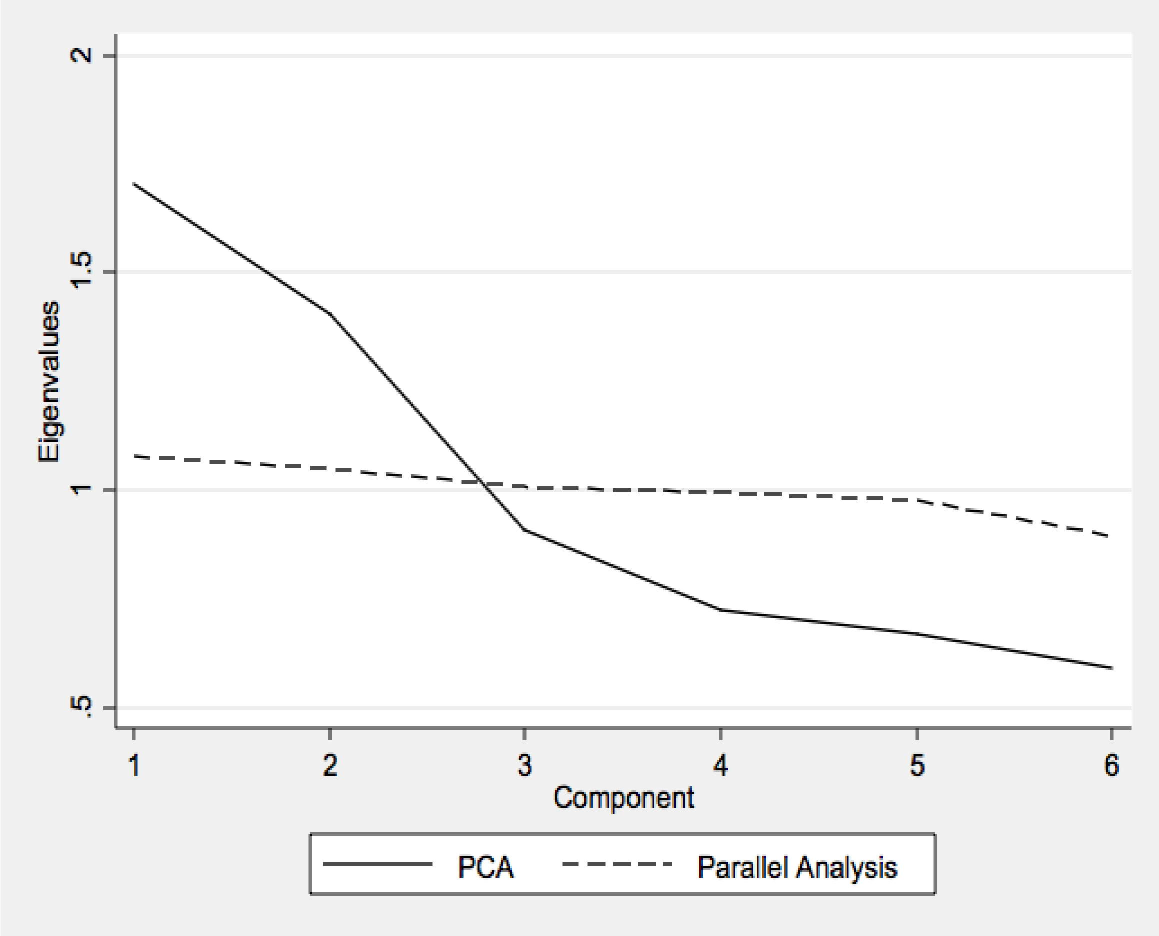


Figure 3.2 PCA and parallel analysis compared. Source: Shiffman, 2011

The parallel analysis for this example indicates that two components should be retained. There are two ways to tell this; (1) two of the eigenvalues in the PCA column are greater than the average eigenvalues in the PA column, and (2) the dashed line for parallel analysis in the graph crosses the solid PCA line before reaching the third component.

3.9.7 Dealing with Missing Data

It is very usual that respondents fail to answer some questions. This can create a problem when analyzing data especially in index construction, which is part of the methodology of this research. This research encountered this problem and the strategy used for handling missing data was that suggested by (Babbie & Rubin, 2010). This method is simply treating the missing as one of the available responses. For instance, the items or questions were assigned 0 score. Nevertheless, only complete responses were used in the questionnaire analysis. However, great care was taken to minimize on missing responses by structuring the most important sections of the research instruments to improve responsiveness. The research instruments were also field checked for completeness before acceptance and most of the picked questionnaires had important sections filled. Finally because no question had more than 3% unresponsiveness the omissions of unfilled questions when carrying out the analysis did not materially affect the results.

3.9.8 Data Reliability Testing

Testing for the reliability of collected data can be carried out using a number of tests:

(i) Test-retest reliability/stability

(ii) Equivalent – forms reliability/ parallel form or alternate forms reliability.

(iii)Internal consistency

Split-half reliability/ subdivided test.

The method of rational equivalence

Kuder-Richardson formulae (KR_{20} and KR_{21})

$$KR_{20} = \frac{k}{k-1} \left(1 - \sum \frac{pq}{\sigma^2}\right)$$

$$KR_{21} = \frac{k}{k-1} \left(1 - \frac{\mu(k-\mu)}{k\sigma^2}\right)$$

Where p= is the proportion passing a given item

q=1-p and σ is the standard deviation of whole test. The pq values are summed over all the k items to obtain the total summation. μ= Mean of the test and k= number of items.

(Iv) Cronbach's Coefficient Alpha

This is a general form of KR_{20} that can be used when items are not scored dichotomously. This is the test that was used to test for the reliability of data in this research with an overall evaluation of 0.78. The formula is given by:

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum \sigma_k^2}{\sigma^2}\right)$$

Where

$\sum \sigma_k^2$ Sum of variances usually of the items.

σ is the standard deviation of the test; k is the number of items; when the parts are individual items $\alpha = KR_{20}$.

3.10 APPROACH OF VALIDATING THE MODEL

The following approaches were considered for validating the model.

The first option considered was to conduct twenty case studies with selected construction companies to compare the model to their actual processes undertaken in their projects. To perform this approach, requires that the model should be thoroughly explained in detail and in depth face to face interviews with specialized people.

The second option considered was to meet with a group of professionals from the construction industry who have the knowledge concerning the subject to discuss with them the model. This would require reviewing and comparing the model to specific projects.

The third option was developing a structured questionnaire for interviews with construction industry players to evaluate the effectiveness of the model using a five-point scale.

The approach that was selected to validate the developed model was to meet senior practitioners with over twenty years of experience and demonstrate to them how the model works and doing the rating together before they were asked to fill a separate research instrument on the performance of the model as discussed in detail in chapter five.

3.11 CONCLUSION

In this Chapter, the research *strategies, designs and methods* used in this study have been presented, and justification for their choice given. In each of the three aspects, a combination of alternative approaches was adopted in order to enable a deeper understanding of the way project management is practiced and help identify the factors that inhibit its improvement. For example, a questionnaire *survey* and *case study* interviews were used to elicit information on how project management is practiced by construction companies and clients in Kenya. The next Chapter presents the data analysis and results.

CHAPTER FOUR: DATA ANALYSIS AND PRESENTATION

4.1 INTRODUCTION

This chapter discusses the factors necessary for the project management evaluation model formulation based on the field research. Factors affecting project management application are discussed. It also discusses project management indicators such as factors for success or failure of projects, problems encountered in the current project management practice in Kenya, problems with current project management models application and factors causing poor workmanship/quality in projects. Identified project management modeling parameters are also tested. The other matters discussed are the current strategies of project management application, project performance indicators and performance of project management functions. The final section is dedicated to project management modeling and respondents' views on project management application in Kenya.

Respondents' satisfaction indices were computed based on a five point Likert scale measurement comprising: least important, less important, uncertain, important and very important. Mean scores were computed in each of the measurements variables for all levels of satisfaction and agreement. These were converted into percentages and ranked. Results are presented in tables and graphs.

Table 4.1: Respondents' Data Sources; Field Survey 2013

	Number of Questionnaires		Percentage Return
	Sent	Returned	%
Engineering	100	57	57%
Architecture	100	87	87%
Quantity surveying	100	75	75%
Project Management	100	48	48%
Contractors	100	45	45%
Total	**500**	**312**	**62.4%**

Data was managed in MS-Excel and analyzed using Statistical Package for Social Sciences (SPSS V20 & R-program).

4.2 GENERAL INFORMATION

The sampling frame was the different construction organizations while the sampling unit comprised of the qualified human resources within those organizations. The respondents' profiles are as presented in table 4.1 above. The response rate by the various respondents who participated in the research indicated an overall percentage of 62.4% which was satisfactory to provide required information for the analysis.

It is generally appreciated that in survey research respondents normally have a response rate getting as low as 30%; but, at a response rate of 62.4% as shown in table 4.1 above, for this study; it can generally be concluded that it was good and results can be generalized to the population. Cronbach's Alpha used ahead indicated that the reliability of data is good with Cronbach's Alpha averaging 0.78 on most of the questions being analyzed. The sample distribution was randomly stratified at 100 members for civil engineers, architects, quantity surveyors, project managers and contractors for each category.

The responsiveness varied significantly and it was noted that 27.9% constituted architects which formed the highest number of respondents, followed by the quantity surveyors at 24.0%. Contractors were the least responsive at 14.4%. Further, the study revealed that majority of the respondents had an experience of more than 10 years since first time registration, that is, at 52.9% of the respondents, and with a varied distribution on status in the organization being as shown in Table 4.2. With such experienced respondents the data received can be comfortably used in handling the study.

Table 4.2: Distribution data of the respondents

Distribution of the respondents according to:								
Category			**Experience**			**Status in organization**		
Profession	**Count**	**%**	**Years**	**Count**	**%**	**Position**	**Count**	**%**
Engineering	57	18.30%	< 5 Years	84	26.90%	Director/principal partner	105	33.70%
Architecture	87	27.90%	5-10 Years	63	20.20%	Senior staff	141	45.20%
Quantity surveying	75	24.00%	> 10 Years	165	52.90%	Managing Director	63	20.20%
Project management	48	15.40%				Other	3	1.00%
Contractor	45	14.40%						
Total	312	100%		312	100%		312	100%

Source: Field survey 2013

4.3 CROSS TABULATION DESCRIPTIVE STATISTICS

Categories were cross tabulated to indicate the respective percentages for each category in terms of period one had served in the organization as per table 4.3. The results indicate that most of these categories (engineers, quantity surveyors, project managers and the contractors) responded that they have experience of more than 10 years at their respective areas of specialization. Architects have a significantly higher percentage being less than 5 years at 44.8% as compared to the other categories; however, 55.2% have more than 5 years' experience. This is an indication that the data sources can be relied on for analysis. Given that the questionnaire targeted top and middle management; the responses from those of 5 years were included in the analysis. However, model validation was conducted using those with 20 years and above.

Table 4.3: Experience of respondents Cross-tabulation

			Experience			Total
			<5 Years	5-10 Years	>10 Years	
Category	Engineering	Count	12	18	27	57
		% within category	21.1%	31.6%	47.4%	100.0%
	Architecture	Count	39	18	30	87
		% within category	44.8%	20.7%	34.5%	100.0%
	Quantity Surveying	Count	18	12	45	75
		% within category	24.0%	16.0%	60.0%	100.0%
	Project Management	Count	15	12	21	48
		% within category	31.3%	25.0%	43.8%	100.0%
	Contractor	Count	0	3	42	45
		% within category	.0%	6.7%	93.3%	100.0%
Total		Count	84	63	165	312
		% within category	26.9%	20.2%	52.9%	100.0%

Source: Field survey 2013

On the other hand, each category is cross tabulated against the status the respondents are serving in the organization for each category and the results are tabulated in table 4.4 below. All the categories involved in construction industry except for the contractors recorded middle level / senior positions in their organizations. This is positively related with the period one had served at the organization. This was necessary for authentication of data received reflecting the experience and position of data sources; the main objective being to test data validity.

Elsewhere the research sought to know the relationship between long period of service and the status one occupies in the organization. The results revealed that the longer the period one had served in the construction industry the higher the status one achieved. For example, compare the level of managing directors below 5 years who accounted for 3.6% as compared to those aged above 10 years in service who accounted for 32.7% of the respondents as illustrated in table 4.5 below. It was necessary to crosscheck this information not only for model formulation but also to generate a relevant model suitable for construction industry in Kenya. Targeting middle and senior management was also essential to improve on response which turned out at 62.4%.

Table 4.4: Categories verses Status in the Organization Cross-tabulation

			Status in the Organization				Total
			Director/Principal Partner	Senior Staff	Managing Director	Other	
Categories	Engineering	Count	24	21	12	0	57
		% reported	42.1%	36.8%	21.1%	.0%	100.0%
	Architecture	Count	27	48	12	0	87
		% reported	31.0%	55.2%	13.8%	.0%	100.0%
	Quantity Surveying	Count	33	36	3	3	75
		% reported	44.0%	48.0%	4.0%	4.0%	100.0%
	Project Management	Count	21	24	3	0	48
		% reported	43.8%	50.0%	6.3%	.0%	100.0%
	Contractor	Count	0	12	33	0	45
		% reported	.0%	26.7%	73.3%	.0%	100.0%
Total		Count	105	141	63	3	312
		% reported	33.7%	45.2%	20.2%	1.0%	100.0%

Source: Field survey 2013

Table 4.5: Experience verses Status in the Organization Cross-tabulation

			Status in the Organization				Total
Period			Director/Principal Partner	Senior Staff	Managing Director	Other	
Years in practice	<5 Years	Count	12	66	3	3	84
		% reported	14.3%	78.6%	3.6%	3.6%	100.0%
	5-10 Years	Count	21	36	6	0	63
		% reported	33.3%	57.1%	9.5%	.0%	100.0%
	>10 Years	Count	72	39	54	0	165
		% reported	43.6%	23.6%	32.7%	.0%	100.0%
Total		Count	105	141	63	3	312
		% reported	33.7%	45.2%	20.2%	1.0%	100.0%

Source: Field survey 2013

Table 4.5 above was also to test the validity of data sources. Having established the reliability and validity of data sources as indicated by the positions the respondents held; the actual analysis started from the next section.

4.4 PROJECT MANAGEMENT INDICATORS

4.4.1 Measures of Success or Failure of the Projects Undertaken

It was revealed accordingly that much as the traditional measures of project management of cost, quality and time are important; there are other measures/variables comprising of scope, business success, health and safety, environmental sustainability, knowledge creation and market impact which are equally important. These findings agree with (Muchungu, 2012) especially on the environmental sustainability, clients' satisfaction measures, time, cost and quality. The ratings on the measures of success or failure of the projects in order of their importance were found to be as reflected in figure 4.1 below. Quality of the project at 81% was the most important measure of the success of the projects followed by the cost of the project at 80%. Knowledge creation and innovation and learning were rated as not being very important in this measurement at 19% and 17% respectively. In general most of the factors were important measures to the success or failure of the projects. This corresponds to PMI measures of project management success as discussed in literature review. It also reflects other models and variables for measurement as discussed in PMBOK model, PRINCE2 Model and Hermes model under literature review.

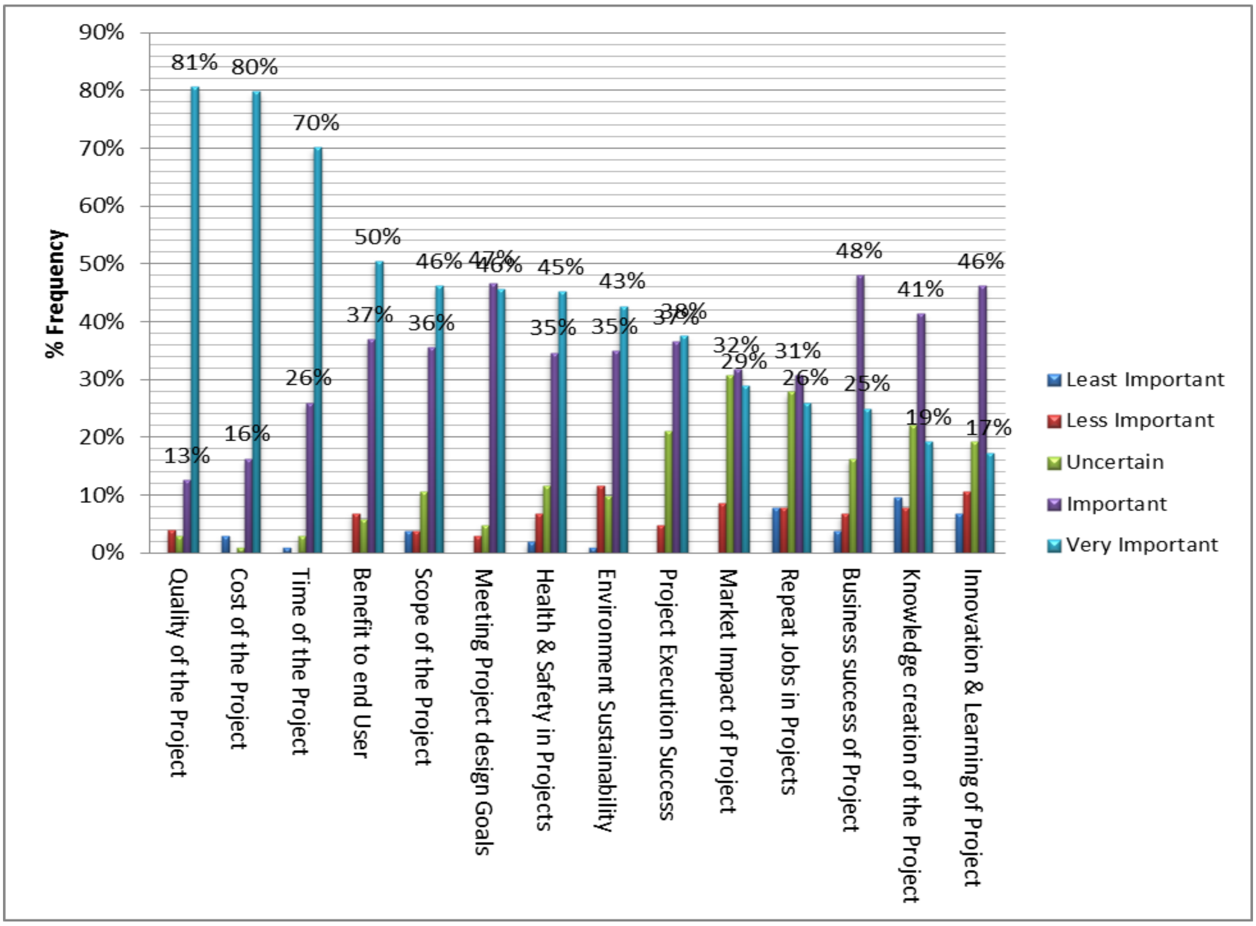


Figure 4.1: Analysis of Measures of Success or Failure of the projects

(Source: Field survey 2013)

From figure 4.1 it was established that cost, quality and time were the most important project management indicators. So the three traditional measures as captured herein have to be incorporated in the project management model. Equally in addressing objective number two they are also confirmed as indicators of a successful execution process of projects. In this regard the research agrees with (Gichunge, 2000)in that cost and time are still major challenges in the construction industry in Kenya.

The line graph captured as figure 4.2 below demonstrates that all the factors contributed significantly to the success of project management. On average 60% of respondents confirmed that all factors were critical while less than 20% stated that they were not important. Cost and quality of the projects constituted 96% and 94% as the most critical factors to be considered in project management. Although most of the factors were rated well, repeat jobs was rated as the most insignificant factor to the success of the projects at 57%.

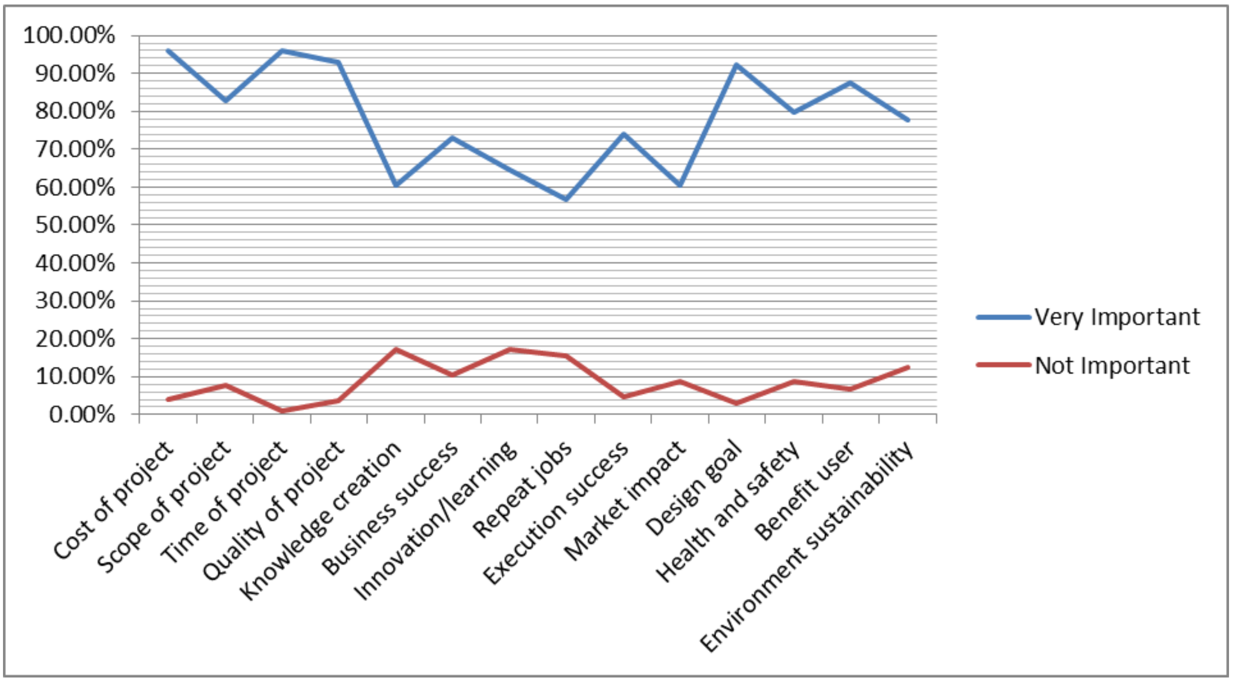


Fig 4.2 Project management failure or success indicators

Source: Field survey 2013

The research sought to compare the factors of success or failure of projects that were identified by the respondents, as being important and very important. The following figure 4.3 illustrates the results in a measurement of 0-1 Likert scale. From the line graph in graph 4.2 above; scope was added to the traditional measures. So apart from cost, quality and time; scope as a fourth variable is added and therefore should be in the model and as a project success indicator. From literature review scope management was also established as crucial in a successful implementation of a project as discussed under the various models.

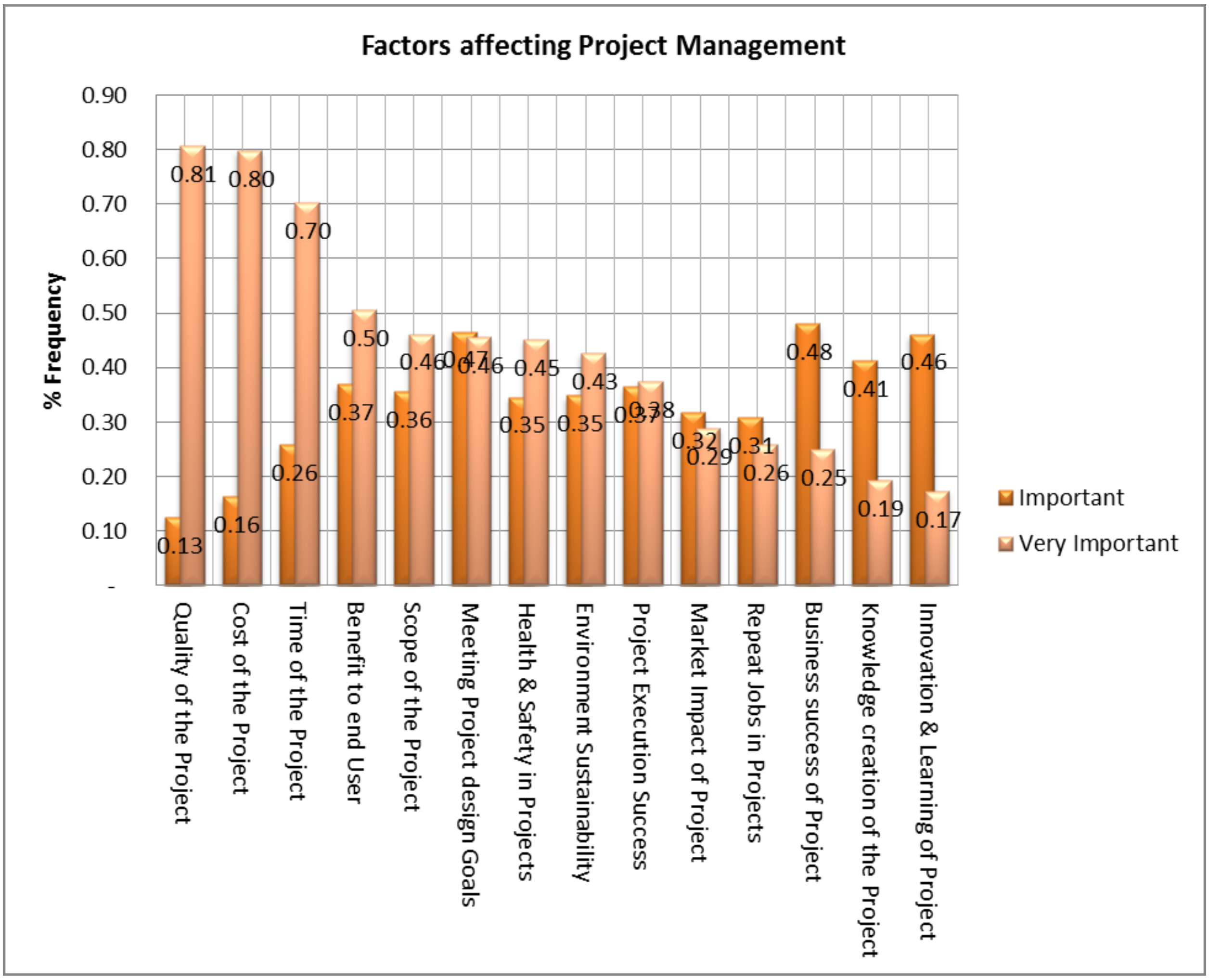


Figure 4.3: Analysis of Measures of Success or Failure of the projects

Source: Field survey 2013

When both important and very important are summed up together then cost at 96%, quality at 94%, time at 96%, benefit to the end user at 87%, scope of the project at 82%, meeting design goals at 93%, health and safety at 80%, environmental sustainability at 78%, project execution success at 75%, market impact of the project at 61%, repeat jobs at 57%, business success at 63%, knowledge creation at 63%; indicate that all factors are important towards successful implementation of projects. The practice of project management should then aim at actualizing and optimizing the performance of these factors in projects. Still cost, quality and time are confirmed as project management indicators. But benefit to end user, scope, meeting design goals and health and safety are also strong indicators. Other than scope which was confirmed previously these other factors relate to project performance and can be added as the fifth indicator.

Table 4.6: Comparing the Means through ranking I (n the factors which determine success/failure of projects:

Name of profession		Project Cost	Project Time	Project Scope	Project Quality	Project Knowle	Project Business	Project Innovati	Repeat Jobs in	Project Execut	Project Market	Project Design	Health & Safety	Benefit to end	Environ ment
Engineering	Mean	4.7895	4.4737	4.6316	4.6842	4.1579	4.3158	4.1579	4.0526	4.3158	4.2632	4.4737	4.4737	4.5263	4.4737
	Rank	3	2	2	3	1	1	1	1	2	1	2	2	2	3
Quantity Surveying	Mean	4.4800	3.9200	4.5600	4.6400	2.9200	3.6800	3.2000	3.6400	3.6400	3.6400	4.2000	3.9600	3.9600	3.4400
	Rank	5	4	5	4	5	4	5	2	5	5	5	3	5	5
Architecture	Mean	4.7241	4.1034	4.5862	4.5862	3.4483	3.7931	3.3448	3.4138	4.1034	3.5517	4.2143	3.8966	4.1786	4.1429
	Rank	4	3	4	5	4	2	4	4	3	4	4	5	4	3
Project Management	Mean	4.8125	3.8125	4.6250	4.6875	3.5000	3.7500	3.5000	3.3125	4.5000	4.1250	4.4375	3.9375	4.3750	3.7500
	Rank	1	5	3	2	3	3	3	5	1	2	3	4	3	4
Contractor	Mean	4.8000	3.7500	4.9333	4.8889	3.9333	3.6667	3.9333	3.6000	3.9333	4.0000	4.6000	4.7333	4.7333	4.8000
	Rank	2	2	1	1	2	5	2	3	4	3	1	1	1	1
Total	Mean	4.7019	4.1635	4.6442	4.6763	3.5288	3.8365	3.5673	3.5962	4.0673	3.8077	4.3495	4.1442	4.3107	4.0680
	Rank	1	6	3	2	14	10	13	12	9	11	5	7	4	8

Under table 4.6; variables were ranked through the mean computation and it was revealed that the cost of the project had the highest mean at 4.7019, followed by the quality of the project at 4.6763. This means that generally, the weighting of importance on the cost of the project was greater than that of quality of the project, as a key measurement on the success or failure of the projects in the construction industry in Kenya. The variable means among the categories showed that the engineers had a high mean score of 4.4135 followed by the contractors with a mean of 4.3730, project managers at 4.0803, architects at 4.0062 while the quantity surveyors reported a mean score of 3.8371. This could be an indication that the architects and quantity surveyors do not attach as much importance to project performance indicators as compared to engineers and contractors. It equally indicates that engineers and contractors are more sensitive to the key success factors in projects. From table 4.6 above; cost, quality, time and scope are still confirmed. New additions include the meeting of design goals, benefits to the end user and health and safety of projects which can all be summarized as project performance as the fifth factor in the model making.

The lowly scored mean was in the knowledge creation of the project, which at the same time recorded a significant difference among the various categories of the respondents; meaning it is of least concern in the course of project execution.

4.5 EXPERIENCE ON CURRENT PROJECT MANAGEMENT PRACTICES

On the current practices of project management; respondents were asked to rate from structured choices on the extent to which they experience problems with current project management practices. Generally, the practice of project management experiences a lot of problems as attested by the responses. Five out of eleven factors are rated above 50% as being problematic. The same case applies on usage of current project management models as formulated in question no. 5 under the research instruments appended. Of the total respondents, 33% and 24% were of the opinion that they experience problems on the current project management practices to a high extent and Low extent respectively. Figure 4.4 below summarizes on how respondents rated various factors

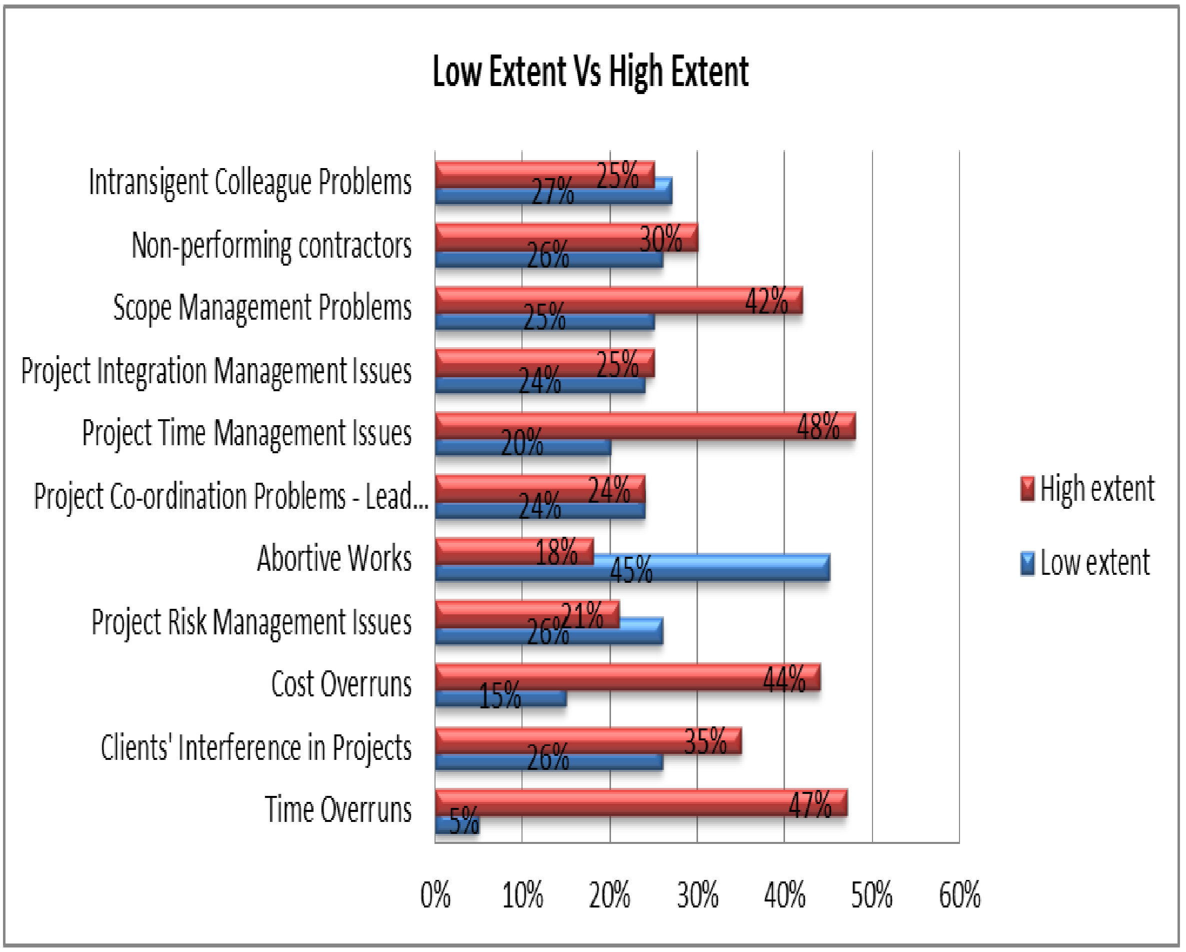


Figure 4.4: Analysis of current project Management practices problems

Source: Field survey 2013

From figure 4.4 as conducted in the study 48% of the respondents confirmed that the major problem was on project time management issues while 45% rated abortive works at a low extent. This implies that majority of the respondents' rarely experienced abortive works as compared to project time management problems.

Out of the total number of respondents, 73% confirmed that time overruns was the major issue on project management followed by time management issues at 64%. The other highly ranked project management problems are cost overruns at 63%, clients' interference in projects at 60%, scope management problems at 56%. Abortive works and intransigent colleagues were the lowest ranked; both at 35%.

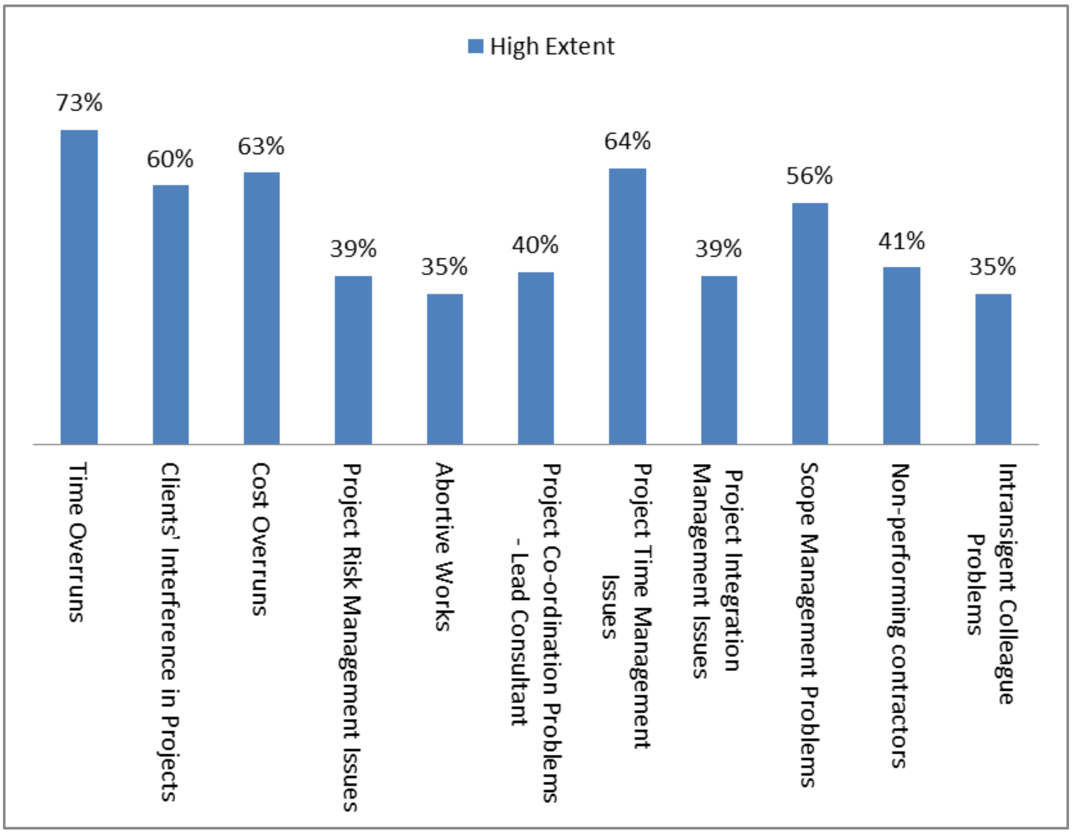


Figure 4.5: Analysis of current project Management practices problems extent.

Source: Field survey 2013

From the analysis in figure 4.5 above; client's management issues is added to the previously established indicators. This is an indication that clients should also be analyzed and should be considered in the final model. Tables 4.7 and 4.8 below illustrate the information in descriptive form. For instance when comparing the mean rankings among the respondents, and problems experienced in project management it was revealed that the problems encompassed mostly the contractors since they are the main implementers of construction projects (mean score of 4.1867) compared to other categories as; for civil engineers' mean score is 3.3263, architects' mean score is 3.1634, quantity surveyors' mean score is 3.1332 whereas the project managers have a mean score of 3.3419.

Table 4.7 Problems facing current project management tabulated raw responses

Problem Facing Current project management practices	No extent	Low extent	Neut ral	High extent	Very high extent
Time Overruns	2%	5%	20%	47%	26%
Clients' Interference in Projects	5%	26%	8%	35%	25%
Cost Overruns	4%	15%	17%	44%	19%
Project Risk Management Issues	8%	26%	28%	21%	18%
Abortive Works	5%	45%	15%	18%	17%
Project Co-ordination Problems - Lead Consultant	10%	24%	26%	24%	16%
Project Time Management Issues	1%	20%	15%	48%	16%
Project Integration Management Issues	5%	24%	32%	25%	14%
Scope Management Problems	0%	25%	19%	42%	14%
Non-performing contractors	2%	26%	30%	30%	11%
Intransigent Colleague Problems	11%	27%	28%	25%	10%
Grand Total	**5%**	**24%**	**21%**	**33%**	**17%**

Source: Field survey 2013

Table 4.8 Comparing the Means through ranking of problems experienced in project management practices

Name of the Profession		Scope Management Problems	Project Co-ordination Problems	Cost Overruns	Time Overruns	Non-performing contractors	Project Integration Management Issues	Project Time Management Issues	Project Risk Management Issues	Intransigent Colleague Problems	Clients' Interference in Projects
Engineering N=57	Mean	3.2105	4.3684	3.5263	3.6316	2.9474	3.2105	3.4211	3.0000	2.8947	3.0526
	Rank	4	1	3	5	5	3	4	3	2	5
Architecture N=84	Mean	3.2857	2.8571	3.3462	3.7143	3.1429	2.9286	3.3333	2.9286	2.7407	3.3571
	Rank	3	5	5	4	3	4	5	5	4	3
Quantity Surveying, N=75	Mean	3.0870	3.1250	3.6000	4.0800	2	2.8800	3.6800	2.9600	2.6000	3.3200
	Rank	5	3	2	2	3.00	5	2	4	5	4
Project Management , N=48	Mean	3.6667	3.0667	3.5000	3.8000	3.1333	3.2143	3.4286	3.1429	2.8000	3.6667
	Rank	2	4	4	3	4	2	3	2	3	2
Contractor N=45	Mean	4.4000	4.0667	4.2000	4.4667	3.6000	4.2000	4.2000	4.0667	4.2000	4.4667
	Rank	1	2	1	1	1	1	1	1	1	1
Total N=312	Mean	3.4500	3.4158	3.5960	3.9118	3.2157	3.5941	3.5800	3.1485	2.9604	3.5000
		6	7	2	1	8	3	4	9	10	5

Source: Field survey 2013

4.6 CAUSES OF POOR WORKMANSHIP/QUALITY IN PROJECTS

The main reason for poor workmanship was due to poor supervision of the projects which rated 51.96% as shown in figure 4.6 below. Change in specifications also contributed 49% while coordination challenges between the main contractor and other Sub-Contractors were rated least important, an indication that most of the project are not affected due to coordination challenges.

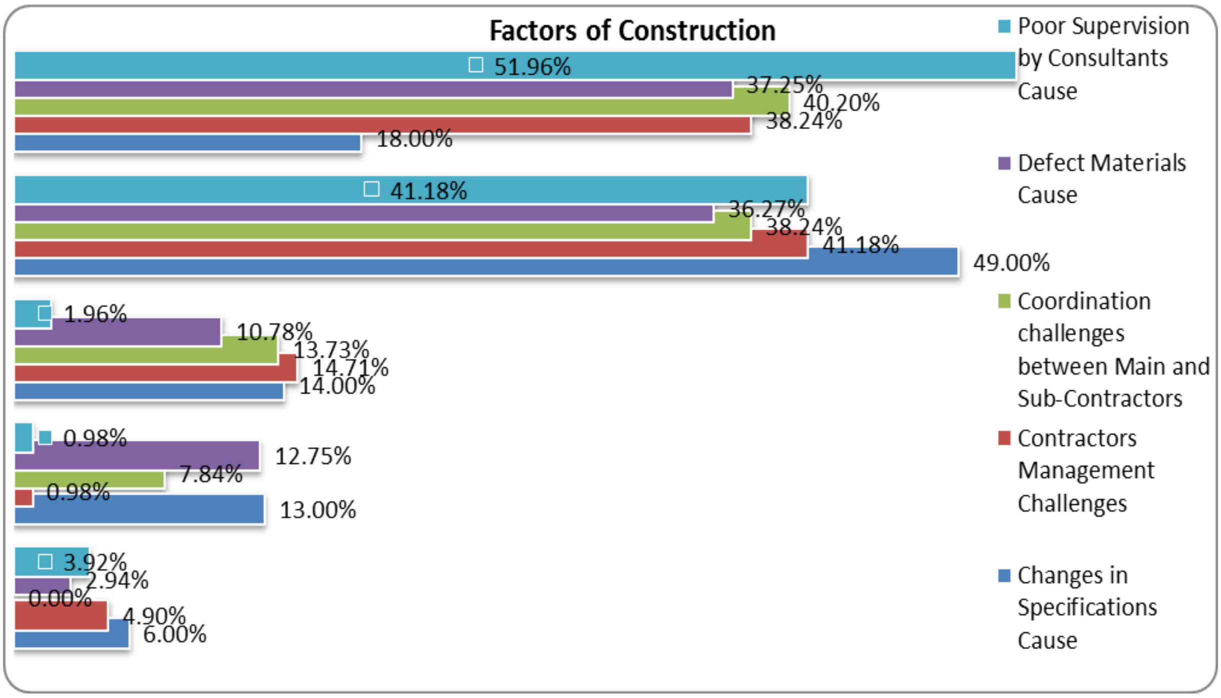


Fig 4.6 Causes of poor workmanship and quality challenges in projects.

Source: Field survey 2013

From figure 4.6 human resource management has to be included in the model and is also a key performance indicator of successful execution of projects arising mainly from poor supervision by consultants and coordination challenges between the main contractor and subcontractors. Hence so far seven factors have been confirmed as follows: Cost, quality, time, scope, projects performance and human resources. Clients' issues have been confirmed and shall be treated separately. Elsewhere, from literature review project issues and people issues were established as key performance indicators (Hamza, 1995). Equally, most of the discussed models from literature review including PMBOK, PRINCE2 and Global Alliance of Project Performance standards clearly indicate that human resource management is one of the key variables of a successful project management practice. Table 4.9 ranks causes that lead to poor quality of projects as follows: poor supervision by consultants as cause No. 1 with a mean score of 4.3627; second is coordination challenges at a mean score of 4.1078; third is contractor's management challenges at 4.06886; fourth is defective materials causes at a mean score of 3.9216 and changes in specifications is ranked fifth at a mean score of 3.600 out of five respectively. The challenge then is appropriate application of project management given highly qualified human resources in the industry as attested by requirements prior to registration with the various professional bodies.

Table 4.9 Showing the ranking of factors that cause/lead to poor quality of projects

Name of the Profession		Poor Supervision by Consultants Cause	Defect Materials Cause	Contractors Management Challenges	Changes in Specifications Cause	Coordination challenges between Main and Sub-Contractors
Engineering	Mean	3.9474	3.6316	3.4737	3.3684	4.1579
N=57	Rank	5	4	5	5	2
Architecture	Mean	4.5000	4.3929	4.1429	3.5385	4.2500
N=84	Rank	2	1	4	3	1
Quantity Surveying	Mean	4.4400	4.0400	4.2000	3.5600	4.0400
N=75	Rank	3	2	2	2	4
Project Management	Mean	4.4000	3.2000	4.3333	3.4000	4.0667
N=45	Rank	4	5	1	4	3
Contractor	Mean	4.4667	3.9333	4.2000	4.2667	3.9333
N=45	Rank	1	3	2	1	5
Total	Mean	4.3627	3.9216	4.0686	3.6000	4.1078
N=306		1	4	3	5	2

Source: Field survey 2013

4.7 USE OF PROJECT MANAGEMENT STRATEGIES

There is less significance on the difference in the performance of the various strategies used in project management. Thus all the strategies had almost the same level of importance in operation of a high extent as depicted in figure 4.7 below. This is deceptively indicative of a successful project management application which is later confirmed as false through other questions in the research instrument. This is an indication that with good project management model application; then construction projects performance in Kenya can improve because practitioners are desirous of taking up any good project management strategies.

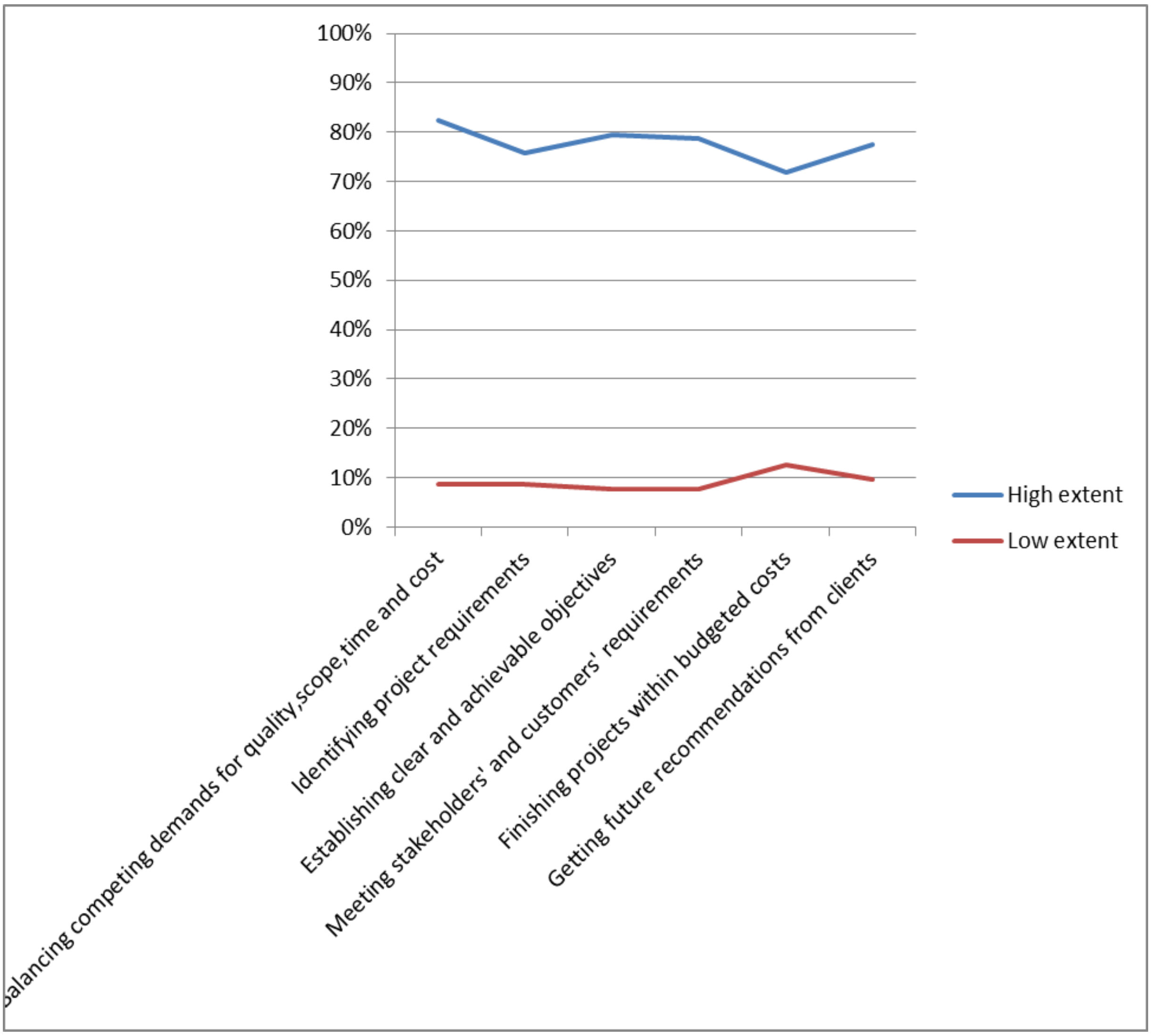


Figure 4.7: Performance of project management strategies

Source: Field survey 2013

4.8 STEPS IN MONITORING WORK PROGRESS OF PROJECTS

The steps that were of high extent in aiding the construction industry for monitoring work progress were: use of tracking and obtaining approvals of variations and reporting on abortive and remedial works before implementation as shown in figure 4.8 below. Use of project management software was reported to be in use at a very low extent among the respondents.

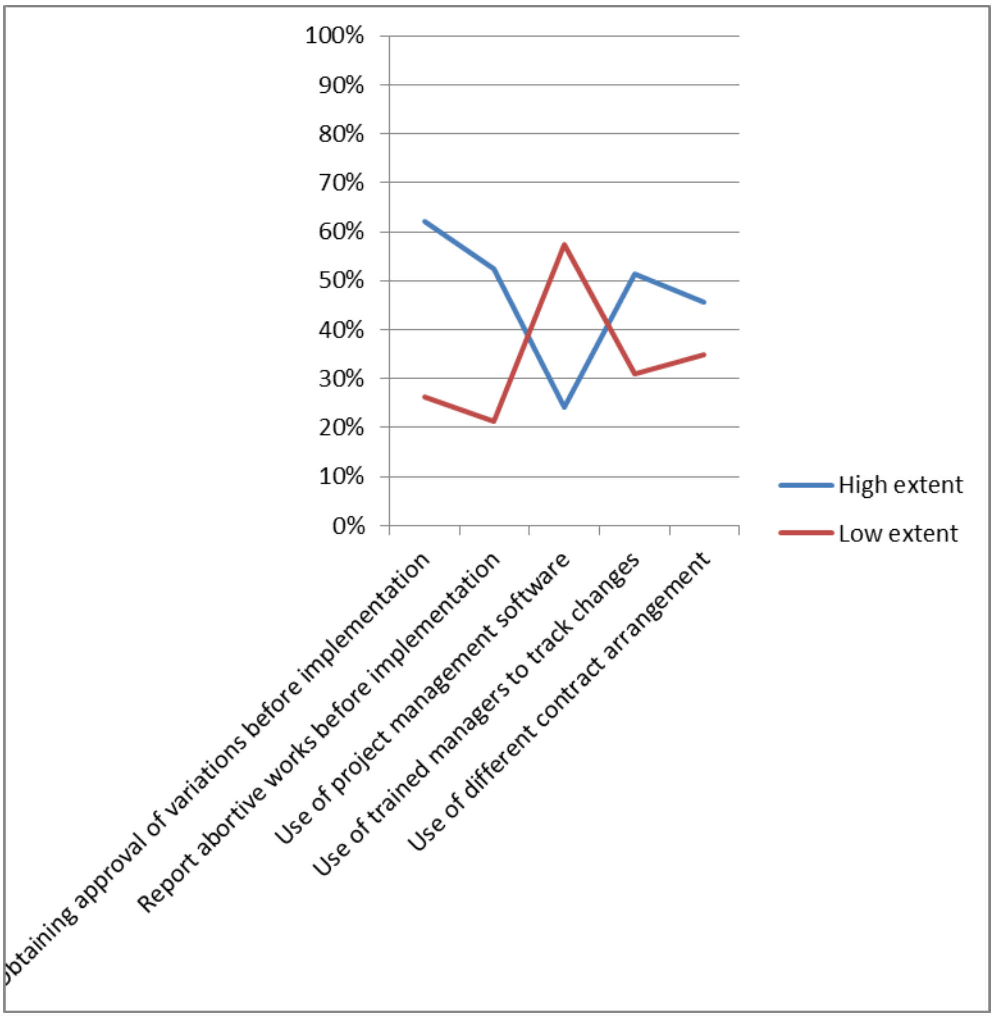


Figure 4.8: Monitoring work progress of projects

Source: Field survey 2013

Since the line graphs intersect twice; it implies that the factors under consideration attract mixed reactions in terms of their importance in projects execution and management in Kenya. That is a reflection of the level of immaturity and inconsistency in the application of project management while executing projects in Kenya. This is an indication that the developed model should aim at improving and structuring the monitoring and control of projects.

4.9 KEY MANAGEMENT FACTORS FOR PROJECT MANAGEMENT ANALYZED THROUGH THE PCA METHOD.

Key management factors of the project management for the various respondents' were analyzed through the Principal Component Analysis (PCA) method. The data for all the respondents' is as shown in table 4.10 below.

Table 4.10: Total Variance explained on the Key management factors for project management

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.239	38.534	38.534	4.239	38.534	38.534	3.315	30.135	30.135
2	1.524	13.856	52.390	1.524	13.856	52.390	2.343	21.300	51.435
3	1.270	11.544	63.934	1.270	11.544	63.934	1.375	12.499	63.934
4	.969	8.806	72.740						
5	.737	6.701	79.441						
6	.626	5.691	85.132						
7	.475	4.319	89.451						
8	.359	3.265	92.716						
9	.304	2.761	95.477						
10	.282	2.560	98.037						
11	.216	1.963	100.000						

Kaiser-Meyer-Olkin Adequacy Measure (KMO): 0.787 Cronbach's Alpha 0.861 Rotation method: Varimax

Source: Field survey 2013

Cronbach's Alpha indicates 0.861 meaning the data is reliable. Equally, KMO at 0.787 is an indication that the sample size is adequate; hence it is possible to derive logical conclusions from the analysis of variables under consideration.

The general data loadings are as shown in table 4.10 above; three components are essential for the analysis and can be interpreted into the following three categories namely; Integration and project management indicators, project performance management and value engineering. Category one has a greater variance that can be explained hence the eight variables are critical.

Table 4.11 below shows that three components were extracted which can be renamed project management performance factor as component one; project execution efficiency as component two and value engineering as component three. The seven most important variables include: project information management, project scope management, project cost, project quality management, project integration management, project risk management and project time management.

Table 4.11: Clustering the factors by the component matrix

	Component		
	1	2	3
Project Integration Management Factor	.648		
Project Scope Management Factor	.789		
Project Time Management Factor	.618	-.547	
Project Cost Management Factor	.767		
Project Quality Management Factor	.728	-.387	
Project Human Resource Management Factor	.262		
Project Information Management Factor	.839		
Project Risk Management Factor	.618		-.364
Project Performance Management Factor	.585	.653	
Construction Site Management Factor	.441	.640	.332
Value Engineering Factor	.072		.872

Source: Field survey 2013

From table 4.11 above project information management, project scope management, project cost management, project time management, project quality management, project risk management, project integration management and project human resource management are confirmed as key indicators. However, it should be noted that project integration and project information management are not consistent in loading and are appearing for the second time.

Table 4.12: Total Variance Explained on the Key management factors for project management for civil engineers

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.663	42.394	42.394	4.663	42.394	42.394	3.860	35.089	35.089
2	2.028	18.440	60.834	2.028	18.440	60.834	2.812	25.565	60.654
3	1.371	12.468	73.301	1.371	12.468	73.301	1.391	12.647	73.301
4	.922	8.379	81.680						
5	.744	6.764	88.445						
6	.692	6.292	94.736						
7	.266	2.416	97.152						
8	.222	2.014	99.166						
9	.069	.625	99.792						
10	.020	.183	99.975						
11	.003	.025	100.000						

Extraction Method: Principal Component Analysis. Rotation method: Varimax

a. Only cases for which Name of the Profession = Engineering are used in the analysis phase.

Source: Field survey 2013

On the other hand for engineers, the variables that were of less variance differed significantly compared with that of whole group whereby the following components were added up, namely; project risk management factor and project integration management factor.

Table 4.13: Component Matrix for engineers

	Component		
	1	2	3
Project Scope Management Factor	.893		
Project Time Management Factor	.722	-.547	
Project Cost Management Factor	.859		
Project Quality Management Factor	.753	-.452	
Project Human Resource Management Factor	.440		
Project Information Management Factor	.908		
Value Engineering Factor	.611	.452	
Project Performance Management Factor	.356	.822	
Construction Site Management Factor	.539	.675	
Project Risk Management Factor			.819
Project Integration Management Factor	.409		-.725

Source: Field survey 2013

From table 4.12 and 4.13 above the key components extracted for engineers are three and can be summarized as project management performance factor as component one; site project management as component two and investment appraisal as component three which is made up of risk analysis and project integration management factors. The seven most important variables are project information management factor, project scope management factor, project cost management factor, project time management factor, value engineering factor and project performance management factor.

In the category of the architects, more factors compared to the entire group data emerged with much less variance from the four components that were accepted. The factors which were significant at component one were scope, human resource, information, risk management, project performance and cost.

Table 4.14: Total Variance Explained on the Key management factors for project management for architects

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.191	38.100	38.100	4.191	38.100	38.100	2.970	27.000	27.000
2	1.812	16.475	54.576	1.812	16.475	54.576	2.382	21.658	48.657
3	1.220	11.094	65.670	1.220	11.094	65.670	1.659	15.078	63.735
4	1.126	10.240	75.910	1.126	10.240	75.910	1.339	12.174	75.910
5	.703	6.390	82.300						
6	.571	5.194	87.494						
7	.489	4.443	91.937						
8	.371	3.376	95.313						
9	.358	3.255	98.568						
10	.094	.855	99.423						
11	.063	.577	100.000						

Extraction Method: Principal Component Analysis. Rotation method: Varimax

a. Only cases for which Name of the Profession = Architecture are used in the analysis phase.

Source: Field survey 2013

The other factors in component 2 of project time and quality were also significant as below.

Table 4.15: Component Matrix for architects

	Component			
	1	2	3	4
Project Scope Management Factor	.824			
Project Cost Management Factor	.588	.442	.431	-.416
Project Human Resource Management Factor	.724	-.344		-.356
Project Information Management Factor	.836		-.322	
Project Risk Management Factor	.605	-.312	.318	
Project Performance Management Factor	.624	-.445		
Construction Site Management Factor	.497	-.437		
Project Time Management Factor	.588	.679		
Project Quality Management Factor	.463	.696		
Value Engineering Factor			.827	.336
Project Integration Management Factor	.589			.708

Source: Field survey 2013

From table 4.15 the architects had four components loading which can be summarized as project management performance factor as component one, project quality and time management as component two, value engineering factor as component three and project integration management factor as the fourth component. The most important variables according to the architects are project information management factor, project scope management, project human resource management factor, project performance management factor, project risk management factor and project cost management factor.

Three components were loaded on the analysis for the quantity surveyors in the study, as follows;

Table 4.16: Total Variance Explained on the Key management factors for project management for quantity surveyors

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.446	49.510	49.510	5.446	49.510	49.510	4.050	36.818	36.818
2	2.012	18.290	67.800	2.012	18.290	67.800	2.345	21.319	58.137
3	1.217	11.065	78.866	1.217	11.065	78.866	2.280	20.728	78.866
4	.797	7.243	86.109						
5	.502	4.562	90.671						
6	.406	3.694	94.365						
7	.207	1.877	96.242						
8	.183	1.667	97.909						
9	.113	1.027	98.936						
10	.064	.584	99.520						
11	.053	.480	100.000						

Extraction Method: Principal Component Analysis. Rotation method: Varimax

a. Only cases for which Name of the Profession = Quantity Surveyors are used in the analysis phase.

Source: Field survey 2013

Three components loaded as shown from table 4.16 above, for quantity surveyors which can be renamed as project management performance factor as component one; project execution management factor as component two; and finally project scope management factor as the fourth component. Most important variables are project integration, information, scope, cost, human resource, risk, value and quality factors as being significant for the quantity surveyors as shown in the table 4.17 below. The quantity surveyors are the practitioners involved in checking the balance for all the other practitioners'.

Table 4.17: Component Matrix for quantity surveyors

	Component		
	1	2	3
Project Integration Management Factor	.761	-.392	
Project Scope Management Factor	.700	-.396	.512
Project Cost Management Factor	.827		-.401
Project Quality Management Factor	.773		-.361
Project Human Resource Management Factor	.634	.304	.500
Project Information Management Factor	.931		
Project Risk Management Factor	.816		-.325
Value Engineering Factor	.810		
Project Performance Management Factor	.591	.661	
Project Time Management Factor	.372	-.724	.404
Construction Site Management Factor		.782	.282

Source: Field survey 2013

The variance explanation on the project managers identified three key components in the analysis as shown in table 4.18 below;

4.18: Total Variance Explained on the Key management factors for project management for project managers

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.559	50.537	50.537	5.559	50.537	50.537	3.505	31.866	31.866
2	2.267	20.612	71.149	2.267	20.612	71.149	3.173	28.846	60.712
3	1.273	11.573	82.721	1.273	11.573	82.721	2.421	22.009	82.721
4	.776	7.057	89.778						
5	.753	6.841	96.620						
6	.161	1.465	98.085						
7	.132	1.197	99.282						
8	.045	.412	99.694						
9	.021	.195	99.889						
10	.012	.111	100.000						
11	8.494E-16	7.722E-15	100.000						

Extraction Method: Principal Component Analysis. Rotation method: Varimax

a. Only cases for which Name of the Profession = Project Management are used in the analysis phase.

Source: Field survey 2013

For project managers three components were extracted which can be renamed project management performance component; value engineering management and project execution efficiency factor. The most important variables include project scope management, project performance management factor, project cost management, project information management factor, project integration management factor and project quality management factor as indicated in table 4.19 below.

Table 4.19: Component Matrix for project managers

	Component		
	1	2	3
Project Integration Management Factor	.778	-.344	-.397
Project Scope Management Factor	.870		
Project Time Management Factor	.631	.621	-.418
Project Cost Management Factor	.820	.332	
Project Quality Management Factor	.763	.454	-.378
Project Human Resource Management Factor	.584	-.364	.485
Project Information Management Factor	.816	-.424	
Project Risk Management Factor	.697	-.560	.306
Project Performance Management Factor	.834		
Construction Site Management Factor	.581	.417	.445
Value Engineering Factor		.794	.336

Source: Field survey 2013

Table 4.20 loaded three component that were qualified to explain the variance needed for the factors in the PCA analysis for contractors.

Table 4.20: Total Variance Explained on the Key management factors for project management for contractors

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.302	39.105	39.105	4.302	39.105	39.105	3.095	28.136	28.136
2	2.938	26.705	65.810	2.938	26.705	65.810	2.854	25.944	54.080
3	1.226	11.149	76.959	1.226	11.149	76.959	2.517	22.880	76.959
4	.947	8.610	85.569						
5	.580	5.270	90.839						
6	.517	4.698	95.537						
7	.231	2.097	97.634						
8	.170	1.541	99.175						
9	.067	.610	99.785						
10	.024	.215	100.000						
11	1.005E-15	9.138E-15	100.000						

Extraction Method: Principal Component Analysis. Rotation method: Varimax

a. Only cases for which Name of the category = Contractor are used in the analysis phase.

Source: Field survey 2013

For contractors three components loaded. The components can be renamed as follows: component one as project management performance factor, project coordination component factor and project human resource coordination component. From table 4.21 the most important variables are project scope management, project performance management factor, project risk management factor, project integration management factor, project human resource management factor and value engineering factor.

Table 4.21: Component Matrix for contractors

	Component		
	1	2	3
Project Integration Management Factor	.614	.397	.506
Project Scope Management Factor	.755		.462
Project Risk Management Factor	.727		-.530
Project Performance Management Factor	.754		-.439
Value Engineering Factor	.701		
Project Human Resource Management Factor	.716	-.389	.368
Project Information Management Factor	.723	-.409	
Project Time Management Factor		.787	
Project Cost Management Factor		.889	
Project Quality Management Factor	.594	.679	
Construction Site Management Factor	.514	-.601	

Source: Field survey 2013

Consequently, for contractors project integration, scope, risk, project performance, value, human resources and information were significant.

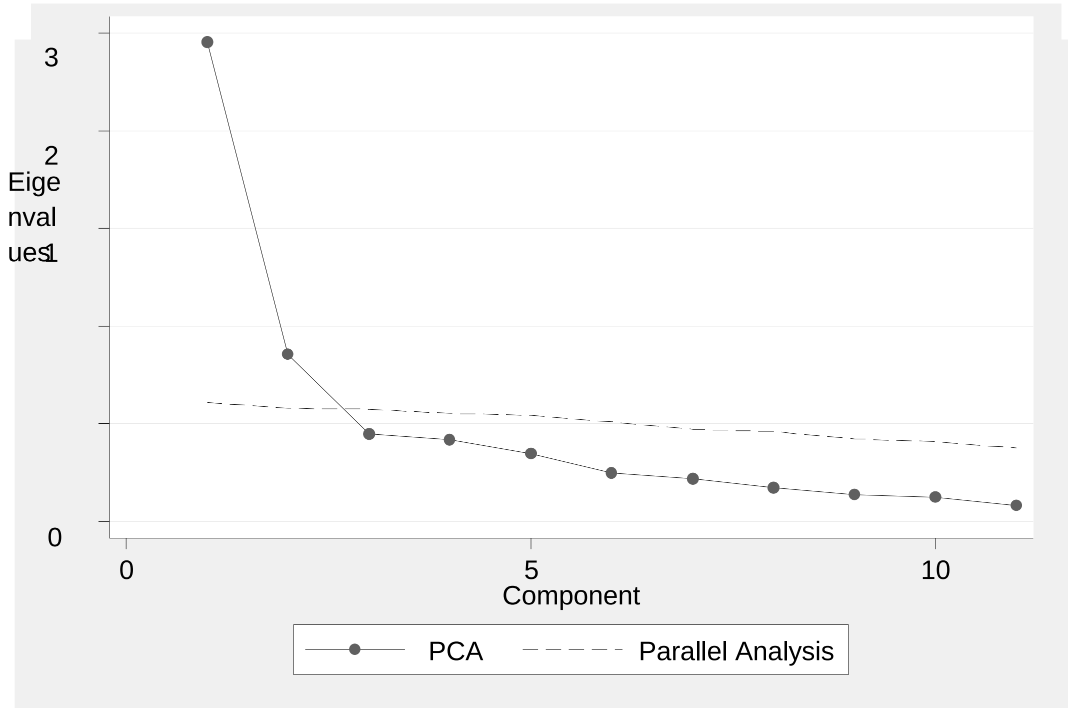


Figure 4.9: Key management factors for project management

Source: Field survey 2013

The parallel analysis from figure 4.9 above indicates that there are at least two components that should be retained. This is because the dashed line for parallel analysis in the graph crosses the solid PCA line before reaching the third component.

Table 4.22 below reveals that all the project management factors are important (Alpha > 0.8), and the deletion of any item indicates almost similar Cronbach's Alpha. Henceforth all the variables under analysis are critical for study and they have to be considered; for any reduction to take place then other procedures and or methods have to be used.

Table 4.22.: Item-Total Statistics for Key management factors for project management

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Project Integration Management Factor	42.5556	28.363	.495	.493	.854
Project Scope Management Factor	42.3535	27.777	.723	.628	.839
Project Time Management Factor	42.1010	30.578	.382	.513	.860
Project Cost Management Factor	42.0000	30.101	.634	.657	.851
Project Quality Management Factor	42.0909	29.982	.532	.609	.853
Project Human Resource Management Factor	42.6970	27.212	.608	.598	.846
Project Information Management Factor	42.7879	25.708	.753	.670	.833
Project Risk Management Factor	42.6970	27.698	.550	.473	.850
Project Performance Management Factor	42.7475	26.298	.607	.579	.846
Value Engineering Factor	42.8283	27.244	.539	.448	.852
Construction Site Management Factor	42.5152	28.163	.451	.464	.859

Source: Field survey 2013

4.10 ANALYSIS FOR THE CORRELATION MATRICES, PCA APPLICATION AND THE SCREE PLOTS GENERATED FROM THE MEASURES/FACTORS OF SUCCESS OR FAILURE IN PROJECT MANAGEMENT

The correlation was done on the factors that are used as measures of success or failure in a project and the following results were tabulated among the general respondents' data as indicated in table 4.23 below;

Table 4.23: Correlation Matrix for measures of success or failure in projects

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Correlation	Cost of the Project	1.000	.236	.228	.077	.158	.279	.191	-.008	-.144	-.097	-.043	-.004	.030	.159
	Scope of the Project	.236	1.000	.454	.252	.407	.184	.276	.139	.165	.125	.272	.377	.342	.404
	Time of the Project	.228	.454	1.000	.125	.299	.274	.306	.246	.088	.080	.348	.259	.184	.450
	Quality of the Project	.077	.252	.125	1.000	.344	.195	.419	-.087	.072	.293	.151	.461	.414	.327
	Knowledge creation of the Project	.158	.407	.299	.344	1.000	.410	.679	.406	.342	.578	.402	.418	.339	.602
	Business success of Project	.279	.184	.274	.195	.410	1.000	.522	.246	.209	.330	.229	.374	.297	.275
	Innovation & Learning of Project	.191	.276	.306	.419	.679	.522	1.000	.274	.246	.410	.278	.526	.513	.614
	Repeat Jobs in Projects	-.008	.139	.246	-.087	.406	.246	.274	1.000	.396	.373	.184	.132	.093	.321
	Project Execution Success	-.144	.165	.088	.072	.342	.209	.246	.396	1.000	.478	.260	.187	.321	.160
	Market Impact of Project	-.097	.125	.080	.293	.578	.330	.410	.373	.478	1.000	.363	.399	.297	.383
	Meeting Project design Goals	-.043	.272	.348	.151	.402	.229	.278	.184	.260	.363	1.000	.423	.340	.425
	Health & Safety in Projects	-.004	.377	.259	.461	.418	.374	.526	.132	.187	.399	.423	1.000	.684	.618
	Benefit to end User	.030	.342	.184	.414	.339	.297	.513	.093	.321	.297	.340	.684	1.000	.559
	Environment Sustainability	.159	.404	.450	.327	.602	.275	.614	.321	.160	.383	.425	.618	.559	1.000

Source: Field survey 2013

The PCA analysis for the factors that were used as measures for success or failure for the general data for the practitioners were done and the results accepted four components in the variance loadings as shown in table 4.24 below:

Table 4.24: Total Variance Explained for measures of success or failure in projects

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.140	36.713	36.713	5.140	36.713	36.713	2.966	21.189	21.189
2	1.608	11.485	48.198	1.608	11.485	48.198	2.546	18.184	39.372
3	1.381	9.866	58.064	1.381	9.866	58.064	2.131	15.219	54.591
4	1.099	7.853	65.917	1.099	7.853	65.917	1.586	11.326	65.917
5	.764	5.461	71.378						
6	.742	5.296	76.674						
7	.700	4.998	81.672						
8	.581	4.150	85.823						
9	.488	3.485	89.307						
10	.459	3.280	92.588						
11	.382	2.729	95.317						
12	.241	1.723	97.040						
13	.225	1.606	98.646						
14	.190	1.354	100.000						

Extraction Method: Principal Component Analysis Kaiser-Meyer-Olkin Adequacy Measure (KMO): 0.803 Cronbach's Alpha: 0.854

Source: Field survey 2013

The factors analyzed revealed that scope and time of the project, which both lay under component 1, did not show any statistical significance at variance of 60%. In component 2, cost and project execution process were both accepted in the variance loadings while in component 3, the factors failed the variance loading test of 60%. Table 4.25 illustrating the results is given below:

Generally the most significant factors are environmental sustainability, innovation and learning, knowledge creation, health and safety, benefit to end user. However, scope, cost, time and meeting design goals feature. The former cluster are inconsistent yet the latter group are consistently featuring meaning they cannot be ignored. The variance loadings in component 4, above had little significance at the recommended 60% variance.

Four components loaded for the general data which can be renamed project execution efficiency as component one, project execution effectiveness as component two and project performance factor as component three. Component four can be renamed project marketing. The most significant variables are environmental sustainability, knowledge creation of the project, innovation and learning of project, health and safety in projects, benefit to end user and market impact of the project.

The study analyzed the data for the engineer practitioners in the project construction industry in Kenya as per table 4.26, unlike in the general data for all the categories where there was little correlation among the factors/measures of success or failure; most factors here depicted a strong correlation to each other. The uniformity of implementing the project management may have resulted to the consistency in the strong correlation as indicated in the results shown below:

Table 4.25: Component Matrix for general respondents' data

	Component			
	1	2	3	4
Scope of the Project	.541	.351		-.368
Time of the Project	.495	.324	.447	-.400
Knowledge creation of the Project	.790			
Business success of Project	.568			.462
Innovation & Learning of Project	.785			.328
Market Impact of Project	.625	-.510		
Meeting Project design Goals	.571			-.446
Health & Safety in Projects	.751			
Benefit to end User	.688		-.424	
Environment Sustainability	.793			
Cost of the Project		.600	.451	.367
Project Execution Success	.442	-.617		
Quality of the Project	.502		-.503	
Repeat Jobs in Projects	.425	-.478	.522	

Table 4.26: Correlation Matrix for measures of success or failure in projects among engineers

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Correlation	Cost of the Project	1.000	.133	-.224	.520	.576	-.220	-.040	.107	-.086	.393	.120	-.260	-.133	.133
	Scope of the Project	.133	1.000	.853	.240	.360	.307	.381	.374	.465	.557	.696	.828	.717	.886
	Time of the Project	-.224	.853	1.000	.068	.169	.417	.433	.439	.570	.387	.664	.900	.779	.736
	Quality of the Project	.520	.240	.068	1.000	.576	.351	.426	-.134	-.073	.334	.216	-.011	.013	.240
	Knowledge creation of the Project	.576	.360	.169	.576	1.000	.337	.602	.225	.313	.694	.396	.168	.190	.439
	Business success of Project	-.220	.307	.417	.351	.337	1.000	.852	.385	.544	.372	.365	.415	.471	.307
	Innovation & Learning of Project	-.040	.381	.433	.426	.602	.852	1.000	.485	.593	.591	.419	.385	.451	.548
	Repeat Jobs in Projects	.107	.374	.439	-.134	.225	.385	.485	1.000	.516	.336	.338	.310	.438	.442
	Project Execution Success	-.086	.465	.570	-.073	.313	.544	.593	.516	1.000	.734	.582	.609	.706	.465
	Market Impact of Project	.393	.557	.387	.334	.694	.372	.591	.336	.734	1.000	.771	.544	.630	.656
	Meeting Project design Goals	.120	.696	.664	.216	.396	.365	.419	.338	.582	.771	1.000	.833	.853	.696
	Health & Safety in Projects	-.260	.828	.900	-.011	.168	.415	.385	.310	.609	.544	.833	1.000	.878	.733
	Benefit to end User	-.133	.717	.779	.013	.190	.471	.451	.438	.706	.630	.853	.878	1.000	.602
	Environment Sustainability	.133	.886	.736	.240	.439	.307	.548	.442	.465	.656	.696	.733	.602	1.000

a. Only cases for which Name of the Profession = Engineering are used in the analysis phase.

b. This matrix is not positive definite.

Source: Field survey 2013

The variance loadings for the engineers are explained by the following component extraction as shown in table 4.27 hereunder.

Table 4.27: Total Variance Explained for measures of success or failure in projects among engineers

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.074	50.525	50.525	7.074	50.525	50.525	5.211	37.219	37.219
2	2.422	17.297	67.822	2.422	17.297	67.822	2.617	18.692	55.911
3	1.497	10.691	78.513	1.497	10.691	78.513	2.387	17.049	72.960
4	1.039	7.424	85.937	1.039	7.424	85.937	1.817	12.977	85.937
5	.781	5.579	91.516						
6	.423	3.022	94.538						
7	.271	1.937	96.475						
8	.230	1.643	98.118						
9	.128	.914	99.032						
10	.089	.635	99.667						
11	.031	.222	99.889						
12	.015	.111	100.000						
13	7.691E-16	5.494E-15	100.000						
14	-4.251E-16	-3.037E-15	100.000						

Extraction Method: Principal Component Analysis. Rotation method: Varimax

a. Only cases for which Name of the Profession = Engineering are used in the analysis phase.

Source: Field survey 2013

All the factors under consideration were statistically significant among the three components of spread as shown in table 4.28 below. The loaded components for engineers can be renamed as project execution efficiency, project execution effectiveness as component two, project performance appraisal as component three and project marketing success as component four. The most important factors are benefit to end user, meeting project design goals, health and safety, environmental sustainability, scope of the project, time of the project and market impact of the project.

Table 4.28: Component Matrix for engineers

	Component			
	1	2	3	4
Scope of the Project	.840		-.379	
Time of the Project	.822	-.374		
Innovation & Learning of Project	.718		.594	
Project Execution Success	.765			.355
Market Impact of Project	.804	.357		
Meeting Project design Goals	.858			
Health & Safety in Projects	.855	-.408		
Benefit to end User	.861	-.315		
Environment Sustainability	.840			
Cost of the Project		.817	-.406	
Quality of the Project		.757		-.512
Knowledge creation of the Project	.528	.735		
Business success of Project	.614		.700	
Repeat Jobs in Projects	.546			.573

Source: Field survey 2013

From the engineers scope, environmental sustainability, time, meeting project goals, health and safety, market impact of the project are key considerations. Equally not left out are cost, quality and knowledge creation although featuring in component two as shown in table 4.28 above.

Table 4.29: Correlation Matrix for measures of success or failure in a project among architects

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Correlation	Cost of the Project	1.000	.294	-.164	-.102	.101	.545	.268	-.309	-.325	-.151	.085	.114	-.007	-.243
	Scope of the Project	.294	1.000	.307	.370	.232	.360	.423	-.245	.156	-.117	.343	.493	.633	.211
	Time of the Project	-.164	.307	1.000	.330	.200	.024	.057	.088	.349	.025	.530	.392	.164	.353
	Quality of the Project	-.102	.370	.330	1.000	.320	-.102	.504	-.248	.222	.047	.265	.479	.366	.277
	Knowledge creation of the Project	.101	.232	.200	.320	1.000	.206	.608	.383	.213	.479	.560	.412	.397	.603
	Business success of Project	.545	.360	.024	-.102	.206	1.000	.250	-.039	.038	.111	.342	.244	.224	.020
	Innovation & Learning of Project	.268	.423	.057	.504	.608	.250	1.000	-.087	-.022	.165	.241	.455	.672	.514
	Repeat Jobs in Projects	-.309	-.245	.088	-.248	.383	-.039	-.087	1.000	.326	.630	.333	.018	.021	.412
	Project Execution Success	-.325	.156	.349	.222	.213	.038	-.022	.326	1.000	.503	.391	.048	.193	.187
	Market Impact of Project	-.151	-.117	.025	.047	.479	.111	.165	.630	.503	1.000	.255	.151	.049	.380
	Meeting Project design Goals	.085	.343	.530	.265	.560	.342	.241	.333	.391	.255	1.000	.330	.231	.540
	Health & Safety in Projects	.114	.493	.392	.479	.412	.244	.455	.018	.048	.151	.330	1.000	.642	.683
	Benefit to end User	-.007	.633	.164	.366	.397	.224	.672	.021	.193	.049	.231	.642	1.000	.524
	Environment Sustainability	-.243	.211	.353	.277	.603	.020	.514	.412	.187	.380	.540	.683	.524	1.000

a. Only cases for which Name of the Profession = Architecture are used in the analysis phase. Rotation method: Varimax

Source: Field survey 2013

The four components which explains the loadings are shown in table 4.30 below;

Table 4.30: Total Variance Explained for measures of success or failure in a project among architects

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.639	33.136	33.136	4.639	33.136	33.136	3.682	26.298	26.298
2	2.561	18.296	51.432	2.561	18.296	51.432	2.534	18.101	44.399
3	1.656	11.827	63.259	1.656	11.827	63.259	2.026	14.472	58.871
4	1.333	9.520	72.778	1.333	9.520	72.778	1.947	13.907	72.778
5	.924	6.597	79.375						
6	.823	5.877	85.252						
7	.549	3.922	89.173						
8	.381	2.720	91.894						
9	.332	2.370	94.264						
10	.257	1.838	96.102						
11	.224	1.602	97.704						
12	.218	1.558	99.262						
13	.094	.673	99.935						
14	.009	.065	100.000						

Extraction Method: Principal Component Analysis.

a. Only cases for which Name of the Profession = Architecture are used in the analysis phase.

Source: Field survey 2013

The correlation among the architects as shown under table 4.29 above also revealed the same trend as that of the general respondents', where the correlations among the various measures of success /failure were highly correlated but not as high as those for civil engineers.

From table 4.30, the four components can be renamed as project execution efficiency as component one, project execution effectiveness as component two, project performance standards as component three and project time management as component four. For the architects; environmental sustainability, health and safety, benefits to end user, knowledge creation, innovation and learning, meeting design goals were important. Others are scope and quality although they narrowly missed the threshold of 0.6 in component one. Time which was also loaded in component 4 was also insignificantly independent under this category see table 4.31 below.

Table 4.31: Component Matrix for architects

	Component			
	1	2	3	4
Scope of the Project	.590	-.523		
Quality of the Project	.553		-.528	
Knowledge creation of the Project	.754			
Innovation & Learning of Project	.701	-.356		-.432
Meeting Project design Goals	.686			.448
Health & Safety in Projects	.763			
Benefit to end User	.731			
Environment Sustainability	.787			
Cost of the Project		-.645	.614	
Repeat Jobs in Projects	.254	.789	.324	
Project Execution Success	.387	.512		.425
Market Impact of Project	.400	.637	.358	
Business success of Project	.322	-.357	.669	.325
Time of the Project	.490		-.367	.584

Source: Field survey 2013

The correlation of the quantity surveyors increased relatively higher than that of the general data/architects but not as high as compared to engineers. Table 4.32 below illustrates the analysis:

Table 4.32: Correlation Matrix for measures of success or failure in projects among quantity surveyors

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Correlation	Cost of the Project	1.000	.200	.519	-.020	.026	.381	.128	.175	-.204	-.414	-.361	-.221	-.021	.303
	Scope of the Project	.200	1.000	.564	.017	.682	.123	.222	.549	.249	.195	.035	-.176	-.234	.307
	Time of the Project	.519	.564	1.000	.103	.514	.562	.549	.463	-.140	.002	-.160	-.127	-.023	.538
	Quality of the Project	-.020	.017	.103	1.000	.321	.312	.514	-.188	.249	.382	.290	.620	.592	.408
	Knowledge creation of the Project	.026	.682	.514	.321	1.000	.258	.607	.563	.302	.345	.269	.369	.126	.482
	Business success of Project	.381	.123	.562	.312	.258	1.000	.341	.205	-.068	.209	.090	.299	.137	.328
	Innovation & Learning of Project	.128	.222	.549	.514	.607	.341	1.000	.280	.048	.133	.308	.447	.427	.706
	Repeat Jobs in Projects	.175	.549	.463	-.188	.563	.205	.280	1.000	.499	.068	-.071	-.016	-.087	.412
	Project Execution Success	-.204	.249	-.140	.249	.302	-.068	.048	.499	1.000	.244	.117	.109	.144	.028
	Market Impact of Project	-.414	.195	.002	.382	.345	.209	.133	.068	.244	1.000	.265	.463	.024	-.029
	Meeting Project design Goals	-.361	.035	-.160	.290	.269	.090	.308	-.071	.117	.265	1.000	.355	.260	.006
	Health & Safety in Projects	-.221	-.176	-.127	.620	.369	.299	.447	-.016	.109	.463	.355	1.000	.545	.319
	Benefit to end User	-.021	-.234	-.023	.592	.126	.137	.427	-.087	.144	.024	.260	.545	1.000	.551
	Environment Sustainability	.303	.307	.538	.408	.482	.328	.706	.412	.028	-.029	.006	.319	.551	1.000

a. Only cases for which Name of the Profession = Quantity Surveying are used in the analysis phase. Rotation method: Varimax

Source: Field survey 2013

The variance loadings for the PCA analysis accepted four components which are as shown in table 4.33 below. The four components accounted for 74.17% for the data. Component one can be renamed project execution efficiency, component two can be renamed as project execution effectiveness, component three as project execution success and finally component four as environmental impact and execution assessment. The six most important factors according to quantity surveyors are innovation and learning; knowledge creation of the project; environmental sustainability, time of the project, quality of the project and health and

Table 4.33: Total Variance Explained for measures of success or failure in a project among quantity surveyors

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.338	30.985	30.985	4.338	30.985	30.985	2.984	21.314	21.314
2	2.851	20.366	51.351	2.851	20.366	51.351	2.976	21.259	42.573
3	1.989	14.208	65.559	1.989	14.208	65.559	2.244	16.030	58.603
4	1.184	8.458	74.017	1.184	8.458	74.017	2.158	15.414	74.017
5	.920	6.570	80.587						
6	.684	4.885	85.472						
7	.633	4.519	89.991						
8	.409	2.920	92.911						
9	.360	2.573	95.484						
10	.237	1.689	97.173						
11	.195	1.393	98.566						
12	.087	.618	99.184						
13	.085	.605	99.790						
14	.029	.210	100.000						

Extraction Method: Principal Component Analysis.

a. Only cases for which Name of the Profession = Quantity Surveying are used in the analysis phase.

Source: Field survey 2013

safety of projects.

The following were the factors that were statistically significant in the four loadings that executed the analysis. Based on table 4.34 component one can be renamed project execution effectiveness; project execution efficiency as component two; project performance as component three and environmental sustainability as component four. For quantity surveyors time, cost, knowledge creation and environmental sustainability were important.

Table 4.34: Component Matrix for quantity surveyors

	Component			
	1	2	3	4
Environment Sustainability	.775		-.325	-.316
Time of the Project	.633	-.632		
Quality of the Project	.610	.539		
Knowledge creation of the Project	.810		.374	
Innovation & Learning of Project	.824			
Cost of the Project		-.628	-.524	
Health & Safety in Projects	.534	.667		
Project Execution Success			.618	-.486

Source: Field survey 2013

The correlation matrices for the project managers are as shown below in table 4.35

Table 4.35: Correlation Matrix for measures of success or failure in projects among project managers

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Correlation	Cost of the Project	1.000	.059	.289	.013	.240	.175	.458	-.147	-.131	.061	.058	.376	.023	.568
	Scope of the Project	.059	1.000	-.014	.485	.079	.196	.065	-.322	.043	.020	.264	.653	.808	.319
	Time of the Project	.289	-.014	1.000	-.147	.000	.056	-.105	-.349	-.422	-.163	.542	.067	-.264	.269
	Quality of the Project	.013	.485	-.147	1.000	.285	.337	.365	.250	-.066	.625	-.171	.794	.748	.390
	Knowledge creation of the Project	.240	.079	.000	.285	1.000	.655	.816	.189	.204	.693	.253	.496	.365	.678
	Business success of Project	.175	.196	.056	.337	.655	1.000	.668	.200	.267	.467	.111	.535	.477	.410
	Innovation & Learning of Project	.458	.065	-.105	.365	.816	.668	1.000	.242	.333	.669	-.030	.618	.357	.596
	Repeat Jobs in Projects	-.147	-.322	-.349	.250	.189	.200	.242	1.000	.220	.456	-.074	.104	-.055	.056
	Project Execution Success	-.131	.043	-.422	-.066	.204	.267	.333	.220	1.000	.411	-.177	.043	.238	-.170
	Market Impact of Project	.061	.020	-.163	.625	.693	.467	.669	.456	.411	1.000	-.064	.533	.459	.499
	Meeting Project design Goals	.058	.264	.542	-.171	.253	.111	-.030	-.074	-.177	-.064	1.000	.208	-.053	.528
	Health & Safety in Projects	.376	.653	.067	.794	.496	.535	.618	.104	.043	.533	.208	1.000	.754	.686
	Benefit to end User	.023	.808	-.264	.748	.365	.477	.357	-.055	.238	.459	-.053	.754	1.000	.395
	Environment Sustainability	.568	.319	.269	.390	.678	.410	.596	.056	-.170	.499	.528	.686	.395	1.000

a. Only cases for which Name of the Profession = Project Management are used in the analysis phase. Rotation method: Varimax

Source: Field survey 2013

The correlation of the factors for project managers reflected a similar correlation with the factors that were analyzed among the quantity surveyors as early shown. The loadings were analyzed in the PCA and results presented under table 4.36 below.

Table 4.36: Total Variance Explained for measures of success or failure in projects among project managers

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.294	37.813	37.813	5.294	37.813	37.813	3.443	24.594	24.594
2	2.514	17.954	55.768	2.514	17.954	55.768	3.298	23.556	48.150
3	2.001	14.293	70.061	2.001	14.293	70.061	2.030	14.500	62.649
4	1.092	7.799	77.860	1.092	7.799	77.860	1.644	11.741	74.390
5	1.080	7.716	85.576	1.080	7.716	85.576	1.566	11.185	85.576
6	.644	4.598	90.174						
7	.519	3.707	93.881						
8	.491	3.508	97.389						
9	.191	1.361	98.750						
10	.096	.686	99.436						
11	.049	.351	99.788						
12	.026	.186	99.974						
13	.003	.024	99.998						
14	.000	.002	100.000						

Extraction Method: Principal Component Analysis. Rotation method: Varimax

a. Only cases for which Name of the Profession = Project Management are used in the analysis phase.

Source: Field survey 2013

Table 4.36 indicates variance loadings among the project managers practitioners' was able to load 5 components that would explain the variance above the 60% for the factors under study, which are as follows; project execution efficiency as component one; project objectives achievement as component two; scope management as component three; project execution effectiveness and design goals satisfaction. Based on table 4.37 the six most important factors according to the project managers include health and safety, knowledge creation, market impact, benefit to end user, environmental sustainability and business success of projects.

Table 4.37: Component Matrix for project managers

	Component				
	1	2	3	4	5
Quality of the Project	.713		-.440	-.481	
Knowledge creation of the Project	.780		.428		
Business success of Project	.716				
Innovation & Learning of Project	.811		.403		
Market Impact of Project	.766	-.374			
Health & Safety in Projects	.894				
Benefit to end User	.749		-.611		
Environment Sustainability	.761	.480			
Time of the Project		.798			
Meeting Project design Goals		.678			.634
Scope of the Project	.477		-.758		
Project Execution Success		-.612		.621	

Source: Field survey 2013

The following is a correlation matrix for the contractor respondents as shown under table 4.38 in the construction industry. Most factors reported a positive strong correlation, comparative to the quantity surveyors.

Table 4.38: Correlation Matrix for measures of success or failure in projects among contractors

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Correlation	Cost of the Project	1.000	.839	.535	.	-.215	-.192	-.049	.167	-.349	-.345	-.068	.075	.075	-.250
	Scope of the Project	.839	1.000	.299	.	-.161	-.343	-.219	-.140	-.455	-.116	.000	-.084	-.084	.000
	Time of the Project	.535	.299	1.000	.	-.019	-.102	-.026	.535	-.031	.000	.327	-.161	.443	-.134
	Quality of the Project	.	.	.	1.000	.	.	.	.	.	.	.	.	.	.
	Knowledge creation of the Project	-.215	-.161	-.019	.	1.000	.798	.627	.592	.618	.743	.674	.444	.444	.682
	Business success of Project	-.192	-.343	-.102	.	.798	1.000	.865	.671	.758	.556	.470	.636	.462	.383
	Innovation & Learning of Project	-.049	-.219	-.026	.	.627	.865	1.000	.686	.673	.406	.520	.606	.384	.196
	Repeat Jobs in Projects	.167	-.140	.535	.	.592	.671	.686	1.000	.668	.345	.612	.452	.641	.167
	Project Execution Success	-.349	-.455	-.031	.	.618	.758	.673	.668	1.000	.602	.617	.719	.719	.523
	Market Impact of Project	-.345	-.116	.000	.	.743	.556	.406	.345	.602	1.000	.704	.312	.468	.690
	Meeting Project design Goals	-.068	.000	.327	.	.674	.470	.520	.612	.617	.704	1.000	.431	.739	.612
	Health & Safety in Projects	.075	-.084	-.161	.	.444	.636	.606	.452	.719	.312	.431	1.000	.659	.452
	Benefit to end User	.075	-.084	.443	.	.444	.462	.384	.641	.719	.468	.739	.659	1.000	.452
	Environment Sustainability	-.250	.000	-.134	.	.682	.383	.196	.167	.523	.690	.612	.452	.452	1.000

a. Only cases for which Name of the Profession = Contractor are used in the analysis phase.

Source: Field survey 2013

The following variance loadings accepted four components in the factors under study as shown in table 4.39 below. Four components were extracted for contractors and can be renamed as follows; component one, is project execution efficiency, component two project execution effectiveness, component three is project environmental sustainability and component four is project quality management. The six most important variables according to contractors are project execution success, knowledge creation, business success of projects; meeting design goals, innovation and learning and finally benefits to end user.

Table 4.39: Total Variance Explained for measures of success or failure in projects among contractors

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.241	44.578	44.578	6.241	44.578	44.578	4.028	28.769	28.769
2	2.481	17.720	62.298	2.481	17.720	62.298	3.303	23.592	52.361
3	1.437	10.262	72.560	1.437	10.262	72.560	2.136	15.258	67.619
4	1.172	8.373	80.932	1.172	8.373	80.932	1.864	13.313	80.932
5	.958	6.840	87.773						
6	.825	5.890	93.663						
7	.317	2.261	95.924						
8	.221	1.580	97.504						
9	.149	1.066	98.570						
10	.101	.718	99.288						
11	.065	.467	99.755						
12	.025	.181	99.935						
13	.009	.061	99.996						
14	.001	.004	100.000						

Extraction Method: Principal Component Analysis.

a. Only cases for which Name of the Profession = Contractor are used in the analysis phase.

Source: Field survey 2013

All the factors under the PCA analysis are statistically significant, save for quality of the project which loaded independently as shown under table 4.40 below.

Table 4.40: Component Matrix for contractors

	Component			
	1	2	3	4
Knowledge creation of the Project	.848			
Business success of Project	.858			
Innovation & Learning of Project	.769		-.395	-.305
Repeat Jobs in Projects	.748	.400	-.401	
Project Execution Success	.901			
Market Impact of Project	.747		.487	
Meeting Project design Goals	.804			
Health & Safety in Projects	.713			-.409
Benefit to end User	.753	.360		
Cost of the Project		.898		
Scope of the Project		.731	.407	-.326
Time of the Project		.809		.496
Environment Sustainability	.642		.651	
Quality of the Project				.478

Source: Field survey 2013

It is important to note that for the contractors scope, time and environmental sustainability did not load in component one. This is because by the time they are brought on board most of these variables are already determined.

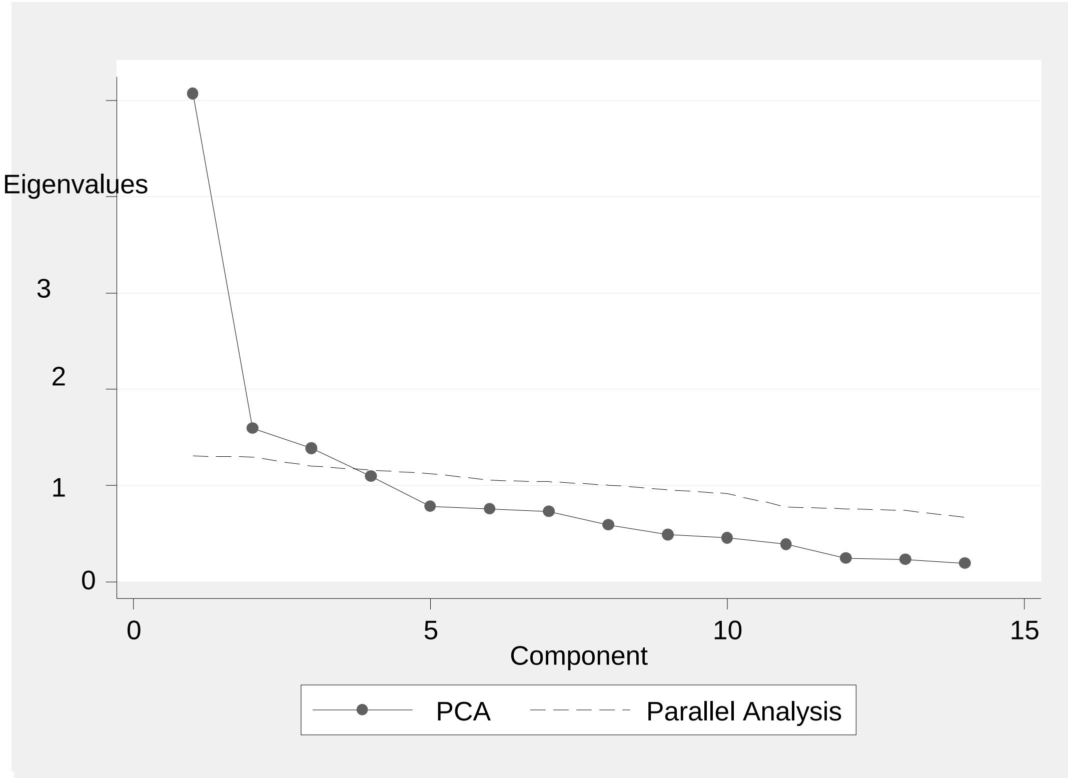


Figure 4.10: Measures of success or failure in project management

Source: Field survey 2013

The parallel analysis as per figure 4.10 shows that there are at least three components that should be retained. However, the fourth component is very close to the dashed line for parallel analysis thus giving an indication that this fourth component could also be retained.

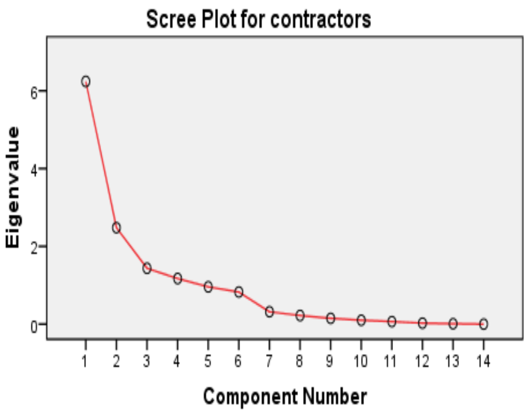
Table 4.41 below also reveals that all the project management factors are important and the deletion of any item indicates almost similar Cronbach's Alpha (Range of 0.034). Cronbach's Alpha cannot then be used to reduce the variables. Other methods have to be employed.

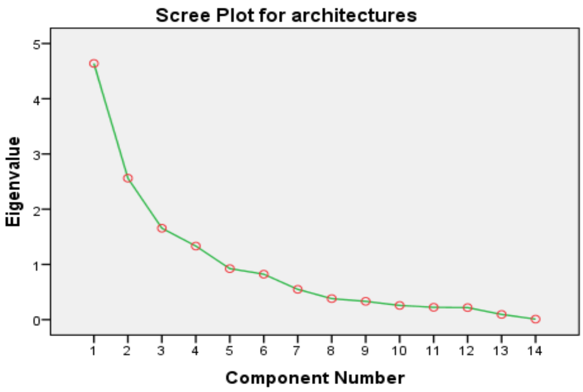
Table 4.41: Item-Total Statistics on measures/factors of success or failure in project management

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Cost of the Project	52.9340	56.698	.136	.249	.862
Scope of the Project	53.4587	51.256	.455	.398	.847
Time of the Project	52.9934	54.377	.431	.388	.849
Quality of the Project	52.9307	54.700	.372	.315	.851
Knowledge creation of the Project	54.1023	45.874	.735	.682	.828
Business success of Project	53.7855	50.719	.501	.409	.844
Innovation & Learning of Project	54.0627	47.013	.709	.651	.830
Repeat Jobs in Projects	54.0132	51.702	.355	.362	.855
Project Execution Success	53.5578	53.380	.374	.403	.851
Market Impact of Project	53.8152	50.661	.539	.523	.842
Meeting Project design Goals	53.3003	53.747	.443	.325	.848
Health & Safety in Projects	53.4488	49.440	.635	.638	.836
Benefit to end User	53.3003	51.290	.572	.589	.841
Environment Sustainability	53.5776	47.589	.707	.660	.831

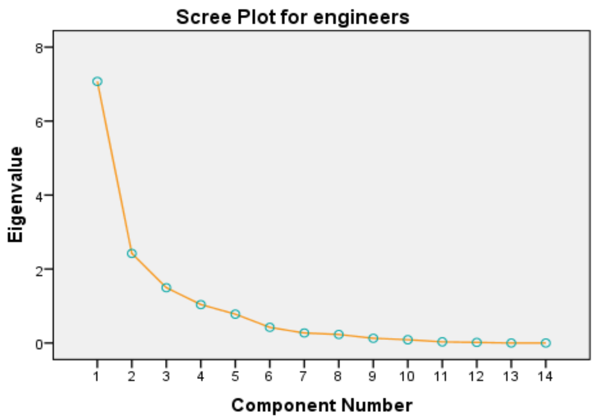
Source: Field survey 2013

The scree plot for the loadings for comparison among the various categories are as follows and similarly as the correlation matrices, they represent a close correlation among quantity surveyors, architects, engineers and contractors. The project managers' plot and general respondents' had same trend but not smooth as presented under figure 4.11 below.


Scree Plot for contractors
Eigenvalue
Component Number


Scree Plot for architectures
Eigenvalue
Component Number


Scree Plot for all professions
Eigenvalue
Component Number


Scree Plot for engineers
Eigenvalue
Component Number

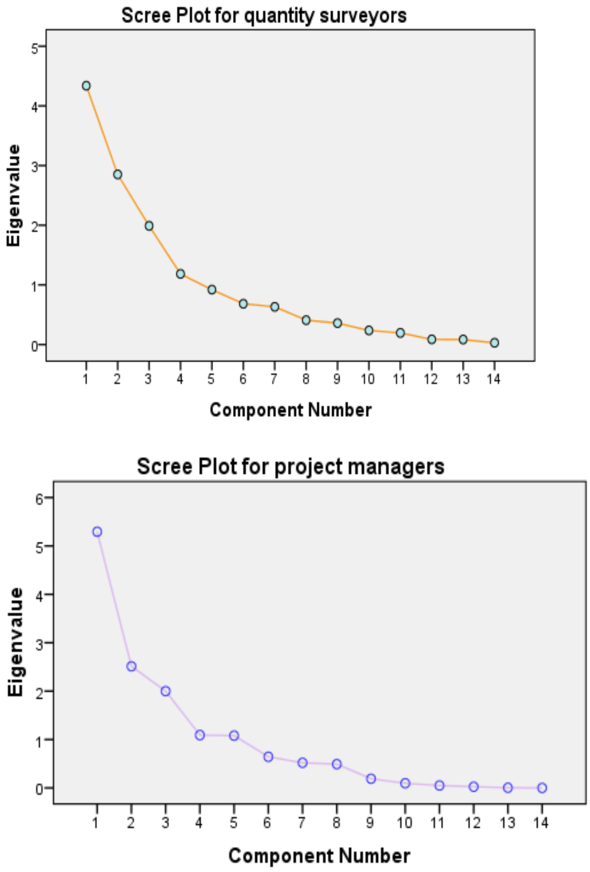


Figure 4.11: Comparison of various scree plots measures of success or failure in projects for the various respondents

Source: Field survey 2013

The extracted components have to attain eigenvalues of more than one in each case. From the scatterplots; components extracted varied from two to five. That trend was already alluded to in the previous discussion under principal component matrices. The scatterplots further validate what we had extracted under parallel analysis and as a measure of validity the data is confirmed and results can be relied on.

4.11 USING THE PCA METHOD TO ANALYZE THE PROBLEMS OFTEN EXPERIENCED IN CURRENT PROJECT MANAGEMENT PRACTICES IN KENYA.

The loadings for the variance on the problems are explained as per tables 4.42 and 4.43 below;

Table 4.42: Total Variance Explained on problems experienced in project management practices

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.853	44.121	44.121	4.853	44.121	44.121	3.255	29.590	29.590
2	1.245	11.322	55.443	1.245	11.322	55.443	2.535	23.049	52.639
3	1.138	10.347	65.790	1.138	10.347	65.790	1.349	12.265	64.904
4	1.016	9.238	75.028	1.016	9.238	75.028	1.114	10.124	75.028
5	.660	6.002	81.030						
6	.543	4.936	85.965						
7	.451	4.099	90.065						
8	.337	3.061	93.126						
9	.309	2.813	95.938						
10	.269	2.445	98.383						
11	.178	1.617	100.000						

Extraction Method: Principal Component Analysis

Kaiser-Meyer-Olkin Adequacy measure (KMO): 0.841

Cronbach's Alpha: 0.792

Source: Field survey 2013

Table 4.43: Component Matrix for general data

	Component 1	2	3	4
Scope Management Problems	.714			
Abortive Works	.553	.386		
Cost Overruns	.764			
Time Overruns	.677			
Non-performing contractors	.701			
Project Time Management Issues	.828			
Project Risk Management Issues	.838			
Intransigent Colleague Problems	.730		.388	
Clients' Interference in Projects	.708			
Project Co-ordination Problems - Lead Consultant		.836		
Project Integration Management Issues			.332	.852

Source: Field survey 2013

From the general data and all respondents combined; four components are extracted from tables 4.42 and 4.43 above. Component one can be renamed inappropriate project management application; component two can be renamed lead consultant challenges; component three can be renamed project team organization challenges and finally component four project integration problems. The most important variables are project risk management issues, project time management issues, cost overruns, intransigent colleagues, scope management problems and clients' interferences in projects.

When analyzing for engineers as per table 4.44 below; the analysis accepts all the problems as having a role to play in the current project management practices. However, scope, time, risk and clients' interference are most important

Table 4.44: Total Variance Explained on problems experienced in project management practices among engineers

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.496	49.964	49.964	5.496	49.964	49.964	4.650	42.271	42.271
2	1.399	12.716	62.679	1.399	12.716	62.679	1.829	16.629	58.899
3	1.260	11.452	74.131	1.260	11.452	74.131	1.676	15.232	74.131
4	.816	7.418	81.549						
5	.636	5.784	87.333						
6	.478	4.349	91.682						
7	.433	3.938	95.620						
8	.332	3.020	98.640						
9	.101	.916	99.556						
10	.038	.350	99.905						
11	.010	.095	100.000						

Extraction Method: Principal Component Analysis. Rotation method: Varimax

a. Only cases for which Name of the Profession = Engineering are used in the analysis phase.

Source: Field survey 2013

The loadings for the engineers are represented as shown in the table 4.45 below; with three components having accepted to satisfy the variance threshold of 60%. The table below also reports that only abortive works was not statistically significant.

Table 4.45: Component Matrix for engineers

	Component		
	1	2	3
Scope Management Problems	.799		.327
Abortive Works	-.505	.499	
Cost Overruns	.963		
Time Overruns	.793		
Non-performing contractors	.724		
Project Time Management Issues	.923		
Project Risk Management Issues	.751	.526	
Intransigent Colleague Problems	.657		-.506
Clients' Interference in Projects	.727		
Project Co-ordination Problems - Lead Consultant		.708	.449
Project integration Management Issues		.568	-.650

Source: Field survey 2013

For Engineers three components were extracted; component 1 can be renamed Project Management problems; component 2; Project Human Resource Management challenges; and component three Co-ordination challenges. The component matrix for engineers shows that scope, time, cost overruns, risk and clients' interference were among the most important factors with strong correlation dependence.

The Variance loadings for the architect respondents accepted three components at 76.6% as shown under table 4.46 below. For Architects, three components were extracted and this can be renamed Project Management problems; Project Co-ordination and control challenges and finally component three scope definition challenges. This information is also illustrated by table 4.47 below.

Table 4.46: Total Variance Explained on problems experienced in project management practices among architects

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.435	49.408	49.408	5.435	49.408	49.408	3.403	30.940	30.940
2	1.878	17.074	66.481	1.878	17.074	66.481	3.117	28.334	59.274
3	1.114	10.130	76.611	1.114	10.130	76.611	1.907	17.337	76.611
4	.657	5.975	82.587						
5	.525	4.769	87.355						
6	.475	4.317	91.672						
7	.338	3.073	94.745						
8	.298	2.708	97.453						
9	.159	1.445	98.898						
10	.098	.895	99.793						
11	.023	.207	100.000						

Extraction Method: Principal Component Analysis. Rotation method: Varimax

a. Only cases for which Name of the Profession = Architects are used in the analysis phase.

Source: Field survey 2013

The factors under the analysis illustrated a similar statistical significance as those of general data except for the intransigent colleague problems which reported a low variance of 56.4%.

Table 4.47: Component Matrix for architects

	Component		
	1	2	3
Clients' Interference in Projects	.612	.553	
Abortive Works	.789		
Project Co-ordination Problems - Lead Consultant	.688	-.476	
Cost Overruns	.682	-.581	
Non-performing contractors	.803		
Project integration Management Issues	.857		
Project Time Management Issues	.850		
Project Risk Management Issues	.830		
Time Overruns	.600	-.677	
Scope Management Problems	.398		.773
Intransigent Colleague Problems	.434	.534	-.564

Source: Field survey 2013

For architects; time, integration, risk, non-performing contractors and abortive works were among the most important. The quantity surveyor loadings accepted a variance of 68% for only two components; which represents a high loading than all the other practitioners for the problems that are mainly experienced in the current project management practices. The results are tabulated under tables 4.48 and 4.49 below.

Table 4.48: Total Variance Explained on problems experienced in project management practices among quantity surveyors

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.528	50.258	50.258	5.528	50.258	50.258	4.083	37.117	37.117
2	2.001	18.189	68.447	2.001	18.189	68.447	3.446	31.330	68.447
3	.882	8.017	76.463						
4	.801	7.279	83.742						
5	.584	5.312	89.054						
6	.388	3.527	92.581						
7	.307	2.791	95.372						
8	.229	2.082	97.454						
9	.189	1.715	99.170						
10	.070	.633	99.803						
11	.022	.197	100.000						

Extraction Method: Principal Component Analysis. Rotation method: Varimax

a. Only cases for which Name of the Profession = Quantity Surveying are used in the analysis phase.

Source: Field survey 2013

Henceforth, the factors in the quantity surveyor practitioners are all statistically significant as expected from the variance loadings above.

For Quantity Surveyor's two components were extracted which can be renamed Project Management application challenges and component two Client interference and Project Co-ordination challenges. The most important variables were cost, time, risk, integration, scope and abortive works and should be in the final model.

Table 4.49: Component Matrix for quantity surveyors

	Component	
	1	2
Scope Management Problems	.760	
Abortive Works	.692	
Project Co-ordination Problems - Lead Consultant	.787	-.424
Cost Overruns	.723	-.563
Time Overruns	.680	-.477
Non-performing contractors	.651	.394
Project Integration Management Issues	.796	.309
Project Time Management Issues	.800	
Project Risk Management Issues	.666	.499
Intransigent Colleague Problems	.736	.500
Clients' Interference in Projects	.428	.635

Source: Field survey 2013

The variance loadings for the project managers at the three components were reported at 78.6% which is represented in the component matrix table 4.50 below.

Table 4.50: Total variance explained for project management problems by project managers.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.821	52.919	52.919	5.821	52.919	52.919	3.444	31.310	31.310
2	1.535	13.957	66.875	1.535	13.957	66.875	3.083	28.031	59.341
3	1.285	11.681	78.556	1.285	11.681	78.556	2.114	19.215	78.556
4	.858	7.798	86.354						
5	.607	5.515	91.869						
6	.465	4.225	96.094						
7	.218	1.981	98.075						
8	.146	1.330	99.404						
9	.049	.443	99.847						
10	.013	.116	99.964						
11	.004	.036	100.000						

Extraction Method: Principal Component Analysis. Extraction method: Varimax

a. Only cases for which Name of the Profession = Project Management are used in the analysis phase.

Source: Field survey 2013

From table 4.51 the factors were all loaded at the first and second component variances. However, the non-performance contractors' problem was not statistically significant at the 60% variance threshold.

Table 4.51: Component Matrix for project managers

	Component		
	1	2	3
Scope Management Problems	.779		.320
Abortive Works	.565	-.453	.358
Project Co-ordination Problems - Lead Consultant	.845		-.484
Cost Overruns	.834		
Time Overruns	.768		
Non-performing contractors	.570	.419	-.449
Project Integration Management Issues	.774	-.336	-.350
Project Time Management Issues	.824		-.380
Project Risk Management Issues	.805		.367
Clients' Interference in Projects	.648	.496	.407
Intransigent Colleague Problems	.471	.812	

Source: Field survey 2013

For Project Managers; three components loaded. Component one can be renamed Project Management application challenges component two can be renamed; Project Human resource co-ordination challenges while component three can be renamed project performance challenges. According to Project Managers, the most important variables are Lead consultant co-ordination challenges; cost overruns; project time management issues; project risk management issues; scope management issues and project integration management issues.

The contractor loadings were the most efficient for the current problems that affect project management practices, mainly because they are the key implementers in the site construction as shown under tables 4.52 and 4.53 below. For contractors; two components loaded. Component one can be renamed Project Management application problems and component two can be named as project co-ordination problems. According to contractors the most important variables are project time management issues; Project risk management issues; abortive works; project integration management issues; intransigent colleague problems and Client's interference problems.

Table 4.52: Total Variance Explained on problems experienced in project management practices among contractors

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.375	57.952	57.952	6.375	57.952	57.952	4.588	41.711	41.711
2	1.892	17.201	75.153	1.892	17.201	75.153	3.679	33.442	75.153
3	.882	8.014	83.167						
4	.635	5.769	88.936						
5	.482	4.379	93.315						
6	.346	3.148	96.463						
7	.211	1.916	98.379						
8	.116	1.057	99.436						
9	.041	.373	99.809						
10	.016	.142	99.951						
11	.005	.049	100.000						

Extraction Method: Principal Component Analysis.

a. Only cases for which Name of the Profession = Contractor are used in the analysis phase.

Source: Field survey 2013

Similarly, all the factors were statistically significant at the confidence interval of 95%, even though time overruns was at 58.2%, which is slightly below the threshold of 60%.

Table 4.53: Component Matrix for contractors

	Component	
	1	2
Scope Management Problems	.599	
Abortive Works	.863	
Cost Overruns	.752	.414
Non-performing contractors	.634	-.428
Project Integration Management Issues	.868	.298
Project Time Management Issues	.912	.018
Project Risk Management Issues	.877	-.389
Intransigent Colleague Problems	.859	-.363
Clients' Interference in Projects	.763	-.505
Project Co-ordination Problems - Lead Consultant	.600	.676
Time Overruns	.521	.582

Source: Field survey 2013

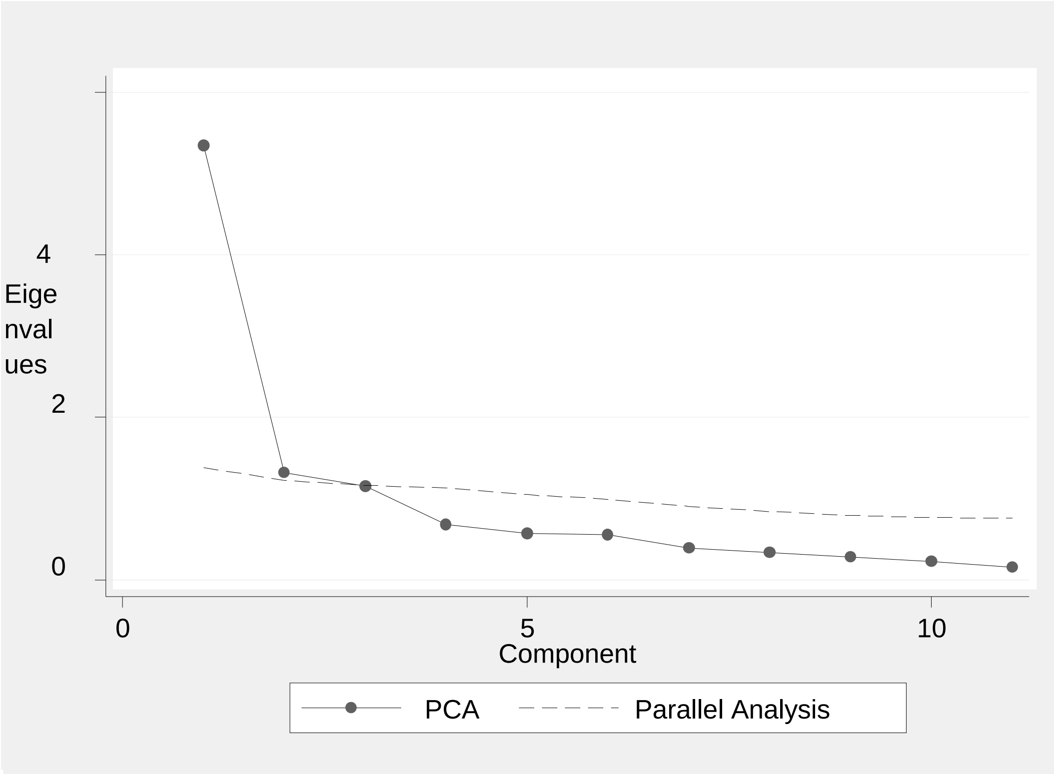


Figure 4.12.: Problems experienced in project management practices in construction industry in Kenya

Source: Field survey 2013

Based on figure 4.12 above; and general respondents' responses, three components are identified in the problems that are often experienced in the current project management practices. On the other hand, the Cronbach's alpha indicates that poject coordination problems caused by the lead consultant item need not be retained in the analysis since it has a variance of 0.125 from all other items measured. If the factor of project co-ordination problems by the lead consultant is deleted then Cronbach's Alpha improves from an average of 0.79 to 0.898; meaning the item is not as important as the other factors. However, all other factors present almost similar Cronbach's Alpha values meaning this process of using Cronbach's Alpha cannot be utilized for data variables reduction for the model. But an important observation is that the Cronbach Alpha values show a very high data validity which is crucial but in terms of data reduction then the data should be handled using principal component analysis and parallel analysis for meaningful results to be achieved.

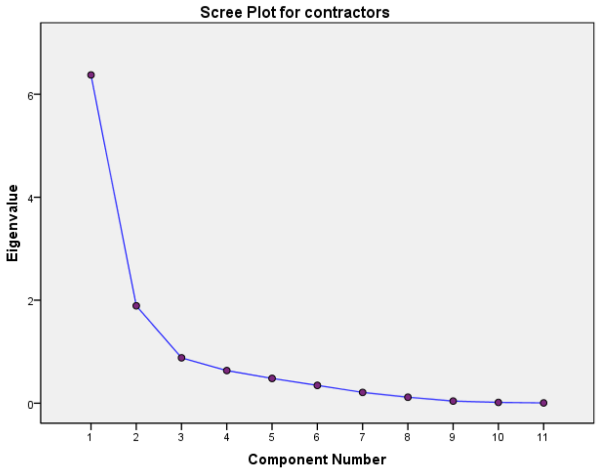
The results for Cronbach's Alpha are shown in table 4.54 below;

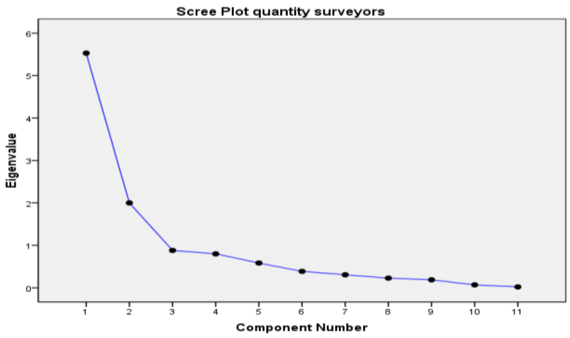
Table 4.54.: Item-Total Statistics on problems often experienced in current project management practices in Kenya

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Scope Management Problems	33.5745	71.840	.568	.500	.769
Abortive Works	34.0426	69.479	.565	.387	.766
Project Co-ordination Problems - Lead Consultant	33.5638	64.154	.148	.278	.898
Cost Overruns	33.4149	70.706	.598	.687	.766
Time Overruns	33.1170	73.385	.540	.636	.773
Non-performing contractors	33.8191	72.362	.536	.436	.772
Project Integration Management Issues	33.7979	68.468	.733	.663	.754
Project Time Management Issues	33.4468	70.091	.694	.708	.760
Project Risk Management Issues	33.8617	66.824	.729	.673	.751
Intransigent Colleague Problems	34.0426	70.674	.559	.616	.768
Clients' Interference in Projects	33.5319	70.414	.509	.525	.771

Source: Field survey 2013

Scree plots for the major problems encountered currently in project management models in Kenya





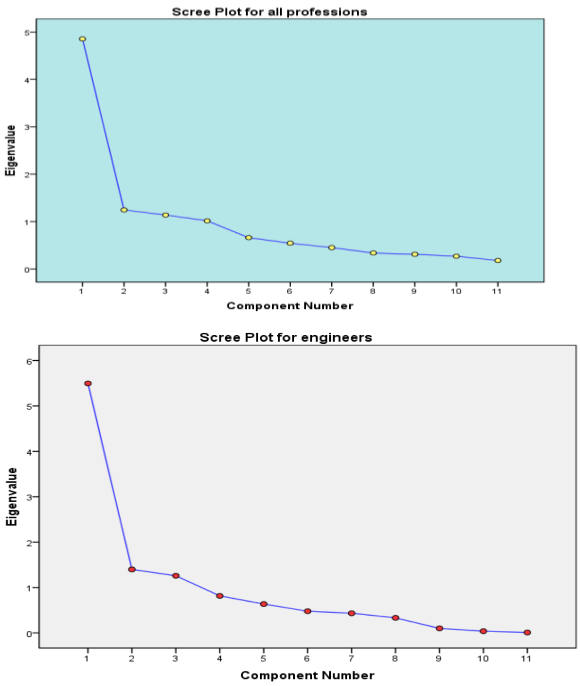


Figure 4.13: Scree plots comparing the problems currently experienced in project management practices in Kenya among respondents

Source: Field survey 2013

The scree plots in Figure 4.13 clusters the engineers together with the project managers and general respondents' while the quantity surveyors, architects and the contractors are also clustered together.

4.12 CORRELATION MATRICES ON THE KEY PERFORMANCE INDICATORS IN THE PROJECT MANAGEMENT OF THE CONSTRUCTION INDUSTRY IN KENYA

The study correlation table 4.55 above shows a strong correlation for many indicators. However finishing according to originally set quality standards, project scope management, value engineering and human resource indicators represented a low correlation as compared to other indicators.

Table 4.55: Correlation Matrix key performance indicators in the project management

		1	2	3	4	5	6	7	8	9	10
Correlation	Finish within original contract Sum	1.000	.660	.310	.566	.518	.267	.410	.291	.221	.447
	Finish according to original Scope	.660	1.000	.369	.652	.527	.294	.386	.334	.281	.453
	Finish according to originally set Quality Standards	.310	.369	1.000	.455	.193	.303	.434	.396	.389	.411
	Finish within originally set Time	.566	.652	.455	1.000	.560	.446	.475	.440	.312	.370
	Perform Project Integration Management	.518	.527	.193	.560	1.000	.644	.552	.409	.408	.450
	Perform Project Scope Management	.267	.294	.303	.446	.644	1.000	.640	.476	.573	.435
	Perform Project Time Management	.410	.386	.434	.475	.552	.640	1.000	.431	.564	.606
	Conduct Value Engineering	.291	.334	.396	.440	.409	.476	.431	1.000	.557	.408
	Perform Human Resource Management	.221	.281	.389	.312	.408	.573	.564	.557	1.000	.742
	Conduct Project Procurement Management	.447	.453	.411	.370	.450	.435	.606	.408	.742	1.000

Kaiser-Meyer-Olkin Adequacy Measure (KMO): 0.787 Cronbach's Alpha:0.861

Source: Field survey 2013

All the indicators were statistically significant and loaded in component one as in table 4.56 below. For general data two components loaded. Component one can be renamed as efficient Project management application while component two can be renamed project execution efficiency. The most important variables are perform project time management; conduct project procurement management; perform project integration management; finish within originally set time; perform project scope management and perform human resource management.

Table 4.56: Component Matrix for general data

	Component	
	1	2
Finish within original contract Sum	.657	.554
Finish according to original Scope	.696	.539
Finish according to originally set Quality Standards	.583	
Finish within originally set Time	.743	.395
Perform Project integration Management	.752	
Perform Project Scope Management	.725	-.313
Perform Project Time Management	.785	
Conduct Value Engineering	.663	
Perform Human Resource Management	.716	-.535
Conduct Project Procurement Management	.756	

Source: Field survey 2013

In sampling for the engineer practitioners, the correlation matrix reported a very high correlation for all the indicators that were measured for efficient project management in the construction industry as illustrated in table 4.57 below.

Table 4.57: Correlation Matrix key performance indicators in the project management among engineers

		1	2	3	4	5	6	7	8	9	10
Correlation	Finish within original contract Sum	1.000	.809	.586	.765	.703	.509	.550	.665	.562	.587
	Finish according to original Scope	.809	1.000	.706	.775	.432	.241	.384	.703	.286	.327
	Finish according to originally set Quality Standards	.586	.706	1.000	.511	.408	.466	.527	.513	.471	.426
	Finish within originally set Time	.765	.775	.511	1.000	.551	.356	.369	.623	.153	.200
	Perform Project Integration Management	.703	.432	.408	.551	1.000	.878	.841	.412	.705	.636
	Perform Project Scope Management	.509	.241	.466	.356	.878	1.000	.949	.441	.843	.731
	Perform Project Time Management	.550	.384	.527	.369	.841	.949	1.000	.585	.907	.816
	Conduct Value Engineering	.665	.703	.513	.623	.412	.441	.585	1.000	.561	.480
	Perform Human Resource Management	.562	.286	.471	.153	.705	.843	.907	.561	1.000	.918
	Conduct Project Procurement Management	.587	.327	.426	.200	.636	.731	.816	.480	.918	1.000

a. Only cases for which Name of the Profession = Engineering are used in the analysis phase. Rotation method: Varimax

Source: Field survey 2013

Similarly, the indicators had a high statistical significance compared to the general practitioners generally as shown in table 4.58 below. For Engineers just like general data two components loaded. Component one can be renamed as efficient project management application and component two can be renamed project execution efficiency. The most important variables according to Engineers are perform project time management; perform project integration management; finish within original contract sum; perform project scope management; perform human resource management and conduct project procurement management.

Table 4.58: Component Matrix for engineers

	Component	
	1	2
Finish within original contract Sum	.846	.350
Finish according to original Scope	.693	.657
Finish according to originally set Quality Standards	.697	
Finish within originally set Time	.649	.627
Perform Project integration Management	.848	
Perform Project Scope Management	.836	-.439
Perform Project Time Management	.898	-.374
Conduct Value Engineering	.748	.309
Perform Human Resource Management	.837	-.478
Conduct Project Procurement Management	.797	-.410

Source: Field survey 2013

The correlation matrix for the architects showed a lower correlation, similar to that for the general practitioners for most indicators as presented in table 4.59. For Architects, three components loaded as shown under table 4.60. Component one can be renamed efficient project management application. Component two can be renamed project execution efficiency and component three can be renamed project execution monitoring and control. According to Architect's the most important variables are perform project integration management; perform project scope management; conduct project procurement management; perform human resource management; perform project time management and finish within original contract sum.

Table 4.59: Correlation Matrix for key performance indicators in the project management for architects

		1	2	3	4	5	6	7	8	9	10
Correlation	Finish within original contract Sum	1.000	.300	.263	.400	.515	.389	.570	.487	.461	.705
	Finish according to original Scope	.300	1.000	.259	.525	.568	.464	.263	.358	.600	.442
	Finish according to originally set Quality Standards	.263	.259	1.000	.253	.076	.174	.437	.196	.192	.455
	Finish within originally set Time	.400	.525	.253	1.000	.448	.514	.460	.238	.154	.267
	Perform Project Integration Management	.515	.568	.076	.448	1.000	.855	.573	.506	.643	.585
	Perform Project Scope Management	.389	.464	.174	.514	.855	1.000	.735	.382	.460	.394
	Perform Project Time Management	.570	.263	.437	.460	.573	.735	1.000	.329	.352	.503
	Conduct Value Engineering	.487	.358	.196	.238	.506	.382	.329	1.000	.703	.471
	Perform Human Resource Management	.461	.600	.192	.154	.643	.460	.352	.703	1.000	.609
	Conduct Project Procurement Management	.705	.442	.455	.267	.585	.394	.503	.471	.609	1.000

a. Only cases for which Name of the Profession = Architecture are used in the analysis phase.

Source: Field survey 2013

The low correlation means greater difference for variance explained hence more component loadings, reason as to why the three components are loaded unlike for other previous cases. However, all the indicators were statistically significant as shown in the table below, except for set time.

Table 4.60: Component Matrix for architects

	Component		
	1	2	3
Finish within original contract Sum	.730		
Finish according to original Scope	.675		
Conduct Project Procurement Management	.775		.394
Finish within originally set Time	.587	.526	
Perform Project integration Management	.853		-.376
Perform Project Scope Management	.785		-.392
Perform Project Time Management	.743	.426	
Conduct Value Engineering	.669	-.480	
Perform Human Resource Management	.753	-.546	
Finish according to originally set Quality Standards	.416	.315	.704

Source: Field survey 2013

The correlation for the indicators among the quantity surveyors reported a lower relationship generally as compared to the general data, represented in table 4.61 below;

4.61: Correlation Matrix key performance indicators in the project management among quantity surveyors

		1	2	3	4	5	6	7	8	9	10
Correlation	Finish within original contract Sum	1.000	.593	.407	.691	.439	.235	.502	.034	.352	.315
	Finish according to original Scope	.593	1.000	.422	.528	.012	.139	.468	.075	.403	.524
	Finish according to originally set Quality Standards	.407	.422	1.000	.505	.251	.201	.355	.145	.123	.135
	Finish within originally set Time	.691	.528	.505	1.000	.552	.395	.569	.440	.494	.299
	Perform Project Integration Management	.439	.012	.251	.552	1.000	.622	.226	.628	.256	.081
	Perform Project Scope Management	.235	.139	.201	.395	.622	1.000	.290	.580	.556	.304
	Perform Project Time Management	.502	.468	.355	.569	.226	.290	1.000	.047	.657	.721
	Conduct Value Engineering	.034	.075	.145	.440	.628	.580	.047	1.000	.314	.149
	Perform Human Resource Management	.352	.403	.123	.494	.256	.556	.657	.314	1.000	.765
	Conduct Project Procurement Management	.315	.524	.135	.299	.081	.304	.721	.149	.765	1.000

a. Only cases for which Name of the Profession = Quantity Surveying are used in the analysis phase.

Source: Field survey 2013

The loadings were distributed in three components and only one indicator; finish according to the set standards was insignificant in the study as illustrated in the table 4.62 below;

Table 4.62: Component Matrix for quantity surveyors

	Component		
	1	2	3
Finish within original contract Sum	.709		.438
Finish according to original Scope	.644	-.477	
Finish within originally set Time	.834		.330
Perform Human Resource Management	.766		-.521
Conduct Project Procurement Management	.672	-.401	-.518
Perform Project Scope Management	.630	.528	
Perform Project Time Management	.763	-.384	
Perform Project integration Management	.584	.673	
Conduct Value Engineering	.469	.714	
Finish according to originally set Quality Standards	.514		.575

Source: Field survey 2013

For Quantity Surveyors; three components loaded. Component one can be renamed efficient project management application. Component two can be renamed project execution efficiency and component three can be renamed project monitoring and control. According to the Quantity Surveyors, the most important variables are; finish within originally set time; perform human resource management; perform project time management; finish within original contract sum; conduct project procurement management and finish according to original scope.

The correlation among the indicators for the project managers increased steadily compared to that of the architects, quantity surveyors and all the practitioners, but not as strong as for the engineers. The results are tabulated under table 4.63 below;

Table 4.63: Correlation Matrix key performance indicators in the project management among project managers

		1	2	3	4	5	6	7	8	9	10
Correlation	Finish within original contract Sum	1.000	.848	.566	.752	.509	.149	.258	.324	.118	.501
	Finish according to original Scope	.848	1.000	.681	.869	.772	.311	.443	.541	.396	.700
	Finish according to originally set Quality Standards	.566	.681	1.000	.589	.524	.506	.655	.652	.562	.611
	Finish within originally set Time	.752	.869	.589	1.000	.846	.562	.562	.566	.403	.514
	Perform Project Integration Management	.509	.772	.524	.846	1.000	.606	.655	.612	.679	.754
	Perform Project Scope Management	.149	.311	.506	.562	.606	1.000	.904	.583	.718	.303
	Perform Project Time Management	.258	.443	.655	.562	.655	.904	1.000	.762	.703	.414
	Conduct Value Engineering	.324	.541	.652	.566	.612	.583	.762	1.000	.522	.372
	Perform Human Resource Management	.118	.396	.562	.403	.679	.718	.703	.522	1.000	.729
	Conduct Project Procurement Management	.501	.700	.611	.514	.754	.303	.414	.372	.729	1.000

a. Only cases for which Name of the Profession = Project Management are used in the analysis phase.

Source: Field survey 2013

The higher correlation also led to few component loadings to explain variance as shown under table 4.64 below. At the same time, the statistical significance of the indicators was very high at 95% confidence interval.

Table 4.64: Component Matrix for project managers

	Component	
	1	2
Conduct Project Procurement Management	.753	
Finish according to original Scope	.840	.501
Finish according to originally set Quality Standards	.808	
Finish within originally set Time	.855	
Perform Project integration Management	.895	
Perform Project Scope Management	.721	-.569
Perform Project Time Management	.812	-.484
Conduct Value Engineering	.760	
Perform Human Resource Management	.744	-.447

Source: Field survey 2013

For Project Managers two components loaded. Component one can be renamed project execution efficiency while component two can be renamed project scope definition and management. The most important variables are perform project integration management; finish within originally set time; finish according to original scope; perform project time management; finish according to originally set quality standards and conduct value engineering. The correlation for the contractors' indicators is represented as shown under table 4.65 below;

Table 4.65: Correlation Matrix for key performance indicators in the project management among contractors

		1	2	3	4	5	6	7	8	9	10
Correlation	Finish within original contract Sum	1.000	.699	.169	.428	.594	.522	.548	.419	.156	.561
	Finish according to original Scope	.699	1.000	.075	.679	.760	.592	.605	.062	-.017	.439
	Finish according to originally set Quality Standards	.169	.075	1.000	.242	.115	-.152	.237	.075	.294	.435
	Finish within originally set Time	.428	.679	.242	1.000	.529	.335	.492	.070	.223	.621
	Perform Project Integration Management	.594	.760	.115	.529	1.000	.382	.447	.000	-.106	.381
	Perform Project Scope Management	.522	.592	-.152	.335	.382	1.000	.099	.144	.010	.401
	Perform Project Time Management	.548	.605	.237	.492	.447	.099	1.000	.441	-.123	.455
	Conduct Value Engineering	.419	.062	.075	.070	.000	.144	.441	1.000	.418	.596
	Perform Human Resource Management	.156	-.017	.294	.223	-.106	.010	-.123	.418	1.000	.533
	Conduct Project Procurement Management	.561	.439	.435	.621	.381	.401	.455	.596	.533	1.000

Table 4.65: Correlation Matrix for key performance indicators in the project management among contractors

		1	2	3	4	5	6	7	8	9	10
Correlation	Finish within original contract Sum	1.000	.699	.169	.428	.594	.522	.548	.419	.156	.561
	Finish according to original Scope	.699	1.000	.075	.679	.760	.592	.605	.062	-.017	.439
	Finish according to originally set Quality Standards	.169	.075	1.000	.242	.115	-.152	.237	.075	.294	.435
	Finish within originally set Time	.428	.679	.242	1.000	.529	.335	.492	.070	.223	.621
	Perform Project Integration Management	.594	.760	.115	.529	1.000	.382	.447	.000	-.106	.381
	Perform Project Scope Management	.522	.592	-.152	.335	.382	1.000	.099	.144	.010	.401
	Perform Project Time Management	.548	.605	.237	.492	.447	.099	1.000	.441	-.123	.455
	Conduct Value Engineering	.419	.062	.075	.070	.000	.144	.441	1.000	.418	.596
	Perform Human Resource Management	.156	-.017	.294	.223	-.106	.010	-.123	.418	1.000	.533
	Conduct Project Procurement Management	.561	.439	.435	.621	.381	.401	.455	.596	.533	1.000

a. Only cases for which Name of the Profession = Contractor are used in the analysis phase.

Source: Field survey 2013

Because of weak correlation among the indicators for the contractors, there are more components loading. However, it was only one indicator that was not statistically significant, that is performing project scope management as shown under table 4.66 below. This can be explained because contractors do not have much leeway as far as scope management in projects is concerned.

Table 4.66: Component Matrix for contractors

	Component			
	1	2	3	4
Finish within original contract Sum	.831			
Finish according to original Scope	.847	-.419		
Conduct Project Procurement Management	.803	.469		
Finish within originally set Time	.758			
Perform Project Integration Management	.720	-.436		
Perform Project Scope Management	.567	-.302	-.556	.321
Perform Project Time Management	.701			-.604
Conduct Value Engineering	.439	.596	-.413	-.487
Perform Human Resource Management		.777		.409
Finish according to originally set Quality Standards	.304	.467	.675	

Source: Field survey 2013

For contractors four components loaded. Component one can be renamed project execution efficiency. Component two can be renamed project co-ordination and value engineering. Component three can be renamed scope definition and management; while component four can be renamed project execution effectiveness. The most important variables according to contractors include finishing according to original scope; finish within original contract sum; conduct project procurement management; finish within originally set time; perform project time management and perform project integration management.

Parallel analysis was carried out to compliment PCA in clearly illustrating the cut off points for selected components as depicted in figure 4.14 below.

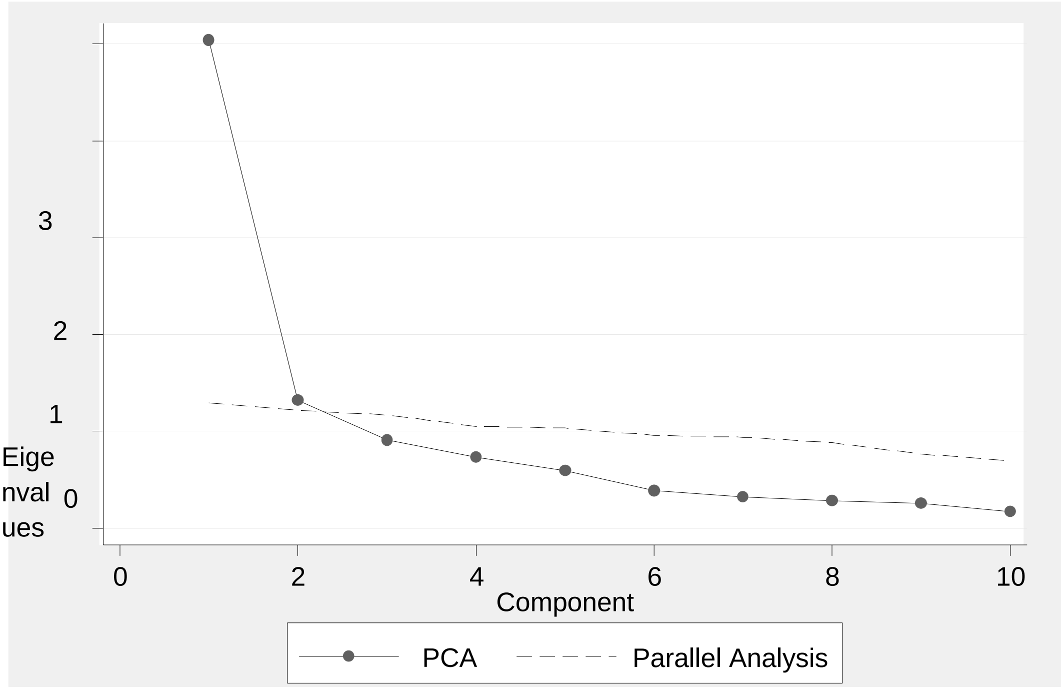


Figure 4.14: key performance indicators in the project management

Source: Field survey 2013

The first two components are recommended to be retained in the analysis and the entire items under the study indicated a high Cronbach's alpha implying a very high correlation and with non-deletion for all items as shown under table 4.67 below.

Table 4.67: Item-Total Statistics on key performance indicators in the project management of the construction industry in Kenya

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Finish within original contract Sum	35.50000	158.700	1.000	.753	.987
Finish according to original Scope	35.50000	132.300	1.000	.467	.983
Finish according to originally set Quality Standards	34.50000	158.700	1.000	.507	.987
Finish within originally set Time	36.00000	145.200	1.000	.579	.983
Perform Project Integration Management	36.00000	145.200	1.000	.692	.983
Perform Project Scope Management	35.50000	158.700	1.000	.577	.987
Perform Project Time Management	35.00000	145.200	1.000	.712	.983
Conduct Value Engineering	35.50000	132.300	1.000	.467	.983
Perform Human Resource Management	35.50000	132.300	1.000	.657	.983
Conduct Project Procurement Management	35.50000	132.300	1.000	.499	.983
Other Project Achievements	35.50000	132.300	1.000	.613	.983

This is an indication that the data should be subjected to a more advanced and or different treatment to reduce the variables to a manageable level.

4.13 APPLICATION OF PROJECT MANAGEMENT MODELS

The following were the results for model use currently by the respondents in Kenyan construction industry. The general use of the models were reported as very low with less than 40% of the respondents accepting use of some form of modeling currently as shown in the figure 4.15.

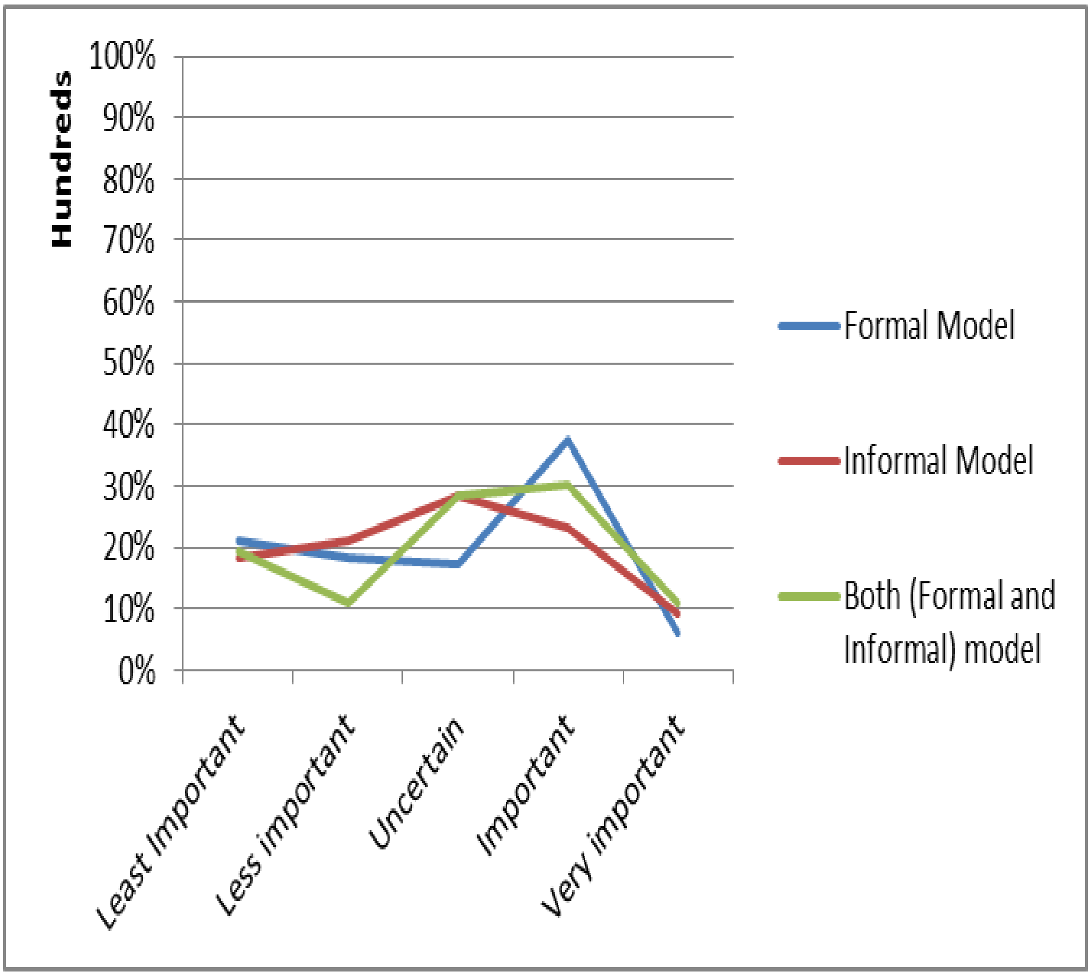


Figure 4.15 Project management model use in Kenya

Source: Field survey 2013

The respondents indicated a lack of project management model in the construction industry in Kenya. The mean and the percentiles of the data show clearly that the data responses were critically challenging the lack of the model illustrated in table 4.68 below.

Table 4.68: Analyzing the percentiles for development of appropriate model

		Lack of a formally Recognized Project Management Application	Lack of Project Management Model	Inaccurate Measurements on the Role of Project Management	Lack of Project Management Matrix Models
Mean		4.0882	3.9802	4.0980	3.7921
Std. Error of Skewness		.139	.140	.139	.140
Percentiles	25	4.0000	4.0000	4.0000	3.0000
	50	4.0000	4.0000	4.0000	4.0000
	75	5.0000	5.0000	5.0000	5.0000

Source: Field survey 2013

The first quarter percentile of the respondents in the research indicates that practitioners agree that there lacks a proper project management model for the construction industry in Kenya. This further, confirms the hypothesis of the study that the development of an appropriate project management model in Kenya, will result to an efficient management practice in the construction industry. The cumulative percentage importance of the models used were reported as shown in table 4.69 below

Table 4.69: Importance of the models in construction industry

Model	Cumulative importance of the model (%)
Simulation	74.00%
Diagrammatic	77.00%
Stochastic	65.40%
Management Matrix	71.60%

Source: Field survey 2013

The study made use of the simulation model because the description of the construction industry behavior by experimentation may not be feasible in Kenya, and being that it can illustrate the model diagrammatically if required otherwise. It is established that respondents favour diagrammatic models followed by simulation models, management matrix models and stochastic models in that order. Table 4.70 below illustrates the abbreviations used in the model variables.

Table 4.70: Abbreviations

Factor	Abbreviation	Factor	Abbreviation
Project Integration Management Factor	**PI**	Project Information Management Factor	**PIM**
Project Scope Management Factor	**PS**	Project Risk Management Factor	**PR**
Project Time Management Factor	**PT**	Project Performance Management Factor	**PP**
Project Cost Management Factor	**PC**	Value Engineering Factor	**VE**
Project Quality Management Factor	**PQ**	Construction Site Management Factor	**CS**
Project Human Resource Management Factor	**PH**	Project Management Evaluation Model	**PME**

Source: Field survey 2013

Project performance management factor is mainly a function of execution efficiency and effectiveness as illustrated in the appendix H.

To assess the comparison among the different factors of project management and to examine how much error we are to use in the predictive model the ANOVA table for key management factors was computed and the results are as shown in table 4.71 below;

4.71 ANOVA table for Key management factors for project management

		Sum of Squares	df	Mean Square	F	Sig
Between factors		902.501	296	3.049		
Within factors	Between Items	276.017	10	27.602	65.352	.000
	Residual	1250.165	2960	.422		
	Total	1526.182	2970	.514		
Total		2428.683	3266	.744		

Grand Mean = 4.2489

Source: Field survey 2013

Table 4.71 shows that; there are significant differences among the factors since the p value is 0.000<0.05. However, the table is not sufficient to show how each group differs from each other thus need for multiple comparisons.

Analysis of the factors argued to affect the Project management model is reported under table 4.72 below:

Table 4.72: Factors affecting project management in Kenya

Factors	Mean	Likert scale Ratings	Std. Deviation	Ranking
Project Integration Management Factor	4.1818	Important	.84666	6
Project Scope Management Factor	4.3838	Important	.69322	4
Project Time Management Factor	4.6364	Very Important	.61162	3
Project Cost Management Factor	4.7374	Very Important	.46323	1
Project Quality Management Factor	4.6465	Very Important	.55714	2
Project Human Resource Management Factor	4.0404	Important	.87672	7
Project Information Management Factor	3.9495	Important	.91578	8
Project Risk Management Factor	4.0404	Important	.87672	7
Project Performance Management Factor	3.9899	Important	1.00164	9
Value Engineering Factor	3.9091	Important	.95604	10
Construction Site Management Factor	4.2222	Important	.93962	5

Source: Field survey 2013

From the mean scores above, the general respondents' data shows two categories of ratings namely; very important and important. The data factors that were being evaluated qualified as being critical in the project management model for the construction industry. The ranking clearly appreciates the current management factors; time, quality and cost as being critical in the management practice of the construction industry (Table 4.72). The other factors which are important include scope, construction site management, integration and project resource management. It should be noted that due to the importance attached to these factors; some researchers have tried to address some of them; one being site management which was addressed by (Masu, 2006) in his PhD under resource mix practices. Human resource management factor has also been investigated by Muchungu, (2012) in his PhD and confirmed as a crucial variable in the performance of construction projects in Kenya.

There is a statistical significance for the factors under study ($p < 0.05$), at KMO 78.4% The KMO measures the sampling adequacy of the data which is very good to subject the factors for analysis. The KMO for the data for this study is presented under table 4.73 below.

Table 4.73: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.784
Bartlett's Test of Sphericity	Approx. Chi-Square	1646.263
	df	55
	Sig.	.000

Source: Field survey 2013

Table 4.74 below represents the percentage of variability attributed to the model amongst the factors that were being investigated. Project performance management factor accounted for 72.9% of the variance of the extracted factors, project information management accounting for 69.4% while project quality management rated at 68.3%. Other factors which rated above the threshold variation of 60% were project scope (64.2), cost management (66.1%), human resource (61.2%) and time management at 68.1%. However Value engineering factor, project risk management, project integration and project site management were rated below the threshold variation thus disqualified to be included in the appropriate model.

Table 4.74: Communalities of the project management factors

	Initial	Extraction	Rank
Project integration Management Factor	1.000	.461	9
Project Scope Management Factor	1.000	.642	6
Project Time Management Factor	1.000	.681	4
Project Cost Management Factor	1.000	.661	5
Project Quality Management Factor	1.000	.683	3
Project Human Resource Management Factor	1.000	.612	7
Project Information Management Factor	1.000	.694	2
Project Risk Management Factor	1.000	.436	10
Project Performance Management Factor	1.000	.729	1
Value Engineering Factor	1.000	.431	11
Construction Site Management Factor	1.000	.589	8

Extraction Method: Principal Component Analysis. Rotation method: Varimax

Source: Field survey 2013

From the table above; all factors ranked from 1-7 qualified to be in the final project management model. Four factors were dropped because they did not meet the minimum threshold of 60% as per Principal Component Analysis evaluation criteria.

The factors that are significant in the cost regression are as follows; project time management, project quality management and human resource management. The p-p plot as shown under figure 4.16 below illustrates the standardized residual which attests the normality of the model simulated data.

4.14 PROJECT EVALUATION INDICATORS

Project evaluation indicators were determined by establishing the relationship between how effective the project managers rated the indicators with the dependent variables on the achievement of those project indicators. For us to determine the relationship between the variables descriptive and multiple regression analysis was performed.

4.14.1 Descriptive Statistics

As indicated in table 4.75 below, the mean value of project cost of 303 observations was 4.7426 with the standard deviation of 0.46006; Project information reported the smallest mean of 3.9406 with standard deviation of 0.93308; Most of the factors had an average mean of 4 and above with a median of 4. It is evident that majority of the respondents rated the factors as important indicators of project management evaluation.

Table 4.75 Descriptive Statistics on performance indicators

		Project Scope	Project Time	Project Cost	Project Quality	Project HR	Project Info	Project Risk	Project Performance
N	Valid	303	303	303	303	303	303	303	300
	Missing	9	9	9	9	9	9	9	12
Mean		4.3762	4.6436	4.7426	4.6436	4.5347	3.9406	4.0198	3.9900
Median		4.0000	5.0000	5.0000	5.0000	4.0000	4.0000	4.0000	4.0000
Mode		5.00	5.00	5.00	5.00	4.00	4.00	4.00	5.00
Std. Deviation		.68838	.60764	.46006	.55643	5.12796	.93308	.89124	.99660

4.14.2 Covariates

The table below illustrates the correlations coefficients amongst individual indicators. It is evident that most of the indicators are highly correlated.

Table 4.76 Correlations of the Individual Indicators

	X1	X2	X3	X4	X5	X6	X7	X8
Project Cost – X1	1.000	.302	.366	.492	.109	.161	.184	.165
Project Scope – X2	.302	1.000	.562	.102	.272	.386	.214	.173
Project Time – X3	.366	.562	1.000	.544	.137	.353	.223	.098
Project Quality – X4	.492	.102	.544	1.000	.012	.327	.010	.221
Project HR – X5	.109	.272	.137	.012	1.000	.282	.171	.229
Project Info – X6	.161	.386	.353	.327	.282	1.000	.506	.423
Project Risk X7	.184	.214	.223	.010	.171	.506	1.000	.363
Project Performance – X8	.165	.173	.098	.221	.229	.423	.363	1.000

From the results displayed on the two outputs above, it's evident that amongst the factors there is a relationship which may be expressed well with the achievement of the projects objectives.

4.15 COST REGRESSION EQUATION

The regression of *project cost performance* on the explanatory variables (*performance* management factor, *scope* management factor, *time* management factor, project *quality* management factor, project *human resource* management factor, project *information* management factor and project performance management factor) gives an R^2 value of 0.563, as shown on table 4.75. Two inferences may be made from this observation. Firstly, only 56.3% of the variability in the cost performance of a project can be explained by the six explanatory variables combined. Secondly, modeling project management efficiency in terms of cost performance alone cannot give a complete picture of the project situation.

Table 4.75 Model Summary for cost model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.751[a]	.563	.554	.30817

a. Predictors: (Constant), Project Performance Management Factor, Project Time Management Factor, Project Quality Management Factor, Project Human Resource Management Factor, Project Scope Management Factor, Project Information Management Factor

b. Dependent Variable: Project Cost Management Factor

Source: Field survey 2013

Generalized linear regression equation on the selected factors produced the below co-efficient which would be useful in developing the project management model.

Table 4.76: Coefficients generated from the cost regression equation

Model		Unstandardized Coefficients		T	Sig.	Collinearity Statistics	
		B	Std. Error			Tolerance	VIF
1	(Constant)	1.586	.180	8.801	.000		
	Project Scope Management Factor	.056	.037	1.511	.132	.489	2.045
	Project Time Management Factor	.150	.039	3.904	.000	.575	1.738
	Project Quality Management Factor	.382	.043	8.935	.000	.557	1.797
	Project Human Resource Management Factor	.064	.030	2.123	.035	.464	2.155
	Project Information Management Factor	.049	.029	1.701	.090	.450	2.222
	Project Performance Management Factor	.004	.023	-.168	.867	.598	1.673

a. Dependent Variable: Project Cost Management Factor

Source: Field survey 2013

From table 4.76 above the General Linear Model (equation) is given by

$$PC_p = 1.586 + 0.056PS + 0.150PT + 0.382PQ + 0.064PH + 0.049PI + 0.004PP$$

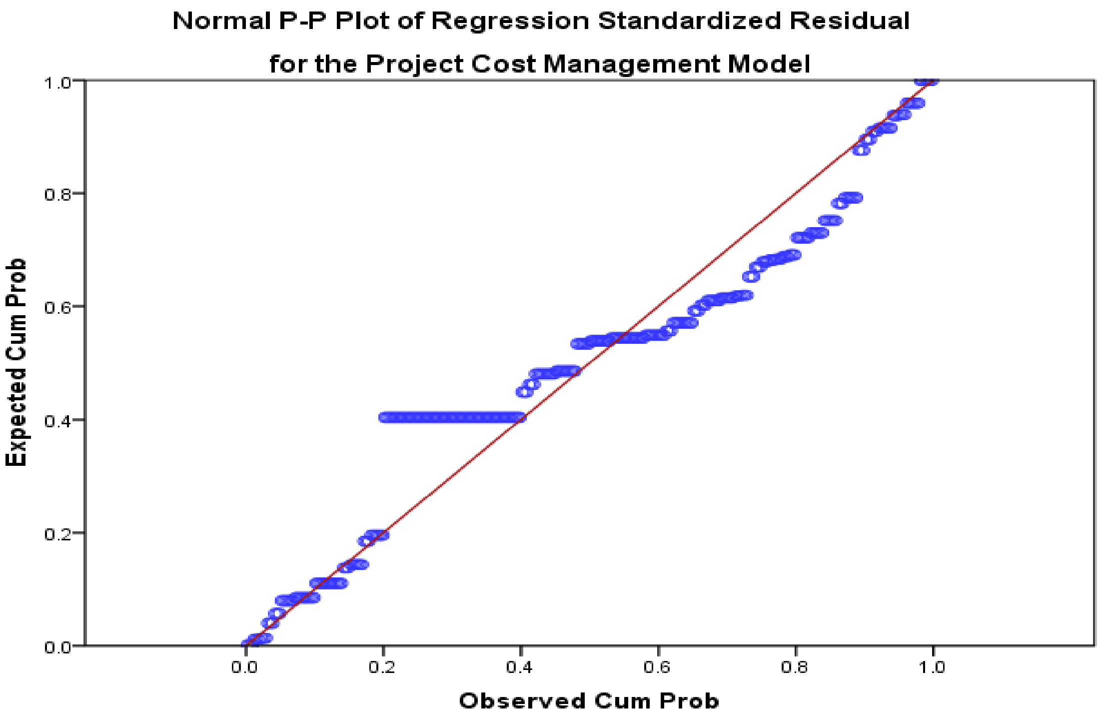


Figure 4.16: Project cost management regression residuals plot

Source: Field survey 2013

4.16 TIME MANAGEMENT REGRESSION EQUATION

The regression of *project time performance* on the explanatory variables (*performance* management factor, *scope* management factor, *cost* management factor, project *quality* management factor, project *human resource* management factor, project *information* management factor and project performance management factor) gives an R^2 value of 0.453, as shown on table 4.77. Two inferences may be made from this observation. Firstly, only 45.3% of the variability in the time performance of a project can be explained by the six explanatory variables combined. Secondly, modeling project management efficiency in terms of time performance alone cannot give a complete picture of the project situation.

Table 4.77: Model Summary for time model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.673[a]	.453	.442	.45547

a. Predictors: (Constant), Project Cost Management Factor, Project Performance Management Factor, Project Scope Management Factor, Project Information Management Factor, Project Human Resource Management Factor, Project Quality Management Factor

b. Dependent Variable: Project Time Management Factor

Source: Field survey 2013

The critical factors in the equation with the coefficients required for modeling are as shown under table 4.78:

Table 4.78: Coefficients generated for the time regression equation

Model		Unstandardized Coefficients		t	Sig.	Collinearity Statistics	
		B	Std. Error			Tolerance	VIF
1	(Constant)	1.065	.293	3.636	.000		
	Project Scope Management Factor	.265	.053	5.050	.000	.528	1.896
	Project Quality Management Factor	.282	.069	4.065	.000	.462	2.164
	Project Human Resource Management Factor	-.082	.044	-1.841	.067	.462	2.163
	Project Information Management Factor	.087	.043	2.033	.043	.452	2.212
	Project Performance Management Factor	.117	.033	-3.499	.001	.623	1.606
	Project Cost Management Factor	.327	.084	3.904	.000	.459	2.177

a. Dependent Variable: Project Time Management Factor

Source: Field survey 2013

Hence the GLM model from the results will be given as;

$$PT_p \quad = \quad 1.065 + 0.265PS + 0.282PQ - 0.082PH + 0.087PI + 0.117PP + 0.327PC$$

There is a statistical significance for all factors under equation analysis except for project human resource management factor.

4.17 QUALITY MANAGEMENT REGRESSION

The regression of *project quality performance* on the explanatory variables (*performance* management factor, *scope* management factor, *time* management factor, project *cost* management factor, project *human resource* management factor, project *information* management factor and project performance management factor) gives an R^2 value of 0.563, as shown on table 4.79. Two inferences may be made from this observation. Firstly, only 56.3% of the variability in the quality performance of a project can be explained by the six explanatory variables combined. Secondly, modeling project management efficiency in terms of quality performance alone cannot give a complete picture of the project situation. Quality must therefore be considered alongside others.

4.79: Model Summary for the quality model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.750[a]	.563	.554	.37282

a. Predictors: (Constant), Project Performance Management Factor, Project Time Management Factor, Project Scope Management Factor, Project Cost Management Factor, Project Information Management Factor, Project Human Resource Management Factor

b. Dependent Variable: Project Quality Management Factor

Source: Field survey 2013

The critical factors in the equation had the coefficients as indicated in table 4.80 below. All the factors agreed on the presence of statistical significance except for two factors; project scope management and project performance management factor.

4.80: Coefficients generated for the quality regression equation

Model		Unstandardized Coefficients		T	Sig.	Collinearity Statistics	
		B	Std. Error			Tolerance	VIF
1	(Constant)	.684	.242	2.827	.005		
	Project Scope Management Factor	.032	.045	.716	.474	.486	2.057
	Project Time Management Factor	.189	.047	4.065	.000	.578	1.731
	Project Cost Management Factor	.560	.063	8.935	.000	.556	1.800
	Project Human Resource Management Factor	-.121	.036	-3.384	.001	.475	2.106
	Project Information Management Factor	.151	.034	4.426	.000	.476	2.103
	Project Performance Management Factor	.044	.028	1.597	.111	.603	1.659

a. Dependent Variable: Project Quality Management Factor

Source: Field survey 2013

$$PQ_p = 0.684 + 0.032PS + 0.189PT + 0.560PC - 0.121PH + 0.151PI + 0.044PP$$

4.18 SCOPE MANAGEMENT REGRESSION EQUATION

The regression of *project scope performance* on the explanatory variables (*performance* management factor, *cost* management factor, *time* management factor, project *quality* management factor, project *human resource* management factor, project *information* management factor and project performance management factor) gives an R^2 value of 0.515, as shown on table 4.81. Two inferences may be made from this observation. Firstly, only 51.5% of the variability in the scope performance of a project can be explained by the six explanatory variables combined. Secondly, modeling project management efficiency in terms of scope performance alone cannot give a complete picture of the project situation. Scope must be considered along other variables.

4.81: Model Summary for the scope regression equation

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.717[a]	.515	.505	.48611

a. Predictors: (Constant), Project Quality Management Factor, Project Human Resource Management Factor, Project Time Management Factor, Project Performance Management Factor, Project Information Management Factor, Project Cost Management Factor

b. Dependent Variable: Project Scope Management Factor

Source: Field survey 2013

The critical factors produced the following co-efficient as shown in table 4.82 below for results. It was only three factors that were statistically significant namely project time management, project human resource management and project information management factors.

4.82: Coefficients generated for the scope regression equation

Model		Unstandardized Coefficients		t	Sig.	Collinearity Statistics	
		B	Std. Error			Tolerance	VIF
1	(Constant)	.261	.319	.819	.414		
	Project Time Management Factor	.302	.060	5.050	.000	.595	1.682
	Project Cost Management Factor	.139	.092	1.511	.132	.440	2.272
	Project Human Resource Management Factor	.287	.045	6.439	.000	.522	1.917
	Project Information Management Factor	.116	.045	2.559	.011	.456	2.195
	Project Performance Management Factor	.047	.036	1.279	.202	.601	1.664
	Project Quality Management Factor	.055	.076	.716	.474	.438	2.282

a. Dependent Variable: Project Scope Management Factor

Source: Field survey 2013

$$PS_p = 0.261 + 0.302PT + 0.139PC + 0.287PH + 0.116PI + 0.047PP + 0.055PQ$$

4.19 PROJECT PERFORMANCE REGRESSION

The regression of *project performance level* on the explanatory variables (*cost* management factor, *scope* management factor, *time* management factor, project *quality* management factor, project *human resource* management factor, project *information* management factor and project *cost* management factor) gives an R^2 value of 0.402, as shown on table 4.83. Two inferences may be made from this observation. Firstly, only 40.2% of the variability in the ‘performance management’ performance of a project can be explained by the six explanatory variables combined. Secondly, modeling project management efficiency in terms of performance management alone cannot give a complete picture of the project situation. Project performance, though a significant variable has to be considered alongside others.

4.83: Model Summary for the project performance regression equation

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.634[a]	.402	.390	.77823

a. Predictors: (Constant), Project Scope Management Factor, Project Quality Management Factor, Project Human Resource Management Factor, Project Time Management Factor, Project Information Management Factor, Project Cost Management Factor

b. Dependent Variable: Project Performance Management Factor

Source: Field survey 2013

The critical factors as shown under table 4.84 had the following coefficients of which all factors proved to be statistically significant except for project cost, quality and scope as shown below.

4.84: Coefficients generated for project performance regression equation

Model		Unstandardized Coefficients		t	Sig.	Collinearity Statistics	
		B	Std. Error			Tolerance	VIF
1	(Constant)	1.347	.506	2.665	.008		
	Project Time Management Factor	.342	.098	-3.499	.001	.570	1.755
	Project Cost Management Factor	-.025	.148	-.168	.867	.437	2.290
	Project Human Resource Management Factor	.496	.071	7.032	.000	.534	1.873
	Project Information Management Factor	.232	.072	3.215	.001	.461	2.167
	Project Quality Management Factor	.194	.121	1.597	.111	.441	2.267
	Project Scope Management Factor	.119	.093	1.279	.202	.488	2.049

a. Dependent Variable: Project Performance Management Factor

Source: Field survey 2013

Hence the GLM is given by

$$PP_p \quad = \quad 1.347 + 0.342PT - 0.025PC + 0.496PH + 0.232PI + 0.194PQ + 0.119PS$$

4.20 PROJECT HUMAN RESOURCE MANAGEMENT REGRESSION EQUATION

The regression of *project human resource performance* on the explanatory variables (*performance* management factor, *scope* management factor, *time* management factor, project *quality* management factor, project *cost* management factor, project *information* management factor and project *performance* management factor) gives an R^2 value of 0.543, as shown on table 4.85. Two inferences may be made from this observation. Firstly, only 54.3% of the variability in the human resource performance of a project can be explained by the six explanatory variables combined. Secondly, modeling project management efficiency in terms of human resource performance alone cannot give a complete picture of the project situation. The project human resources have to be considered with others.

4.85: Model Summary for the human resource management regression equation

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.737[a]	.543	.534	.59567

a. Predictors: (Constant), Project Performance Management Factor, Project Time Management Factor, Project Quality Management Factor, Project Scope Management Factor, Project Information Management Factor, Project Cost Management Factor

b. Dependent Variable: Project Human Resource Management Factor

Source: Field survey 2013

The critical factors as shown under table 4.86 are statistically significant except the factors of project cost and time; and have the following coefficients developed from the model.

4.86: Coefficients for the human resource management regression equation

Model	Unstandardized Coefficients		t	Sig.	Collinearity Statistics	
	B	Std. Error			Tolerance	VIF
(Constant)	.850	.389	2.187	.030		
Project Time Management Factor	-.140	.076	-1.841	.067	.553	1.807
Project Cost Management Factor	.238	.112	2.123	.035	.443	2.255
Project Information Management Factor	.278	.054	5.156	.000	.486	2.057
Project Quality Management Factor	-.310	.092	-3.384	.001	.454	2.200
Project Scope Management Factor	.431	.067	6.439	.000	.554	1.805
Project Performance Management Factor	.291	.041	7.032	.000	.698	1.432

a. Dependent Variable: Project Human Resource Management Factor

Source: Field survey 2013

$$PH_p = 0.850 - 0.140PT + 0.238PC + 0.278PI - 0.310PQ + 0.431PS + 0.291PP$$

4.21 PROJECT INFORMATION MANAGEMENT REGRESSION EQUATION

The regression of *project information performance* on the explanatory variables (*performance* management factor, *scope* management factor, *time* management factor, project *quality* management factor, project *human resource* management factor, project *cost* management factor and project performance management factor) gives an R^2 value of 0.554, as shown on table 4.87. Two conclusions may be drawn from this observation. Firstly, only 55.4% of the variability in the information performance of a project can be explained by the six explanatory variables combined. Secondly, modeling project management efficiency in terms of information performance alone cannot give a complete picture of the project situation. Project information management has to be considered alongside others.

4.87: Model Summary for the project information model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.745[a]	.554	.545	.61855

a. Predictors: (Constant), Project Human Resource Management Factor, Project Time Management Factor, Project Quality Management Factor, Project Performance Management Factor, Project Scope Management Factor, Project Cost Management Factor

b. Dependent Variable: Project Information Management Factor

Source: Field survey 2013

All the critical factors except for the project time and cost were statistically significant and have the following coefficients as shown under under table 4.88 below.

Table 4.88: Coefficients generated for the project information regression equation

Model		Unstandardized Coefficients		t	Sig.	Collinearity Statistics	
		B	Std. Error			Tolerance	VIF
1	(Constant)	-2.270	.385	-5.903	.000		
	Project Time Management Factor	.160	.079	2.033	.043	.555	1.803
	Project Cost Management Factor	.198	.117	1.701	.090	.441	2.268
	Project Quality Management Factor	.415	.094	4.426	.000	.467	2.143
	Project Scope Management Factor	.188	.074	2.559	.011	.496	2.016
	Project Performance Management Factor	.147	.046	3.215	.001	.619	1.616
	Project Human Resource Management Factor	.299	.058	5.156	.000	.498	2.006

a. Dependent Variable: Project Information Management Factor

Source: Field survey 2013

$$PI_p = -2.270 + 0.160PT + 0.198PC + 0.415PQ + 0.188PS + 0.147PP + 0.299PH$$

The factor is dropped from the final model because its unit derived in the regression is not reliable and realistic. However, this may imply that the factor has been compounded by the other critical factors already discussed above. Hence we remain with only six factors to produce the final model of project management which includes project cost, quality, time, human resource, performance and scope.

4.22 AN AMALGAMATED MODEL OF PROJECT MANAGEMENT EFFICIENCY

In Sections 4.15 – 4.21 before, each of the seven aspects of project performance was separately regressed against a set of six explanatory variables based on consultants' and contractors' views on their levels of performance and the ranking of the importance of the factors in their projects. The argument was that *the level of project management effectiveness* of a consultant (or a contractor) is influenced by the *rankings of the importance of project management factors*, because all the factors are important anyway. It was deduced that the assessment of project management efficiency cannot be comprehensively done by consideration of any one or two of the aspects alone. Therefore, the more realistic approach to the modeling of project performance is *to consider all the aspects simultaneously*, either in a multivariate regression scenario or a similar functional relationship.

If consultants rank project management factors highly, they will pay great attention to all of them, and as a result their projects will be relatively more successful. This is because of the cause and effect relationship which does naturally exist between *assignment of importance* of a factor in a project and *the effort applied* to address the related aspects in the execution of the project. The main determinant of project failure or success is the performance of project participants. This does not downplay the influence of a contractor, but it recognizes that the responsibility for project results rests more with the consultants than with the contractor. Therefore, in a given project, the performance of consultants (+ contractor[s]) in respect of all the seven aspects of project management can be logically combined to make a combined measure of the project management efficiency in the project. Accordingly, an amalgamated general model which can be used to evaluate projects may therefore be stated as follows: -

$PME_{cs\&cr}$ = fn (PT_p, PC_p, PQ_p, PI_p, PS_p, PH_p, PP_p)

Where: **PMEcs&cr** is project performance efficiency (considering consultants & contractor[s]).

Fn means 'function of' (influenced by).

PC_p function will give us the performance of a given project in terms of cost as evaluated using different factors; PP_p is the performance of the construction process as per coordination processes evaluated using different factors; PH_p is the performance of human resources in a given project; PS_p is the performance of scope; PT_p is the performance of time; PQ_p is the performance of quality as analyzed.

This concept is the one adopted in the model building in Chapter 5 later. This model reflects the consultants' *plus* contractors' management efficiency score, which is 82% of the overall performance, as observed in the literature review (see Section 2.3).

Clients also play a significant role in the performance of projects and their contribution to the overall performance is 18%, bringing the total to 100% (i.e. 82% + 18%). The clients' views on project performance are discussed in the next section.

4.23 CLIENTS' DATA ANALYSIS RESULTS

This section discusses the factors contributing to the formalization of the project management model and scope definition. It also looks at the factors affecting project management functions for projects and thus supports the proposed predictive project management model in construction in Kenya.

Out of a targeted sample size of 80 clients only 32 responded. The sample units were project managers and technical personnel in the clients' organization. The response rate is at 40% for this group. Clients play a significant role to the success or failure of projects depending on how they define the scope and relate to both consultants and contractors.

Data used was collected from various clients in both public and private organizations in Kenya. The sample size captured a total number of 32 clients who provided the basic information required to support the proposed model for project management in construction in Kenya.

4.23.1 Projects Usually Undertaken by the Organization

Respondents were asked to rate the kinds of the projects undertaken by various clients. The results are as summarized in table 4.104 below:

Table 4.104: Projects undertaken by the Organization verses type of Client Cross tabulation

			Type of Client		Total
			Public	Private	
Projects undertaken by the Organization	All Projects	Count	12	4	16
		% within Projects undertaken by the Organization	75.0%	25.0%	100.0%
	Not all Projects	Count	7	9	14
		% within Projects undertaken by the Organization	43.75%	56.25%	100.0%
Total		Count	19	13	32
		% within Projects undertaken by the Organization	59.38%	40.62%	100.0%

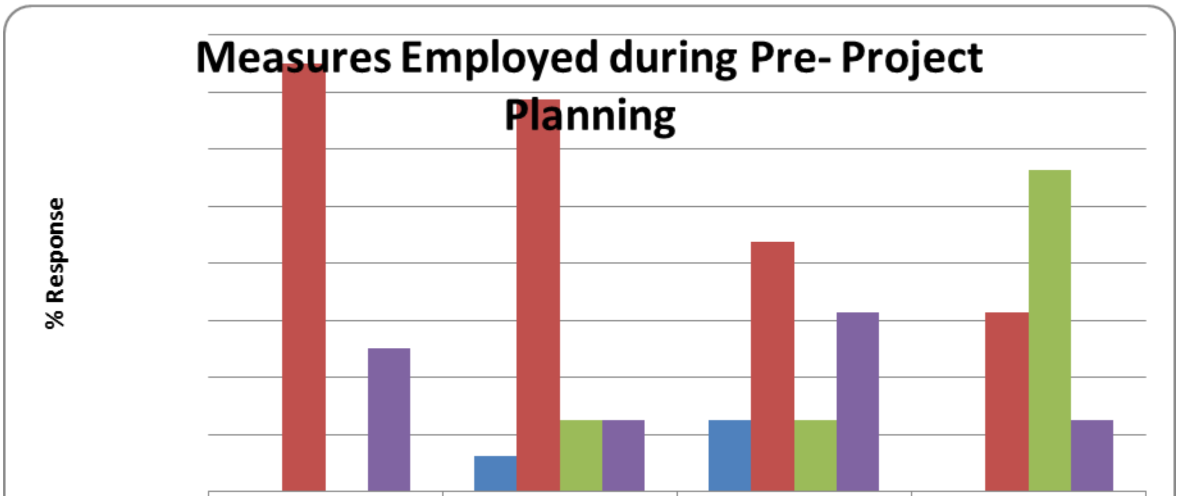
Source: Field survey 2013

Types of projects undertaken by various organizations were classified under two categories of clients: Public and Private. Out of the 32 clients interviewed 59.38% were public clients while 40.62% were private clients. Out of the 50% or 16 clients who were involved in all categories of projects; 75% of public clients performed all projects as compared to 25% of the private clients. Of the remaining 50% who did not execute all projects; they comprised 43.75% and 56.25% for public and private clients respectively.

4.23.2 Factors Employed During Pre-Project Planning

An investigation was sought on the clients' roles in scope definition. The scope of the project was looked at the pre-planning stage of the project. Measures that were considered during the pre-project planning were rated to what extent they are employed in various organizations. Proper scope definition by clients can go a long way in improving project management for the construction industry because consultants can be evaluated at intervals and variations tracking can be managed better.

Based on figure 4.17 below only 25% of the clients agreed to often using a formal scope definition process; 12.5% used an assigned team to specifically tackle scope definition whereas 31.3% had a written procedure to define roles and finally 12.5% used sufficiency of time and budget allocation as a measure. All in all scope definition process in Kenya can be said to be unsatisfactory with 75% of respondents indicating that they never use any formal process. 75% equally do not assign any client teams to tackle this issue; 56.3% do not have any written procedure defining roles for teams and 31.1% do not even use time allocation and budget as a measure while 56.3% sometimes use this as a measure. Without proper scope definition; then, it will be difficult for consultants to be held into account given that scope management is one of the key project performance factors. The most important roles of clients are in scope definition and financing of projects as per Fig 4.17 below.



	A formal process for defining needs	A team assigned for pre-project planning	A written procedure defining roles for team	Suffiecent time and budget allocated for pre-project planning
Never		6.3	12.5	
Rarely	75	68.8	43.8	31.3
Sometimes		12.5	12.5	56.3
Often	25	12.5	31.3	12.5

Figure 4.17: Measures employed during pre-project planning

Source: Field survey 2013

4.23.3 Risk Factors Considered During Pre-Project Planning

Majority of the respondents often consider most of the risk factors before they undertake any project. Budget cost was the most highly rated risk factor to be considered during pre-project planning (93.8%), planning regulations (87.5%), contract duration & safety and health were rated at 81.3% [Figure 4.18].

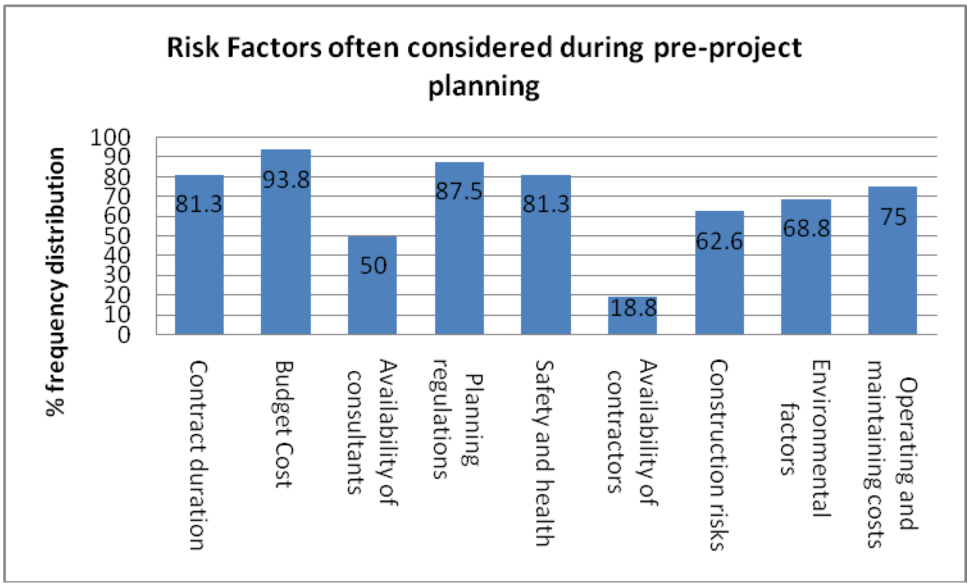


Figure 4.18: Risk factors considered during pre-project planning

Source: Field survey 2013

An investigation was also sought to establish clients' take on various construction risks which are in turn used to evaluate or measure project management results. The research established as shown on figure 4.18 that most of the respondents took the listed risks seriously. Most clients considered budgeted cost or cost of the project as the most important factor at 93.8%, followed by planning regulations at 87.5%, contract duration (time) at 81.3%, safety and health at 81.3%, operating and maintenance costs at 75%, environmental factors at 68.8%, construction risks at 62.6%, availability of consultants at 50% and lastly availability of contractors at 18.8%.

The implication is that contractors' availability is not taken as a serious risk because there are many capable contractors and with a meticulous procurement approach; a capable contractor can always be identified. Likewise availability of consultants is also not taken very seriously at 50% because there are many qualified consultants/professionals and a good referral approach can always yield a capable consultant. Interestingly construction risks are ranked lowly. Generally clients would like to see construction projects executed at budgeted costs; timely, meeting planning regulations, with a good health and safety record and at reasonable operating and maintenance costs. The aforementioned, constitute project management performance criteria as far as clients are concerned.

Table 4.105 below summarizes how respondents considered risks prior to commencement of projects

Table 4.105: Risk Factors considered during pre-project planning in (%)

Risk Factors/Ratings	Never	Rarely	Sometimes	Often	Very often
Availability of consultants		12.5	37.5	37.5	12.5
Availability of contractors		75	6.3	12.5	6.3
Budget Cost			6.3	75	18.8
Construction risks		6.3	31.3	56.3	6.3
Contract duration			18.8	50	31.3
Environmental factors		6.3	25	62.5	6.3
Operating and maintaining costs	6.3		18.8	75	
Planning regulations		6.3	6.3	75	12.5
Safety and health		6.3	12.5	68.8	12.5

Source: Field survey 2013

4.23.4 Factors Considered During Project Management Execution Plan

Table 4.106: Factors in Project Execution plan in (%)

Factors in Project Execution plan	Rarely	Sometimes	Often	Very often
Assessing project environment	12.5%	56.3%	31.3%	
Commissioning and hand over procedures	6.3%	12.5%	68.8%	12.5%
Developing project objectives		18.8%	75%	6.3%
Financing the project	12.5%	25%	56.3%	6.3%
Health and safety plan		18.8%	81.3%	
Organizational resourcing and project definition	6.3%	56.3%	37.5%	
Planning and cost control			75%	25%
Procurement approach			87.5%	12.5%
Quality control and environment plans		25%	75%	
Safety and construction strategy	50%	25%	25%	
Use of value management and engineering procedures	12.5%	12.5%	75%	

Source: Field survey 2013

Clients' respondents were asked to identify the major considerations for clients while evaluating the project management execution strategies. The indicators are crucial to the measurement of success or failure of projects. This question was to authenticate the responses from project consultants on key project management performance indicators. This question was also to validate the responses in the previous question on some of the responses. Proper execution is the dependent variable while the rest are independent variables. The overall ranking on the variables when using scores often and very often are as follows;

Table 4.107 Factors in project execution plan considerations ranked

Factors in Project Execution Plan	Score (%)	Rank
Planning and cost control	100%	1
Procurement approach	100%	1
Commissioning and handing over procedures	81.3%	3
Developing project objectives	81.3%	3
Health and safety plan	81.3%	3
Quality control and environmental plans	75	6
Use of value management and engineering procedures	75	6
Financing the project	62.8	8
Organization resourcing and project definition	37.5	9
Assessing project environment	31.3	10
Safety and construction strategy	25	11

Source: Field survey 2013

Planning and cost control and procurement approach factors were the most considered by construction clients. The next set of factors considered were commissioning and handing over procedures, developing project objectives, health and safety plan at 81.3%. Quality control and environmental plans and use of value management and engineering procedures at 75% were ranked 6th most important. Financing the project at 62.8% and ranked at position 8 finished the factors that are most crucial. Organization resourcing and project definition, assessing the project environment and safety and construction strategy were the least important at 37.5%, 31.3% and 25% respectively. The observations from this question tally with the previous question especially on health and safety and the importance attached to costing and quality as shown in figure 4.19 below.

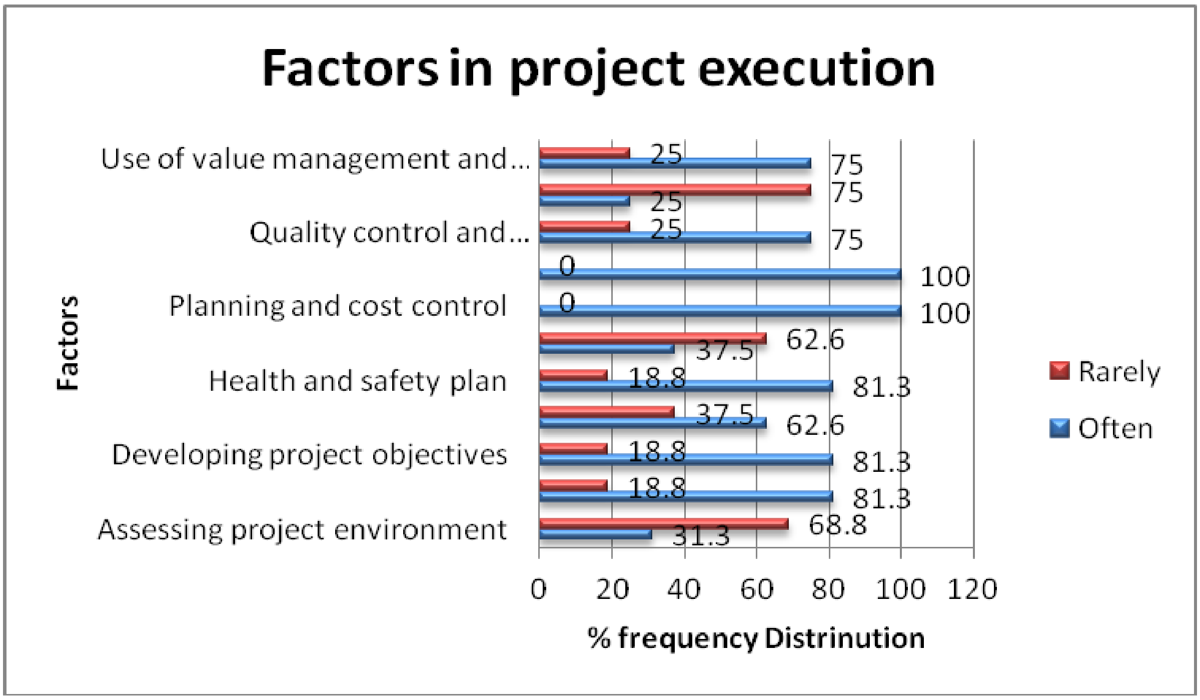


Figure 4.19: Factors considered in project execution plan

Source: Field survey 2013

4.23.5 Tools Used By Companies during Pre-Project Planning

The clients apply/use project tools as pre-planning project management strategies. Table 4.108 illustrates the level of current tools under use in Kenya.

Table 4.108: Tools used by companies during pre-project planning in (%)

Tools Used	Never	Rarely	Sometimes	Often	Very often	Ranking
Agreement matrix	37.5 %	43.8 %	12.5%			8
Alignment thermometer	31.3 %	25%	37.5%			9
Benchmarking	6.3%	75%		6.3%		7
Brainstorming		18.8 %	43.8%	31.3 %	6.3%	2
Lesson leartnt from previous projects		6.3%	37.5%	43.8 %	12.5%	1
Management by objectives		18.8 %	43.8%	18.8 %	12.5%	6
Project definition rating index (PDRI)	18.8 %	75%				10
Scope definition checklist		25%	31.3%	37.5		3

				%		
Value engineering programs	6.3%	12.5 %	37.5%	37.5 %		3
Work process flow diagram		12.5 %	50%	37.5 %		3

Source: Field survey 2013

The use of indicated tools during pre-project planning as part of project management strategies is dismal. Lessons learnt from previous projects at 66.3% is the only reasonably considered factor. The rest like project definition index is rarely or never used at 93.8%. Other factors not usually used are agreement matrix, alignment thermometer and benchmarking. Scope definition checklist, value engineering and brainstorming are inadequately used at 37.5%. Ideally, clients play a significant role in construction projects and clear scope definition is useful. The role of clients in construction projects can be rated at 18% overall for successful projects execution otherwise if they do not cooperate with consultants, it is very rare for project performance to achieve above 70% on overall performance success. The perfection of these tools usage will go a long way in ensuring efficiency in the construction industry with closer coordination, monitoring and evaluation of the performance of construction projects.

4.24 PRE-PROJECT MANAGEMENT PERFORMANCE INDICATORS

This section handles performance indicators from the clients' perspective. Early project management requirement indicators used to refine scope definition and management are discussed under section 4.24.1 while level of usage of project management tools are discussed under subsection 4.24.2 Factors crucial for the formalization of the projects evaluation model are handled under section 4.24.3. Sections 4.24.4 and 4.24.5 deal with factor analysis in relation to project management indicators while sections 4.24.6 and 4.24.7 deal with the role of the clients organizations towards project procurement strategies.

4.24.1 Early Project Management Requirement Indications

An investigation was sought to establish the occurrence of early project management requirements problems attributed to clients. The results are presented under table 4.109 below. It was established that clients authorized project execution before completing pre-project planning, allocated insufficient time for conducting pre-project planning and experienced poorly established priorities between project objectives all at 81.3%. Other factors which occurred as part of early project management problems include; lack of leadership at 75.1% and poor communication between team members at 50%; which can be considered neither a serious problem nor not a problem as such. The rest of the indicators were not significant problems as per the table hereunder with lack of experience with new technology and unclear definition of team members' roles at 18.8% indicating that the two factors are insignificant problems. The indication is that in Kenya new technology is embraced readily and team members' roles are clearly identified.

Table 4.109: Occurrences of pre-planning performance problems in (%)

Performance Indicators	Never	Rarely	Sometimes	Often	Very often	Often and very often combined	Ranking
Authorization of Project execution before designs		12.5	6.3	18.8	62.5	81.3	1
Insufficient budget for pre-project planning		12.5	6.3	43.8	37.5	81.3	1
Insufficient time for conducting pre-project planning	6.3	6.3	50	12.5	25	37.5	8
Lack of a clear process for pre-project planning	6.3	25	25	18.8	25	43.8	7
Lack of experience with new technology	6.3	12.5	62.5	6.3	12.5	18.8	9
Lack of leadership	6.3	12.5	6.3	43.8	31.3	75.1	4
Lack of team skills	12.5	31.3	6.3	43.8	6.3	50.1	5
Poor communication between team members		12.5	37.5	37.5	12.5	50	6
Poorly established priorities between project objectives		18.8		50	31.3	81.3	1
Unclear definition of team members' roles		43.8	37.5	12.5	6.3	18.8	9

Source: Field survey 2013

4.24.2 Use of Project Management Tools in Scope Definition

Respondents were asked to rate how often they employed various project management tools while defining scope. Prepare conceptual estimates, define deliverables, document project scope and preliminary design are the mostly used tools. On the other hand use of partnership approach to spread risk, use of tools for evaluating completeness of scope before start of detailed design is rarely used. More details are on figure 4.20 below. Since some of the tools are strongly used and others rarely used it cannot be concluded that the construction industry in Kenya is superior or inferior to the other developing countries. However developed countries have perfected these tools and they use all of them but mutually exclusively.

Respondents were asked to rate how often they employ various factors while defining the scope. It was noted that 93.8% of the respondents rarely use partnership approach to spread risk as a tool to scope definition, while 100% confirmed conceptual estimates forms a crucial tool when producing a scope definition. Figure 4.20 below shows the summary on how often various tools are used while defining a scope.

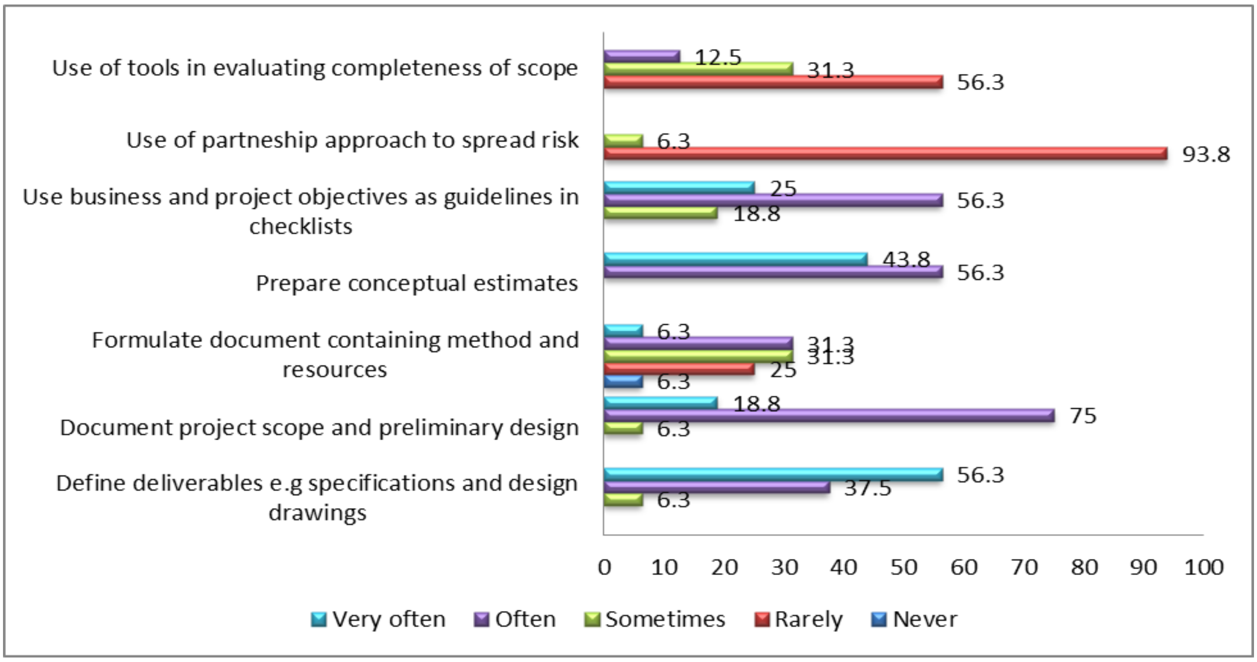


Figure 4.20: Factors employed while defining scope production

Source: Field survey 2013

4.24.3 Formalization of Project Management Model in Kenya

Table 4.110 below shows the frequency distribution on the factors that formalizes the model for project management. It's clearly shown that all factors are considered to be critical for model formation.

Table 4.110: Formalization of project management model in (%)

Factors for Model Formalization	Uncertain	Less important	Important	Very Important	Very important & important combined	Ranking
Acceptable quality			12.5	87.5	100	1
Completion within budget		6.3	12.5	81.3	93.8	3
Completion within time	6.3		12.5	81.3	93.8	3
Documented procedures	6.3		50	43.8	93.8	3
Environmental sustainability	6.3		62.5	31.3	93.8	3
Policy and procedure manuals	6.3		68.8	25	93.8	3
Satisfaction of client's objectives			62.5	37.5	93.8	3
Satisfaction of project users	12.5		50	37.5	87.5	9
Scope definition and management			25	75	100	1

Source: Field survey 2013

After thorough literature review and formulation of research instruments; a number of factors considered important towards a formalized project management model were evaluated. From table 4.110 it is clearly shown that all factors are considered to be critical for model development. All the nine factors are considered to be 87.5% to 100% when using important or very important combined as a measure. This is an indication of the importance attached to them by clients towards a formalized project management model. For better analysis the researcher opted to subject the variables to factor analysis.

4.23.4 Factor Analysis

On the factors contributing to the formalization of project management modeling it was found appropriate to carry out Factor analysis as a data reduction tool. In particular Principal Component Analysis was found appropriate despite the low sample size since the KMO Measure of Sampling Adequacy was approximately 0.5 as required and Bartlett's Test of Sphericity were appropriate and was <0.001 as shown under table 4.111 below.

Table 4.111 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.494
Bartlett's Test of Sphericity	Approx. Chi-Square	359.233
	df	36
	Sig.	.000

Source: Field survey 2013

4.112 Descriptive Statistics on Client factors

	Mean	Std. Deviation	Ranking
Scope definition and management	4.7500	.43994	2
Completion within budget	4.6875	.78030	4
Completion within time	4.7500	.56796	2
Acceptable quality	4.8750	.33601	1
Policy and procedure manuals	4.1875	.53506	9
Satisfaction of client's objectives	4.3750	.49187	5
Environmental sustainability	4.2500	.56796	7
Satisfaction of project users	4.2500	.67202	7
Documented procedures	4.3750	.60907	5

Source: Field survey 2013

As far as clients are concerned and based on table 4.112 above; the key issues to be cured by the model include quality, cost, time, scope, satisfaction of objectives meaning project performance and environmental sustainability. The only missing factor but which is analyzed elsewhere is human resource performance. Descriptive statistics demonstrated that all factors were critical as they were having a mean of 4 and above out of 5. Figure 4.21 below demonstrates the cumulative percentages distribution in respect to important and least important.

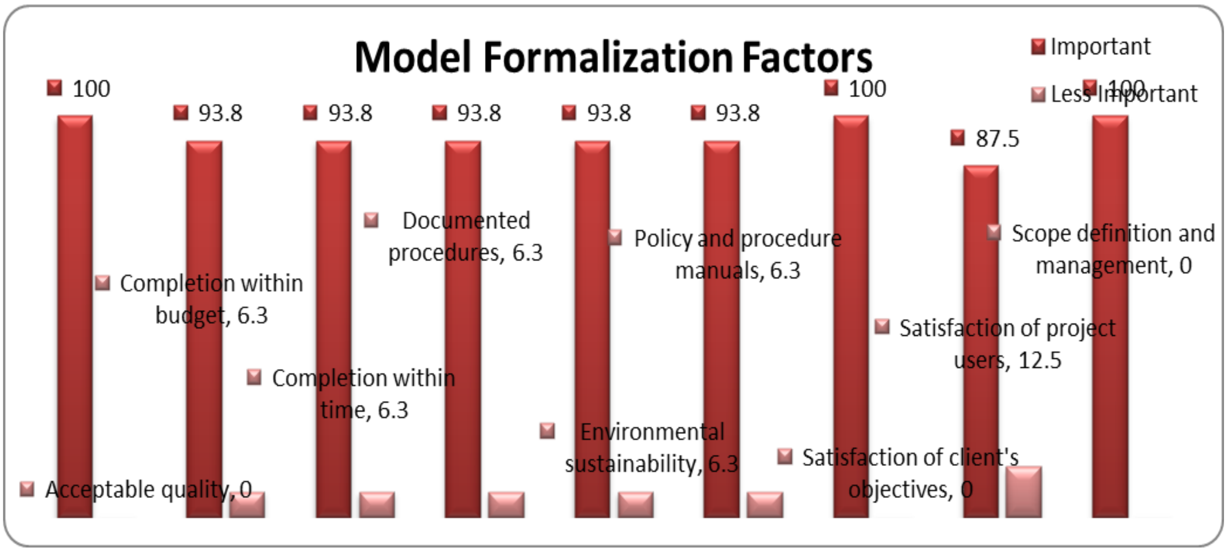


Figure 4.21 Model formalization factors

Source: Field survey 2013

Thus the analysis was done and the following factors were extracted into two components with their respective communalities as shown below.

Table 4.113: Communalities for clients modeling

	Initial	Extraction
Scope definition and management	1.000	.677
Completion within budget	1.000	.945
Completion within time	1.000	.962
Acceptable quality	1.000	.803
Policy and procedure manuals	1.000	.756
Satisfaction of client's objectives	1.000	.736
Environmental sustainability	1.000	.833
Satisfaction of project users	1.000	.813
Documented procedures	1.000	.631

Extraction Method: Principal Component Analysis.
Source: Field survey 2013

Table 4.114: Rotated Component Matrix[a] for clients modeling factors

	Component	
	1	2
Scope definition and management	.823	-.002
Completion within budget	.952	.195
Completion within time	.954	.229
Acceptable quality	.886	.132
Policy and procedure manuals	.119	.861
Satisfaction of client's objectives	-.332	.791
Environmental sustainability	.468	.784
Satisfaction of project users	.363	.825
Documented procedures	.155	.779

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.
Source: Field survey 2013

Two components were loaded. Component one can be renamed project management efficiency and component two project execution effectiveness. The most important variables are scope definition and management, completion within budget, within time and to acceptable quality. Others are policy and procedure manuals and satisfaction of project users.

All factors forms variability of above the threshold of 60% with documenting the procedures being the least with 63.1% variability as compared to completion within time at 96.2% amongst others. ***Therefore the client check analysis justifies that the developed project management evaluation model in Kenyan industry is indeed predictive, that is:***

$$PME_{cs\&cr} = fn(PT_p, PC_p, PQ_p, PI_p, PS_p, PH_p, PP_p)$$

This model measures up to 82% for consultants' project management rating. To finalize the model, 18% was allocated to clients' contribution in projects performance to make a total of 100%. Key indicators for clients are project scope definition, time for honouring consultants' payments, time for honouring contractors' payments and cooperation to project design team and implementation team. However, parties are free to modify the client measurement criteria which should account for 18% of projects performance. An overall score of say 80% for clients performance will account for (80% of 18% project performance = 14.4%) the score is then added to the consultants' score to get a cumulative score for the project.

4.23.5: Factors that Contribute to the Formalization of Project Management Model

Table 4.115: Factor that contribute to the formalization of project management model

	Mean	Std. Deviation	Rank
Scope definition and management	4.7500	.43994	2
Completion within budget	4.6875	.78030	4
Completion within time	4.7500	.56796	2
Acceptable quality	4.8750	.33601	1
Policy and procedure manuals	4.1875	.53506	9
Satisfaction of client's objectives	4.3750	.49187	5
Environmental sustainability	4.2500	.56796	7
Satisfaction of project users	4.2500	.67202	7
Documented procedures	4.3750	.60907	5

Source: Field survey 2013

Descriptive statistics demonstrated that all factors were critical as they were having a mean of 4 and above as shown in table 4.115 above. Figure 4.22 below demonstrates the cumulative percentages distribution in respect to important and least important.

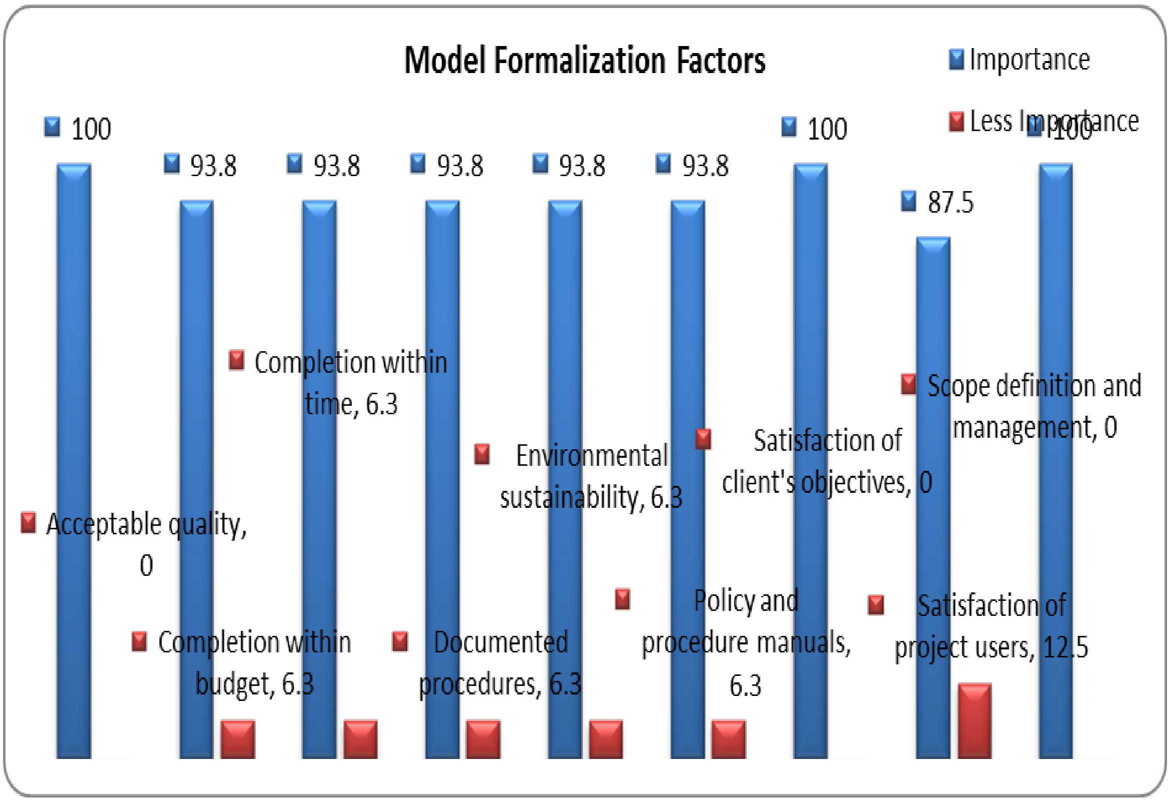


Figure 4.22 Importance of formalization factors

Source: Field survey 2013

4.24.6 Project Objectives Alignment on Current Project Procurement Strategies

For any organization to align its objectives on the current existing models, they have to use the following measures as shown in table 4.116 below. All respondents confirmed that they often have regular meetings to keep communications open, 87.6% ensured appropriate stakeholders representation as well as use of teamwork which was having the same weight. In general all measures were considered positively for the alignment of project objectives when using current models of project management.

Table 4.116: Measures used to align the project objectives on current project management models in (%)

Measures on Project alignment	Rarely	Sometimes	Often	Very often
Assess and identify potential areas of disagreement		12.5%	62.5%	25%
Ensure appropriate stakeholders representations		12.5%	56.3%	31.3%
Regular meetings to keep communications open			43.8%	56.3%
Use of contractors		37.5%	56.3%	6.3%
Use of specialists	6.3%	12.5%	43.8%	37.5%
Use of sub-contractors		50%	43.8%	6.3%
Use of tools to ensure team agreement	18.8%	25%	56.3%	
Use of tools to ensure team focus on objectives	18.8%	18.8%	56.3%	6.3%
Use teamwork and team building programs	6.3%	6.3%	68.8%	18.8%

Source: Field survey 2013

Further, looking at the relationship between measures which are rarely used against the most often used measures on project management, the study shows that on average 50% of subcontractors are used as a measure on project alignment. Most of the respondents confirmed that at least 80% often use most of the measures except for those ones who use team agreement and contractors and team focus measures which constituted 56.3% and 62.6% respectively.

4.24.7 Factors Affecting Project Procurement Strategies

All factors are considered to be critical in the performance of project management functions with leadership style, legislation support requirements and training & competences being rated as the most important factors, Table 4.117.

Table 4.117: Factors affecting project performance functions in (%)

Factors affecting project management functions	Least important	Less important	Uncertain	Important	Very Important
Culture	6.3%	6.3%	6.3%	37.5%	43.8%
Leadership style				12.5%	87.5%
Legislation support requirements				18.8%	81.3%
Personality traits	6.3%		12.5%	31.3%	50%
Procurement methods			6.3%	25%	68.8%
Project management approach			6.3%	12.5%	81.3%
Project management policies		6.3%		25%	68.8%
Project risk management			6.3%	12.5%	81.3%
Training and Competencies				12.5%	87.5%

Figure 4.23 below illustrates the strength of rating against individual factors, leadership style, Legislation, and training competencies constituted 100% with culture being rated the least at 81.3%. The data has a high correlation to the reporting that was reported by the practitioners in the construction industry hence showing the reliability of the data collected.

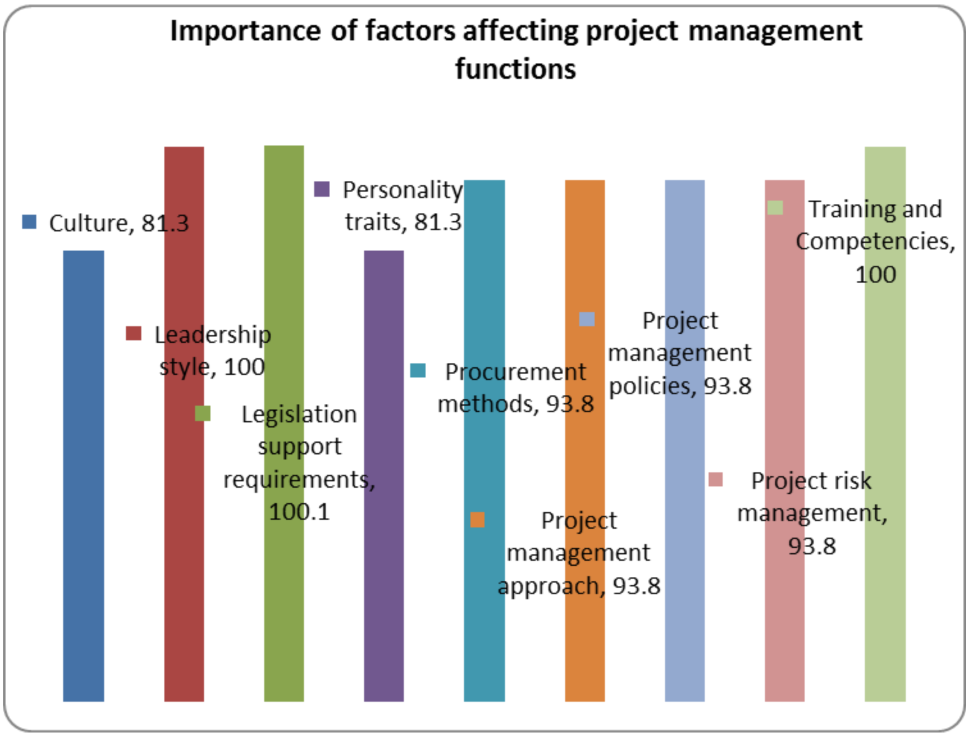


Figure 4.23 Project management functions factors

Source: Field survey 2013

4.25 CONSULTANTS' VIEWS ON PROJECT MANAGEMENT

Respondents were asked to express their opinions on the current status of project management in Kenya towards effective and efficient execution of projects. Some of the emerging views were as follows:-

(i) That the roles of project managers should be clearly defined and certification of project managers is required to ensure quality of project management in ensuring projects execution efficiency in Kenya.

(ii) That with even unstructured and minimal application of project management to construction projects; has resulted in effective and efficient execution of construction projects. If a more structured form with measures is adopted then the results will be tremendous.

(iii) That there is need for early inclusion of project managers in construction projects execution.

(iv) That there should be building information modeling systems as an approach to modern construction and design should be introduced to project managers early so as to achieve quality, cost and timely projects execution

(v) That the role of project management in construction projects is gradually getting indispensable as projects get more complex and bigger.

(vi) That project management provides a useful way to enable clients to better interact with financial institutions, authorities, consultants and contractors especially on large projects and for clients who may be green to construction.

(vii) That there is need for regulation in the practice of project management. Currently everybody is calling himself/herself a project manager without requisite qualifications and evaluation criteria.

(viii) That for efficiency and effectiveness as a result of project management in Kenya; there is need for all stakeholders to adopt it, must appreciate it and practice it. The design team and employers particularly must do so; so that a lot of gaps in design and execution are filled.

(ix) That project management is not properly regulated; therefore, usually practiced by unprofessional persons aiming for a quick profit.

(x) That architects have refused to embrace it.

(xi) That currently construction project management as practiced in the industry appears to be informal and unstructured being performed by professionals with no or little formal training in the discipline. As a result projects and clients rarely receive the optimal benefits touted by the practitioners.

(xii) That project managers are just taking the role of coordinating and delivering project from the Architects and Engineers. The consultants are generally reluctant to take on a project manager because they relinquish control. While clients see them as another fee expense yet a good project manager can really help a project to actualize the set objectives.

(xiii) That the role of project management should be transferred from present to future meaning a qualified person with project management skills should be at the top of the projects; managing specifically the scope and time since cost is already taken care of by the Project Quantity Surveyor (PQS).

(xiv) That currently the concept of project management has not been fully embraced. However with proper structuring of project management can give good results for both the client and the consultant, this will also require proper definition of roles to avoid overlapping roles of individual consultants.

4.26 VIEWS ON APPLICATION OF PROJECT MANAGEMENT MODELING IN KENYA.

The following observations were raised by respondents.

(1) That there is currently non-application of any structured project management modeling in Kenya.

(2) That application of structured project management shall ensure effective and efficient execution of construction projects.

(3) That all consultants and contractors should be facilitated to attend training on project management modeling. This would ensure both parties have the same baseline in assessing the performance of contractors in various projects and also ensure all parties can independently verify the timelines and cost in project implementation.

(4) That application of project management modeling has been without regulation and haphazard in Kenya resulting in less than optimal planning and quality of

services to clients and financiers leaving a lot to be desired. This is as far as this research is concerned a key concern that has been treated with a formalized project management model application in Kenya.

(5) That project management modeling is only appreciated in theory; practical aspects have not been appreciated yet.

(6) That project management concepts and modeling should be localized to adapt the current situation in Kenya; a developing economy.

(7) That unlike in the developed world, project management modeling in Kenya is still a long way to go. Many of our professionals still do not know when and how to engage project management modeling.

(8) That proper application of project management would greatly improve the efficiency and effectiveness in execution of construction projects.

(9) That there exists a threat in terms of corruption in execution of project which will affect the application and implementation of project management modeling.

(10) That project management modeling should be implemented progressively to control the construction implementation challenges as they arise.

(11) That project management models used in the west or eastern economies may not work in the African setting. Professionals in this field should develop a modified system that caters for Africa's unique conditions and for Kenya in this particular instance.

(12) That if properly applied the benefits will be great.

(13) That the actors in the construction industry do not appear to have been properly sensitized to the process and the benefits to be derived from project management modeling application. More education and marketing needs to be done by properly qualified practitioners.

(14) That if put into practice a lot will be achieved like having the right management tools which will help on tracking the projects as they progress.

(15) That if properly applied it will add value to the entire building team in all aspects, of project from inception stage, design, tendering, implementation and the end product to the user. Currently the results are not fully realized because of improper and or no application of project management modeling.

(16) That proper application of project management modeling will make tracking and running of projects an easy task with tangible results.

4.27 CLIENT VIEWS ON PROJECT MANAGEMENT

Clients through their project managers were asked to give their opinions on the current status of project management in Kenya towards effective and efficient execution of projects. Most of the clients indicated that they prefer traditional arrangement but still wanted to maintain a strong presence while project implementation is underway. They also observed that a lot of potential does exist especially with the new tools now available to assist in project management application. It was also noted that there is a big difference between projects where project management is employed with those that do not.

They finally indicated that they would prefer to be proactively engaged in scope definition, project management and evaluation of project performance results. They concurred for a structured project management application in Kenya.

From the foregoing it is noted that by adopting a structured project management model application shall ensure effective and efficient execution of construction projects. Adoption and proper implementation of project management is now inevitable.

4.28 HYPOTHESIS TESTING

The hypothesis testing equations are as below;

In our study we are interested to know whether the addition of extra indicators to the existing project evaluation model (that is cost, quality and time) would contribute significantly to efficiency of the project management evaluation model;

$$y = \beta_0 + \beta_1 X_1 + \cdots + \beta_p X_p + \epsilon_i$$

Where

y = Project performance efficiency

β = Coefficient Estimates

$X_{i...p}$ = Project management performance factors

ϵ = Error term

Therefore the null hypothesis will state as follows:

Does the addition of some group of independent variables of interest add significantly to the prediction of y obtained through other independent variables already in the model?

$$H_0 : \beta_1 = \beta_2 = \cdots = \beta_p = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \; (1.1)$$

Alternative Hypothesis will be:-

$H_1 : \beta_j \neq 0$ For at least one j, j = 1, . . . , p …………………………………..(1.2)

Rejection of H_0 implies that at least one of the regressors/factors , x1, x2, . . . , xp, contributes significantly to the model. We will use a generalization of the F-test in regression to test this hypothesis at $\alpha = 0.05$

Table 4.118: Hypothesis Testing of Between-Subjects Effects for the traditional factors of project management

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	55.724[a]	10	5.572	3.508	.000
Intercept	381.744	1	381.744	240.287	.000
Pro_time_mangment	3.530	2	1.765	1.111	.331
Pro_cost_mangment	2.516	2	1.258	.792	.454
Pro_qm_factor	10.124	2	5.062	3.186	.043
Corrected Total	519.624	302			

Dependent Variable:Name of the Profession a. R Squared = .107 (Adjusted R Squared = .077)

Source: Field survey 2013

Table 4.119: Hypothesis Testing of Between-Subjects Effects for the proposed factors of project management

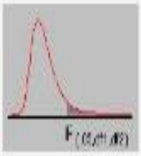
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	289.730[a]	41	7.067	8.089	.000
Intercept	576.356	1	576.356	659.715	.000
Pro_time_mangment	1.333	1	1.333	1.526	.218
Pro_cost_mangment	.000	0	.	.	.
Pro_qm_factor	39.734	2	19.867	22.741	.000
Pro_hr_managmnt	2.064	3	.688	.788	.502
Pro_sco_managemnt	.045	2	.023	.026	.974
Pro_perfoma_managmnt	29.274	4	7.318	8.377	.000
Corrected Total	515.130	299			

Dependent Variable:Name of the Profession a. R Squared = .562 (Adjusted R Squared = .493)

Source: Field survey 2013

The comparison of the two hypothesis testing tables as shown above using the f-values indicate that the f-value for table 4.118 model 1 (which compares time, cost and quality) is 3.508.

F Table for alpha=.05



df2/df1	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	INF
1	161.4476	199.5000	215.7073	224.5832	230.1619	233.9860	236.7684	238.8827	240.5433	241.8817	243.9060	245.9499	248.0131	249.0518	250.0951	251.1432	252.1957	253.2529	254.3144
2	18.5128	19.0000	19.1643	19.2468	19.2964	19.3295	19.3532	19.3710	19.3848	19.3959	19.4125	19.4291	19.4458	19.4541	19.4624	19.4707	19.4791	19.4874	19.4957
3	10.1280	9.5521	9.2766	9.1172	9.0135	8.9406	8.8867	8.8452	8.8123	8.7855	8.7446	8.7029	8.6602	8.6385	8.6166	8.5944	8.5720	8.5494	8.5264
4	7.7086	6.9443	6.5914	6.3882	6.2561	6.1631	6.0942	6.0410	5.9988	5.9644	5.9117	5.8578	5.8025	5.7744	5.7459	5.7170	5.6877	5.6581	5.6281
5	6.6079	5.7861	5.4095	5.1922	5.0503	4.9503	4.8759	4.8183	4.7725	4.7351	4.6777	4.6188	4.5581	4.5272	4.4957	4.4638	4.4314	4.3985	4.3650
6	5.9874	5.1433	4.7571	4.5337	4.3874	4.2839	4.2067	4.1468	4.0990	4.0600	3.9999	3.9381	3.8742	3.8415	3.8082	3.7743	3.7398	3.7047	3.6689
7	5.5914	4.7374	4.3468	4.1203	3.9715	3.8660	3.7870	3.7257	3.6767	3.6365	3.5747	3.5107	3.4445	3.4105	3.3758	3.3404	3.3043	3.2674	3.2298
8	5.3177	4.4590	4.0662	3.8379	3.6875	3.5806	3.5005	3.4381	3.3881	3.3472	3.2839	3.2184	3.1503	3.1152	3.0794	3.0428	3.0053	2.9669	2.9276
9	5.1174	4.2565	3.8625	3.6331	3.4817	3.3738	3.2927	3.2296	3.1789	3.1373	3.0729	3.0061	2.9365	2.9005	2.8637	2.8259	2.7872	2.7475	2.7067
10	4.9646	4.1028	3.7083	3.4780	3.3258	3.2172	3.1355	3.0717	3.0204	2.9782	2.9130	2.8450	2.7740	2.7372	2.6996	2.6609	2.6211	2.5801	2.5379
11	4.8443	3.9823	3.5874	3.3567	3.2039	3.0946	3.0123	2.9480	2.8962	2.8536	2.7876	2.7186	2.6464	2.6090	2.5705	2.5309	2.4901	2.4480	2.4045
12	4.7472	3.8853	3.4903	3.2592	3.1059	2.9961	2.9134	2.8486	2.7964	2.7534	2.6866	2.6169	2.5436	2.5055	2.4663	2.4259	2.3842	2.3410	2.2962
13	4.6672	3.8056	3.4105	3.1791	3.0254	2.9153	2.8321	2.7669	2.7144	2.6710	2.6037	2.5331	2.4589	2.4202	2.3803	2.3392	2.2966	2.2524	2.2064
14	4.6001	3.7389	3.3439	3.1122	2.9582	2.8477	2.7642	2.6987	2.6458	2.6022	2.5342	2.4630	2.3879	2.3487	2.3082	2.2664	2.2229	2.1778	2.1307
15	4.5431	3.6823	3.2874	3.0556	2.9013	2.7905	2.7066	2.6408	2.5876	2.5437	2.4753	2.4034	2.3275	2.2878	2.2468	2.2043	2.1601	2.1141	2.0658
16	4.4940	3.6337	3.2389	3.0069	2.8524	2.7413	2.6572	2.5911	2.5377	2.4935	2.4247	2.3522	2.2756	2.2354	2.1938	2.1507	2.1058	2.0589	2.0096
17	4.4513	3.5915	3.1968	2.9647	2.8100	2.6987	2.6143	2.5480	2.4943	2.4499	2.3807	2.3077	2.2304	2.1898	2.1477	2.1040	2.0584	2.0107	1.9604
18	4.4139	3.5546	3.1599	2.9277	2.7729	2.6613	2.5767	2.5102	2.4563	2.4117	2.3421	2.2686	2.1906	2.1497	2.1071	2.0629	2.0166	1.9681	1.9168
19	4.3807	3.5219	3.1274	2.8951	2.7401	2.6283	2.5435	2.4768	2.4227	2.3779	2.3080	2.2341	2.1555	2.1141	2.0712	2.0264	1.9795	1.9302	1.8780
20	4.3512	3.4928	3.0984	2.8661	2.7109	2.5990	2.5140	2.4471	2.3928	2.3479	2.2776	2.2033	2.1242	2.0825	2.0391	1.9938	1.9464	1.8963	1.8432
21	4.3248	3.4668	3.0725	2.8401	2.6848	2.5727	2.4876	2.4205	2.3660	2.3210	2.2504	2.1757	2.0960	2.0540	2.0102	1.9645	1.9165	1.8657	1.8117
22	4.3009	3.4434	3.0491	2.8167	2.6613	2.5491	2.4638	2.3965	2.3419	2.2967	2.2258	2.1508	2.0707	2.0283	1.9842	1.9380	1.8894	1.8380	1.7831
23	4.2793	3.4221	3.0280	2.7955	2.6400	2.5277	2.4422	2.3748	2.3201	2.2747	2.2036	2.1282	2.0476	2.0050	1.9605	1.9139	1.8649	1.8128	1.7570
24	4.2597	3.4028	3.0088	2.7763	2.6207	2.5082	2.4226	2.3551	2.3002	2.2547	2.1834	2.1077	2.0267	1.9838	1.9390	1.8920	1.8424	1.7896	1.7330
25	4.2417	3.3852	2.9912	2.7587	2.6030	2.4904	2.4047	2.3371	2.2821	2.2365	2.1649	2.0889	2.0075	1.9643	1.9192	1.8718	1.8217	1.7684	1.7110
26	4.2252	3.3690	2.9752	2.7426	2.5868	2.4741	2.3883	2.3205	2.2655	2.2197	2.1479	2.0716	1.9898	1.9464	1.9010	1.8533	1.8027	1.7488	1.6906
27	4.2100	3.3541	2.9604	2.7278	2.5719	2.4591	2.3732	2.3053	2.2501	2.2043	2.1323	2.0558	1.9736	1.9299	1.8842	1.8361	1.7851	1.7306	1.6717
28	4.1960	3.3404	2.9467	2.7141	2.5581	2.4453	2.3593	2.2913	2.2360	2.1900	2.1179	2.0411	1.9586	1.9147	1.8687	1.8203	1.7689	1.7138	1.6541
29	4.1830	3.3277	2.9340	2.7014	2.5454	2.4324	2.3463	2.2783	2.2229	2.1768	2.1045	2.0275	1.9446	1.9005	1.8543	1.8055	1.7537	1.6981	1.6376
30	4.1709	3.3158	2.9223	2.6896	2.5336	2.4205	2.3343	2.2662	2.2107	2.1646	2.0921	2.0148	1.9317	1.8874	1.8409	1.7918	1.7396	1.6835	1.6223
40	4.0847	3.2317	2.8387	2.6060	2.4495	2.3359	2.2490	2.1802	2.1240	2.0772	2.0035	1.9245	1.8389	1.7929	1.7444	1.6928	1.6373	1.5766	1.5089
60	4.0012	3.1504	2.7581	2.5252	2.3683	2.2541	2.1665	2.0970	2.0401	1.9926	1.9174	1.8364	1.7480	1.7001	1.6491	1.5943	1.5343	1.4673	1.3893
120	3.9201	3.0718	2.6802	2.4472	2.2899	2.1750	2.0868	2.0164	1.9588	1.9105	1.8337	1.7505	1.6587	1.6084	1.5543	1.4952	1.4290	1.3519	1.2539
inf	3.8415	2.9957	2.6049	2.3719	2.2141	2.0986	2.0096	1.9384	1.8799	1.8307	1.7522	1.6664	1.5705	1.5173	1.4591	1.3940	1.3180	1.2214	1.0000

This value is relatively lower than that of the table 4.119 model (compares time, cost, quality, scope, human resource and performance) which is 8.089. The same can be compared using the adjusted r-squared values. For project cost under table 4.119 is a Z-report implying marginal errors.

Consequently, because $f_{312(6)}cal$ = 8.089 is greater than $f_{312(3)}cal$ = 3.508 (both being greater than) the tabulated f-values; we conclude that the corrected model of the six project management factors implied by the alternate hypothesis is more efficient and effective to be applied in the construction industry in Kenya.

The F table tabulated below shows $f_{312(6)}tab$ = 2.2899 at C-1 which is less than (<) the $f_{312(6)}cal$ = 8.089. Similarly the $f_{312(3)}tab$ = 3.0718 at C-1which is less than (<) the $f_{312(3)}cal$ = 3.508. Therefore, we reject the null hypothesis and conclude that the alternate is true at the pre-determined confidence interval of 95% because we obtain better results with six variables. A further emphasis on the same is obtained with chi-square below.

It was necessary to also use chi-square to check whether modelling using three variables as compared to six variables was statistically significant. The Cross-tabulation table below shows that most respondents would prefer a 6-variable model to a 3-variabe model in construction industry in Kenya. The 6-variable total preference is 59% in the study compared with 14.8% for the three-variable model.

Table 4.120: Model preference * Model Importance Cross- tabulation

			Model Importance		
			Very Important	Least Important	Total
Model preference	For 6 Variables	Count	184	43	227
		row % of Model preference	81.1%	18.9%	100.0%
		col % of Model Importance	85.2%	44.8%	72.8%
		% of Total	59.0%	13.8%	72.8%
	For 3 Variables	Count	32	53	85
		row % of Model preference	37.6%	62.4%	100.0%
		col % of Model Importance	14.8%	55.2%	27.2%
		% of Total	10.3%	17.0%	27.2%
Total		Count	216	96	312
		row % of Model preference	69.2%	30.8%	100.0%
		col % of Model Importance	100.0%	100.0%	100.0%
		% of Total	69.2%	30.8%	100.0%

Chi square table

Table 4.121: Chi-Square Tests

	Value	df	Asymptotic Significance	Exact Significance (2-sided)	Exact Significance (1-sided)
Pearson Chi-Square	54.709[a]	1	.000		
Continuity Correction[b]	52.690	1	.000		
Likelihood Ratio	52.198	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	54.534	1	.000		
N of Valid Cases	312				

a. 0 cells (.0%) expf < 5. Min exp = 26.15...

b. Computed only for a 2x2 table

We are interested in the pearson Chi square score given at df=1, 54.709; *p*-value is 0.000 which implies that there is statistical difference between the 6-variable model and the 3-variable construction models in Kenya thereby supporting alternate hypothesis.

The symmetrical table
Table 4.122: Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.419	.000
	Cramer's V	.419	.000
N of Valid Cases		312	

The Phi and Cramer's indicate the strength of association among the variables, which is relatively good. The bar chart below captured as figure 4.24 gives the visual illustration in model preference.

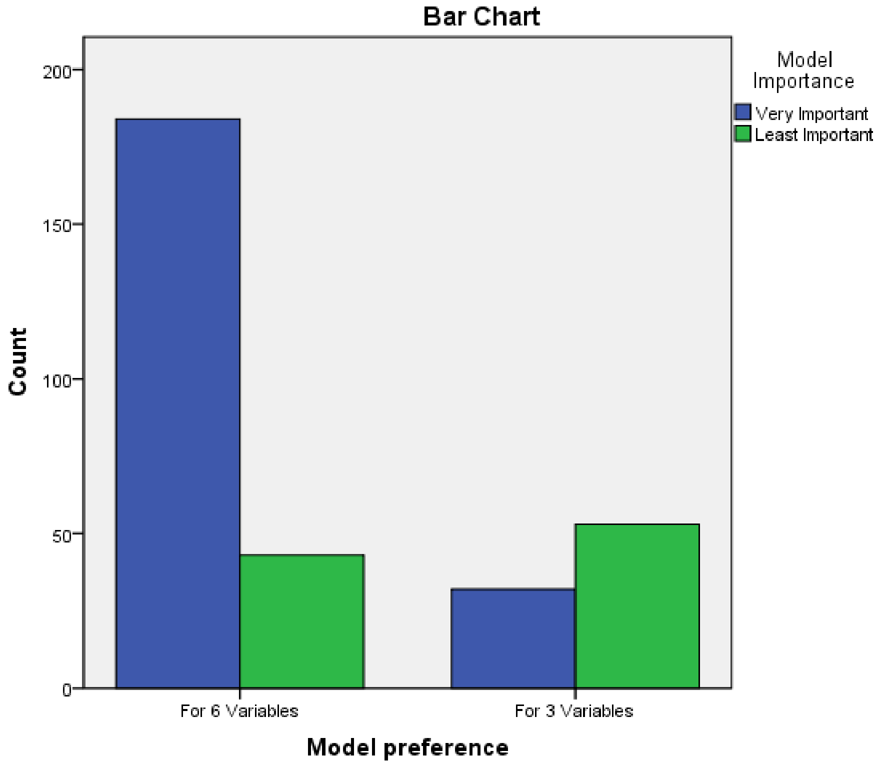


Figure 4.24: Chi-square model preference illustration

4.29 CONCLUSION

This chapter has presented the analysis of data and results obtained. The critical model formulation factors were identified using descriptive statistics, principal component analysis and regression analysis. There was a very positive response in the research and respondents answered to their best of knowledge. Generally the results are a true reflection of the situation of the construction industry in Kenya. Both the practitioners and contractors agreed on what a project management model in Kenya is supposed to comprise. It was generally appreciated that lack of a project management evaluation model has affected the efficiency and effectiveness in execution of construction projects. An appropriate model can therefore help in the performance of the construction industry in Kenya. The respondents indicated preference for diagrammatic, simulation, management matrix or stochastic models, in that order.

Finally, from the clients' and practitioners' responses, an amalgamated *project management efficiency model* was suggested, whereby 82% of the project management efficiency is assigned to consultants *plus* contractors, and 18% of the same, assigned to the client. In the next Chapter, the model building and validation processes are amplified.

CHAPTER FIVE: MODEL BUILDING AND VALIDATION

5.1 INTRODUCTION

This chapter is devoted to the explanation of the model designed for use in assessing the performance of a construction project. It is a major deliverable in this research and specifically addresses the main objective of the research that is "to formulate a project management model for the construction industry in Kenya". This is based on the performance models developed from the data analysis presented in Chapter 4.

The Chapter begins by showing the characteristics of the model. It then continues to explain the procedures used in measuring, scoring, and calculating the performance scores of practitioners, contractors and clients. In addition, it provides a guideline of how the factors that influence the indicators are estimated and related to the indicators for the monitoring and controlling part. This is accomplished by the use of Forms 1 to 4 (Appendix F), for practitioners and clients. Form 4 is a decision form for management. In addition, there is a flowchart showing the entire procedure of assessment and monitoring of the project. A computer program is then developed for final score calculations in the model. Finally, the key features of the model and its importance to clients and practitioners are outlined.

The relative average weights of each of the 6 factors of project performance are as follows shown under table 5.1a, defined as the average importance of the net of the respondents' estimated response over the entire factor effect.

Table 5.1a: Composition for the project management model factors

	PT	PC	PQ	PS	PH	PP	Totals
Least Important	0	0	0	0	0	3	3
Less Important	0	0	0	3	18	27	48
Uncertain	21	3	12	27	54	51	168
Important	66	72	84	126	129	108	585
Very Important	216	228	207	147	102	111	1011
Total	303	303	303	303	303	300	1815

5.1 b: Changing the averages for the factors above into Percentage gives **100**

Least Important	0	0	0	0	0	0.17%	0.17%
Less Important	0	0	0	0.17%	0.99%	1.49%	2.64%
Uncertain	1.16%	0.17%	0.66%	1.49%	2.98%	2.81%	9.26%
Important	3.64%	3.97%	4.63%	6.94%	7.11%	5.95%	32.23%
Very Important	11.90%	12.56%	11.40%	8.10%	5.62%	6.12%	55.70%
Total	16.69%	16.69%	16.69%	16.69%	16.69%	16.53%	100%

Sum Weights (Important and Very Important)	282	300	291	273	231	219	1596
							100
Average Weights (%)	**17.67%**	**18.80%**	**18.23%**	**17.11%**	**14.47%**	**13.72%**	**100%**

Source: Field survey 2013

From Chapter 4, our functional relationship equation which was stated:

$PME_{cs\&cr} = fn(PT_p, PC_p, PQ_p, PI_p, PS_p, PH_p, PP_p)$ (see Section 4.22)

From Table 5.1a&b, the functional relationship may reasonably be specified as:

$$PME_{cs\&cr} = 17.67\%PT_p + 18.80\%PC_p + 18.23\%PQ_p + 17.11\%PS_p + 14.47\%PH_p + 13.72\%PP_p$$

Where:

$PME_{cs\ \&\ cr}$ is the project efficiency as contributed by consultants and contractors

PC_p is project cost performance from regression equation in Section 4.15

PT_p is project time performance from the regression equation in Section 4.16

PQ_p is project quality performance from regression equation in Section 4.17

PS_p is project scope performance from regression equation in Section 4.18

PP_p is project process performance from regression equation in section 4.19

PH_p is project human performance from regression equation in Section 4.20

This model reflects the consultants' and contractors' general model score pegged at 82%. As established from data analysis the clients also play a significant role in the performance of projects and their performance rating is at 18% to make a total of 100%.

5.2 THE CHARACTERISTICS OF THE PROJECT MANAGEMENT MODEL

The model is a simulation for assessing construction project performance. It is so called because it also incorporates the multidimensional concept by lending itself to multiple measures and is based on the demands of the project and its stakeholders. Its guiding principle is to provide a means by which, through the use of measures, construction project could be managed with the help of objective measurements and in a way that will represent the perspectives of the relevant stakeholders and the particular circumstances of the project. The model focuses on the perspective of the key stakeholders –clients (the owner and financier) and practitioners (supervisors) based on the models in chapter 4. The contents of these are shown in Table 5.1. The implementation strategy involves the independent and parallel assessment of practitioners' and clients' perspective of the performance of the project and finally combining them into a shared perspective both for consultants' scores and client's scores through weighted average scores. The maximum score for consultants' component is 82% whereas for clients it is 18%.

Table 5.1 Components in the model of the Tool

Stakeholder	Dimension	Expectation	Measures	Factors
Practitioners	Project Monitoring and Control	Execution Efficiency and effectiveness	*Cost, Quality, Time, human resource management, project performance and scope management.*	Related to (*project manager, project, project team, contractor, client's org., project external environment)*
Clients	Project scope definition, financing and performance of employer obligations.	Project execution efficiency.	*Scope definition, cooperation with design team, timely financial arrangements*	*Project Manager for client and Client's top management.*
Combined	Shared Perspective	Overall Project Performance	*Combination of the measures from above whereby the practitioners and contractors contribute 82% whereas Clients contribute 18%.*	Project Management Model

5.3 BRIEF DESCRIPTION OF MODEL IMPLEMENTATION PROCEDURE

In brief, implementing the model goes as follows: A Project Manager is appointed at the pre-tender stage whose duties among others will be to guide the rest of the project team and the client's representatives to establish the standards or planned performance metrics against which actual performances will be compared. The next step is to agree with them on how often and at what intervals the assessment should take place, for example, monthly, bi-monthly, and quarterly and so on, depending on the nature of the project and its duration. At the agreed dates for assessment, the project manager sends Practitioners Forms 1, 2 and 3 to the consultants and each member of the Project Team to provide the actual performance figures as actually measured. At the same time, the project manager provides Forms 1, 2 and 3 to Client Management team in charge of the project to fill in with actual performance figures; if the Client's team is not endowed with the necessary expertise then the agreed parameters at the start of the project are held constant and only the Consultant's project manager and team are allowed to fill the forms. In each case, Form 1 provides criteria for measuring while form 2 is for actual measurements. Form four is for tracking the indicators and influencing factors. These people are the *respondents* in the assessment procedure. The project manager computes the *assessment* and *scoring* in Form 3 using figures obtained in Form 2 in each case. The project manager also transfers averaged figures obtained from Form 3 on to the software application for processing. The project manager then calls a meeting consisting of the other consultants, the Project Team, and the Client's Management team at which he provides his assessment report of the state of affairs of the project. The report would indicate:

1. The overall performance in the perspective of practitioners.
2. The overall performance in the perspective of the client.
3. The result of the Shared Perspective (averaged score).
4. The need to take action based on assessment. [All responses are averaged by the project manager before scoring]

The implementation steps are outlined in more details below.

5.4 DETAILED PROCEDURE IN THE IMPLEMENTATION OF THE MODEL

The following steps describe the general procedure for the implementation of the model.

1 The Pre-determinations: Before putting the model into operation, it is necessary to predetermine the following:

i. People to do the measurements

This is achieved by following the model proposed covering the six variables of cost, quality, time, human resources, project performance and scope and their respective sub-variables. The researcher agrees with (Atkinson, 1999) and Struckenbruk (1987) that the four most important stakeholders to decide criteria are the Project Manager, Top Management, Customer-Client and the Project Team. This should be done at the pre-contract stage.

ii. Agreeing on the periods (intervals) of the assessment

As discussed above, this will depend on the nature and duration of the project. These periods could also be chosen to coincide with the completion of identifiable sections of the project, especially, in situations where it will not be practicable to depend on the duration alone. This should be agreed on between the two; client and consultants. This is to ensure collaborations and comparison of related information emanating from the assessments.

5.4.1 The Assessment Procedure

The assessment procedure involves firstly, the measurement of the actual performance indicators, scoring them, calculating the average scores of each indicator, then calculating the overall performance score of each criterion and, finally, the overall performance score for each perspective as described below.

(a) Measure the performance of the Indicators

This is done on Form 1 for practitioners and clients by the respondents for each criterion; track and measure the performance of the indicators by identifying them and using the appropriate methods as discussed below. [NB: Action by the respondents on Form 1, see Table 5.2 below for an example of a typical Form 1]. The procedure is as shown below: -

i. Identify the category of the indicators

The measurement method used will depend on whether the indicator is a *monetary, quantitative* or *qualitative* measure.

a**. Monetary (M):** These are indicators against which monetary values can be attached. These include such measurements as related to direct cost and cost related measures.

b. Quantitative (Qty): These are indicators against which monetary values are not applicable, but results or impacts can be quantified for example indicators related to time, work done and productivity.

c. Qualitative (Qly): These are indicators against which neither monetary values nor quantitative values can be attached. These indicators are measured on a scale (ordinal) for instance a Likert scale of assessing the efficiency or effectiveness of the management team.

ii. Measuring

a. Measure the actual value.

b. Calculate the average actual value for consultants and clients.

c. Enter the values in the software for computations and print results.

iii. Rules for scale measurement (1-10 scale)

The following rules are recommended for use in situations where scaled (Likert) measurement is the option.

1.0	Very weak performance	-	0 - 10%
2.0	Weak performance	-	11 - 20%
3.0	Very poor performance	-	21 - 30%
4.0	Poor performance	-	31 - 40%
5.0	Fair performance	-	41 - 50%
6.0	Average performance	-	51 - 60%
7.0	Fairly good performance	-	61 - 70%
8.0	Good performance	-	71 - 80%
9.0	Very good performance	-	81 - 90%
10.0	Excellent performance	-	91 - 100%

Table 5.2 Example of Form 1

	Category	Type of Measurement	Measurement for the present phase				
			1	**2**	**3**	**4**	**5**
No.							
1.	***Cost***						
i	Contract sum	Actual amount					
ii	Variation cost	Actual amount					
iii	Contingencies	Actual amount					
iv	Abortive works costs	Actual amount					
v	Fluctuation cost	Actual amount					
vi	Total cost overrun	Actual amount					
2.	***Time***						
i	Design time	Actual time					
ii	Design time as achieved	Actual time					
iii	Contract time as specified	Actual time					
iv	Time for completing of major specified work sections	Percentage					
3.	***Quality***						
i	Reworks (number)	No. of times					
ii	Reworks (extent)	Area					
iii	Material test records	No. of times					
iv	Service test records	No. of times					
v	Engineer's/Architect's approval records	No.					

vi	Engineer's/Architect's disapproval records	No.					
vii	Variation (number)	No. of times					
viii	Variation (extent)	Area					
4.	***Project performance***						
i	Decision making process	Scaled mst.					
ii	Communication and responsibility	Scaled mst.					
iii	Efficiency of project team	Scaled mst.					
iv	Supervision of contractor	Scaled mst.					
v	Site meeting regularity	No. of times					

(b) Score the Measurements.

This is done on Form 2; score the results of each measured indicator based on the relative performance scale. This brings all measurements into a common denominator (percentages) to facilitate overall assessments. The detailed procedure is as follows:

i. General Description of the Performance Scale

A scoring system that adequately reflects the performance of a construction project being assessed is the key to any evaluation system. Scoring the measurement implies the combination of monetary, quantitative and qualitative measurements to achieve an overall evaluation of performance. This requires that all measurements are expressed in a common denominator. In this evaluation system, all measurements are to be expressed in percentages to achieve this objective. The process involves the use of the weighted performance scale, based on the 'weighted scale of preference' to bring all measurements into percentages based on the principle of relative strengths or levels of performance (Figure 5.1). This is a scale whose main section is anchored at its ends with the least performance level (0) and the most performance level (100). Scores are assigned to the remaining options so that differences in the numbers represent differences in strength or level of performance. Performance is scored against a pre-determined standard, target or benchmark. This could be represented by the estimated or planned performance such as planned cost, time or other activity level, or agreed previously recorded best practice (from similar projects undertaken or known to either client or practitioners). Later, it should be possible to compare performance standards to institutionally acknowledged best practice in the region or country of the project. The measurements are then reduced to a scale of 0-1 and subjected to linear regression equations. The resultant score is then subjected to the respective factor weighting in the project management model.

The developed PME software does all the computations; what the project manager needs to enter is the weighted scores obtained at each level of assessment routinely done up to the end of the project.

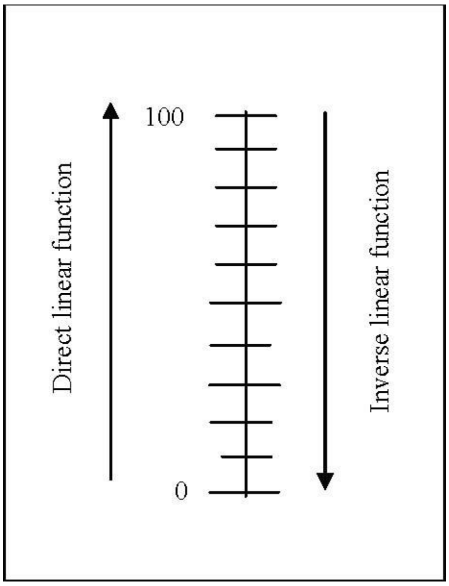


Fig.5.1 The weighted performance scale (Source: own formulation, 2013)

The model in this research, however, uses planned or expected values of the project as the main pre-determined standards. This should be agreed as such at the beginning of the project for assessment purposes. Based on the direction of the weighted strength or level of performance, this scale may operate on either of the two functions below: -

a. Direct Linear Function (DLF), in which case the highest measurements score towards the 100 and lowest measurements score towards the 0; for instance scoring efficiency, effectiveness, impacts and quality are direct linear functions.

b. Indirect/Inverse Linear Function (ILF), in which case the highest measurements score towards the 0 and lowest measurements score towards the 100; for example scoring for cost and time overruns. The different scaling methods result in numbers that represent relative strength or level of performance for the indicators.

ii. Guidelines for scoring

The model proposes the following guide for scoring indicators:

a. If an indicator scores less than 50% then it should be taken as a warning sign that something is seriously wrong and that if something is not done there will be a failure in that indicator before the end of the project with its likely consequences on the other variables of the project.

b. There should be a limit set on the lowest side (Zero mark) beyond which decisions will have to be taken. For example where there are institutional requirements that fluctuations should not exceed certain percentages of the original prices, they should be used to set a limit to the extent of fluctuation. It is recommended that in the absence of any such regulations, the project management team (including the client organization) should set these limits alongside its pre-determined standards and targets. This means scoring on the relative performance scale are best done on the basis of *pro rata*.

iii. Cases of 'Perfect' or 'Superior' Performances

The model provides allowances for extra normal performances, such as 'perfect' or 'superior' performances.

a. Perfect Performance: this is a situation when the measured indicator showed the same figures or values as the standard against which it is being compared. In such a situation the relative performance scale will read 100%.

b. Superior Performance: this is a situation when the measured indicators showed figures or values more than the standard against which it is being compared; for example when there is a cost savings and/or time savings. In such a situation, it would mean that the relative performance scale will naturally be expected to read more than 100%. However, because the scale is limited to 100, all superior performance will be given the maximum value just like perfect 'perfect' performance. However, the exact values will be recorded and documented as measured on the relevant measurement sheets for information and learning purposes. In a rare situation of superior performance in all the indicators, overall performance in all of the relevant criteria would be expected to exceed 1 or 100%. This should also be treated as perfect performance results, limiting everything to 100% and documenting the raw measurements. In all such situations, it should be necessary to investigate whether the result shows a superior performance or the standards of comparison were, in fact, erroneously low. Eventually the rating is reduced to between 0 and 1 and plugged to the generated linear regression model.

iv. Scoring

i. Fix the pre-determined standard at the 100% mark on the scale.
ii. Set the limit of lowest possible measurement at zero.
iii. Assign positions on the scale for all measurements to show their relative performance by *pro rata*.
These are done on the individual factors for all the six factors. While doing this the harmonized or mean measures are the ones to be used.

(c) Calculating the Performance Scores

After scoring the measures, the project manager then calculates firstly, the weighted scores of each indicator, then the performance score of each criterion, and finally, the performance score of each perspective. This is then used in the final Project Management Model for the identified six measures of project cost, quality, time, scope, human resources and project performance. The values are supposed to range between 0 and 1 for each of the measures.

i. Calculate the weighted score

Calculate the **weighted score** by multiplying the score of each indicator by its weight, leaving the results in terms of percentages.

ii. Determine the performance scores of the Criterion

The assessment is based on the linear additive model. According to this model, "if it can be proved or reasonably assumed, that the measures are preferentially independent of each other and if uncertainty is not formally built into the Multi-criteria analysis model, then the simple linear additive evaluation model is applicable". This shows how an option's values on many criteria can be combined into an overall value. This is done by multiplying the value score on each criterion by the weight of that criterion and then adding all these weighted scores together. The main items are discussed below.

Add the weighted scores of all the indicators in each criterion to obtain the overall project performance (weighted) score of the criterion, using the established relationships (refer to equation 5.1).

The Performance of any criterion, C, could be expressed as:

PC = $w1I1 + w2I2 + w3I3 + ... + wnIn$ 5.1

Where, PC is the performance of the criterion C . *Wn* = the weighting of the nth indicator. *In* = the nth indicator. For each indicator *In*, with weight *Wn* the weighted score is given by *WnIn*.. For this research see appendix F on how the factors interact.

iii. Determine the overall Performance in the relevant perspective for each phase

Add all the performance (weighted) scores of each criterion in the perspective to obtain the overall performance (weighted) score in that perspective, using the established relationship. This is illustrated in the equation 5.2. For each period, for example period 1, the overall performance could be calculated as:

Pop = $w1C1 + w2C2 + w3C3 + ... + wnCn$ 5.2

Where, Wn = the weight of each criterion, Cn = the score of each criterion, Pop = the overall performance.

iv. Illustrations Using the Relationships

Equations 5.3 to 5.11 show the actual procedure of adding.

1. For Practitioners, this is reported as:

$PME_{cs\&cr}$ = $17.67\%PT_p+18.80\%PC_p+18.23\%PQ_p+17.11PH_p + 14.47\%PP_p + 13.72\%PS_p$ 5.3

b. For Clients:

$PME_{ct} = 0.5PF + 0.3PS + 0.10PC + 0.1.Pp$…………………………………5.4

Where PME_{ct} is the clients overall performance measurement

PF is the client's project financial arrangements and preparedness.

PS is the role of the client in clear scope definition and in scope change management process;

PC is the level of the client coordination with consultants in ensuring a diligent execution of projects.
Pp is the level and timely honouring of payments by the client to both the consultants and contractors.

Overall project execution efficiency reflecting good project management is measured thus:

$Pe = 82\%PME_{cs\&cr} + 18\%PME_{ct}$

Where: Pe is the overall project execution efficiency;

$PME_{cs\&cr}$ is the consultant and contractor contribution component as per equation 5.3

While PME_{ct} is the client's contribution as per equation 5.4

The individual factor contributors in the PME model are determined by the following equations which have already been extensively discussed in chapter four. .multiple regression analysis was used and the following linear functions extracted.

These scores can also be rated on 0 to 1 scale which is used in the model and reduced to percentages.

$PC_p = 1.586+0.056PS+0.150PT+0.382PQ+0.064PH+0.004PP$ --- (5.5)

$PT_p = 1.065+0.265PS+0.282PQ-0.082PH+0.117PP+0.327PC$ ----- (5.6)

$PQ_p = 0.684+0.032PS+0.189PT+0.560PC-0.121PH+0.044PP$ ------ (5.7)

$PS_p = 0.261+0.302PT+0.139PC+0.287PH+0.047PP+0.055PQ$ ------ (5.8)

$PP_p = 1.347+0.342PT-0.025PC+0.496PH+0.194PQ+0.119PS$ ……. (5.9)

$PH_p = 0.850-0.140PT+0.238PC-0.310PQ+0.431PS+0.291PP$ …… (5.10)

The foregoing are general linear regression equations generated by SPSS using data from the field. The various scores are used to work out the overall $PME_{cs\&cr}$ for consultants and contractors.

5.4.5 Dealing With Temporal Variability

The developed model allows for modifications on coefficients weights under maintenance if the situation obtaining changes. But if the variables change in future the whole research process has to be repeated to develop a revised model under the same procedure but different interacting variables.

5.5 GUIDELINES FOR MEASURING AND SCORING THE INDICATORS

Scoring the set of indicators used for this assessment system are done following the two categories discussed above and as shown in Appendix F Tables 1 and 2. The approaches to assessing each of the indicators under consideration are described as follows.

5.5.1 Practitioners' Indicators

i. Indicators of Cost

All the indicators here are monetary and are measured as the actual cost incurred. With reference the planned or expected cost as standards these indicators are scored as inverse/indirect linear function (ILF). This means that the higher the cost in excess of the standard, the lower the percentage scores. The initial cost function as developed in the research is given by:

F.A= C.S +TCO

TCO= AWC+ V.C +F.C- CT

F.A should tend to C.S For optimum performance.

F.A=Final Account, C.S= Contract Sum, TCO= Total Cost Overrun, V.C = Variations Costs, AWC= Abortive Works Costs, F.C= Fluctuation Costs and CT= Contingency.

ii. Indicators of Time

All the indicators of time are quantitative and are measured as the actual time used. With reference to the planned time as the standard, these indicators are scored as ILF. Examples are times for design completion against planned design time, contract completion against contract duration as estimated. The initial time function is given by:

$$PT = 0.2f(x) + 0.8f1(x)$$

Whereby PT = Time performance; *f(x)* is the design time performance while *f1(x)* is the construction time performance.

iii. Indicators of Quality

The indicators of Quality are of varying category. The change order indicators (variation and reworks) are measured in two categories such as quantitative and qualitative. The number of reworks and variation are measured as quantitative, while their extent are measured in qualitative. All are scored as ILF. The test records (material and service) and the approval records are measured as quantitative items (actual number). The test records represent positive indicators for quality and direct linear function (DLF). The approval records are measured as direct linear functions and ultimately recorded as DLF adjusted to percentages on scale.

The initial quality function is given by:

$$PQ = \sum_{i=1}^{n} q_i$$

Where:

PQ= Project quality evaluation.

q_i= quality measurement parameters reduced to between 0-1.

iv. Project performance

All the indicators under this criterion are measured as a percentage and results averaged and reduced to a scale measure of 0 to 1. Here all the relevant stakeholders such as client's representative, contractor's management team and project management team (for self-assessment) are involved. They are measured as DLF.

$$PP = \sum_{i=1}^{n} p_i$$

Where:

PP= Project performance evaluation.

p_i= project performance measured and reduced to between 0-1.

v. Indicators of Human Resources Management

These are Direct Linear Functions indicating to what extent the various team players including the Consultants and Contractor are performing their obligations efficiently. The measurements are weighted depending on the importance of each team player. For example the overall weighting can be agreed as the Contractor to carry 30%; Architect 20%, Quantity Surveyor 20%, Project Manager at 10%, Civil/Structural engineer 10% and Services engineers at 10% to make a total of 100% or 1. Each of the players are rated first on a scale of 0 to 100 as a percentage and the overall score reduced to the percentage weighting as agreed and as tentatively given in this example. If for instance the architect is rated at 70% on the performance of his obligations then his overall contribution to the human resource performance factor will be:70% of 20%HRM= 14% meaning at the final score we have already lost 6 %. Similarly the other factors are rated. This is done at given agreed intervals until the project is completed. The developed software does these calculations automatically hence no need for manual calculations.

Where PH= Project Humana resource performance

$$PH = \sum_{i=1}^{n} 0.2x_i + 0.2a_i + 0.2e_i + 0.1m_i + 0.3c_i$$

xi=quantity surveying variables, *ai*= architect's variables, *ei*= engineering variables, *mi*= Project management variables and *ci*= contractors' variables.

vi. Scope management factor

All the indicators under this criterion are also measured as quantitative but in an Inverse Linear Function form. They can be measured in terms of percentages covering to what extent the various variables are managed and scope changes are minimized and/or mutually agreed upon.

$$PS = \sum_{i=1}^{n} s_i$$

Where

PS= Project scope evaluation.

s_i= scope variables reduced to between 0-1.

5.5.2 Client's Indicators

The clients measurements are direct linear functions (DLF) relating to the performance of their obligations. The ratings are done by the client's project managers or senior management in parallel with the consultants' ratings. The project manager is tasked with working out the averages and overall shared perspectives which are used to evaluate the client's scores for each period of assessment and at the final overall score. The major considerations relate to financing, honouring period for payments, scope definition and overall coordination with the project team.

5.5.3 Final Calculations and Model Reports

Upon entering all variables the software computes and produces a report which forms a basis for management to make decisions. The process is continued until project completion.

5.6 MONITORING AND CONTROLLING BY THE PROJECT TEAM

The results obtained from the measurements of the indicators lead us to the obvious questions: which factors are causing the results? How influential are they among other factors? How do we manipulate these factors to ensure that we get improved results in the next phase of the assessment? Thus, the second function of the model is that it assists in the monitoring and controlling of the project to ensure good performance. This is done by relating the factors to the indicators and determining the likely factors that is producing the observed effect on the indicators as measured above. Being purely a management issue, the success of this exercise depends largely on the skill and experience of the project management team and the client's organization as, together, they represent the *strategic posture* of the project. To address this part of the process, each practitioner on the project is called on to make efforts to identify which factor or factors are likely to be influencing the results in each of the indicators, whether they are positive or negative factors and to what extent.

Form 4 comprises a matrix of indicators on the vertical and factors on the horizontal allowing the respondent to provide a figure showing the extent to which, in their estimate, each of the factors is influencing the indicators. In the end each indicator is also found to be differentially influenced by all the factors. In addition to the empirically determined factors provided, respondents are also allowed to list any new factor or factors they identify during the course of the project as influencing any indicator or indicators. These should be documented as such and be added to the data of factors for analysis and categorization in the tool for future use.

5.6.1 The Monitoring Procedure

The monitoring procedure follows the following steps: -

i. Rules for Estimating the Effect of the Factors

NB: Unlike the indicators and the criteria, all factors should not be pre-weighted at the point of assessment. The following procedure should be used to fill the forms to determine the factors at play:

1. Map each factor to each indicator
2. In each box indicate the factors' effect on the indicator by marking the following:

a. No Effect- (0)

b. Low Effect:- [(1+): Low positive effect] and (1-): Low negative effect]:–when the effect is very negligible

c. Medium Effect:- [(2+): Medium to High positive effect] and [(2-): Medium to High negative effect]: – if its impact is noticeable but not so significant (needs to be watched)

d. High Effect:- [(3+): High positive effect] and [(3-): High negative effect]:–when the effect on the indicator is very noticeable and works in combination with other factors to produce critical effect.

e. Critical Effect:- [(4+): Critical positive effect] and [(4-): Critical negative effect]: –if its effect is so strong that it alone acts to change the performance of that indicator. Factors that score 3 and 4 should be considered very influential factors.

ii. Estimate the effect of the factors on the indicators

Make efforts to identify which factor or factors are likely to be influencing the results in each of the indicators. The measurement is done by the individual respondents estimating the effect of each factor on each indicator according to the rules of estimating provided above.

iii. Calculating the Relative Weighted (effect) Scores of the Factors

On the reception of the estimates on the Form 4 from all the respondents, the project manager proceeds to undertake the following calculations.

a. Calculating the relative weighted (effect) score of the factors

In this model, the relative weighted effect of each factor is defined as the average of the net of all the practitioners' estimated effect of that factor on the specific indicator. In Appendix F Table 4.1, for example, estimates the effect of the factors related to the *project* on the set of indicators of *cost*. It is about averaging each of the raw estimates provided by respondents. These relative weights are sent to Form 4 where the factors are linked with the indicators.

b. Calculate the relative weighted (effect) score of each factor on all indicators in a criterion.

For each factor, this is obtained by calculating the averages of all the net results of the effect of the factor across all the indicators in the criterion. In Appendix F Table 4.1, these are the results in the last rows of each criterion: 10+, 0, 10+, 10+, 6+ and 0 (see Table 5.3 below). These results are important data providing information for documentation for further analysis and learning purposes. Such information over time will guide project managers as to the general behavior of these factors in relation to the given indicators.

c. Calculate the relative weighted (effect) of the factor group on each indicator

This is obtained by calculating the averages of all the net effect of all the factors in a factor group on a particular indicator. In Appendix F Table 4.1, these are the results in the last column of each factor group: 6+, 12+, 6-, 18+ and 6+ (see Table 5.3 below). These results are also documented as an important data providing information for documentation for further analysis and learning purposes.

d. Calculate the relative weighted (effect) score of each factor group on each criterion

This is obtained by calculating the average of the net total of each last row of a criterion or last column of a factor group. In Appendix F Table 4.1, we have a result by the respondent as 16+ (see Table 5.3 below). The average of several such results is then calculated to represent the relative weighted effect of that factor group on the criterion *cost*. These are also for documentation and learning purposes.

Equation 5.11 underlines the relationship between a factor group and its set of factors. Each factor group, G, is expressed as:

$$PFG = w1F1 + w2F2 + w3F3 + ... + wnFn \quad .... 5.11$$

Where, PFG represents the factor group G. *Wn* = the relative weighted score of the *nth* factor. *Fn* = the *nth* factor.

Where; PFG represents the factor group G

Wn = the relative weighted score of the nth factor.

In = the nth factor.

In the relationship above,

Table 5.3 Examples of Form 4.1

Criteria	Indicator	FACTORS						
		Pj						
		Pj_1	Pj_2	Pj_3	Pj_4	Pj_5	Pj_6	$\sum_{Pj}$
Cost	C_1	4+	2-	0	2-	2+	4+	6+
	C_2	6+	4+	0	0	4+	2-	12+
	C_3	2-	2-	0	2+	2-	2-	6-
	C_4	8+	0	8+	4+	2-	0	18+
	C_5	6-	0	2+	6+	4+	0	6+
	$\sum_C$	10+	0	10+	10+	6+	0	16+
Time	T_1							
	T_2							
	T_3							
	T_4							
	$\sum_T$							
Quality	Q_1							
	Q_2							
	Q_3							
	Q_4							
	Q_5							
	$\sum_Q$							
PP	PP_1							
	PP_2							
	PP_3							
	PP_4							
	PP_5							
	PP_6							

5.6.2 The Controlling Procedure

(a) Software Reports

For each variable the software generates/ computes the final score which is compared against a maximum possible score.

(b) The Controlling Procedure

The controlling aspect follows recommendations based on each variable score. It allows management to:

i. Strategically manipulate those negative factors that are causing poor performance in certain indicators in order to ensure the achievement of expected results;

ii. Ensure that positive factors are encouraged to continue to influence performance in the expected direction. With three of the factor groups representing the strategic decision makers comprising practitioners, project manager and client organization; it also means that the effort to react strategically, based on the results, will depend not only on what they expect others to do but also on what they have to do. This approach is used throughout the continuous assessment of the project at the pre-determined stages as well as at the final stages. The process is expected to include, but not limited to the steps discussed below.

i. Analyze the factors

The next stage is to analyze those factors which are identified to be impacting positively or negatively on indicators identified to be performing badly or quite well, and so on. These critical factors, originally classified in their factor groups, may relate to either the project's internal or external environment. It therefore requires the project team to find out the true nature of these factors and how they act individually or in combination to impact on the indicators. The following key questions should govern the analyses:

i. Which critical factors are at play on which indicators?

ii. How are they impacting on the indicators (positively or negatively or neutral)?

iii. Are these factors related to the project's internal or external environment?

iv. Are they working alone or in combination with other factors?

ii. Take a decision

Based on the findings from the analyses, management should then proceed to take a strategic decision as to the way forward towards better performance in the next period of the project. This will require a strategic management effort towards the following:

i. Control those factors which are impacting negatively on the indicators.
ii. Promote those factors which are impacting positively on the indicators.
iii. Monitor other factors determined to be neutral.

iii. Take prompt action

To ensure that events conform to plans at the next assessment levels, management must proceed to take prompt action straight away based on the strategic decisions. Required resources must be sought for and the stakeholders, including contractors and the client, should be informed about the true state of affairs based on the performance evaluation conducted and the decisions taken by the project management team. It is about providing the timely information to the effect that: *it has been identified that certain things are not right with some aspects of the project, and that some things need to be done immediately today in order to avoid a potential disaster tomorrow; and to ensure an expected performance.*

See the appended software manual on the process of evaluation and reports as appendix F.

5.7 VALIDATION OF THE MODEL

We shall use five models with the following range (0-1). The models vary from in the importance of the factors under study. A value close to 0 – 0.2 means least important, 0.2 – 0.4, means less important, 0.4 – 0.6 means averagely important while 0.6 – 0.8 means important and 0.8 – 1.0 means very important. The model will want to ascertain if the factors which were included in the determination of the project management model are key in the study and thus need to be included in the development of the model and further to illustrate their application.

5.8 ASSUMPTIONS OF THE MODEL

The model undertakes various assumptions that exist in the construction industry currently. Model 1, provided in the below table highlights the failure to comply to all the key factors for project accomplishment. The research sought to compare the factors of time, quality and cost against the factors of human resource, scope and project performance. The comparison is important because the practitioners have been considering time, quality and cost as key factors to measure for the successful project completion. This is compared with the assumption of the research which introduces three more factors namely; human resource, scope and project performance. This is addressed by the models 2 and 3, where model 2 validates the efficiency of the time, quality and cost factors whereas model 3 validates the efficiency of human resource, scope and project performance. Model 4 deals with the ideal situation for all the factors incorporated in the model, which though may not be realistic in the industry since some factors have negative impact to others and also it is very difficult for everything to run according to plan. Model 5 takes the assumption that some factors will be done well, while others may suffer and therefore it reflects a situation depicting the current practice of project management where results are evaluated after the event, unlike the final prognosis and project modeling application as suggested in this study.

The model values sampled for validation for various respective factors are presented under table 5.4 as follows;

Table 5.4: Various types of model assumption for model validation

	PT	**PC**	**PQ**	**PH**	**PS**	**PP**
Model 1	0.2	0.2	0.2	0.2	0.2	0.2
Model 2	0.2	0.2	0.2	1	1	1
Model 3	1	1	1	0.2	0.2	0.2
Model 4	1	1	1	1	1	1
Model 5	0.3	0.7	1	0.5	.1	0.4

Model one provides the following results among the factors being tested. The values highlighted in yellow are as a result application of the formula developed for each factor. For example for PT model 1, it is given by

$$PT\ Model\,1 \quad = \quad 1.065 + 0.265 * 0.2 + 0.282 * 0.2 - 0.082 * 0.2 + 0.117 * 0.2 + 0.327 * 0.2 = 1.2468$$

The complete results are presented under table 5.5 as follows:-

Table 5.5: Model 1 Validation

	PT	PS	PQ	PH	PP	PC
Model 1 validation	0.2	0.2	0.2	0.2	0.2	0.2
PT Coefficients	1.065	0.265	0.282	-0.082	0.117	0.327
PT model 1	1.2468	0.053	0.0564	-0.0164	0.0234	0.0654
PS Coefficients	0.302	0.261	0.055	0.287	0.047	0.139
PS model 1	0.0604	0.427	0.011	0.0574	0.0094	0.0278
PQ Coefficients	0.189	0.032	0.684	-0.121	0.044	0.56
PQ model 1	0.0378	0.0064	0.8248	-0.0242	0.0088	0.112
PH Coefficients	-0.14	0.431	0.238	0.85	0.291	-0.025
PH model 1	-0.028	0.0862	0.0476	1.009	0.0582	-0.005
PP Coefficients	0.342	0.119	0.194	0.496	1.347	-0.025
PP model 1	0.0684	0.0238	0.0388	0.0992	1.5722	-0.005
PC Coefficients	0.15	0.056	0.382	0.064	-0.004	1.586
PC model 1	0.03	0.0112	0.0764	0.0128	-0.0008	1.7156

The P.M.M percentage is given as

1.2468	**0.427**	**0.8248**	**1.009**	**1.5722**	**1.7156**
17.67	**17.11**	**18.23**	**14.47**	**13.72**	**18.80**
22.03096	7.30597	15.0361	14.60023	21.57058	32.25
					112.80%

The calculation of the final Project management model therefore will be given as follows by the application of the formula

$$PMM = 17.67\% PT + 18.80\% PC + 18.23\% PQ + 17.11\% PH + 14.47\% PP + 13.72\% PS$$

Hence,

$$PMM = 0.1767 * 1.2468 + 0.188 * 1.7156 + 0.1823 * 0.8248 + 0.1711 * 1.009 + 0.1447 * 1.4354 + 0.1372 * 0.427 = 1.1280$$

This implies for every construction project, the input of marginal project management functions will improve the efficiency of projects execution by 16.45% arrived at as follows (112.80-96.35)%. The percentage contribution of project management modeling application is the difference from the zero application at 96.35% to 112.80% in project performance according to this model as presented under table 5.6 below.

Table 5.6: Model 2 Validation

	PT	**PS**	**PQ**	**PH**	**PP**	**PC**
Model 2 validation	0.2	1	0.2	1	1	0.2
PT Coefficients	1.065	0.265	0.282	-0.082	0.117	0.327
PT model 2	1.4868	0.265	0.0564	-0.082	0.117	0.0654
PS Coefficients	0.302	0.261	0.055	0.287	0.047	0.139
PS model 2	0.0604	0.6942	0.011	0.287	0.047	0.0278
PQ Coefficients	0.189	0.032	0.684	-0.121	0.044	0.56
PQ model 2	0.0378	0.032	0.7888	-0.121	0.044	0.112
PH Coefficients	-0.14	0.431	0.238	0.85	0.291	-0.025
PH model 2	-0.028	0.431	0.0476	1.5866	0.291	-0.005
PP Coefficients	0.342	0.119	0.194	0.496	1.347	-0.025
PP model 2	0.0684	0.119	0.0388	0.496	2.0642	-0.005
PC Coefficients	0.15	0.056	0.382	0.064	-0.004	1.586
PC model 2	0.03	0.056	0.0764	0.064	-0.004	1.8084

The P.M.M percentage is given as

1.4868	**0.6942**	**0.7888**	**1.5866**	**2.0642**	**1.8084**
17.67	**17.11**	**18.23**	**14.47**	**13.72**	**18.80**

26.27176	11.87776	14.37982	22.9581	28.32082	34.00
					137.81%

The PMM model generated from the model 2 above is given by: -

$$PMM = 0.1767*1.4868+0.188*1.8084+0.1823*0.7888+0.1711*1.5866+0.1447*2.0642+0.1372*0.6942=1.3781$$

Hence as a result of perfecting scope definition, human resource and project performance the overall project performance has improved from 96.35% to 137.81% a reflection of 41.46%. When compared against the ideal situation at 178.58%; this a reflection of 50% improvement in efficiency. However, most researches have not been considering these three indicators which are significant contributors towards project execution efficiency. The next model surpresses the new indicators while the traditional parameters are given prominence as presented under table 5.7 below.

Table 5.7: Model 3 Validation

	PT	**PS**	**PQ**	**PH**	**PP**	**PC**
Model 3 validation	1	0.2	1	0.2	0.2	1
PT Coefficients	1.065	0.265	0.282	-0.082	0.117	0.327
PT model 3	1.734	0.053	0.282	-0.0164	0.0234	0.327
PS Coefficients	0.302	0.261	0.055	0.287	0.047	0.139
PS model 3	0.302	0.8238	0.055	0.0574	0.0094	0.139
PQ Coefficients	0.189	0.032	0.684	-0.121	0.044	0.56
PQ model 3	0.189	0.0064	1.424	-0.0242	0.0088	0.56
PH Coefficients	-0.14	0.431	0.238	0.85	0.291	-0.025
PH model 3	-0.14	0.0862	0.238	1.0674	0.0582	-0.025
PP Coefficients	0.342	0.119	0.194	0.496	1.347	-0.025

PP model 3	0.342	0.0238	0.194	0.0992	1.981	-0.025
PC Coefficients	0.15	0.056	0.382	0.064	-0.004	1.586
PC model 3	0.15	0.0112	0.382	0.0128	-0.0008	2.1412

The P.M.M percentage is given as

1.734	**0.8238**	**1.424**	**1.0674**	**1.981**	**2.1412**
17.67	**17.11**	**18.23**	**14.47**	**13.72**	**18.80**
30.63978	14.09522	25.95952	15.44528	27.17932	40.25
					153.57%

The PMM model generated from the model 3 above is given by;

$$PMM \quad = 0.1767*1.734 + 0.188*2.1412 + 0.1823*1.424 + 0.1711*1.0674 + 0.1447*1.981 + 0.1372*0.8238 = 1.5357$$

Hence, because of perfecting the original factors of project management, there is overall project performance improvement of 57.22%. This implies that the traditional measures have only been giving us a skewed view of project success levels as a whole 43% has not been previously incorporated.

The model 3 validation took the assumption that the quality, time and cost of the project were very important whereas scope, human resource and performance were least important and yielded practitioners' marginal efficiency of 153.57%. On the other hand, if model 2 took the assumption that the scope, human resource and performance were very important while quality, time and cost of the project were least important the practitioners' marginal efficiency of 137.81%. This implies that the two set of factors are both important in project management since their marginal efficiencies have no significant difference. However, the traditional measures have 15.76% advantage over the introduced variables in this research. But this is not reflective of the importance previously attached to the traditional measures.

Model 4 below considers the assumption that all the factors are very important, the results as shown under table 5.8 below.

Table 5.8: Model 4 Validation

	PT	**PS**	**PQ**	**PH**	**PP**	**PC**
Model 4 validation	1	1	1	1	1	1
PT Coefficients	1.065	0.265	0.282	-0.082	0.117	0.327
PT model 4	1.974	0.265	0.282	-0.082	0.117	0.327
PS Coefficients	0.302	0.261	0.055	0.287	0.047	0.139
PS model 4	0.302	1.091	0.055	0.287	0.047	0.139
PQ Coefficients	0.189	0.032	0.684	-0.121	0.044	0.56
PQ model 4	0.189	0.032	1.388	-0.121	0.044	0.56
PH Coefficients	-0.14	0.431	0.238	0.85	0.291	-0.025
PH model 4	-0.14	0.431	0.238	1.645	0.291	-0.025
PP Coefficients	0.342	0.119	0.194	0.496	1.347	-0.025
PP model 4	0.342	0.119	0.194	0.496	2.473	-0.025
PC Coefficients	0.15	0.056	0.382	0.064	-0.004	1.586
PC model 4	0.15	0.056	0.382	0.064	-0.004	2.234

The P.M.M percentage is given as

1.974	**1.091**	**1.388**	**1.645**	**2.473**	**2.234**
17.67	**17.11**	**18.23**	**14.47**	**13.72**	**18.80**
34.88058	18.66701	25.30324	23.80315	33.92956	42.00
					178.58%

The PMM model generated from the model 4 above is given by;

$$PMM = 0.1767*1.974 + 0.188*2.234 + 0.1823*1.388 + 0.1711*1.645 + 0.1447*2.473 + 0.1372*1.091 = 1.7858$$

At perfect project management the model scores 178.58% for practitioners; this is about 82% and this is the maximum score for perfect project management in a given project. The balance possible maximum score of 18% is attributed to the clients.

However, at any given situation it is impossible to attain all the marks hence to attain the perfect maximum of 100% is impossible but near 100% is very much possible for a perfect excellent performance.

The validation for model 5 assumption is as table 5.9 as follows;

Table 5.9: Model 5 Validation

	PT	**PS**	**PQ**	**PH**	**PP**	**PC**
Model 5 validation	0.3	0.1	1	0.5	0.4	0.7
PT Coefficients	1.065	0.265	0.282	-0.082	0.117	0.327
PT model 5	1.6082	0.0265	0.282	-0.041	0.0468	0.2289
PS Coefficients	0.302	0.261	0.055	0.287	0.047	0.139
PS model 5	0.0906	0.6662	0.055	0.1435	0.0188	0.0973
PQ Coefficients	0.189	0.032	0.684	-0.121	0.044	0.56
PQ model 5	0.0567	0.0032	1.093	-0.0605	0.0176	0.392
PH Coefficients	-0.14	0.431	0.238	0.85	0.291	-0.025
PH model 5	-0.042	0.0431	0.238	1.188	0.1164	-0.0175
PP Coefficients	0.342	0.119	0.194	0.496	1.347	-0.025
PP model 5	0.1026	0.0119	0.194	0.248	1.886	-0.0175
PC Coefficients	0.15	0.056	0.382	0.064	-0.004	1.586
PC model 5	0.045	0.0056	0.382	0.032	-0.0016	2.049

The P.M.M percentage is given as

1.6082	**0.6662**	**1.093**	**1.188**	**1.886**	**2.049**
17.67	**17.11**	**18.23**	**14.47**	**13.72**	**18.80**
28.41689	11.39868	19.92539	17.19036	25.87592	38.52
					141.33%

The PMM model generated from the model 4 above is given by;

$$PMM = 0.1767*1.6082 + 0.188*2.049 + 0.1823*1.093 + 0.1711*1.188 + 0.1447*1.886 + 0.1372*0.6662 = 1.4362$$

This is a reflection of an average performance which can also be regarded as the pass mark or a point below which then the overall result indicates a failed project management performance and by extension project failure. This can also be estimated by averaging model 1 and model 4 which gives (178.58 + 112.80)/2 = 145.69.

However, the absolute failure begins at zero management and perfect project management which is (96.35% + 178.58%)/2 = 137.47%. Averaging the latter two gives 141.58% which is very comparable to model 5. The argument is that below 137.47% or 41.12% (137.47-96.35%) is an indicator of total failure; whereas between 137.47 to 145.69% (equivalent to 41.12-49.34%) is marginal or average success whereas above 145.69% (49.34%) is very much acceptable. Finally a score close to 178.58 for project consultants indicates excellent project management application and therefore success and/or efficiency of projects execution.

5.9 ACTUAL INDUSTRY VALIDATION

The generated model was tested based on five number very senior consultants with over 20 years' experience and based on three number projects per consultant. In total fifteen number projects were evaluated to establish the accuracy and/or efficiency of the model in evaluating performance of construction projects. The tables 5.10 and 5.11 below gives the results.

Table 5.10 Consultant and model scores on fifteen projects

Item	Indicators	project scores a scale of 0-10														
		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15
1	Project time	2.00	4.00	2.00	6.00	8.00	9.00	8.50	4.00	6.00	8.00	6.00	7.00	7.00	3.00	9.00
2	Project scope	4.00	6.00	5.00	8.00	8.50	8.00	9.00	6.00	9.00	6.00	6.00	8.00	8.00	9.00	9.00
3	Project quality	8.00	8.00	7.00	8.50	9.00	8.00	8.00	8.00	7.00	7.00	9.00	8.00	9.00	8.00	9.00
4	Project performance	7.00	8.00	7.00	8.50	8.50	8.00	8.50	6.00	7.00	7.00	7.00	8.00	8.00	4.00	9.00
5	Project Human Resource	6.00	8.00	7.00	8.00	9.00	9.00	8.00	6.00	7.00	9.00	9.00	5.00	7.00	8.00	9.00
6	Project cost	8.00	7.00	6.00	9.00	9.00	9.00	9.00	5.00	8.50	8.00	8.00	8.00	7.00	6.00	9.00
	Overall score % (consultant)	58.33%	68.33%	56.67%	80%	86.67%	85%	85%	58.33%	74.16%	75%	75%	73.33%	76.70%	63%	90%
	Overall score % (model)	60%	68%	56%	81%	87%	85%	85%	60%	75%	74%	76%	75%	77.70%	64.90%	90%
	Clients' scores %	80%	80%	70%	85%	85%	85%	85%	60%	90%	80%	90%	80%	80%	40%	90%
	Weighted total score (%) consultant at .82 of consultants + .18 of Clients'	62.23%	70.40%	59.07%	80.90%	86.36%	85%	85%	58.63%	77.01%	75.90%	77.70%	74.53%	77.29%	58.86%	90%
	Weighted total score model (	63.60%	70.16%	58.52%	81.72%	86.64%	85%	85%	60%	77.70%	75.08%	78.52%	75.90%	78.11%	60.42%	90%

Table 5.11 Actual industry validation scores compared with model scores

Project	Predicted performance (%) model	Actual performance (%) consultant	Deviation (%)	Yes	No
1	81.72	80.9	0.82	√	
2	86.64	86.36	0.28	√	
3	85	85	0	√	
4	78.11	77.29	0.82	√	
5	60.42	58.86	1.56	√	
6	90	90	0	√	
7	85	85	0	√	
8	60	58.63	1.37	√	
9	70.7	70.01	0.69	√	
10	75.08	75.9	-0.82	√	
11	78.52	77.7	0.82	√	
12	75.90	74.53	1.37	√	
13	63.60	62.23	1.37	√	
14	70.16	70.43	-0.27	√	
15	58.52	59.07	-0.55	√	

The evaluation indicated a tie on 3 projects; 9 projects received a slightly favourable score by the model while 3 projects received a slightly unfavourable score by the model. All in all the standard variance was less than 0.5% which is a very accurate score. None of the projects received a deviation of more than 1.56%.

The responses from the respondents on the validation exercise are appended as appendix F.

Mainly the respondents had more than 20 years of experience and comprised of two architects and three quantity surveyors. Two respondents were from the public sector while three were from the private sector.

5.10 FUNCTIONALITY OF THE MODEL

The table below represents the responses on the respondents on the various model performance indicators as per table 5.11 below;

Table 5.11 Functionality of model

ITEM	DESCRIPTION	RANKING				
		Poor	Average	Good	Very good	excellent
(i)	The extent to which the model represent project management resources.	-	-	-	4 or 80%	1 or 20%
(ii)	The extent to which the models could assist in making better project management decisions.	-	-	-	1 or 20%	4 or 80%
(iii)	The ability of the model to facilitate communication of project objectives.	-	-	-	1 or 20%	4 or 80%
(iv)	The usefulness of the models to help in the overall project management and construction process	-	-	1 or 20%	-	4 or 80%
(v)	Others; specify	None	None	None	None	none

Given that the consultants rated the model as either very good or excellent; this is a big step towards finding a solution for the project performance management of the construction industry in Kenya. Indeed it is a clear demonstration that the developed model shall be very useful if adopted in the construction industry.

5.11 USE OF THE MODEL IN MEASURING PROJECT MANAGEMENT EFFECTIVENESS

The model was rated by the respondents on its effectiveness in the construction industry. The results are as indicated in the table 5.12 below:-

Table 5.12 Model effectiveness measures

ITEM	DESCRIPTION	RANKING				
		Poor	Average	Good	Very good	excellent
(i)	The effectiveness of the models in measuring project management progress.				4 or 80%	1 or 20%
(ii)	The usefulness of the model to the project team.				4 or 80%	1 or 20%
(iii)	The easiness of using the model				1 or 20%	4 or 80%
(iv)	Other; specify				None	None

The concentrations of the respondents were either on very good or excellent meaning the model is useful in predicting construction performance effectiveness.

5.12 THE USE OF THE MODEL AS A PROJECT MANAGEMENT IMPROVEMENT TOOL

The generated model was tested on its usefulness towards enabling project management improvement. The results are presented as per table 5.13 below:-

Table 5.13 Ranking of model in project management improvement

ITEM	DESCRIPTION	RANKING				
		Poor	Average	Good	Very good	excellent
(i)	The accuracy of the model in identifying the factors that influence project management improvement.			1 or 20%	3 or 60%	1 or 20%

(ii)	The usefulness of the model in assessing the factors that influence project management improvement.				3 or 60%	2 or 40%
(iii)	The ability of the model in predicting problems occurring during project execution.				1 or 20%	4 or 80%
(iv)	Other; specify				None	None

The rating ranged from good to excellent. Based on the model as an evaluation criteria; only one respondent who rated the model and in only one factor as good measure of project management improvement. The indication is that the model is accurate; useful and can predict accurately the problems occurring during project execution. This is a major deliverable in this research undertaking.

5.13 CONSULTANTS' VIEWS

The final section on the industry validation was about the consultants views on the developed model. 40% rated it as excellent while 60% rated it as very good. The overall indication is that the developed model is very useful in the construction industry to ensure efficiency and effectiveness in the execution of construction projects. The absolute rating can be calculated as follows:

60% of 4 + 40% of 5 = 4.4

4.4/5 x 100 = 88%

Only one consultant who gave further improvement comments as follows:-

(i) That weighting factors can be improved to make the model accurate.
(ii) That there should be stricter definition of predicting factors.

These were effected in the final model and formed useful insight in the research. The particular consultant was acknowledged in the acknowledgement page of this research.

5.14 KEY FEATURES AND POTENTIAL BENEFITS OF THE PROJECT MANAGEMET MODEL

The assessment model under consideration has been designed to satisfy the following objectives:

i. To fall in line with the monitoring and control processes of project management.

ii. To emphasize participatory assessment of key members and stakeholders on the project.

iii. To make the assessment an essential part of the management of the project.

iv. To make it adaptable to any project situation.

V. To ensure continuous assessment.

5.14.1 Features of the Model

The following are the key distinguishing features of the model.

i. It is tailored to the project situation

Being a project management-based tool, it is made flexible to be adaptable to any project anywhere. This is seen in the pre-determination of the performance measures and parameters based on the expectations of the project. This means that depending on the type of the project and its probable contingency variables defined by the emphasis of each specific requirement of the client and the external environmental factors prevailing, either all or only some of the indicators may be relevant for use. This is a major distinguishing feature of the model as compared with the existing ones as discussed in chapter 2 of this thesis. In particular, Shenhar et al. (2002) identify this as a main weakness in most of the existing models.

ii. It allows for an objective assessment and management of construction projects

By working with measures that reflect and describe the true state of the project, by quantifying their performance against set standards and by taking management decisions and actions based on these findings, the model provides a means of assessing and managing construction projects objectively. Objectivity is also ensured by the process of data collection and processing for results and decisions. By involving all the relevant participants on the project to estimate the factors at play and their impact, the analyzed results provide management with an unbiased report on the true state of affairs for decision making. By assigning the clients some responsibility at 18% and consultants at 82% weighting the Clients are encouraged to play an active role in execution of projects. Equally projects can now be assessed absolutely on their performance instead of the success or failure dichotomous assessment which is inadequate.

iii. It allows predictions to be made on performance

Based on the information obtained after each assessment, the project team is able to predict the possible occurrence in certain aspects of the project, on which basis advice can be given. The results of the analyses of the critical factors affecting the project in identifiable indicators broadly provide the following two statements:

i. Certain factors are positively affecting certain indicators and must be encouraged in order to sustain good results in these indicators so that desired performance can be achieved;

ii. Certain factors are negatively affecting certain indicators and must be discouraged in order to restore good results in those indicators so that desired performance can be achieved. In effect, these predict the future performance of the project based on prevailing results**.** This is also another gap that the model proposes to fill. A major problem noted in project performance assessment models is that they do not link the criteria to the factors and hence the models do not form part of an assessment system ((Beatham et al., 2004; Takim & Akintoye, 2002)).

iv. It allows for learning and improvements in the on-going project as well as future projects

The model is used for both continuous assessment of the project at pre-determined stages, as well as for final assessment. The results of the assessment of each stage offers opportunity for management to take decisions and effect strategic changes for the next stages of the project. At the end of the project, the various assessment results and decisions taken are documented as a resource for learning and improvements in future project performance. This becomes data which will support other researches in project management. This feature of the model sets it apart from all project success and failure considerations which are declared at the end of the project. One of the major challenges faced by project management researchers is the difficulty in getting data on already completed projects. Russel & Lawrence, (1997) attributed this to the fact that past project records were not in a format suitable to fill in data collection tools. This ability of learning from project is one thing that is lacking in construction project execution as a temporary organization. Usually, when a project is completed, the team is disbanded, and the only organized part that is left is the edifice that epitomizes the concepts of the design. There are usually no concerted efforts to document happenings that will serve as a source of learning.

v. It takes care of the impact of the scope changes and management in projects.

By affording the Client an opportunity to structure scope definition and by continuously monitoring the six key variables at agreed intervals; the major source of scope creep is eliminated and makes the ownership and management of construction a proactive shared responsibility between clients and consultants.

vi. It is client focused

The model is designed with clients' ultimate satisfaction in mind. In addition to clients being allowed to assess performance in their own perspective, its use in ensuring objective management as well as expressing the final performance in a shared perspective are all intended to benefit the client. Also, apart from monitoring his own satisfaction and expectation levels, the client is given the benefit of real update from the practitioners' side.

vii. It addresses the human elements in Project Performance

One key feature of the model is that it measures the performance of the core human factors as a means of monitoring project performance and for its management. Most of the factors that it measures as affecting project performance are human related, similarly, the necessary changes that are required for good or improved performance are also mostly human related. This addresses the finding from both theoretical and empirical research that human core factors are the leading determinants of construction project management performance.

5.14.2 Benefits to the Client

The model offers some important benefits to the client as outlined below.

i. It offers the opportunity for high involvement of the client in the affairs of the project

By allowing clients to have their own assessment regarding their perspective of project, and by allowing them to take part in some of the assessments of the project, clients are given the opportunity to increase their involvement of the running of the projects. The clients are proactively involved in the management of projects and they are even rated. The weighting of both the clients and consultants project management performance measurements affords an opportunity for a holistic approach towards projects implementation and management. One of the inherent features of the model is that it affords the opportunity to also learn, both on the project and afterwards. By involving the client this much, it also affords them the opportunity to learn. As expected by the industry, those clients become initiators, not only for projects but also for improvements (Latham, 1994); these involvements in project management and the knowledge acquisition will certainly equip them for these tasks.

ii. It allows Client's satisfaction criteria to be designed and assessed by Clients

A key distinguishing feature of this model is that it allows clients to determine their satisfaction criteria and expectations from service providers as well as allowing them to effect the assessment of these. In other words, service providers desire to satisfy their clients is made meaningful by the fact that it is really going to be objectively assessed by the clients in the end. This is in sharp contrast to the usual situations when client's satisfaction is not only considered as an item on project success criteria, but is also determined in the practitioners' perspective. Both teams (Clients and consultants/practitioners are given an opportunity to design the evaluation criteria based on the six measures of scope, time, quality, human resource management, projects performance and cost.

iii. Clients have the opportunity to ensure better performance from service providers

By agreeing on the specific expectations from the service providers for assessments, monitoring and controlling, clients have been given the rare opportunity to ensure better performance from service providers and, ultimately value for money. It also affords clients the basis for their continuous engagement or otherwise of these service providers.

iv. The Concept of the "shared perspective" removes disputes between clients and practitioners

With the ultimate aim of assessing construction projects in a shared perspective (of the client and practitioners), and by involving the client in some of the assessment in practitioners perspective, the model and its working principle has virtually removed all forms of disputes that usually results when clients disagree with reports given by practitioners on the state of the projects, especially when it involves extra resources. There is also the benefit of increasing collaboration and teamwork between the client and the practitioners throughout the course of the interim assessments to the final completion and this improves the relationship and understanding between them. The model also improves the process and structure of scope definition and management in projects by ensuring a structured scope definition and management approach.

5.14.3 Benefit to Practitioners

The model is important to the practitioners (the project managers/consultants and the project team) as outlined below.

i. It gives them a further clarification on the project's expectations

The model provides a means by which the demands of the project as contained in the contract conditions, bills of quantities, specifications, and drawings, are further cascaded into performance measures. This puts them in a good position to go the extra mile to satisfy those expectations and to ensure that events occur as planned. This also helps them to be on track. In addition, by ensuring that relevant measures, with their agreed weightings are used as a guide for the management of the project, each practitioner is made to focus on what really matters with regard to the on-going project. This keeps them alert and eliminates the feeling of "the usual routines". Finally since the project performance can be measured in absolute terms it enables them to evaluate their performance from project to project.

ii. It gives them the needed support for effective decision making

Better decisions for an on-going project are enhanced when they are supported with the right information. The model allows practitioners to benefit from this information by reporting on (i) the performance of the indicators (ii) by identifying the factors at play, and by relating them in such a way that they will know exactly which aspect of the project to address to ensure good performance of the project especially on the six variables identified. A part from the three usual factors of cost, quality and time project management measures it was established that human resource management, scope management and project performance were the other important measures in project management performance measurements.

iii. It helps practitioners to improve upon their capacity and competence

The entire exercise of the implementation of the model on a project and the documentation allow practitioners to learn from their special interaction with the client and contractors. Familiarity with the performance measures and their behaviours and interactions, and the overall outcomes is standardized for project implementers to follow. Over time, practitioners will have a wealth of knowledge, skills and capacity to provide better services to clients. The final documents representing the story of the project life-cycle becomes a wealth of knowledge for every participating practitioner.

5.15 SOME ANTICIPATED LIMITATIONS OF THE MODEL

In spite of its potential to address most of the limitations of the existing models, the following limitations are expected from the implementation of the model.

1. Its use is likely to cause additional cost to the project. This is because the implementation calls for the appointment of a project manager; especially for small projects, to manage the whole assessment procedure throughout the project. It is expected, however, that the benefits will outweigh the cost because, as a results of good front-end management promoted by the model, and the continuous monitoring and controlling it offers, most of the *ad hoc* activities that emanate from poor and hasty planning will be eliminated. A good preparation at the outset of the project will prevent misunderstandings during the execution stages. These activities inherently, provide clarifications of all the goals of the project and increase participation.
2. In addition, it is likely to increase the volume of work at the pre-tender stages because, apart from contemplating the design and tendering procedure, the Project Manager and the Project Team are expected to undertake the extra work of pre-determining planned/expected standards against which actual performance will be compared. Also, the project team and the project management team from the client's organization are given extra work, in addition to their specific roles, of responding to questions and filling assessment forms from the project manager.
3. Another weakness envisaged is that because the model will be used to assess the project at the pre-determined stages, it means that it will suffer from the limitation

of reporting some performance after they had occurred without giving room for correction and improvement on the spot. What happens if in-between the agreed assessment periods “some things” just happened for which a prompt action was required based on assessment? It is expected, however, that once the tool is operationalized in practice, it will undergo needed adaptations to meet this challenges and demands of projects in the long run. For example, based on the notification of the project manager, management can organize and take emergency decisions in-between the agreed periods of assessment.

4. The influence of external environment such as political situations in a given country on the model has not been factored in. However, the project manager can adapt this as one of project performance indicators and incorporate it in the measurements accordingly.

5.16 PROJECT EVALUATION USING LOGISTIC REGRESSION

The alternative to the aforementioned modelling process is to use logistic regression as discussed hereunder. Project evaluation indicators were determined by establishing the relationship between how effective the project managers rated the indicators with the dependent variables on the achievement of those project indicators. For us to determine the relationship between the variables descriptive and logistic regression analysis was performed.

5.16.1 Descriptive statistics

As indicated in table 5.15 below, the mean value of project cost of 303 observations was 4.7426 with the standard deviation of 0.46006; Project information reported the smallest mean of 3.9406 with standard deviation of 0.93308; Most of the factors had an average mean of 4 and above with a median of 4. It is evident that majority of the respondents rated the factors as important indicators of project management evaluation.

Table 5.15 Descriptive Statistics on performance indicators

		Project Scope	Project Time	Project Cost	Project Quality	Project HR	Project Info	Project Risk	Project Performance
N	Valid	303	303	303	303	303	303	303	300
	Missing	9	9	9	9	9	9	9	12
Mean		4.3762	4.6436	4.7426	4.6436	4.5347	3.9406	4.0198	3.9900
Median		4.0000	5.0000	5.0000	5.0000	4.0000	4.0000	4.0000	4.0000
Mode		5.00	5.00	5.00	5.00	4.00	4.00	4.00	5.00
Std. Deviation		.68838	.60764	.46006	.55643	5.12796	.93308	.89124	.99660

5.16.2 Covariates

The table below illustrates the correlations coefficients amongst individual indicators. It is evident that most of the indicators are highly correlated. Therefore we will consider individual relationships amongst the selected factors through the PCA.

Table 5.16 Correlations of the Individual Indicators

	X1	X2	X3	X4	X5	X6	X7	X8
Project Cost – X1	1.000	.302	.366	.492	.109	.161	.184	.165
Project Scope – X2	.302	1.000	.562	.102	.272	.386	.214	.173
Project Time – X3	.366	.562	1.000	.544	.137	.353	.223	.098
Project Quality – X4	.492	.102	.544	1.000	.012	.327	.010	.221
Project HR – X5	.109	.272	.137	.012	1.000	.282	.171	.229
Project Info – X6	.161	.386	.353	.327	.282	1.000	.506	.423
Project Risk X7	.184	.214	.223	.010	.171	.506	1.000	.363
Project Performance – X8	.165	.173	.098	.221	.229	.423	.363	1.000

From the results displayed on the two outputs above, it's evident that amongst the factors there is a relationship which may be expressed well with the achievement of the projects objectives.

5.17 Logistic Regression

Model-building techniques used in statistics are aimed at finding the best fitting and reasonable model to describe the relationship between an outcome (dependent or response) variable and a set of independent (predictor or explanatory) variables. These independent variables are often called *covariates.* The traditional method used is often linear regression model where the outcome variable is assumed to be continuous.

Logistic regression model differs from the linear regression model in that the outcome variable in logistic regression is *binary* or *dichotomous.* This distinction is reflected on their assumptions.

In all regression problems the key quantity is the mean value of the outcome variable, given the value of the independent variable. This quantity is called the *conditional mean* and expressed as *E*(Y/**x**), where *Y* denotes the outcome variable (default or non-default) and ***x*** denotes a value of the independent variables (covariates).

Many distribution functions have been proposed in modeling binary outcome data for example Linear Discriminant Analysis (LDA), today logistic regression is the most preferred because:

(i) there are fewer assumption violations, especially as it does not demand normally distributed independent variables;

(ii) it works better where group sizes are very unequal;

(iii) Mathematically the resulting models are easier to interpret due to its mathematical simplicity.

The form of logistic regression is defined as:

$$p(x) = \frac{e^{\beta_0+\beta_1X_1+\beta_2X_2+\cdots+\beta_pX_p}}{1+e^{\beta_0+\beta_1X_1+\beta_2X_2+\cdots+\beta_pX_p}} \qquad (4.0)$$

The logit function (4.0) can be transformed into:

$$g(x) = \ln\left(\frac{p(x)}{1-p(x)}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p + \varepsilon \qquad (4.1)$$

Logistic regression use Maximum Likelihood Estimation (MLE) to estimate the values of the unknown parameters which maximizes the probability of obtaining the observed set of data. The maximum likelihood estimators of these parameters are chosen to be those values that maximize the function.

Previous studies from the literature review indicate that there exist significant relationships amongst factors when monitoring and evaluating the performance of the indicators. In our study we used the likert scale of 1 to 5 where 1- least important and 5- very important.

For us to regress the individual responses we coded the individual responses into two categories that is Least Important and Important.

Where:

0 = Least Important {1-3 grouped}

1 = Important {4-5 grouped}

5.17.1 Project scope Management model

A logistic regression analysis was conducted to predict whether project scope contributed to project management evaluation model subject to the other indicators. A test of the full model against a constant was statistically significant, indicating that the predictors as a set reliably distinguished between those who rated the indicators as important and those who said they were least important (chi square = 152.315, $p < .000$ with $df = 6$). Nagelkerke's R^2 of .582 indicated a moderately strong relationship between prediction and grouping. Prediction success overall was 90% (95% for decline and 50% for accept. Except for cost ($p = .053$) the Wald criterion demonstrated that all indicators made a significant contribution to prediction, Table 5.17-5.19

Table 5.17 Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	111.983[a]	.303	.582

a. Estimation terminated at iteration number 8 because parameter estimates changed by less than .001.

Table 5.18: Classification Table[a]

	Observed		Predicted		
			psco		Percentage Correct
			.00	1.00	
Step 1	psco	.00	18	18	50.0
		1.00	12	252	95.5
	Overall Percentage				90.0

a. The cut value is .500

Table 5.19: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Pro_time_mangment	2.183	.440	24.606	1	.000	8.876
	Pro_cost_mangment	-1.021	.528	3.740	1	.053	.360
	Pro_qm_factor	.915	.408	5.025	1	.025	2.497
	Pro_hr_managmnt	1.506	.356	17.912	1	.000	4.509
	Pro_perfoma_managmnt	.690	.281	6.026	1	.014	1.995
	Constant	-13.908	2.936	22.448	1	.000	.000

a. Variable(s) entered on step 1: Pro_time_mangment, Pro_cost_mangment, Pro_qm_factor, Pro_hr_managmnt, Pro_perfoma_managmnt.

The 'B' values are the logistic coefficients that can be used to create a predictive equation (similar to the b values in linear regression). In this case our model will be:-

Ln[PS] = 1.506PH+0.69PP+2.183PT-13.908+0.915PQ

The above function shows that project management evaluation can cannot be modelled project scope alone; there is need to consider other variables.

5.17.2 Project time Evaluation management model

Time constitutes one of the most important performance indicators in monitoring and evaluation to both the practitioners and the clients; it's evident that the predictors do have significant effect and create essentially a different model. (table 5.20)

Table 5.20 Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	75.261	6	.000
	Block	75.261	6	.000
	Model	75.261	6	.000

Nagelkerke's R2 of .364 indicated a moderately strong relationship between prediction and grouping meaning project time alone is insufficient to model project performance. Prediction success overall was 92% (9.5% for least important and 98.2% for Important indicators) (table 5.21-5.22).

Table 5.21: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	105.242[a]	.145	.364

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

Table 5.22: Classification Table[a]

	Observed		Predicted		
			PT		Percentage Correct
			.00	1.00	
Step 1	PT	.00	2	19	9.5
		1.00	5	274	98.2
	Overall Percentage				92.0

a. The cut value is .500

The Wald criterion demonstrated that quality and scope made a significant contribution to prediction (p = <.05). Project human resources and performance indicators were not significant predictors as per table 5.23.

Table 5.23: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Pro_cost_mangment	.237	.559	.179	1	.672	1.267
	Pro_qm_factor	1.437	.371	15.008	1	.000	4.208
	Pro_hr_managmnt	-.427	.351	1.477	1	.224	.653
	Pro_perfoma_managmnt	-.173	.300	.333	1	.564	.841
	Pro_sco_managemnt	.994	.414	5.753	1	.016	2.702
	Constant	-4.989	2.327	4.596	1	.032	.007

a. Variable(s) entered on step 1: Pro_cost_mangment, Pro_qm_factor, Pro_hr_managmnt, Pro_perfoma_managmnt, Pro_sco_managemnt.

Our predictive model out of the 'B' coefficients is as follows.

Ln[PT]= 1.437PQ+0.994PS-4.989

5.17.3 Project Human resource management model

Human resource relationship with other indicators was done and it was established that the predictors do have significant effect. Nagelkerke's R^2 of .526 indicated a moderately strong relationship between prediction and grouping. Prediction success overall was 84.8% (62.5% for least important and 92.0% for Important indicators as per tables 5.24, 5.24 & 5.25 respectively.

5.24 Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	128.897	6	.000
	Block	128.897	6	.000
	Model	128.897	6	.000

5.25 Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	200.095[a]	.352	.526

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

The implication is that project is that project human resources alone cannot be used to model project management evaluation.

5.26 Classification Table[a]

	Observed		Predicted		
			phr		Percentage Correct
			.00	1.00	
Step 1	phr	.00	45	27	62.5
		1.00	18	207	92.0
	Overall Percentage				84.8

a. The cut value is .500

Time, cost and quality performance indicators were not significant predictors. The Wald criterion demonstrated that scope, information and performance indicators made a significant contribution to prediction (p = <.05) table 5.27 below.

5.27 Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Pro_sco_managemnt	1.461	.357	16.752	1	.000	4.310
	Pro_time_mangment	.003	.358	.000	1	.993	1.003
	Pro_cost_mangment	-.087	.546	.025	1	.873	.917
	Pro_qm_factor	-.439	.461	.907	1	.341	.644
	Pro_inform_mangmnt	.676	.266	6.447	1	.011	1.966
	Pro_perfoma_managmnt	1.050	.211	24.891	1	.000	2.859
	Constant	-8.894	1.863	22.792	1	.000	.000

a. Variable(s) entered on step 1: Pro_sco_managemnt, Pro_time_mangment, Pro_cost_mangment, Pro_qm_factor, Pro_inform_mangmnt, Pro_perfoma_managmnt.

Our predictive model out of the ‘B’ coefficients is as follows.

$$Ln[PH] = 1.461PS+0.676PI+1.05PP-8.894$$

5.17.4 Project cost Management relationship

Successful projects incur cost amongst other factors which contributes to project performance. A test of the full model was statistically significant, indicating that the predictors as a set reliably distinguished between those who rated the indicators as important and those who said they were less important (chi square = 161.101, $p < .000$ with $df = 6$). Nagelkerke's R^2 of .598 indicated a moderately strong relationship between prediction and grouping. Prediction success overall was 84% (71.4% for decline and 88.4% for accept). Except for scope and time, the Wald criterion demonstrated that all indicators made a significant contribution to prediction, Table 4.28-4.31.

Table 5.28: Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	161.101	6	.000
	Block	161.101	6	.000
	Model	161.101	6	.000

Table 5.29: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	194.671[a]	.416	.598

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

Table 5.30: Classification Table[a]

	Observed		Predicted		
			pcost		Percentage Correct
			.00	1.00	
Step 1	pcost	.00	60	24	71.4
		1.00	24	192	88.9
	Overall Percentage				84.0

a. The cut value is .500

Table 5.31: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Pro_sco_managemnt	-.329	.361	.828	1	.363	.720
	Pro_time_mangment	.111	.398	.077	1	.781	1.117
	Pro_info_mangment	1.373	.498	7.586	1	.006	3.946
	Pro_qm_factor	1.779	.422	17.760	1	.000	5.925
	Pro_perfoma_managmnt	.814	.219	13.791	1	.000	2.256
	Pro_hr_managmnt	.871	.300	8.439	1	.004	2.389
	Constant	-18.931	2.239	71.469	1	.000	.000

a. Variable(s) entered on step 1: Pro_sco_managemnt, Pro_time_mangment, Pro_info_mangment, Pro_qm_factor, Pro_perfoma_managmnt, Pro_hr_managmnt.

Our predictive model out of the 'B' coefficients is as follows.

Ln[PC] = 1.373PI+1.779PQ+0.814PP+0.871PH -18.931

5.17.5 Performance project management relationship

A test of the full model was statistically significant, indicating that the predictors as a set reliably distinguished between those who rated the indicators as important and those who said they were less important (chi square = 66.887, p < .000 with df = 6). Nagelkerke's R^2 of .0.290 indicated a moderately weak relationship between prediction and grouping. Prediction success overall was 77% The Wald criterion demonstrated that time, human resource and project information indicators were significant to prediction, Table 5.32-5.35.

Table 5.32: Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	66.887	6	.000
	Block	66.887	6	.000
	Model	66.887	6	.000

Table 5.33: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	283.069[a]	.200	.290

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Table 5.34: Classification Table[a]

	Observed		Predicted		
			pperf		Percentage Correct
			.00	1.00	
Step 1	pperf	.00	33	48	40.7
		1.00	21	198	90.4
	Overall Percentage				77.0

a. The cut value is .500

Table 5.35: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Pro_sco_managemnt	-.053	.295	.032	1	.858	.949
	Pro_time_mangment	-.909	.331	7.529	1	.006	.403
	Pro_cost_mangment	-.016	.492	.001	1	.975	.984
	Pro_qm_factor	.423	.398	1.128	1	.288	1.526
	Pro_hr_managmnt	.643	.223	8.277	1	.004	1.902
	Pro_inform_mangmnt	.868	.227	14.669	1	.000	2.383
	Constant	-2.205	1.514	2.120	1	.145	.110

a. Variable(s) entered on step 1: Pro_sco_managemnt, Pro_time_mangment, Pro_cost_mangment, Pro_qm_factor, Pro_hr_managmnt, Pro_inform_mangmnt.

Our predictive model is as follows;

$$Ln[PP] = 0.643PH+0.868P-0.909PT-2.205$$

5.17.5 Quality management relationship

Project evaluations entirely entails on the quality of the end results of the project done. Table 5.36 showed that the factor was highly correlated with other factors, it's clear that the model is evident as its explained by 46.1% show in table 4.96 below.

Table 5.36: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	214.880[a]	.304	.461

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Prediction success overall was 85% The Wald criterion demonstrated that information, performance and cost indicators were significant to prediction, Table 5.37-5.38. The implication is that quality alone cannot be used to model for project management evaluation. It has to be done alongside other indicators.

Table 5.37 Classification Table[a]

	Observed		Predicted		
			pquality		Percentage Correct
			.00	1.00	
Step 1	pquality	.00	39	30	56.5
		1.00	15	216	93.5
	Overall Percentage				85.0

a. The cut value is .500

Table 5.38: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Pro_sco_managemnt	-.389	.307	1.601	1	.206	.678
	Pro_time_mangment	-.389	.341	1.297	1	.255	.678
	Pro_hr_managmnt	.025	.121	.043	1	.836	1.025
	Pro_inform_mangmnt	1.010	.246	16.842	1	.000	2.746
	Pro_perfoma_managmnt	.744	.199	14.028	1	.000	2.104
	Pro_cost_mangment	1.727	.466	13.746	1	.000	5.625
	Constant	-9.943	1.781	31.175	1	.000	.000

a. Variable(s) entered on step 1: Pro_sco_managemnt, Pro_time_mangment, Pro_hr_managmnt, Pro_inform_mangmnt, Pro_perfoma_managmnt, Pro_cost_mangment.

Our predictive model can be expressed as follows:

Ln[Y] = 1.010PI+0.744PP+1.727PC-9.943

5.17.6 Project information relationship

The model summary attributes to 100% of the extracted factors as shown under table 5.39- 5.41 below. This is because the maximum iterations cannot be reached. Although significant, (chi square = 33.601, p < .000 with df = 6), a test of the full model was not statistically significant.

Table 5.39 Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	33.601	6	.000
	Block	33.601	6	.000
	Model	33.601	6	.000

5.40 Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	.000[a]	.106	1.000

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Table 5.41: Classification Table[a]

	Observed		Predicted		
			pcost		Percentage Correct
			.00	1.00	
Step 1	pcost	.00	3	0	100.0
		1.00	0	297	100.0
	Overall Percentage				100.0

a. The cut value is .500

Table 5.42: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Pro_sco_managemnt	13.126	2776.320	.000	1	.996	501643.620
	Pro_time_mangment	10.736	3498.411	.000	1	.998	45968.991
	Pro_qm_factor	19.358	3514.524	.000	1	.996	255266092.470
	Pro_hr_managmnt	3.606	2494.859	.000	1	.999	36.832
	Pro_cost_mangmnt	-14.198	1650.804	.000	1	.993	.000
	Pro_perfoma_managmnt	5.528	1387.240	.000	1	.997	251.577
	Constant	-130.653	9770.358	.000	1	.989	.000

a. Variable(s) entered on step 1: Pro_sco_managemnt, Pro_time_mangment, Pro_qm_factor, Pro_hr_managmnt, Pro_cost_mangmnt, Pro_perfoma_managmnt.

The factor is dropped from the final model because its unit derived in the regression is neither reliable nor realistic. However, this may imply that the factor has been compounded by the other critical factors already discussed above. Hence we remain with only six factors to produce the final model of project management for consultants and contractors which includes project cost, quality, time, human resource, performance and scope. In general all factors are significant; however, they cannot be represented in the individual models as they have already been expressed in the other factors.

Thus the general model is given as

$$PMM = 17.67\%PT + 18.80\%PC + 18.23\%PQ + 17.11\%PS + 14.47\%PH + 13.72\%PP$$

This model reflects the consultants' and contractors' general model score pegged at 82%. As established from data analysis the clients also play a significant role in the performance of projects and their performance rating is at 18% to make a total of 100%.

iii. Determine the overall Performance in the relevant perspective for each phase

Add all the performance (weighted) scores of each criterion in the perspective to obtain the overall performance (weighted) score in that perspective, using the established relationship. This is illustrated in the equation 5.2a. For each period, for example period 1, the overall performance could be calculated as:

Pop = $w1C1 + w2C2 + w3C3 + ... + wnCn$ 5.2a

Where, Wn = the weight of each criterion, Cn = the score of each criterion, Pop = the overall performance.

iv. Illustrations Using the Relationships

Equations 5.3a to 5.11a show the actual procedure of adding.

2. For Practitioners, this is reported as:

$PMM = 17.67\%PT_p + 18.80\%PC_p + 18.23\%PQ_p + 17.11PH_p + 14.47\%PP_p + 13.72\%PSp$..................5.3a

b. For Clients:

$PMMc = 0.5PF + 0.3PS + 0.10PC + 0.1.Pp$……………………………………5.4a

Where PMMc is the clients overall performance measurement

PF is the client's project financial arrangements and preparedness.

PS is the role of the client in clear scope definition and in scope change management process;

PC is the level of the client coordination with consultants in ensuring a diligent execution of projects.

Pp is the level and timely honouring of payments by the client to both the consultants and contractors.

Overall project execution efficiency reflecting good project management is measured thus:

$Pe = 82\%PMM + 18\%PMMc$

Whereby Pe is the overall project execution efficiency;

PMM is the consultant and contractor contribution component as per equation 5.3

While PMMc is the client's contribution as per equation 5.4

The individual factor contributors in the PMM model are determined by the following equations which have already been extensively discussed in chapter four.Logistic regression was used and the following logistic linear functions extracted after finding the logarithms.

These scores can also be rated on 0 to 1 scale which is used in the model and reduced to percentages.

PC = 0.72PS+1.117PT+5.925PQ+2.256PP+2.389PH------------- ---(5.5a)

PT = 2.702PS+4.208PQ+0.653PH+0.841PP+1.267PC---------------(5.6a)

PQ = 0.678PS+0.678PT+5.625PC+1.025PH+2.104PP----------------(5.7a)

PS = 8.876PT+0.36PC+4.509PH+1.995PP+2.497PQ-------------------(5.8a)

PP = 0.949PS+0.403PT+0.984PC+1.526PQ+1.902PH-------------------(5.9a)

PH = 4.31PS+1.003PT+0.917PC+0.644PQ+0.431PS+2.859PP---------5.10a)

The foregoing are general logistic linear regression equations generated by SPSS using data from the field. The various scores are used to work out the overall PMM for consultants.

5.18 ASSUMPTION OF THE MODEL

The model undertakes various assumptions that exist in the construction industry currently. Model 1, provided in the below table highlights the failure to comply with all the key factors for project accomplishment. The research sought to compare the factors of time, quality and cost against the factors of human resource, scope and project performance. The comparison is important because the practitioners have been considering time, quality and cost as key factors to measure for the successful project completion. This is compared with the assumption of the research which introduces three more factors namely; human resource, scope and project performance. This is addressed by the models 3 and 4, where model 3 validates the efficiency of the time, quality and cost factors whereas model 4 validates the efficiency of human resource, scope and project performance. Model 2 deals with the ideal situation for all the factors incorporated in the model, which though may not be realistic in the industry since some factors have negative impact to others and also it is very difficult for everything to run according to plan.

The model values sampled for validation for various respective factors are presented under table 5.43 as follows;

Table 5.43: Various types of model assumption for model validation

	PT	PC	PQ	PH	PS	PP
Model 1	0	0	0	0	0	0
Model 2	1	1	1	1	1	1
Model 3	1	1	1	0	0	0
Model 4	0	0	0	1	1	1

Model one provides the following results among the factors being tested. The values highlighted in yellow are as a result of application of the formula developed for each factor. When all factors are not being handled for model 1 then; the model returns a zero implying there is no project running. For example for PT table 5.45 , it is given by :

PT=0*17.67+
13.72*8.876+0.678*18.23+1.003*17.11+.403*14.47+18.80*1.117=178.13%

$$PT\ \ Model\ 1 = (178.13/1088.59) = 16.33\%$$

There is 16.33% improvement in project performance as a result of perfecting time management.

Table 5.44 When all factors are at their worst.

	PT	PS	PQ	PH	PP	PC	Model %	
validate points	0	0	0	0	0	0		
PT MODEL Coefficients	0	2.702	4.208	0.653	0.841	1.267		
PT Final model	0						**17.67**	
PS MODEL	8.876	0	2.497	4.509	1.995	0.36		
PS Final Model	0						**13.72**	
PQ MODEL	0.678	0.678	0	1.025	2.104	5.625		
PQ Final Model	0						**18.23**	
PH MODEL	1.003	4.31	0.644	0	2.859	0.917		
PH Final Model	0						**17.11**	
PP MODEL	0.403	0.949	1.526	1.902	0	0.984		
PP Final Model	0						**14.47**	
PC MODEL	1.117	0.72	5.925	2.389	2.256	0		
PC Final Model	0						**18.8**	
	FINAL PMM MODEL=17.67%PT+18.8%PC+18.23%PQ+17.11%PH+14.47%PP+13.72%PS							
		0.00%						

Table 5.45 Time variable is perfected

	PT	PS	PQ	PH	PP	PC	Model %	
validate points	1	0	0	0	0	0		
PT MODEL Coefficients	0	2.702	4.208	0.653	0.841	1.267		
PT Final model	0						**17.67**	
PS MODEL	8.876	0	2.497	4.509	1.995	0.36		
PS Final Model	8.876						**13.72**	
PQ MODEL	0.678	0.678	0	1.025	2.104	5.625		
PQ Final Model	0.678						**18.23**	
PH MODEL	1.003	4.31	0.644	0	2.859	0.917		
PH Final Model	1.003						**17.11**	
PP MODEL	0.403	0.949	1.526	1.902	0	0.984		
PP Final Model	0.403						**14.47**	
PC MODEL	1.117	0.72	5.925	2.389	2.256	0		
PC Final Model	1.117						**18.8**	
	FINAL PMM MODEL=17.67%PT+18.8%PC+18.23%PQ+17.11%PH+14.47%PP+13.72%PS							
		178.13%						

The complete results are presented under table 5.46 as follows:-

Table 5.46 Project Management Evaluation at Excellent performance

	PT	PS	PQ	PH	PP	PC	Model %	
validate points	1	1	1	1	1	1		
PT MODEL Coefficients	0	2.702	4.208	0.653	0.841	1.267		
PT Final model	9.671						**17.67**	
PS MODEL	8.876	0	2.497	4.509	1.995	0.36		
PS Final Model	18.237						**13.72**	
PQ MODEL	0.678	0.678	0	1.025	2.104	5.625		
PQ Final Model	10.11						**18.23**	
PH MODEL	1.003	4.31	0.644	0	2.859	0.917		
PH Final Model	9.733						**17.11**	
PP MODEL	0.403	0.949	1.526	1.902	0	0.984		
PP Final Model	5.764						**14.47**	
PC MODEL	1.117	0.72	5.925	2.389	2.256	0		
PC Final Model	12.407						**18.8**	
	FINAL PMM MODEL=17.67%PT+18.8%PC+18.23%PQ+17.11%PH+14.47%PP+13.72%PS							
		1088.59%						

From the model as per table 5.46 then the overall performance = (1088.59/1088.59)%= 100%

Table 5.47 Project Management Evaluation using Traditional Indicators

	PT	PS	PQ	PH	PP	PC	Model %	
validate points	1	0	1	0	0	1		
PT MODEL Coefficients	0	2.702	4.208	0.653	0.841	1.267		
PT Final model	5.475						**17.67**	
PS MODEL	8.876	0	2.497	4.509	1.995	0.36		
PS Final Model	11.733						**13.72**	
PQ MODEL	0.678	0.678	0	1.025	2.104	5.625		
PQ Final Model	6.303						**18.23**	
PH MODEL	1.003	4.31	0.644	0	2.859	0.917		
PH Final Model	2.564						**17.11**	
PP MODEL	0.403	0.949	1.526	1.902	0	0.984		
PP Final Model	2.913						**14.47**	
PC MODEL	1.117	0.72	5.925	2.389	2.256	0		
PC Final Model	7.042						**18.8**	
	FINAL PMM MODEL=17.67%PT+18.8%PC+18.23%PQ+17.11%PH+14.47%PP+13.72%PS							
		591.03%						

From table 5.47 when we perfect the traditional factors then overall project performance as per consultant is given by:

$$PMM_{cs\&cr} \quad = \quad 17.67\%PT_p + 18.80\%PC_p + 18.23\%PQ_p + 17.11\%PH_p + 14.47\%PP_p + 13.72\%PS_p$$

$PMM_{cs\&cr}$= (591.03%/1088.59%)= 54%

This is as per logistic regression as captured in table 5.47 above.

Table 5.48 Project Management Evaluation using Additional Indicators

	PT	PS	PQ	PH	PP	PC	Model %	
validate points	0	1	0	1	1	0		
PT MODEL Coefficients	0	2.702	4.208	0.653	0.841	1.267		
PT Final model	4.196						**17.67**	
PS MODEL	8.876	0	2.497	4.509	1.995	0.36		
PS Final Model	6.504						**13.72**	
PQ MODEL	0.678	0.678	0	1.025	2.104	5.625		
PQ Final Model	3.807						**18.23**	
PH MODEL	1.003	4.31	0.644	0	2.859	0.917		
PH Final Model	7.169						**17.11**	
PP MODEL	0.403	0.949	1.526	1.902	0	0.984		
PP Final Model	2.851						**14.47**	
PC MODEL	1.117	0.72	5.925	2.389	2.256	0		
PC Final Model	5.365						**18.8**	
	FINAL PMM MODEL=17.67%PT+18.8%PC+18.23%PQ+17.11%PH+14.47%PP+13.72%PS							
		497.56%						

PMMCs&cr= (497.56%/1088.59%)= 46%

This is as per logistic regression as captured in table 5.9 above based on additional project management indicators.

The calculation of the final Project management model therefore will be given as follows by the application of the formula

$$PMM_{cs\&cr} = 17.67\%PT_p + 18.80\%PC_p + 18.23\%PQ_p + 17.11\%PH_p + 14.47\%PP_p + 13.72\%PS_p$$

Hence as a result of perfecting scope definition, human resource and project performance the overall project performance has improved by 46%. When compared against the ideal situation at 100%; this is a reflection of 46% improvement in efficiency. However, most researches have not been considering these three indicators which are significant contributors towards project execution efficiency. The traditional indicators of cost, quality and time contribute 54% as only as per logistic regression in the model.

At perfect project management the model scores 1088.59% for practitioners; this is then reduced to 82% and this is the maximum score for perfect project management in a given project for consultants. The balance possible maximum score of 18% is attributed to the clients. However, at any given situation it is impossible to attain all the marks hence to attain the perfect maximum of 100% is impossible but near 100% is very much possible for a perfect excellent performance. Since logistic regression gives almost similar results as multiple linear regression; readers are encouraged to use whichever method they are comfortable with without any significant change in the final outcome.

5.19 CONCLUSION

The project management evaluation model presented in this Chapter is aimed at providing an objective, tailor-made and realistic assessment of the performance of construction projects, with a view to enhancing their execution efficiency. It provides a closer collaboration and integration of the views of the key stakeholders in the management of the project, which is a paradigm shift from the existing scenario of fragmentation in views of various stakeholders regarding a project's performance. By integrating the views of clients and practitioners, the model eliminates potential disputes regarding the state of the project, which is a great strength. Therefore, use of the model should enhance teamwork in project execution, which is vital to improving the overall project efficiency and effectiveness.

By making it a continuous assessment model, and by providing a means of relating the factors to the affected indicators, the model provides an opportunity for information-based monitoring and control emanating from the key actors of the project, creating a comprehensive performance assessment system. The declaration of the overall performance level at each stage comprises the performance level of each individual criterion. It gives information on the management aspect in the project where good or bad performance is being achieved, as well as information on the overall performance of the project. This approach does away with the success/failure dichotomy which has been described as lagging in their use. By using metrics and records throughout the assessment process the model automatically provides a comprehensive documentation of all the relevant occurrences among the measures of assessment. This provides the information required during project execution which is necessary not only for decision making for the present project but also for learning for improvements in future projects execution. This is at the core of the research – a situation that is common in manufacturing industry but lacking in construction.

Finally, the evaluation model specifically addresses the aim of this research - to develop a means by which construction project performance can be assessed at any stage of the project execution with criteria that reflect the perspectives of the client and consultants, as well as the particular circumstances of the project within different socio-economic settings, with a view of enhancing project execution efficiency and effectiveness. Additionally, the model validation process - both in terms of formulation and from the industry/field – was has also been explained. In terms of formulation, the added parameters of human resource performance, scope and project performance were found to be useful and contributed 42% towards enhancing projects execution and project management evaluation. It has been shown that the traditional measures of project management comprising of quality, cost and time only account for 57% of project management and projection execution performance evaluation, which indicates inaccurate measurements and/or evaluation that has been done in practice so far. Therefore, the model created in this study is an attempt to address this inaccuracy.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

This chapter begins by summarizing the main research findings. It also relates the findings to the construction industry in Kenya by showing its suggested implications, its contribution to knowledge and general applicability in Kenya. It highlights the main limitations of the research and then recommends areas where further research is needed. Finally it covers the course of action for implementation of the proposed project management evaluation model in Kenya.

6.2 SUMMARY OF THE RESEARCH FINDINGS

The expected outcome of this study was a project management evaluation model for the construction industry in Kenya, which will make the construction industry more efficient and effective while taking cognizance of the existing local conditions. The research came up with a project management evaluation model which was validated using very experienced practitioners on fifteen projects. The experience was arrived based on the number of years one had been in active practice since professional qualifications and the level of active participation in form of articles published in the professional journals. The model was able to predict and actually score the project management performance on all the fifteen projects within an error margin of 0.5%. This is a major achievement of this study.

The model was modified to software form for ease of application. The software is attached in form of a CD and the manual is appended to this thesis. Secondly the performance of projects objectively using leading measures instead of lagging measures is emphasized. Finally it was established that the traditional measures of cost, quality and time are only measuring 57% of the entire performance of the construction projects and have been distorting project process performance results. Another set of criteria covering human resources, scope and performance efficiency were introduced to make the measurement of project performance evaluation more objective.

In addressing the research aim, specific **objective number 1** was to identify project management shortcomings in Kenya requiring management interventions. It was established that the projects exist as temporary organizations therefore requiring different management strategies. It was also established that projects require continual evaluations to improve performance under project health reports as opposed to project autopsy reports which report the event once it has occurred leaving little room for intervention measures. Apart from the foregoing there is also need to know the proper project management indicators which were determined to be six instead of the traditional project management indicators of cost, quality and time which have been giving only 57% of the project situation. There is need therefore for a paradigm shift in the project management evaluations as discussed in chapter 2 and backed by empirical study in chapter four. The comparison of the two hypothesis testing tables as shown on pages 282&283 using the f-values indicate that the f-value for table 4.118 model 1 (which compares time, cost and quality) is 3.508. This value is relatively lower than that of the table 4.119 model 2 (compares time, cost, quality, scope, human resource and project process performance) which is 8.089. The same can be compared using the adjusted r-squared values. Therefore, the six factors are the appropriate project management variables for Kenya. Consequently, because $f_{312(6)}cal =$ 8.089 is greater than $f_{312(3)}cal =$ 3.508 (both being greater than) the tabulated f-values of 2.289 and 3.0718 respectively; we conclude that the corrected model of the six project management factors implied by the alternate hypothesis is more efficient and effective to be applied in the construction industry in Kenya; thus satisfying objective number one. This is also confirmed by table 4.121 on page 286 using Chi-square tests that there is a significant difference between a model of three variables and the proposed one of six variables.

It was established that currently there is heavy reliance on lagging measures as opposed to leading measures (Beatham et al., 2004). There is also a lack of project management model application in the industry as established from the field study (pg. 241). There is lack of a formally recognized project management application, application of inaccurate measurements on the role of project management considering cost, time and quality only which have been established to account for only 57% of the project management performance (pg. 317) from the analysis. It was established that if there is any improvement of projects performance then there has to be a complete measure of the extent of project management. (Gichunge, 2000) identified cost, quality and time as some of the challenges which need to be addressed. Apart from those it was also established that the complete practice of project management should also include human resources, scope, project process performance and client issues. This has been discussed in chapter 4. The added indicators contributed 42% towards project performance.

Both clients and consultants are agreed on the six key project management measures of cost, quality time, human resources, project process performance and scope (pg 275, data analysis). Equally instead of these measures being evaluated on a success /failure mode they can be modeled to be evaluated as leading measures and in stages (pgs. 303-312). This is also reinforced with literature review on (Beatham et al., 2004). Principal component analysis was used to extract the factors. Some factors like project information and project risk management were not consistently loading and therefore eliminated from the final model.

Objective number 2 was to establish relevant management indicators for Kenya. Several models were reviewed with a view of establishing their relevance or otherwise to the Kenyan situation mostly PMBOK model, CIOB model, Germany model, GAPPS standards, BERR guidelines and Hermes were reviewed and found not to be very useful in the Kenyan context in their current state. However, they were used to extract useful variables for the model in Kenya. There was quite an overlap on these models and the researcher decided to focus PMBOK guide as published in 2013 to come up with relevant project management indicators. Principal Component Analysis was used to do a factor reduction and the reduced factors were subjected to a general linear regressions and logistic regression; independently, to establish the interactions of the factors while executing projects. Based on the regressions a model was developed capturing six key indicators for consultants and four indicators for clients to form a shared perspective.

Objective number 3 was to develop a project management evaluation model for Kenya by regressing identified project management indicators. From analysis of data 77% respondents preferred diagrammatic models, while 74% preferred simulation models. However, it was found out that simulation models are better because they can also be represented diagrammatically; stochastic and management matrix models were ruled out because developing many models at the same time can complicate implementation. Furthermore these models were not among the most preferred (pg. 242). The final model is therefore a muiltiple regression model developed on simulation basis. (pgs. 197 – 209).

This objective was satisfied first of all by reviewing literature to establish key inputs to the model which were identified as the traditional measures of cost, quality and time. People issues and process issues were also found to be significant. The latter two were modified to read human resource management and project performance issues. Apart from the time factors; client issues and project scope management were established as the key variables to the model. The final model incorporated the six factors of scope, cost quality, time, human resources and project performance. Client issues were incorporated in the model as part B complementary accounting for 18% of project performance. The developed models are summarized below:

These scores can also be rated on 0 to 1 scale which is used in the model.

PC_p = 1.586+0.056PS+0.150PT+0.382PQ+0.064PH+0.004PP ---(5.5)

PT_p = 1.065+0.265PS+0.282PQ-0.082PH+0.117PP+0.327PC -----(5.6)

PQ_p = 0.684+0.032PS+0.189PT+0.560PC-0.121PH+0.044PP ------(5.7)

PS_p = 0.261+0.302PT+0.139PC+0.287PH+0.047PP+0.055PQ ------(5.8)

PP_p = 1.347+0.342PT-0.025PC+0.496PH+0.194PQ+0.119PS …….(5.9)

PH_p = 0.850-0.140PT+0.238PC-0.310PQ+0.431PS+0.291PP ……(5.10)

$PME_{cs\&cr}$ =17.67%PT_p+18.80%PC_p+18.23%PQ_p+17.11PH_p + 14.47%PP_p + 13.72%PS_p ……………………………………………………………...5.3

The foregoing are multiple linear regression equations generated by SPSS using data from the field. The various scores are used to work out the overall PME for consultants. For individual variable scores the calculations are as per appendix five attached. Finally the models were reduced to a project management software application which is a key deliverable for the research. Refer to appendix F for the manual of its application.

b. For Clients:

PME_{ct} = 0.5PF + 0.3PS + 0.10PC + 0.1.Pp……………………………………………5.4

Where PME_{ct} is the clients overall performance efficiency measurement

PF is the client's project financial arrangements and preparedness.

PS is the role of the client in clear scope definition and in scope change management process;

PC is the level of the client coordination with consultants in ensuring a diligent execution of projects.

Pp is the level and timely honouring of payments by the client to both the consultants and contractors.

Overall project execution efficiency reflecting good project management is measured thus:

Pe = 82%$PME_{cs\&cr}$ + 18%PME_{ct}

Where Pe is the overall project execution efficiency;

The developed model allows for routine measurements to be objectively carried out to aid in corrective actions before the project performance turns bad. Being software it provides a universal approach towards project management evaluation in Kenya.

The developed model had features of being tailored to the project situation, it allows an objective measurement and management of construction projects, it allows predictions to be made in performance, it allows for learning and improvements in the ongoing projects as well as future projects, it takes care of impact of scope definition changes and management in projects and finally addresses the human elements in project performance.

Objective number 4 was to assess the effectiveness of the developed model on efficient and effective execution of construction projects in Kenya. On this objective it was established that project management has been majorly producing autopsy reports as opposed to health reports (Beatham et al., 2004; Senge, 2006). The way forward is production of health reports. The model was able to predict project performance expectations with an acceptance rating of 88% from the industry senior consultants.

The developed model was tested and found useful in measuring success or failure of projects to 0.5% error margin. The control and measuring part whereby it was emphasized to link the project success indicators and their associated influencing factors can play a significant role in measuring the effectiveness on the performance of construction projects. Attached as appendix E are results from a live project based on the model application.

The model does have benefits to both the practitioner and clients. For clients the major benefits are in the concept of shared project performance perspective hence eliminating conflicts between clients and consultants; it also offers an opportunity for clients to be highly involved in the affairs of the project. For consultants it gives them a further clarification on the project's expectations; it gives them the needed support for decision making and finally it helps them to improve upon their capacity and competence. Above all the model contributes to knowledge in form of a software application which can be used by consultants and clients to evaluate the performance of projects in Kenya hence ensuring an effective and efficient execution of projects. The model contributes to knowledge by allocating weighted scores to the performance of projects. By emphasizing corrective measures the model ensures that good performance is achieved.

6.3 SUMMARY OF RESEARCH ACHIEVEMENTS

This research has identified the need to pay more attention to improve project management in construction in order to promote improvement in the construction performance and achieve client satisfaction in Kenya. The main achievements of this research include the following:-

- The development of a project management evaluation model
- The identification of project management approaches that help in effective and efficient execution of projects.
- The development of assessment tools for measuring project evaluation and monitoring.
- A new approach of doing construction business is developed

6.4 KEY FINDINGS

This section discusses the key findings from the research both at theoretical stage and at empirical study stage.

(1) Deliverables

It was found necessary to develop a shared perspective of projects performance taking into consideration the clients and consultants' perspectives. Both clients and consultants were agreed on six parameters of assessing project execution namely; cost, quality, time, human resource, project scope and project process performance.

To enhance the integration of the management of the project in a unified direction and purpose, the research recommends this evaluation be done in a shared perspective as the representation of overall project performance in form of 82% for consultants and 18% for clients. Better still the model encourages continuous evaluations whereby the non-performing organization is given an opportunity to rectify the situation before it is too late. The model is further developed to a software which can be used in the industry to better project management and overall project expectations.

(2) The Theoretical Framework

A major product of this research is the theoretical framework developed. This framework allows researches in project management to be conducted within the well-developed theories of organizations. The framework was developed based entirely on the recent theory of the project as a temporary organization thus identifies a strong relationship between the project organization (a temporary organization) and a business organization (a permanent organization). The theoretical framework is then amplified and discussed within the nascent theory of project action at the center and learning and expectations. Within these parameters improvement of project performance is encouraged.

(3) Project Management Models

The research process also helped in the delivery of a project management model for use in evaluating the performance of a typical project. This followed the process used within research for building the measures and sub-measures which defined the perspectives of the clients and consultants. The client's perspectives corroborated with consultants' and contractors views which formed the model formulation variables.

6.5 IMPLICATIONS SUGGESTED BY THE FINDINGS

6.5.1 More appropriate project measurement variables

Both clients and consultants agreed that projects can be evaluated using not only the usual cost, quality and time criteria, but also human resource measurements, scope and projects process performance. The results also indicate that clients are seeking a more active role in the execution of projects just like in developed economies.

The results also indicate that human related factors are very important in execution of projects and it can be concluded that the performance of projects is a reflection of the project management team involved.

While the model for project management evaluation contributes to ensuring that only the right criteria or indicators are used in assessing any construction projects performance, the proposed assessment model goes further to provide relevant data through its documentation from projects which will serve as a source of information on executed projects. A collection of these over a period will serve as an important knowledge base in the industry for research and development improvement in project execution through learning from executed projects. More so the executed and completed projects are subjected to an objective measurement rating as opposed to success/failure rating. The ratings can be a success of 80%; 85%, 70% and 90%; among other scores depending on the overall score of a given project.

6.5.2 Universal measurement criteria

By using the developed software in form of a project management evaluation model; consultants are provided with a universal approach to practice project management in Kenya.

The software also eliminates the tendency of consultants hiding their mistakes because of standardization and mathematical formulation of variables. It provides a fair basis of conducting the measurements by providing both the consultants and clients an opportunity to participate in the measurement process.

6.6 GENERAL APPLICABILITY OF THE PMM MODEL AND FINDINGS

The method used in determining the variables for inclusion in the model may be applied in other countries (especially developing) for similar purposes with appropriate adaptations where necessary.

Significantly; assessing projects performance in the given criteria of cost, quality, time, human resources, scope and project process efficiency as a shared perspective holds promise for general application everywhere because it addresses three important aspects necessary for improvements in construction industry:

i. It addresses the needs of efficient management.
ii. It addresses the requirements of sustainability.
iii. It addresses the needs of the client.

Most importantly; projects consultants have sometimes reported mixed results in the performance of projects in different project execution circumstances; an observation attributed to the level of coordination and input from the clients. To address this discrepancy the roles of clients are now rated towards the performance of projects; with an overall weighting of 18%.

6.7 CONTRIBUTION OF THE RESEARCH AND FINDINGS TO KNOWLEDGE

The research has provided the empirical evidence that both clients and consultants contribute towards efficient and effective execution of projects with some degree of measurable criteria. The ability of the developed project management evaluation model to provide a continual project performance evaluation, while encouraging learning expectation and action is the major development of this research. The study has taken some steps towards enhancing our understanding of performance measurement and management as they relate to construction projects. It has shown that evaluating the performance of a construction project requires a unique approach and diversified concepts.

Through the conclusions drawn from literature review and the development of the project management model, this study has also added to the growing body of literature regarding construction projects performance and project management, particularly the debate on project success or failure, showing that they should neither be looked at in absolute terms nor should they be seen as dichotomous terms; they both can exist in different degrees in a continuum according to which criteria or indicators we are referring to in the evaluation process.

Finally the study has also shown unlike other projects, construction projects performance requires an evaluation process which identifies with its one-off nature, its temporariness, its contingent nature and above all its relevant stakeholders with diversified background, functions and expectations. The most significant contribution to knowledge is the development of the right project management measures and also the reduction of the same to a practical model in software form for use in the construction industry in Kenya.

6.8 CONCLUSIONS

The research purposed to provide a project management model of evaluating any construction project performance throughout its life cycle until completion. In addressing the main aim and objectives of the research, the main approach used was to study the state of art as found in literature mainly from the developed countries. It was then followed by investigating the relevance of these findings in Kenya. This was accomplished by the use of multiple methods. At the end of the empirical study a set of criteria were found which reflected the perspectives of project implementers on project management for practitioners; contractors and clients. In combination, they form a shared perspective of project performance for project management model formulation.

Based on the two perspectives a project management model was developed for use in assessing construction project management in the performance of construction projects. This model gives a weighting of 82% towards project consultants performance in ensuring efficient and effective project execution. The clients are also considered and given a weighting of 18% in the developed model. The developed model also expands the parameters of measuring the performance and/or efficiency of execution of projects from the traditional variables of cost, quality and time; by three more variables of scope; human resources and project process performance as other key considerations in the success or otherwise of projects. A significant contribution of this research is the ability to allocate weighted scores in the performance of projects.

The study has come up with some key contributions to knowledge especially in enhancing understanding in construction project management performance assessment. This is in relation to the nascent theory developed from literature review. Another key contribution is the development of leading measures as opposed to lagging measures in assessing projects performance. This is achieved through the development of project "health" reports as opposed to project "autopsy" reports which give account of what happened instead of what should happen. The study came up with a practical project management model.

This study proposes that the successful implementation of this model in the construction industry in Kenya will contribute in no small way in bringing about improvements in project execution, developments in the construction industry and thereby, contributing towards efficiency and effectiveness in execution of projects.

This research has given account of the problems associated with construction project evaluation in terms of success or failure. The literature review has argued for a major shift towards project performance measurements as the best way to ensure improvements in execution and to ensure that targets are achieved. In this consideration the thesis advocates for the consideration of clients' perspective of project performance via independent evaluation using the developed variables. The clients are also given consideration in terms of their critical roles in scope definition and management and arranging for project financing.

The clients are equally independently rated by consultants and their total contribution is 18% as opposed to consultants who are at 82%. However, measurements are done independently for both on any given project. This increases the client's roles in the management of the projects.

The study provides a basis for continuous assessment of performance of projects based on predetermined intervals depending on the particular circumstances of a project. This is a major contributor towards efficiency as the notable failures can be addressed instead of waiting until the end of the project to evaluate.

6.9 AREAS FOR FURTHER RESEARCH

This study brings in its wake several questions recommending further research in six areas, as outlined below: -

Firstly, a study similar to the current one is needed with a slight change in the research methods. For example, a method making the unit of observation and/or the unit of analysis to be 'the construction project.' In that case, the levels of project management performance are observed from one project to another, as opposed to being observed from one consultant/contractor/client to another. Such a study should help refine the project management evaluation model developed in this study.

Secondly, there is the need for a study to be carried out on pre-project planning modeling to assist clients in scope definition and planning. Such a study is very important because the later stages of project implementation are dependent on good scoping and planning and more especially before starting projects.

Thirdly, information communications technology was not adequately covered in this research. There is need for a study to be carried out on the impact of ICT and mechanization on the performance of this model with a view of improving the implementation and adaptation of the developed model.

Fourthly, contractors' perspective of project performance needs to be investigated. This will provide an evaluation model exclusively for contractors with key evaluation criteria. It is expected that this will give a further input on projects execution efficiency particularly on the part of contractors. Most importantly, the research was carried out against the backdrop that the Kenyan construction industry still depends heavily on the traditional systems of project execution in which practitioners are employed to supervise and manage the project. With the emergence of construction management contracts and Public Private Partnerships (PPP), it will even become necessary to consider the perspective of the contractor who becomes the construction manager.

Fifthly, there is the need for a study to investigate the satisfaction levels of those users whose projects used this model versus those which did not. This will bring out the relevance and contribution of this model towards facility users' satisfaction.

Finally, the research proposes an empirical research on the relationship between construction project management, system thinking and environmental theories of the firm. Such a study should cover the construction industry and hence its component parts as a system and subsystems respectively within a super-system; organizational environmental theories defining the projects external and internal environment. A model should then be developed linking the construction industry and the sustainable use of resources and/or preservation of the environment with a view of ensuring sustainable construction approach and preservation of the environment.

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