TIME AND COST OVERRUNS IN ROAD CONSTRUCTION PROJECTS IN KENYA UNDER KENYA NATIONAL HIGHWAYS AUTHORITY

By
Stanley W. Mwawasi

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DECLARATION

This research project is my original work and has not been presented for any academic credit in this or any other university.

Stanley W. Mwawasi
D61/70872/2014

Signed……..
Date…….

This research project has been submitted for examination with my approval as the university supervisor.

Signed……..
Date…….

Prof. Gituro Wainaina
Department of Management Science,
School of Business
University of Nairobi

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Above all, I thank Almighty God for his enduring love.

DEDICATION

Special dedication to my dear wife, Hannah W. Wamwandu; my daughters and sons for their understanding and bearing with my absence during my entire MBA study. This project would not have been possible without their love and unwavering support.

To my father, Robin W. Mwawasi and my mother, Difroda W. Mwawasi, who despite tremendous odds ensured l attended very good schools, hence a firm foundation.

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ABBREVIATIONS

CPM	Critical Path Method
GDP	Gross Domestic Product
IDs	Inherent Difficulty Indicators
KeNHA	Kenya National Highways Authority
KeRRA	Kenya Rural Roads Authority
KURA	Kenya Urban Roads Authority
LPDS	Lean Project Delivery System
MR&R	Maintenance, Rehabilitation and Repair
TFV	Transformation-Flow-Value

ABSTRACT

Many projects in developing countries encounter considerable time and cost overruns, fail to realize their intended benefit or are even totally terminated and abandoned before or after their completion. This study sought to investigate the factors that contribute to time and cost overruns in road construction projects in Kenya. The study adopted a multiple case study and was guided by the following specific objectives; to identify variables influencing road construction time and cost overruns in Kenya, to establish the relative importance of these variables and to determine the quantitative impact of time and cost overruns in road construction projects in Kenya. The study utilized both primary and secondary data. Primary data was collected using a semi-structured questionnaire while secondary data was obtained from annual corporate reports, KeNHA database, contract documents, claims reports, project completion reports, expenditure data bases, project progress reports, and donor agency reports on various road projects run by KeNHA. The target population consisted of 24 successfully completed road projects undertaken by KeNHA in the last three fiscal years. A 40 percent random sample (10 projects) was taken from the sampling frame for the study. A 4-point Likert scale was used to measure the output of each item answered by the participants. Descriptive statistics were used to describe (and analyze) the variables numerically. Principal component analysis was applied to cluster the various variables for easy analyzability, which extracted the following factors as the most critical factors causing time and cost overruns; increase in scope of work, delayed payments to the contractor; poor cost control, foreign exchange rate fluctuations, poor or inadequate specifications in the contract, and unpredicted weather. The Relative Importance Indicator (RII) was used to measure the likelihood or recurrence of the variable from the respondent's point of view. According to the RII analysis, 35 variables had a high possibility of recurring in future similar projects. A multiple linear regression model was used to establish the relationship between the various factors and time and cost overruns in the selected road projects. Time overruns constituted the project time extension in months while cost overrun was measured by the total cost deviations from the initial project cost estimates. Increase in scope of work can be considered to have been the lead factor in contributing to time and cost overruns on the road projects. The other factors in order of significant were delayed payments to contractors, poor or inadequate specifications in the contract, foreign exchange rate fluctuations, unpredictable weather and poor cost control mechanisms. At macro-level, the study recommends that policy makers both at county and national level formulate strategies geared towards mitigating the impact of these factors given the fact that most of them have a high chance of recurring in future road projects. At the micro-level, contractors, consultancies, and other stakeholders need to do proper definition of project scope and apply modern project management tools given the fact that increase in scope of work is a lead factor in the factor contributing to time and cost overruns on road projects. At the preliminary stages, enough material and time resource's should be committed to ensure that adequate feasibility studies are conducted to avoid duality. The study was limited to the extent that; a study of this magnitude should include a survey of sizeable number of road projects over a wider time span of, say 10 years. On the other hand, the study period was a-bit short for a study of this nature and the fact that some of the respondents were non-committal posing major challenge in the field during the data collection. Studies involving confirmatory factor analysis will need to be carried out to further test the model so established and to confirm the findings of this study. Having identified the factors causing time and cost overruns in road projects in Kenya, there is need for further research to focus on the critical success factors in the implementation of road construction projects in Kenya.

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

The increasing complexity of infrastructure projects and the environment within which they are constructed place greater demand on construction managers to deliver projects on time, within the planned budget and with high quality. In many developing countries, major construction activities account for about 80 percent of the total capital assets, 10 percent of their Gross Domestic Product (GDP), and more than 50 percent of the wealth invested in fixed assets. In addition, the industry provides high employment opportunity, probably next after agriculture (Ofori, 2006).

Despite the construction industry's significant contribution to the economy of developing countries and the critical role it plays in those countries development, the performance of the industry still remains generally low (Enshassi, 2008). Studies over the past 20 years reveals a trend of rising cost of construction input resources (Osei-Tutu, 2008) and this trend is expected to continue because the factors responsible for the increased cost trend remain the same. In Africa, the combined prices of labour and materials have increased by 1,229 percent between 1997 and 2010 (Ghana Statistical Services, 2010).

According to Idoko, 2008) many projects in developing countries encounter considerable time and cost overruns, fail to realize their intended benefit or even are totally terminated and abandoned before or after their completion. Moreover, the development of the construction industry in developing countries generally lags far behind from other industries in those countries and their counter parts in developed nations. Generally, construction industry in developing countries fails to meet expectations of governments, clients and society as a whole (Ofori, 2006; & Jekale, 2004).

In Kenya, major road projects have a history of problems; cost overruns, delays, failed procurement, or unavailability of private financing is common yet most overruns are foreseeable and avoidable with the right legal and institutional frame works. Researches on construction projects in some developing countries indicate that by the time a project is completed, the actual cost exceeds the original contract price by about 30 percent (Bruland & Mahamid, 2011). Risk is also under-managed in the later stages of infrastructure projects,

destroying a significant share of their value. Apart from causing budget overruns, it also results in uncertain cost-benefit for decision-making (Jenpanitsub, 2011).

Cost overrun of transport projects is one of the most important problems in transport planning. Apart from causing budget overruns, it also results in uncertain cost-benefit for decision-making. Past empirical findings confirms that cost overrun problem is a global phenomenon and the average cost overruns in rail projects are always higher than in road projects. Although, risk in construction has been the object of attention because of time and cost overruns associated with construction projects, few studies have focused on factors leading to construction risks and failure of road projects in Kenya, hence this study.

1.1.1 Time and Cost Overrun

Time overrun is defined as the extension of time beyond planned completion dates traceable to the contractors (Kaming, Olomolaiye, Holt & Harris, 1997). Delays are incidents that impact a project's progress and postpone project activities; delay causing incidents may include weather delays, unavailability of resources, and design delays. In general, project delays occur as a result of project activities that have both external and internal cause and effect relationship (Vidalis, Allinson & Hayes, 2002).

Choudhry (2004) and Chan (2001) defined the time overrun as the difference between the actual completion time and the estimated completion time. It is measured in number of days. Project delays are those that cause the project completion date to be delayed (Al- Gahtani & Mohan 2007). From above, time overrun is defined as the time increased to complete the project after planned date, which is caused by internal and external factors surrounding the project. In construction, the word "delay'' refers to something happening at a later time than planned, expected, specified in a contract or beyond the date that the parties agreed upon for the delivery of a project (Pickavance, 2005). Lo, Fung and Tung (2006) define delay as the slowing down of work without stopping construction entirely and that can lead to time overrun either beyond the contract date or beyond the date that the parties have agreed upon for the delivery of the project. Syed, Azhar, Castillo and Kappagantula, (2002) classify delays into non-excusable delays, excusable non-compensable delays, excusable compensable delays and concurrent delays. Non-excusable delays are delays, which the contractor either causes or assumes the risk for. Excusable non-compensable delays are delays caused by

factors that are not foreseeable, beyond the contractor's reasonable control and not attributable to the contractor's fault or negligence. Compensable excusable delays are excusable delays, suspensions, or interruptions to all or part of the work caused by an act or failure to act by the owner resulting from owner's breach of an obligation, stated or implied, in the contract. Concurrent delays occur when both owner and the contractor are responsible for the delay.

Causes of delays have been identified in various parts of the world such as Malasyia, Saudi Arabia, Jordan, Kuwait, Hong Kong and Thailand (Sambasivan & Soon, 2007; Al-Kharashi & Skitmore, 2008; Al-Momani, 2000; Kumaraswamy & Chan, 1998; Noulmanee, Wachirathamrojn, Tantichattanont & Sittivijan, 1999). The results reveal that there are differences and similarities as to the causes of delays. A degree of change can be, and to a certain extent should be, expected in construction, as it is difficult for clients to visualize the end product that they procure. Cost overrun is also known as "change orders". Cost overrun is defined as the deviation from the amount agreed, as per the contract sum, divided by the agreed original amount of the contract (Zawawi, Azman, Shamil & Kamar, 2010).

Cost overrun is, thus an excess of actual cost over budget and is also sometimes called "cost escalation" cost increase," or "budget overrun (Zhu, Pang & Khan, 2004). Cost overrun is defined as the change in contract amount divided by the original contract award amount. This calculation can be converted to a percentage for ease of comparison (Jackson 1990). Choudhry (2004) defined the cost overruns as the difference between the original cost estimate of project and actual construction cost on completion of works of a commercial sector construction project. According to Jahren, Curtis and Weber (1990), on their research on predictors of cost overrun rates, they found the following factors to influence the cost overrun rates; the size of the project, the difference between lowest bid and engineer's cost estimate, the type of delivery method, the level of competition, quality of contract documents, and the nature of interpersonal relations on the project.

According to Lyneis, Ptero and Tang (2010), problems of cost and schedule overrun on projects have persisted for decades, in spite of numerous advances in the field of ''project management''. In the 1950s, the static network modeling approaches Program Evaluation and Review Technique (PERT) and the Critical Path Method (CPM) were developed. These have

continued to evolve with the addition of probabilistic parameter estimates and integration with resource loading assessments. Finally, teaming, concurrent engineering, and the recognition and emphasis on ‘‘soft’’ and people factors have emerged as methods of enhancing project performance.

1.1.2 Kenya National Highways Authority

The KeNHA is responsible for the management, development and maintenance of national roads. The Kenya Roads Act, 2007 Section 22(1) empowers KeNHA to construct, maintain, operate, improve and manage the roads under its jurisdiction. The roads that fall under KeNHA are classified as A, B and C. The KeNHA recognizes that road development is not only road construction and maintenance alone, but in the broader sense includes the management and protection of road reserves. The KeNHA is an autonomous road agency, responsible for the management, development, rehabilitation and maintenance of international trunk roads linking centres of international importance and crossing international boundaries or terminating at international ports (class A road), national trunk roads linking internationally important centres (class B roads), and primarily roads linking provincially important centres to each other or two higher-class roads (class C roads). Besides roads, KeNHA has 13 weighbridges, which are used to enforce the traffic regulations in the ferrying of goods across the country and the greater East African region.

1.2 Research Problem

The successful execution of construction projects, keeping them within estimated cost and the prescribed schedules primarily depends on the existence of an efficient construction sector capable of sustained growth and development. Consequently, the iron triangle (cost, time, and quality) is used to measure the project performance and success. Generally, the success measure for a project is defined by completing it within specified cost, time and quality. However, the construction industry is full of projects that were completed with significant cost deviation (Amhed, Zahara & Juma, 2010). Since independence, the imperative to scale up infrastructure and improve the competitiveness of the Kenyan economy has been constrained by construction cost and time overruns. A list of 24 successfully completed road projects undertaken by KeNHA in the last three fiscal years indicating variances in time and cost during project implementation is presented in Appendix III.

The Kenya Vision 2030 aims to transform Kenya to a middle-income country by 2030. The government recognizes that the attainment of Vision 2030 will depend heavily on the quality of the road infrastructure through the reduction of transport costs, improvement of accessibility and road safety. The centrality of the road infrastructure in the Vision 2030 and the heavy annual budgetary allocations to the sector, underscores the need to investigate the time and cost drivers that contribute to time and cost overruns. Financial resources are so scarce in developing countries like Kenya, hence time and cost related issues in Kenya's construction industry are sensitive issues. Therefore, carrying out a research in this area will have a paramount importance. Identification of causes of cost overrun is a prerequisite to minimize or to avoid cost overrun in the construction industry.

A number of studies have been carried out on construction time and cost overruns. Kagiri (2005) in his study of time and cost overruns in power projects in Kenya outlined underlying factors that contribute to time and cost overruns. He identified eight underlying factors including; improper project planning, resource planning, interpretation of requirements, works definition, timeliness, government bureaucracy, and risk allocation as having significantly contributed to time and cost overruns in the projects. While his study provided vital insights into the subject of time and cost overruns, it was conducted in a different study context.

Mahamid (2011) investigated the statistical relationship between actual and estimated cost of road construction activities based on a sample of 100 road construction projects awarded in the West Bank in Palestine. The findings revealed that the average cost deviation in the investigated activities was as follows; earthworks -15.7 percent, base works 12.9 percent, asphalt works 18.5 percent and furniture works 36.4 percent. His findings, however fell short of investigating the cost drivers responsible for the deviation between actual and estimated cost.

Studying the significant factors that cause delay of construction projects in Malaysia, Alaghbari, Kadir, Salim & Ernawati (2007) used four categories for analysis, namely contractor, consultant, owner and external. As far as causes related to contractor actions were concerned; financial problems, shortage of materials and poor site management were ranked among the top three. Owner causes included delayed payments, slow decision-making and

contract scope changes. The top three consultant causes were poor supervision, slowness to give instructions and lack of experience. Finally, external causes of delay included shortage of materials, poor site conditions and lack of equipment and tools in the market.

Anzinger and Kostika (2015) carried out a cross-sect oral analysis of large projects in Germany based on a database of 170 cases (119 finished, 51 unfinished projects) of projects between 1960 and 2014, and found out that there were significant variations in infrastructure project outcomes across sectors in Germany. The energy and Information and Communication Technology (ICT) sectors especially were facing significant cost overruns, with 136 percent and 394 percent on average for finished projects, respectively. In building and transportation, average cost overruns are lower, at 44 percent and 33 percent. By selecting specific examples, and by drawing attention to the most successful and most unsuccessful infrastructure projects, the study summarized possible explanations for this variation and offered recommendations for better management of large-scale public infrastructure projects.

While a-lot of literature exists on construction time and cost overruns, literature on construction time and cost overruns is limited to the developed world with just a few focusing on Kenya. Despite the fact that road project time and cost overruns create a significant financial risk to the government with a history of road construction full of projects that were completed with significant cost overruns, literature on the subject of road construction time and cost overruns in Kenya remains scanty. It is against this backdrop, the current study sought to assess factors that contribute to time and cost overruns in road construction projects in Kenya. The study aimed at answering the following research question; what factors cause time and cost overruns in road construction projects in Kenya?

1.3 Research Objectives

The general objective of this study was to determine the time and cost overruns in road construction projects in Kenya under KeNHA, whereas the specific objectives were to:

(i) Identify variables influencing road construction time and cost overruns in Kenya,

(ii) Establish the relative importance of these variables, and

(iii) Determine the quantitative impact of time and cost overruns in road construction projects in Kenya.

1.4 Value of the Study

Identifying the occurrences of time and cost overrun in public construction projects in any country is important before identifying its causes. In this regard, the findings of the this study will provide vital information to the roads and infrastructure ministry and allied agencies on improved cost control and monitoring measures that should be implemented throughout road project stages in Kenya in their quest to mitigate the problem of cost overruns. The level of performance of cost overrun will assist the professionals and the public officials to become aware of the severity of the problem of time and cost overrun in road construction projects in Kenya.

The study findings will equally benefit the private sector particularly in this era when the Kenya government is encouraging public-private partnerships in mega construction projects in the country. For instance, this study will provide insights into the implementation of quality and value management techniques to ensure that the designs adequately cover what the client brief entails. The study will provide backstopping for future scholars on the subject of time and cost overruns in road projects in Kenya. From the recommendations for further studies, this study will identify areas that require further investigation in the dynamic and evolving nature of construction time and cost overruns not only in Kenya but across Sub-Saharan Africa.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviews theoretical and empirical literature from past studies on the subject of time and cost overruns. The chapter focuses on; the theoretical framework of the study, the empirical literature review, conceptual framework of the study and finally a summary of the literature review.

2.2 Theoretical Framework

This study will be informed by the following theories; Construction Management Theory (CMT), Transformation-Flow-Value Theory (TFVT) and Planning Theory (PT). Each of these theories is discussed here below with respect to cost and time overruns.

2.2.1 Theory of Construction Management

Advanced by Milan and Bennett (2012) CMT provides a "rigorous theory" based on a "tool kit of concepts and relationships" that will improve the efficiency and quality of "construction products". The distinction between the conventional approach of CMT, where contractors deliver projects, and the idea of companies producing a product is an important element in the thinking behind the theory proposed here. Following that intention they identify and define the concepts needed to understand CMT. Radosavljevic and Bennett (2012) self-consciously developed their theory without drawing on general management theories, rather wanting to base their ideas on construction industry projects and practice, which makes these definitions extremely important to their CMT and to the understanding of that theory.

The CMT is critical in road construction project management since it focuses on the concepts, construction products, processes, organizations, interactions, relationships, and learning and performance that constitute the successful project management principles. The theory, thus presents a model by which project managers can put in place critical success factors including communication, feedback lops, and how well established relationships are (called internal) or not (called boundary relationships).

2.2.2 Transformation-Flow-Value Theory

Application of new production philosophy to construction production theory has developed into TFVT (Koskela, 2000). This is a theory that draws on the management literature and history as its base, and its origins are covered in Koskela (2000), where the roots of Lean Construction (LC) in production theory are explored. Koskela, Ballard and Tommelein (2002) argued that what is needed is production theory and related tools that fully integrate the transformation, flow and value concepts. As a first step toward such integration, we can conceptualize production simultaneously from these three points of view however; the ultimate goal should be to create a unified conception of production instead.

The relevance of TFVT to road project management emanates from the fact that ideas and methods of LC in particular offer an alternative to management theories. There are three reasons apart from the usefulness of conceptualizing production processes in a discipline traditionally preoccupied with practical matters. First, LC was prior to Radosavljevic and Bennett (2012), the only theory of production to have been developed specifically for the construction industry. Therefore, it provides insights into the range of processes that are involved, based on theory, that lead to propositions that can be tested by application to building and construction projects. The many case studies that have been published about LC over the years are all tests of the theory and practice of LC. These tests now add to a substantial body of evidence for the effectiveness of LC in a wide range of settings.

2.2.3 Theory of Planning

The term last planner refers to the hierarchical chain of planners, where the last planner acts at the interface to execution. Thus, this method concentrates on the detailed planning just before execution, rather than the whole planning process. The method of last planner distinguishes planned tasks according to can, should and will modalities. The tasks pushed from the higher planning levels belong to the ‘should’ category. In look-ahead planning (with a time horizon of three to four weeks), the prerequisites of up-coming assignments are actively made ready; they are transferred to the ‘can’ category. This, in fact is a pull system (Ballard 1999) that is instrumental in ensuring that all the prerequisites are available for the assignments. In conventional project management, the plan pushes tasks to execution; only the ‘should’ category is recognized.

The PT is relevant to construction project management given the fact that the model enables project managers mitigate the risk of variability propagation to the downstream flows and the tasks reducing the need for large material buffers on site. The last planner effectively combines the control and the improvement to fight back against variability and the waste caused by it. Thus, last planner combines the flow and the transformation view in short term planning, execution and control.

2.3 Empirical Literature Review

Research conducted by Azis, Memon, Rahman, Latif and Nagapan (2012) focused on the objective of assessing the level of effectiveness of various cost management techniques implemented in large construction projects in South Malaysia. The results of the study showed that the most effective technique of cost management was cash flow forecasting, tender budgeting/estimating, and an elemental cost plan. Caruthers, Kuotcha MaCcaffer and Edum (2008), however described a cost estimate as an approximation. Therefore, cost estimations require the utmost accuracy in order for clients to ensure that they have sufficient funds to execute the projects without delays due to underestimations (Kaliba, Muya & Mumba, 2010).

Caruthers et al. (2008) stated that the management of costs begins with the financial feasibility study, progresses through all the costs that are required to purchase all the resources needed by the project, through to using cost control to ensure that all work that is done is properly completed. The cost implications of scope creep need to be rigorously controlled by way of formal variation orders (Caruthers et al., 2008).

Kagiri (2005) in his study based in Kenya about the factors of time and cost overruns in power projects found that Kenya was also not a stranger to the recurrence of cost overruns in their projects. The projects experienced time and cost overruns at the same time, but cost overruns on the projects ranged from 9.4 percent to 29 percent. The crucial factors that contributed to overruns in the power projects were contractor inabilities, improper project preparation, resource planning, and interpretation of requirements, definition of works, timeliness, government bureaucracy, and risk assessment.

Kaming, et al. (1997), studied 31 construction projects in Indonesia and found that from a contractor's point of view, cost overruns were mainly caused by inaccuracy of material take-off, increase in material costs and cost increase due to environmental restrictions. Studying the cost overruns and delays on groundwater projects in Ghana, Frimpong, Oluwoye & Crawford (2003), contractors found that late monthly payments from clients were the most important cost and time delay factors, with clients ranking poor contractor performance as the most important cost and time delay factor.

Mansfield, Ugwu & Doran (1994) studied the performance of transportation infrastructure projects in Nigeria and concluded that material price fluctuations, inaccurate estimates, project delays and additional work contributed most to cost overruns. In a fourth study on construction projects in Nigeria by Elinwa & Buba (1994), found that cost of materials, fraudulent practices and fluctuations in materials prices were the main cause of cost and time overruns. Baloyi and Bekker (2010) found that the most significant factor causing cost overruns due to client action was additional work or changes to work.

Supplementing their research on the causes for cost overruns, Kaming et al. (1997) found that design changes, materials shortage and inadequate planning were the most significant contributors to time delays on construction projects. Similarly Sambasivan and Soon (2007) categorized their findings into client, contractor and consultant categories, with all three categories listing poor site management, inadequate contractor experience and poor sub-contractors among the top five causes for time delays on construction projects. Assaf, Al-Khalil & Al-Hazmi (1995) used 56 questions in three categories, namely owner, architects/engineers and contractors, to determine the main causes of delays on large building projects in Saudi Arabia. Their survey showed that contractors believed that preparation of shop drawings, delays in contractor's progress and payment by owners were the most important factors contributing to time delays.

Flyvbjerg, Bent and Lund (2009) study provided a clear indication of the severity of time and cost overruns in large infrastructure projects by deducing that over-budgeting and overtime occur repeatedly. Furthermore, explanations of project under-performance in terms of optimum bias and strategic mis-representation lead to high failure rates for projects as a consequence of flawed decision-making. Love (2012), in a study undertaken in Australia to

determine the probable costs of rework, confirmed that the rate of cost overruns for construction projects ranged from a maximum of 244 percent to a minimum of -84 percent (cost under-run). In brief, of the 218 projects assessed by Love (2012), 79 percent of them experienced total rework costs of less than 16 percent.

Cantarelli, van Wee, Molin & Flyvbjerg (2012) indicated that the magnitude of cost overruns on construction projects in the Netherlands did not differ from that of other countries as they highlighted the range of cost overruns, of -40.3 percent to 164 percent. The data implied that an average cost overrun of 16.5 percent. Mahamid (2013) conducted an investigation into the effects of project's physical characteristics on the cost deviation of 74 road constructions in Palestine. In the analysis of cost under-estimation based on the project's category, the study showed that small projects have the highest average of cost under-estimations of 24.9 percent while large projects have the largest average of 15.9 percent.

Time and cost are considered to be the most crucial factors that contribute to the success of a project, and in reality are the only factors on which everything hinges, and are the most critical factors in the decision on whether a project commences or is shelved. Azhar, Farooqui and Ali and Kamaruzzan (2010) concluded that cost performance of construction projects in Malaysia was a critical issue in that country and the recurrence of this problem indicated a need for research to clarify what should be done to mitigate the said problem.

Farooqui, Hussain, Umer and Lodi (2012) confirmed that the factors affecting costs in Pakistan are the most crucial criteria for assessing the success of a project. In their study, they reached the conclusion that poor project management drawn from (management factors) was the key factor affecting the construction costs; this showed that the project manager and his/her teams were in urgent need of improving the performance graph as far as the construction industry of Pakistan was concerned. Poor performance of work (management factor) was the third most crucial factor with a definite potential for affecting the construction cost. The top three location factors were political unrest in the area, followed by remote location and unforeseen ground conditions (Ali & Kamaruzzan, 2010).

2.4 Summary of the Literature Review

The literature reviewed covered the problem of time and cost overrun and shows that it is a problem in developing countries. More importantly, literature on problems of cost overrun in

the context of Kenyan projects has been examined. Recent literature has also revealed that professionals in the construction industry at large, see this problem recurring more and more frequently. A summary of the key literature reviewed is presented in Table 2.1 below.

2.5 Conceptual Framework

In order to investigate research questions, the conceptual framework as shown in Figure 2.1 was adopted. The dependent variable was time and cost overruns, measured by the percentage deviation from the initial project time and cost estimates. The independent variables were the factors that cause time and a cost overrun in road construction projects in Kenya.

Figure 2.1 Conceptual Framework

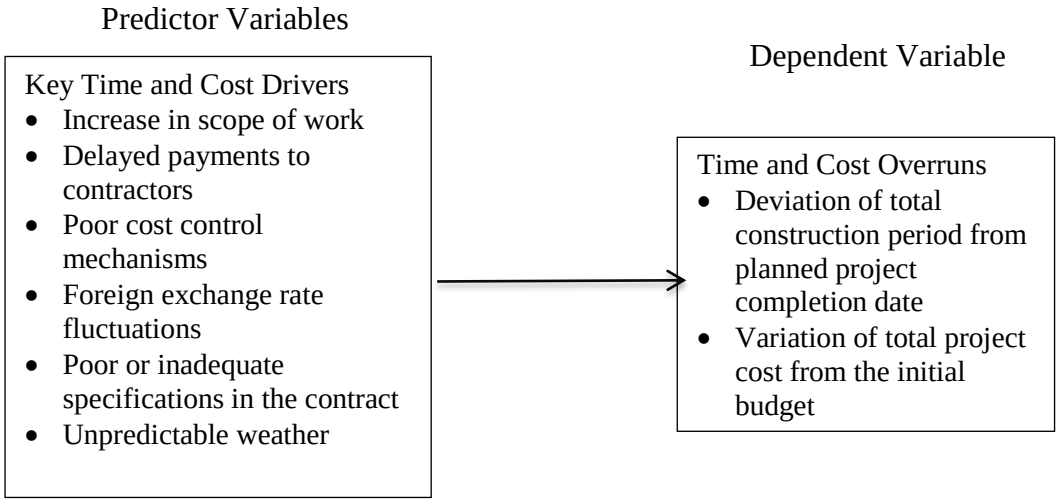

Table 2.1 Summary of Literature Review

Author	Study	Objectives	Methodology	Findings
Ramabodu and Verster (2010)	Identifying causes of cost overruns and effective cost control measures of public projects in Free State Province (FSP) – South Africa	• Identify causes of cost overruns and associated remedial measures for use in South African construction • Identify causes of cost overruns in public sector projects in FSP • Determine frequency of cost overruns among public sector projects in FSP • Ascertain if rate of cost overrun occurrence constitutes performance problem in FSP	Multiple-case study	Changes in scope of work on site, incomplete design at the time of tender, contractual claims (extension of time with cost), lack of cost planning and monitoring of funds, and delays in costing variations and additional works cause delays
Anzinger and Kostika (2015)	A cross-sect oral analysis of large projects in Germany	Find out where cost overruns in public infrastructure are most problematic and why	Cross-sect oral analysis	There are significant variations in infrastructure project outcomes across sectors in Germany Need for better management of large-scale public infrastructure projects
Kagiri, D. (2005)	Time and cost overruns in public sector power projects in Kenya: A case study of Kenya Electricity Generating Company Limited	• Identify factors that significantly contributed to time and cost overruns in power projects • Establish the relative importance of these factors • Quantify time and costs associated with the significant factors	Case study	Improper project planning, resource planning, interpretation of requirements, works definition, timeliness, government bureaucracy, and risk allocation cause delays
Mahamadi, Y. (2011).	Problems of projects and effects of delays in the construction industry of Pakistan.	Investigate the statistical relationship between actual and estimated cost of road construction activities in Pakistan.	Multiple case study	• Small projects have the highest average of cost under-estimations • Medium projects have the smallest average of cost over-estimation • Large projects have the largest average of cost over-estimation

Table 2.1 Cont.

Frimpongs et al. (2002)	Factors that cause cost overruns in construction of ground water projects in Ghana	• Evaluate factors that contribute to delay and cost overruns in groundwater construction • Identify main factors that influence causes of delay and cost overruns in construction of groundwater projects	Descriptive survey design	Poor contractor management, monthly payment difficulties from agencies, material procurement, poor technical performances, escalation of material prices according to their degree of influence cause delays
Nasiru, et al. (2006)	Trends in US rail transit project cost overrun	Examine if magnitude of cost overruns in rail transit projects have changed	Multiple case study	Cost overruns for projects completed before 1990 are different from that of projects completed after 1994
Noulmanee et al. (1999)	Causes of delays in highway construction in Thailand	Determine factors that cause construction disruptions leading to time overruns	Descriptive survey design	Inadequacy of sub-contractors, insufficient resources, incomplete and unclear drawings and deficiencies between consultants and contractors cause delays

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

Scandura and Williams (2013) refers research methodology as a systematic way to solve a problem. The literature review explored and provided sources, which articulated methods for the data collection, analysis and exposition, with respect to the objectives of the research. The following section deals with general description of the research strategy adopted for this study as well as a rationale for the methodology. The key topics in this chapter include research design, data collection, sample size, questionnaire design and data analysis.

3.2 Research Design

Kothari (1990) argues that research design is the conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement and analysis of data. As such, the design includes an outline of what the researcher will do from writing the hypothesis and its operational implications to the final analysis of data.

The study adopted a multiple case study; a multiple case study enables the researcher to explore differences within and between cases. The goal is to replicate findings across cases and because comparisons will be drawn, it is imperative that the cases are chosen carefully so that the researcher can predict similar results across cases, or predict contrasting results based on a theory (Yin, 2003). Examples of studies that have employed multiple case studies include Campbell and Ahrens (1998) 'Innovative Community Services for Rape Victims: An Application of Multiple Case Study Methodology and Kagiri (2005), 'Time and Cost Overruns in Public Sector Power Projects in Kenya: A Case Study of Kenya Electricity Generating Company Limited'. Tripsas and Gavetti's (2000) in-depth case study of the Polaroid corporation. Case studies give the researcher not only the possibility to describe certain relationships, but also to test theory for a special setting.

3.3 Population and Sampling Design

Snow and Thomas (2013) define a population as an aggregate of all that conform to given characteristics. The target population consisted of 24 successfully completed road projects undertaken by KeNHA in the last three fiscal years (See Appendix III). A 40 percent random sample of 10 projects was taken from the sampling frame for the study. According to Mugenda

and Mugenda (2003), a representative sample is one, which is at least 10 percent of the population, thus the choice of 40 percent was considered as representative.

A sample design is a definite plan for obtaining a sample from a given population. It refers to the technique or the procedure the researcher would adopt in selecting items for the sample (Kothari, 2011). Three respondents were selected from each of the projects consisting of the project manager, a representative from the consultant agency and the main contractor. The selection was based on the time available for conducting the research work and the reliability of the respondents, so that the overall research work would indicate the reality of the situation.

3.4 Data Collection

Both secondary and primary data were utilized in the study. According to Kothari (2011) primary data are those, which are collected afresh and for the first time and thus happen to be original in character. Primary data was collected using a semi-structured questionnaire divided into three parts (see Appendix II). Part A consisted of open-ended questions aimed at obtaining demographic information of the respondents and part B examined objective one, two and three aimed at identifying factors influencing road construction time and cost overruns, to establish the relative importance of these factors, and determining the quantitative impact of time and cost overruns, respectively. In this part, the respondents were required to identify factors, which they perceived to have contributed to time and cost overruns by responding to a Likert scale from 1 (not important) to 4 (very important). Part C of the questionnaire aimed at covering emerging variables that may have risen during the study.

Secondary data was obtained from annual corporate reports, KeNHA database, contract documents, claims reports, project completion reports, expenditure databases, project progress reports, and donor agency reports on various road projects under KeNHA. Secondary data was used to evaluate magnitude of time and cost overruns and relationship between time and cost overruns and the successful completion of road construction projects undertaken by KeNHA.

3.5 Data Analysis

The data was analysed using descriptive statistics, Principal factor component analysis and multiple linear regression analysis as illustrated in Table 3.1.

Table 3.1 Summary of Research Methodology

Objectives	Data	Analyses
Identify variables influencing road construction time and cost overruns in Kenya	Primary data	Descriptive statistics Principal component factor
Establish the relative importance of these variables	Primary data on the ranking of the various factors contributing to time and cost overruns	Relative importance index
Determine the quantitative impact of time and cost overruns in road construction projects in Kenya	Secondary and primary data	Multiple linear regression

CHAPTER FOUR: DATA ANALYSIS, FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter presents the findings of the study in investigating the factors that cause time and cost overruns in road construction projects in Kenya, which was based on the following specific objectives to identify variables influencing road construction time and cost overruns in Kenya; to establish the relative importance of these variables; and to determine the quantitative impact of time and cost overruns in road construction projects in Kenya. Data was analyzed using Statistical Package for Social Sciences (SPSS) in-order to determine the factors that cause time and cost overruns. Mean scores, standard deviations, coefficients of variation and multiple linear regression analysis were used to describe and infer the findings.

4.2 Demographic Characteristics of the Respondents

Thirty questionnaires were mailed to potential respondents that participated in the implementation of one or more of the road projects. Twenty eight questionnaires were returned representing a response rate of 93 percent. This response rate was sufficient and representative and conforms to Mugenda and Mugenda (2003) stipulation that a response rate of 50 percent is adequate for analysis and reporting; a rate of 60 percent is good while a response rate of 70 percent and over is excellent. Of these 10 (35.7 percent) respondents were from the project management team, a similar number from the consulting agency and eight (28.6 percent) questionnaires were received from the main contractors.

The demographic characteristics of the respondents included respondent's distribution on the projects, position/designation in the respective projects, academic and professional qualifications and working experience. The study sought to investigate the spread of the respondents across the various road construction projects under this study and the results are presented in Table 4.1 below.

From Table 4.1, it is clear that the number of respondents was the same from each of the projects (10.7 percent) other than Timboroa to Eldoret and Kendu-bay to Homa-bay with 7.1 percent respectively. This implies that the sample was representative enough to capture reliable data for the study.

Table 4.1 Respondents Distribution on Projects

	Project	`	Percent
Valid	Eldoret to Webuye	3	10.7
	Timboroa to Eldoret	2	7.1
	Marsabit to Turbi	3	10.7
	Kendubay to Homabay	2	7.1
	Homa Bay to Mbita	3	10.7
	Sotik to Ndanai	3	10.7
	Londian to Fortenan	3	10.7
	Maji ya Jumvi to Miritini	3	10.7
	Mau Sammit to Kericho	3	10.7
	Nyamasaria to Kericho	3	10.7
	Total	28	100.0

An inquiry was made into the designation of the respondents' in the respective projects and the results are shown in Table 4.2 below.

Table 4.2 Designation of Respondents

	Designation	Frequency	Percent
Valid	Project engineer	6	21.4
	Resident engineer	8	28.6
	Project manager	4	14.3
	Assistant project manager	3	10.7
	Accountant	1	3.6
	Site agent	2	7.1
	Project director	1	3.6
	Contract manager	1	3.6
	Project manager for the employer	1	3.6
	Others	1	3.6
	Total	28	100.0

The designation of the respondents ranged from project engineers, resident engineers, projects managers, assistant projects engineers to site agents and contract managers amongst others. As depicted in Table 4.2, most of the respondents were resident engineers (28.6 percent) while project engineers constituted 21.4 percent of the respondents. This fair distribution of the respondents implies that the data was collected from well informed participants in the various road construction project under study, hence the reliability.

The study sought to investigate the academic and professional qualifications of the respondents and the results are presented in Table 4.3. According to the results in Table 4.3, 78.6 percent of the respondents had at least a bachelor's degree in the relevant engineering field with both Bachelor of Science in civil engineering and Master of Science in civil or technology at 39.3

percent while 3.6 percent had a master of science in transportation. This implied that most respondents were knowledgeable in road construction technicalities and associated issues. However, the fact that only 14.3 percent of the respondents had managerial and project management qualifications in addition to the engineering qualifications need to be addressed. This implies that the road projects were largely managed by managers with limited project management skills.

Table 4.3 Academic and Professional Qualification of the Respondents

	Qualification	Frequency	Percent
Valid	BSC - Civil Engineering	11	39.3
	MSC - Civil and Technology	11	39.3
	Project or Business Management	4	14.3
	MSC Transport and Road Engineering	1	3.6
	Others	1	3.6
	Total	28	100.0

In the same context, the study sought to investigate the working experience of the respondents in road construction project and the findings are indicated in Table 4.4.

Table 4.4 Working Experience

	Working Experience (Years)	Frequency	Percent
Valid	1 to 5	13	46.4
	6 to 10	7	25.0
	11 to 15	2	7.1
	Over 20	6	21.4
	Total	28	100.0

From Table 4.4, 46.4 percent of the respondents had between 1 and 5 years' experience while 25 percent of them had between 6 and 10 years of working experience. The same findings indicate that 7.1 percent had between 11 and 15 years' experience. According to the findings, 21.4 percent of the respondents had over 20 years' experience. This implies that the data was collected from individuals with substantial experience in road construction, further affirming the confidence in the data collected.

4.3 Extent of Contribution to Cost and Time Overruns

The calculated mean and standard deviations of the respondents to the extent of contribution of the causes of delay and cost are shown in Table 4.5 below. The questionnaires sent to the respondents had listed 57 causes of time and cost overruns in road construction projects. From 4.5, poor or inadequate specifications in the contract had the highest mean of 3.68 implying that

Table 4.5 Descriptive Statistics – Variables Extent of Contribution

Variables	N	Mean		Std. Deviation
	Statistic	Statistic	Std. Error	Statistic
Poor or inadequate specifications in the contract	28	3.6786	1.14209	.04338
Delayed payments to contractors	28	3.2857	.16148	.85449
Employer cash flow problems	28	3.1071	.18785	.99403
Increase in scope of work	28	3.0357	.18886	.99934
Inaccuracy of bill of quantities	28	2.8571	.22251	1.17739
Inadequate planning by the client	28	2.8571	.19048	1.00791
Relocation of services	28	2.7143	.21735	1.15011
Underestimation of project durations	28	2.7143	.22335	1.18187
Unforeseen ground conditions	28	2.6786	.20608	1.09048
Unpredictable weather	28	2.5714	.20203	1.06904
Fluctuations in material, labour and plant costs	28	2.5714	.18133	.95950
Foreign exchange rate fluctuations	28	2.5357	.19574	1.03574
Delay of access to site	28	2.5357	.21506	1.13797
Poor resource planning by contractor	28	2.5357	.16652	.88117
Increase in scope of work	28	2.5000	.22123	1.17063
Poor cost control mechanisms	28	2.4286	.19537	1.03382
Planning capabilities and effective resource coordination	28	2.3929	.17320	.91649
Contractor cash flow problems	28	2.3929	.22026	1.16553
Contractor's lack of professional project management skills	28	2.3571	.20062	1.06160
Environmental challenges	28	2.3214	.20608	1.09048
Poor site management	28	2.2857	.19147	1.01314
In appropriate organizational structure	28	2.2857	.17711	.93718
Government bureaucracy	28	2.2857	.18443	.97590
Lack of adequate scope and works specification	28	2.2500	.18276	.96705
Delays in approvals by engineer	28	2.2143	.18798	.99469
Dispute between key stakeholders	28	2.2143	.22629	1.19744
Ambiguous client budgets	28	2.2143	.18081	.95674
Inadequate supervision of road projects	28	2.1786	.21240	1.12393
Political interference	28	2.1786	.21240	1.12393
Poor construction methods/ approaches	28	2.1429	.21028	1.11270
Low labour productivity	28	2.1429	.19730	1.04401
Slow speed of decision-making	28	2.1429	.22837	1.20844
The ability of the organization to manage risk	28	2.1429	.16836	.89087
Risk allocation	28	2.1071	.14853	.78595
Lack of sufficient contractor experience	28	2.1071	.20791	1.10014
Poor contract management	28	2.1071	.20145	1.06595
Cost increase due to environmental restrictions	28	2.0357	.17429	.92224
Poor sub-contracting	28	2.0357	.18886	.99934
Shortage of materials, finance and payment of completed works	28	2.0000	.18545	.98131
Procurement obstacles	28	1.9643	.19574	1.03574
Delays in release of drawings	28	1.9643	.20238	1.07090
Complex interfaces of various work packages	28	1.9286	.20528	1.08623
Lack of top management support	28	1.8929	.18068	.95604
Labour disputes	28	1.8929	.18785	.99403
Poor relationship between lead engineers/managers and contractor	28	1.8929	.18068	.95604
Inappropriate client organizational structure	28	1.8571	.17604	.93152
Poor safety measures	28	1.8571	.15183	.80343
Corruption	28	1.8571	.18340	.97046
Lack of adequate quality management systems	28	1.8571	.15183	.80343
Poor quality control	28	1.8214	.19282	1.02030
Length of the project	28	1.7857	.18081	.95674
Poor infrastructure e.g. telecommunications, access roads	28	1.7857	.17334	.91721
Lack of motivation among the project team managers	28	1.7857	.16553	.87590
Clint relations with financier	28	1.7500	.19670	1.04083
Poor Interpretation of requirements	28	1.7143	.15307	.80999
Engineer lack of adequate professional project management skills	28	1.7143	.20482	1.08379
Poor organizational communication systems	28	1.7143	.15307	.80999
Valid N (listwise)	28			

it affects the time and cost overrun to a large extent based on the Likert scale. The same findings indicate that poor organizational communication systems had the lowest mean of 1.71 and standard deviation of 0.15 indicating that it affects time and cost overruns to a small extent. Since the response to each statement varied from 1 to 4, a mean score of 2.4 (60 percent) was considered to affect cost and time. Based on this criteria, poor or inadequate specifications in the contract; delayed payments to contractors; employer cash flow problems; increase in scope of work; inaccuracy of bill of quantities; inadequate planning by the client; relocation of services; underestimation of project durations; unforeseen ground conditions; unpredictable weather; fluctuations in material, labour and plant costs; foreign exchange rate fluctuations; delay of access to site; poor resource planning by contractor; increase in scope of work; and poor cost control mechanisms were causes of delay in cost and time.

Other variables included planning capabilities and effective resource coordination, planning capabilities and effective resource coordination, contractor cash flow problems, contractor's lack of professional project management skills, environmental challenges, poor site management, in-appropriate organizational structure, government bureaucracy, lack of adequate scope and works specification, delays in approvals by engineer, dispute between key stakeholders, ambiguous client budgets, inadequate supervision of road projects, political interference, poor construction methods/approaches, low labour productivity, slow speed of decision-making, ability of the organization to manage risk, risk allocation, lack of sufficient contractor experience, poor contract management, cost increase due to environmental restrictions, poor sub-contracting, shortage of materials, finance and payment of completed works, procurement obstacles, delays in release of drawings, complex interfaces of various, work packages, lack of top management support, labour disputes, poor relationship between the lead engineers/managers and the contractor, inappropriate client organizational structure, poor safety measures, corruption, lack of adequate quality management systems, poor quality control, length of the project, poor infrastructure, for example telecommunications, access roads, Llack of motivation among the project team managers, client relations with financier, poor interpretation of requirements, engineer's lack of adequate professional project management skills and poor organizational communication systems.

The standard deviation, varied between 0.79 and 1.21, for response scale of 1 to 4 a standard deviation of more than 1 was considered high. Twenty-eight variables (49.12 percent) had standard deviations of more than 1. This variability can be attributed to the degree of variation of the occurrences of the causes of time and cost overruns in the projects, technical and managerial capacity of the project's team.

4.4 Relative Importance to Cost and Time Overruns

This approach was applied to analyse part B of the questionnaire where respondents were required to rate the chances of occurrence for each variable. The relative importance index was computed as $\text{RII} = \frac{\sum w}{A*N}$

where:

W = weighting as assigned by each of the respondent in a range of 1 to 3, where 1 implied "low", 2 implied "medium" and 3 implied "high";

A = highest weight (3);

N = total number in the sample

The RII indicator is a measure of the likelihood or recurrence of the variable from the respondent's point of view. The indices can, therefore be used to determine the rank of each variable and the results are shown in Table 4.6 below.

By applying a criterion of over 60 percent or RII mean score of 1.8 to identify variable that had higher rating for occurrence, in appropriate organizational structure, unforeseen ground conditions, employer cash flow problems, poor sub-contracting, increase in scope of work, inadequate planning by the client, poor cost control mechanisms, lack of sufficient contractor experience, increase in scope of work, contractor cash flow problems, length of the project, unpredictable weather, underestimation of project durations, delayed payments to contractors, inaccuracy of bill of quantities, poor resource planning by contractor, relocation of services, shortage of materials, finance and payment of completed works, fluctuations in material, labour and plant costs, poor relationship between the lead engineers/managers and the contractor, corruption, political interference, poor contract management, dispute between key stakeholders, cost increase due to environmental restrictions, environmental challenges, government bureaucracy, Poor infrastructure e.g. telecommunications, access roads, poor safety measures, poor or inadequate specifications in the contract, low labour productivity, lack of top

Table 4.6 Relative Importance Indices for the Variables

Relative Importance	N	Sum	Mean	RIIs
In appropriate organizational structure	28	76.00	2.7143	0.762
Unforeseen ground conditions	28	75.00	2.6786	0.702
Employer cash flow problems	28	71.00	2.5357	0.810
Poor sub-contracting	28	68.00	2.4286	0.714
Increase in scope of work	28	66.00	2.3571	0.619
Inadequate planning by the client	28	65.00	2.3214	0.571
Poor cost control mechanisms	28	64.00	2.2857	0.655
Lack of sufficient contractor experience	28	63.00	2.2500	0.583
Increase in scope of work	28	62.00	2.2143	0.679
Contractor cash flow problems	28	61.00	2.1786	0.690
Length of the project	28	61.00	2.1786	0.583
Unpredictable weather	28	60.00	2.1429	0.667
Underestimation of project durations	28	59.00	2.1071	0.714
Delayed payments to contractors	28	58.00	2.0714	0.667
Inaccuracy of bill of quantities	28	58.00	2.0714	0.643
Poor resource planning by contractor	28	57.00	2.0357	0.619
Relocation of services	28	57.00	2.0357	0.929
Shortage of materials, finance and payment of completed works	28	56.00	2.0000	0.643
Fluctuations in material, labour and plant costs	28	56.00	2.0000	0.548
Poor relationship between the lead engineers/managers and the contractor	28	55.00	1.9643	0.619
Corruption	28	55.00	1.9643	0.940
Political interference	28	54.00	1.9286	0.560
Poor contract management	28	54.00	1.9286	0.560
Dispute between key stakeholders	28	53.00	1.8929	0.595
Cost increase due to environmental restrictions	28	53.00	1.8929	0.464
Environmental challenges	28	53.00	1.8929	0.714
Government bureaucracy	28	52.00	1.8571	0.643
Poor infrastructure e.g. telecommunications, access roads	28	52.00	1.8571	0.786
Poor safety measures	28	52.00	1.8571	0.571
Poor or inadequate specifications in the contract	28	52.00	1.8571	0.607
Low labour productivity	28	52.00	1.8571	0.571
Lack of top management support	28	52.00	1.8571	0.667
Foreign exchange rate fluctuations	28	52.00	1.8571	0.881
Poor site management	28	51.00	1.8214	0.690
The ability of the organization to manage risk	28	51.00	1.8214	0.667
Engineer's lack of adequate professional project management skills	28	50.00	1.7857	0.821
Lack of adequate scope and works specification	28	50.00	1.7857	0.690
Lack of motivation among the project team managers	28	49.00	1.7500	0.655
Contractor's Lack of professional project management skills	28	49.00	1.7500	0.643
Planning capabilities and effective resource coordination	28	49.00	1.7500	0.738
Poor quality control	28	48.00	1.7143	0.643
Labour disputes	28	48.00	1.7143	0.595
Risk allocation	28	48.00	1.7143	0.762
Poor organizational communication systems	28	47.00	1.6786	0.655
Ambiguous client budgets	28	47.00	1.6786	0.774
Complex interfaces of various work packages	28	47.00	1.6786	0.643
Delays in release of drawings	28	47.00	1.6786	0.583
Clint relations with financier	28	47.00	1.6786	0.536
Procurement obstacles	28	47.00	1.6786	0.738
Inappropriate client organizational structure	28	46.00	1.6429	0.845
Delays in approvals by engineer	28	46.00	1.6429	0.595
Poor construction methods/approaches	28	45.00	1.6071	0.643
Delay of access to site	28	45.00	1.6071	0.786
Poor Interpretation of requirements	28	43.00	1.5357	0.595
Lack of adequate quality management systems	28	43.00	1.5357	0.595
Slow speed of decision-making	28	43.00	1.5357	0.595

management support, foreign exchange rate fluctuations, poor site management and ability of the organization to manage risk were seen as the most frequent variables to occur during implementation of similar road projects in Kenya.

4.5 Comparison Between Extent of Contribution and Relative Importance Index

In order to relate the respondents' rating of the extent of contribution to rating on each occurrence of each variable, a comparison using the mean score of rating on the extent of contribution and relative importance was examined as depicted in Table 4.7 below. A scatter plot of contribution index versus RII was done as shown in Figure 4.1 below to examine the bivariate relationship between the two rankings.

Figure 4.1 Contribution Index Against Relative Importance Index

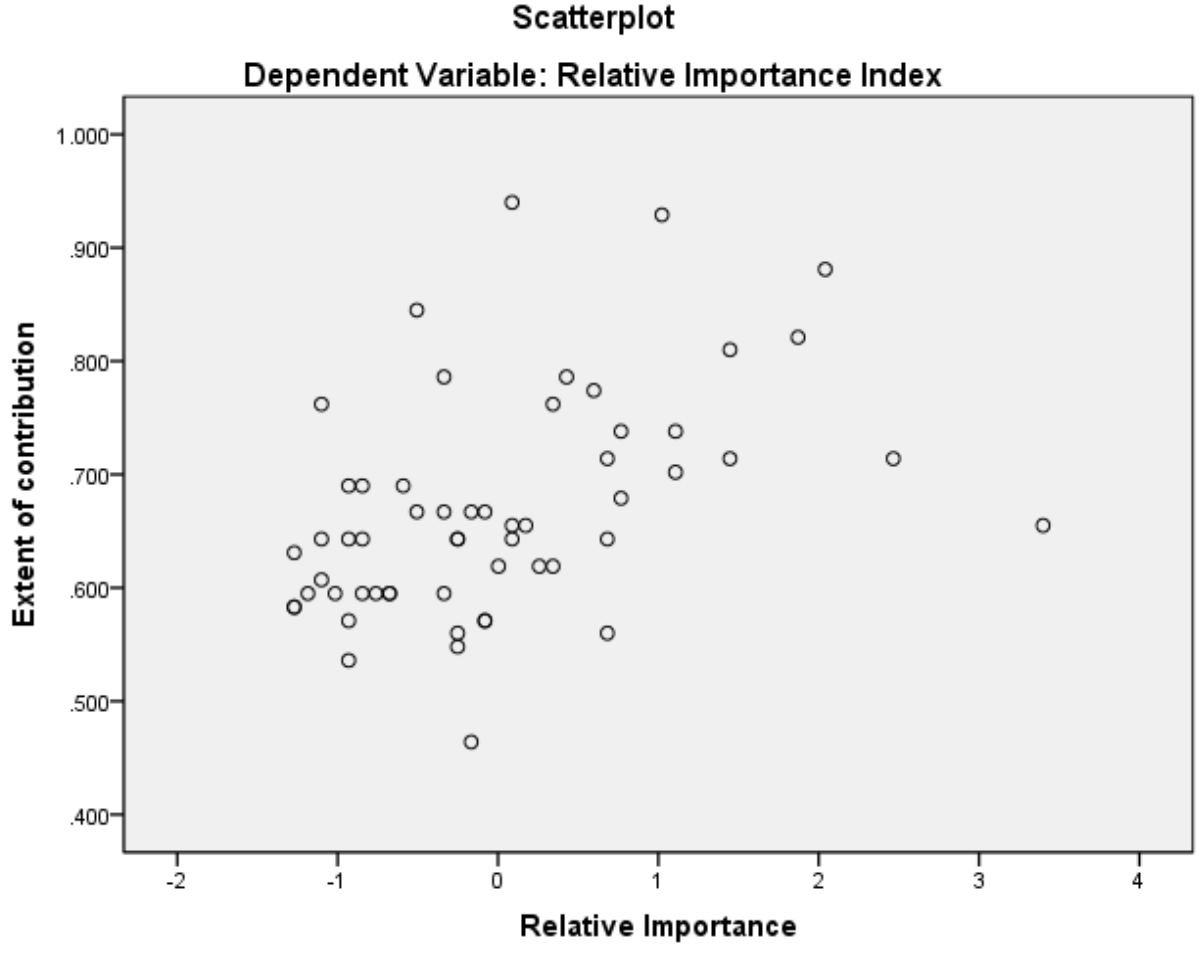

Table 4.7 Comparison of Extent of Contribution to Frequency of Occurrence of Variables

Extent of Contribution	Extent Index	Rank	RII	Rank
Poor or inadequate specifications in the contract	3.6786	1	0.655	28
Delayed payments to contractors	3.2857	2	0.714	16
Employer cash flow problems	3.1071	3	0.881	3
Increase in scope of work	3.0357	4	0.821	5
Inaccuracy of bill of quantities	2.8571	5	0.714	15
Inadequate planning by the client	2.8571	6	0.810	6
Relocation of services	2.7143	7	0.702	17
Underestimation of project durations	2.7143	8	0.738	12
Unforeseen ground conditions	2.6786	9	0.929	2
Unpredictable weather	2.5714	10	0.738	13
Fluctuations in material, labour and plant costs	2.5714	11	0.679	21
Foreign exchange rate fluctuations	2.5357	12	0.643	31
Delay of access to site	2.5357	13	0.560	53
Poor resource planning by contractor	2.5357	14	0.714	14
Environmental challenges	2.5000	15	0.774	9
Poor cost control mechanisms	2.4286	16	0.786	7
Planning capabilities and effective resource coordination	2.3929	17	0.619	38
Contractor cash flow problems	2.3929	18	0.762	11
Contractor's lack of professional project management skills	2.3571	19	0.619	39
Client relations with the financier	2.3214	20	0.655	26
Poor site management	2.2857	21	0.643	29
In appropriate organizational structure	2.2857	22	0.940	1
Government bureaucracy	2.2857	23	0.655	27
Lack of adequate scope and works specification	2.2500	24	0.619	37
Delays in approvals by engineer	2.2143	25	0.571	50
Dispute between key stakeholders	2.2143	26	0.667	25
Ambiguous client budgets	2.2143	27	0.571	51
Inadequate supervision of road projects	2.1786	28	0.464	57
Political interference	2.1786	29	0.667	24
Poor construction methods/ approaches	2.1429	30	0.560	54
Low labour productivity	2.1429	31	0.643	33
Slow speed of decision-making	2.1429	32	0.548	55
The ability of the organization to manage risk	2.1429	33	0.643	29
Risk allocation	2.1071	34	0.595	46
Lack of sufficient contractor experience	2.1071	35	0.786	8
Poor contract management	2.1071	36	0.667	22
Cost increase due to environmental restrictions	2.0357	37	0.667	23
Poor sub-contracting	2.0357	38	0.845	4
Shortage of materials, finance and payment of completed works	2.0000	39	0.690	18
Procurement obstacles	1.9643	40	0.595	41
Delays in release of drawings	1.9643	41	0.595	44
Complex interfaces of various work packages	1.9286	42	0.595	45
Lack of top management support	1.8929	43	0.643	32
Labour disputes	1.8929	44	0.595	42
Poor relationship between lead engineers/managers and contractor	1.8929	45	0.690	20
Inappropriate client organizational structure	1.8571	46	0.571	52
Poor safety measures	1.8571	47	0.643	34
Corruption	1.8571	48	0.690	19
Lack of adequate quality management systems	1.8571	49	0.536	56
Poor quality control	1.8214	50	0.595	46
Length of the project	1.7857	51	0.762	10
Poor infrastructure, for example telecommunications, access roads	1.7857	52	0.643	35
Lack of motivation among the project team managers	1.7857	53	0.607	40
Clint relations with financier	1.7500	54	0.595	43
Poor Interpretation of requirements	1.7143	55	0.583	48
Engineer's lack of adequate professional project management skills	1.7143	56	0.631	36
Poor organizational communication systems	1.7143	57	0.583	49

The Pearson moment coefficient of correlation, which is a measure of the strength of the linear relationship between the two variables, was 0.6133 and the correlation was significant at 0.01 level (1-tailed)**.** This observation can be attributed to the fact that in the respondents' opinion, factors considered significant in contributing to time and cost overruns were also perceived as having a high frequency of occurrence in future road projects.

4.6 Variables Influencing Time and Cost Overruns

To establish the multivariate interrelationships among the variables identified as significant contributors to time and cost overruns, and to further explore the structure of the data, the Principal Component Analysis (PCA) technique was applied. According to Kleinbaum, Kupper and Muller (1988), PCA enables a researcher explain relationships among several difficult-to-interpret, correlated variables in terms of a few conceptually meaningful, relatively independent factors. The technique's appropriateness for factor extraction was examined through the Keiser-Meyer-Olkin (KMO) static.

Sixteen highly ranked variables based on their extent of contribution indices (mean scores) were selected for factor analysis since their extent of contribution were perceived above "moderate extent" to "very large extent". Their mean scores approximated to or more than 2.4 (60 percent) on scale of 1 to 4. Before factor extraction, there were 16 eigenvectors, which corresponded to the highly ranked factors causing time and cost overruns. Six principal components were extracted for time and cost overruns causes. Observation indicated that the six decision factors accounted for 75.031 percent of the total variation in time and cost overruns as shown in Table 4.8.

To achieve factor loadings that were easier to interpret, varimax rotation was done. Table 4.8 shows extracted factors and their respective variables that have loadings greater than 0.5. As indicated in Table 4.9, the variables were then clustered into six most influential factors causing time and cost overruns; increase in scope of work; delayed payments to the contractor; poor cost control; foreign exchange rate fluctuations; poor or inadequate specifications in the contract; and unpredicted weather. Increase in scope of work had the greatest influence on time and cost overruns since it accounted for up to 24.2 percent of the total variation followed by delayed payments to the contractor (15.6 percent). Poor cost control was next accounting for 10.7 percent

and foreign exchange rate fluctuations at 10 percent. The fifth most influential factor was poor or inadequate specifications in the contract, which account for 8.1 percent of the variation. Unpredicted weather was the least influential of the six variable variables accounting for 6.5 percent of the total variation in time and cost overruns.

Table 4.8 Factors Influencing Time and Cost Overruns

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	Percent of Variance	Cumulative Percent	Total	Percent of Variance	Cumulative Percent	Total	Percent of Variance	Cumulative Percent
1	3.875	24.222	24.222	3.875	24.222	24.222	2.776	17.350	17.350
2	2.495	15.591	39.813	2.495	15.591	39.813	2.419	15.116	32.467
3	1.708	10.675	50.488	1.708	10.675	50.488	1.999	12.495	44.962
4	1.606	10.034	60.523	1.606	10.034	60.523	1.695	10.596	55.557
5	1.288	8.050	68.572	1.288	8.050	68.572	1.584	9.901	65.458
6	1.033	6.459	75.031	1.033	6.459	75.031	1.532	9.573	75.031
7	.871	5.444	80.475						
8	.754	4.714	85.190						
9	.671	4.192	89.381						
10	.489	3.053	92.435						
11	.379	2.371	94.806						
12	.315	1.967	96.773						
13	.205	1.279	98.052						
14	.177	1.105	99.158						
15	.109	.681	99.839						
16	.026	.161	100.000						

Extraction Method: Principal Component Analysis

Figure 4.2 Scree Plot

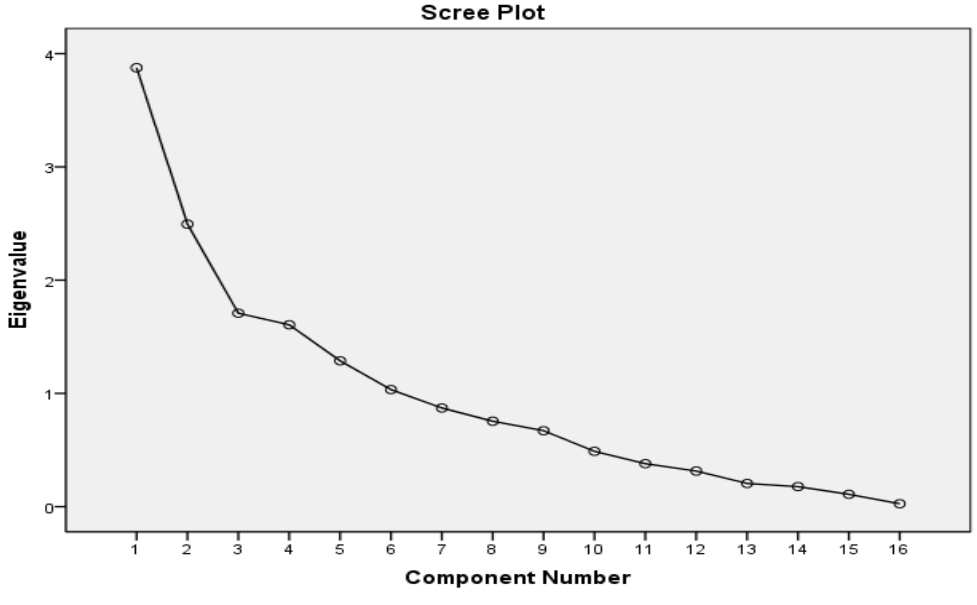

Table 4.9 Factors (Rotated) Influencing Time and Cost Overruns

	Component					
	1	2	3	4	5	6
Poor or inadequate specifications in the contract	.030	.021	.082	.005	.921	.042
Delayed payments to contractors	-.156	.860	.096	.096	-.022	-.161
Employer cash flow problems	.163	.742	.185	-.107	-.025	.272
Increase in scope of work	.870	-.037	-.076	.077	.088	.215
Inaccuracy of bill of quantities	.527	.458	.427	.023	.214	-.171
Inadequate planning by the client	.810	-.175	.309	-.138	.056	-.118
Relocation of services	.803	.137	.029	.030	-.074	.003
Underestimation of project durations	.392	.174	.391	.408	.276	.342
Unforeseen ground conditions	.052	.703	-.217	.267	.248	.073
Unpredictable weather	-.145	.324	-.111	-.130	.238	.813
Fluctuations in material, labour and plant costs	-.064	.084	.196	.695	.367	-.175
Foreign exchange rate fluctuations	.024	.082	-.104	.855	-.198	.152
Delay of access to site	.333	.114	.753	-.220	-.062	-.011
Poor resource planning by contractor	.134	.343	.401	.044	.474	.126
Environmental challenges	.259	-.301	.173	.274	-.170	.697
Poor cost control mechanisms	-.099	-.054	.803	.231	.217	.027

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 10 iterations.

4.7 Relationship Between Variables and Time and Cost Overruns

A multiple linear regression model was used to establish the relationship between the various time and cost overruns factors in the selected road projects. Time overruns constituted the project time extension in months while cost overrun was measured by the total cost deviations from the initial project cost estimates as indicated in Table 4.10.

Table 4.10 Time and Cost Overruns

Project Name	Cost Deviation (Million KShs)	Time Deviation (Months)
Eldoret to Webuye	2,005.55	36
Sotik to Ndanai	225.73	11
Marsabit to Turbi	320.12	25
Londian to Fortenan	871.88	29
Maji Ya Chumvi to Miritini	291.92	2
Homabay to Mbita	499.81	27
Timboroa to Eldoret	2,100.05	10
Kendu Bay to Homa Bay	0	9
Mau Summit to Kericho	320.12	25
Nyamasaria to Kericho	2,320.97	20

Time overruns (dependent variable) was measured by the deviation in months from the planned project completion time and the results are shown in Table 4.11.

Table 4.11 Time Overrun Versus Deviation in Projects Durations in Months

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.947[a]	.897	.004	10.44793	.897	1.018	6	21	.001	2.482

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	667.029	6	111.172	1.018	.001[a]
	Residual	2292.343	21	109.159		
	Total	2959.372	27			

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	9.137	12.515		.730	.473	-16.889	35.163
	Increase in scope of work	3.499	2.151	.334	1.627	.001	-.974	7.972
	Delayed payments to contractors	1.453	2.482	.119	.585	.002	-6.614	3.709
	Poor cost control mechanisms	3.044	2.129	.301	1.430	.001	-1.384	7.471
	Foreign exchange rate fluctuations	-1.757	2.053	-.174	-.001	.001	-6.027	2.512
	Poor or inadequate specifications in the contract	.648	.382	.374	1.695	.003	-1.444	.147
	Unpredictable weather	1.593	1.959	.163	.813	.002	-2.480	5.666

From Table 4.11 the coefficient of determination (R^2 Square) was 0.897 indicating that 89.7 percent of the variation in time overruns can be attributed to the factors that cause time and cost overruns in road construction projects in Kenya. As shown in Table 4.11 the F static was 1.018 with a significant p – value of 0.001. This implies that the impact of the various factors causing time overruns was significant at 5 percent confidence level. In addition, Table 4.11 shows which factors were significant. All the factors were significant (p – value less than 0.05) and apart from foreign exchange rate fluctuations, all the factors had a positive impact on time overruns in road construction projects in Kenya. From Table 4.11, the predictive equation was TOR = 3.499ISW + 1.453DPC + 3.044PCM - 1.757FEL + 0.648ISC + 1.593UPW

where;

TOR = Time Overruns (in months)

ISW = Increase in scope of work
DPC = Delayed payments to contractors
PCM = Poor cost control mechanisms
FEL = Foreign exchange rate fluctuations
ISC = Poor or inadequate specifications in the contract
UPW = Unpredictable weather

The predictive equation indicates that, a unit increase in the increase in scope of work, delayed payments to contractors, poor cost control mechanisms, poor or inadequate specifications in the contract, and unpredictable weather will lead to 3.5, 1.5, 3, 0.6 and 1.6 months increase, respectively in time overruns in road construction projects and an increase by one unit in foreign exchange fluctuation rates will read to a decrease in time overruns in road construction projects by 1.8 months.

The six most significant factors causing cost overruns were regressed against the total project cost deviations to establish the relationship between the factors and cost overruns. Cost overruns (dependent variable) was measured by the deviations in total project cost in Kenya Shillings and the results are presented in Table 4.12 below. From Table 4.12 the coefficient of determination (R^2 Square) is 0.794 indicating that 79.4 percent of the variation in cost overruns was by the factors that cause time and cost overruns in road construction projects in Kenya. In addition, the overall model was significant since p - value was less than the level of confidence ($0.001 < \propto = 0.05$.

Table 4.12 also shows which factors were significant and all the factors were significant (p – value less than 0.05) and had a positive impact on cost overruns in road construction projects in Kenya. From Table 4.12, the predictive equation was COR = 9.6728+ 3.4718SW + 2.7138DPC + 0.6419PCM + 0.9545FEL + 1.2439ISC + 0.8810UPW
where; COR = Cost Overruns (in million Kenya shillings)

The predictive equation indicates that, a unit increase in the increase in scope of work, delayed payments to contractors, poor cost control mechanisms, foreign exchange fluctuation rates, poor or inadequate specifications in the contract, and unpredictable weather will lead to 3.5, 2.7, 0.6, 1, 1.2 and 0.9 increase, respectively in cost overruns in road construction projects.

Table 4.12 Cost Overrun Versus Deviation in Budgeted Projects Cost in Shillings

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Dur bin-Wat son
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.891[a]	.794	.103	8.08089	.794	1.516	6	21	.001	2.425

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.93818	6	9.89717	1.516	.001[a]
	Residual	1.37119	21	6.53017		
	Total	1.96519	27			

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
1 (Constant)	9.6728	9.6808		.999	.001	-1.0469	2.9809
Increase in scope of work	3.4718	1.6648	.407	2.086	.001	817.900	6.9318
Delayed payments to contractors	2.7138	1.9208	-.272	-.413	.001	-6.7058	1.2798
Poor cost control mechanisms	.6419	1.6478	-.078	-.390	.002	-4.0668	2.7828
Foreign exchange rate fluctuations	.9545	1.5888	-.075	-.387	.001	-3.9178	2.6888
Poor or inadequate specifications in the contract	1.2439	.8562	-.197	-.941	.001	.1403	2.137
Unpredictable weather	.8810	1.5158	.077	.405	.002	-2.5368	3.7658

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This study sought to investigate the factors that cause time and cost overruns in road construction projects in Kenya. A descriptive survey of project personnel drawn from contractors, consultant and KeNHA staff involved in 10 recently completed road projects was conducted to establish the factors that had significantly contributed to time and cost overruns during the implementation of the respective road projects. This chapter presents summary of the findings, conclusion and recommendations of the study.

5.2 Summary

The study was guided by three objectives; the first objective of the study was to identify variables influencing road construction time and cost overruns in Kenya. The study focused on 57 variables that were deemed to have had significant contribution to time and cost overruns. The analysis of the variables' extent of contribution to overruns gave 16 highly ranked variables based on their extent of contribution indices (mean scores) since their extent of contribution were perceived above "moderate extent" to "very large extent". Their mean scores were approximated to or more than 2.4 (60 percent) on a scale of 1 to 4. According to the findings, poor or inadequate specifications in the contract had the most influence on time and cost overruns. Others were delayed payments to contractors, employer cash flow problems, increase in scope of work, inaccuracy of bill of quantities, inadequate planning by the client, relocation of services, underestimation of project durations, unforeseen ground conditions, unpredictable weather, fluctuations in material, labour and plant costs, foreign exchange rate fluctuations, delay of access to site, poor resource planning by contractor, increase in scope of work, and poor cost control mechanisms.

The PCA was applied to categorize the various variables for easy analyzability and identify any multivariate inter-relationships among the 16 variables identified as contributors to time and cost overruns. Six factors causing time and cost overruns were extracted; increase in scope of work, delayed payments to the contractor, poor cost control, foreign exchange rate fluctuations, poor or inadequate specifications in the contract, and unpredicted weather. Among these factors, increase

in scope of work had the most influence on the time and cost overruns followed by delayed payments to the contractor while unpredicted weather had the least influential of the six factors accounting for the total variation in time and cost overruns in the road projects.

The second objective of the study was to determine the relative importance of the variables causing time and cost overruns in road construction projects. The study sought to elicit those factors that were considered to have high frequency of occurrence in future on similar project environment. The relative importance of these factors in contributing to time and cost overruns on future projects was achieved through ranking using the extent of contribution index and in particular RII and 35 factors were identified as having a high chance of occurrence

In order to examine the bivariate relationship between the two rankings, a scatter plot of correlation coefficients was done and the plot indicated a high positive correlation between the two rankings. This observation can be attributed to the fact that in the respondents' opinion, factors considered significant in contributing to time and cost overruns were also perceived as having a high frequency of occurrence in future road projects.

The third objective of the study was to determine the quantitative impact of time and cost overruns in road construction projects in Kenya. The quantitative assessment of the impact of the variables involved a multiple linear regression analysis of the six most significant factors contributing to time and cost overruns and two regression models were established for both time and cost overruns. The regression analysis indicated that most (89.7 percent) of the variations in time overruns were attributed to unpredictable weather, foreign exchange rate fluctuations, poor cost control mechanisms, increase in scope of work, delayed payments to contractors and poor or inadequate specifications in the contract with increased scope of work having the biggest impact on time overruns in road construction projects. Apart from foreign exchange rate fluctuations, which had a negative coefficient, all the other factors had positive coefficients. On the relationship between the factors and cost overruns, the study established that the six factors had a significant impact on cost overruns over the period under study accounting for 79.4 percent of the total variation in cost overruns and they all had positive coefficients.

5.3 Conclusion

The findings of this study corroborate past empirical literature on challenges associated with successful implementation of construction projects as outlined in the literature review. Although several factors have contributed to time and cost overruns in road construction projects in Kenya, the most significant of them include unpredictable weather, foreign exchange rate fluctuations, poor cost control mechanisms, increase in scope of work, delayed payments to contractors and poor or inadequate specifications in the contract with increased scope of work having the biggest impact on time and cost overruns in road construction projects.

From this study, the above variables have a high chance of occurrence, hence the need for respective agencies to devise ways of mitigating their impact on future road projects. Increase in scope of work can be considered to have been the lead factor in contributing to time and cost overruns on the road projects. The other factors in order of significant were delayed payments to contractors, poor or inadequate specifications in the contract, foreign exchange rate fluctuations, unpredictable weather and poor cost control mechanisms. Based on this study, it can be inferred that the variation in time and cost overruns can be attributed to the six factors above and that there exists a positive relationship between these factors and time and cost overruns. From the findings of this study, it can also be concluded that the occurrence of these factors is contextual, hence will largely depend on the project environment.

5.4 Recommendations

The findings of this study portray challenges facing the implementation of infrastructural projects in Kenya and their economic impact; consequently, the study makes the following recommendations. At macro-level, policy makers both at county and national levels formulate strategies towards mitigating the impact of these factors given the fact that most of them have a high chance of recurring in future road projects. There is need for the line ministries and other agencies allied to infrastructural development in Kenya to establish enabling factors for successful implementation of road and other infrastructural projects in Kenya.

At micro-level, contractors, consultancies, and other stakeholders need to do proper definition of project scope and apply modern project management tools given the fact that increase in scope of work was lead factor in contributing to time and cost overruns on road projects. At the

preliminary stages, enough material and time resources should be committed to ensure that adequate feasibility studies are conducted to avoid duality. This will go a long way in ensuring that specifications are well prepared, scope is well defined, proper materiel and time estimates are done. In addition, geographical and socio-economic risk determinant like weather, inflation and exchange rates should be factored in the initial planning stages.

5.5 Limitations of the Study

The study sought to investigate the factors that cause time and cost overruns in road construction projects in Kenya. It is clear that a study of this magnitude should include a survey of sizeable number of road projects over a wider time span of say, 10 years. However, time and material resources did not make this feasible and for this reason, the study concentrated on 10 major roads completed in the recent past under KeNHA.

In addition, the study period for this study was short for a study of this nature. The researcher had to juggle between work and the field, particularly during data collection. This was a major hindrance particularly in ensuring that the research work did not hamper the performance and productivity of the researcher at the work place. At the same time, some of the respondents were non-committal posing major challenge in the field during the data collection.

5.6 Suggestions for Further Research

Studies involving confirmatory factor analysis will need to be carried out to further test the model so established and to confirm the findings of the study. Further studies can be conducted to test and confirm factor loadings in different infrastructural projects so as to establish the validity and strength of the model. Having identified the factors causing time and cost overruns in road projects in Kenya, there is need for further research to focus on the critical success factors in the implementation of road construction projects in Kenya.

The fact that the degree to which various factors affects time and cost overruns varies from one road project to the other, calls for further research efforts to identify optimal project management practices and on the possibility of setting benchmarks in Kenya's construction industry. The need for further research into this aspect of project management is further compounded by the fact that operations management practice is a relatively new phenomenon particularly in the building

sector in Kenya where most project managers are oriented towards engineering professional and academic qualifications.

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APPENDICES

Appendix I Letter of Introduction

OFFICE OF THE CHAIRMAN, DEPARTMENT OF BUSINESS ADMINISTRATION

To: Whom it may concern

From: Chairman, Business Administration Department

Date: August, 15th, 2015

SUBJECT: ASSISTANCE IN DATA COLLECTION

This is to certify that **Stanley W. Mwawasi** of Registration No. **D61/70872/2014** is registered in the Masters of Business Administration Programme at the School of Business, University of Nairobi. In partial fulfilment of the requirements for the award of the degree, the candidate is required to undertake an empirical study to enable him write a thesis. To this end, **Stanley W. Mwawasi** is carrying out a study **"TIME AND COST OVERRUNS IN ROAD CONSTRUCTION PROJECTS IN KENYA UNDER KENYA NATIONAL HIGHWAYS AUTHORITY"**

This is to request you to offer him the necessary support to enable him collect primary data, which will be used for academic purposes only.

Thank you.

Chairperson

SCHOOL OF BUSINESS - UNIVERSITY OF NAIROBI

S/No. _____

Appendix II Questionnaire

The objective is to determine cause factors of time and cost overruns in road construction projects and their relative importance data shall be used for this research only.

PART A: GENERAL INFORMATION

1. The name of your project?

   _____

2. Your position/designation in the project?

   _____

3. What was your role in the project

   _____

   _____

   _____

4. Please list your qualification(s)

   _____

   _____

   _____

5. For how long have you worked in your position?

   _____

6. Please describe any relevant previous work experience on similar assignment

   _____

   _____

   _____

   _____

PART B: FACTORS INFLUENCING ROAD CONSTRUCTION TIME AND COST OVERRUNS

7) In your opinion, to what extent did each of the following factors contribute to time and cost overruns in your project? Please tick (✓) on a scale of 1-4 where: 1= No Extent, 2= Avery Small Extent; 3= Large Extent; 4= Very Large Extent.
Please tick (✓) the chance of occurrence of the factor on Scale of 1-3 where: 1= Low, 2= Medium, 3= High

Factors Causing Time and Cost Overruns	Extent of Contribution				Chance of Occurrence		
	4	3	2	1	3	2	1
Length of the project							
Relocation of services							
Inadequate planning by client before comment of construction							
Poor resource planning by contractor							
Lack of adequate scope and works specifications							
Delays in approvals by engineer							
Government bureaucracy							
Risk allocation							
Fluctuations in material, labour and plant costs							
Shortage of construction materials							
Poor interpretation of requirements							
Poor contract management							
Inaccuracy of bill of quantities							
Cost increase due to environmental restrictions							
Ability of the organization to manage risk							
Planning capabilities and effective resource coordination							
Unforeseen ground conditions							
poor site management							
Slow speed of decision-making by engineer							
Contractor's lack of adequate professional project management skills							
Inappropriate contractor organizational structure							
Delay of access to site							
Poor construction methods/ approaches							
Procurement obstacles							
Inadequate supervision of road projects by engineer							
Delayed payments to contractors							

Foreign exchange rate fluctuations							
Ambiguous client budgets							
Poor cost control mechanisms							
Lack of motivation among the project team managers							
Inappropriate client organizational structure							
Political interference							
Employer cash flow problems							
Corruption							
Dispute between key stakeholders							
Increase in scope of work							
Poor relationship between the lead engineers/managers and the contractor							
Environmental challenges							
Lack of top management support							
Underestimation of project durations							
Low labour productivity							
Labour disputes							
Contractor cash flow problems							
Poor or inadequate specifications in the contract							
Increase in scope of work							
Poor safety measures							
Poor organizational communication systems							
Lack of adequate quality management system							
Unpredictable weather							
Poor sub-contracting							
Client relations with financier							
Poor infrastructure e.g telecommunication, access roads							
Lack of sufficient contractor experience							
Delays in release of drawings							
Complex interfaces of various work packages							
Poor quality control							
Engineer’s lack of adequate professional project management skills							

PART C: EMERGING FACTORS

6. What other factors might have contributed to time and cost overruns in the project/s you were involved in? Please list seven (7) in the order of their importance.

i. _____

ii. _____

iii. _____

iv. _____

v. _____

vi. _____

vii. _____

Appendix III Successfully Completed Projects

No	Project Name	Length (Km)	Completed	Time variance	Cost variance (Million KShs)	Remarks
1.	Nairobi – Thika (A2) (Lot 1)	12.4	2012	7	3,513.4	Project under defects liability
2.	Nairobi – Thika (A2) (Lot 2)	14.1	2012	7	3,169.08	Project under defects liability
3.	Nairobi – Thika (A2) (Lot 3)	23.88	2012	12	1,205.26	Project under defects liability
4.	Isiolo – Merille (A3)	136	2012	No information	1,442.72	Project under defects liability
5.	Athi River – Namanga (A104) (OSBP)	136	2011	16	1,609.58	Project under defects liability
6.	Kendu Bay – Homa Bay (C19)	38	2012	9	0	Project under defects liability
7.	Athi River – Namanga (A104) Project	No information	No information	No information	0	No information
8.	Lanet – Dundori (C69)	30	2012	0	No information	Project under defects liability
9.	Ndori – Ng'iya (C27)	40	2013	No information	148.67	Project under defects liability
10.	KCC (Sotik)-Ndanai (C15)	57.4	2014	11	225.7	Project under defects liability
11.	Londiani - Fortenan (C35)	63	2014	29	871.88	Project under defects liability
12.	Modika - Nuno	12	2014	No information	0	Project under defects liability
13.	Marsabit - Turbi (A2)	121	2015	25	320.12	Project under defects liability
14.	Timboroa - Eldoret (A104)	73	2015	10	2,100.05	Project under defects liability
15.	Eldoret - Webuye (A104)	6	2015	36	2,005.55	Substantially complete
16.	Homa Bay –Mbita (C19)	43	2015	27	499.81	Substantially complete
17.	Miritini - Maji ya Chumvi	40	2007	2	291.92	Complete
18.	Lanet – Njoro Turnoff	16	2008	1.8	551,.51	Complete
19.	Njoro Turnoff – Timboroa	84	2010	No information	1,901.70	Complete
20.	Sultan Hamud - Machakos Turnoff	55	2013	15.8	1,756.64	Complete
21.	Machakos Turn off - JKIA	33	2013	18.9	4,054.97	Complete
22.	Kericho - Nyamasaria Road (A1)	76	2014	20	2,320.97	Complete
23.	Kericho - Mau Summit	58	2015	25	320.12	Complete
24.	Nyamasaria - Kisumu & Kisumu Southern Bypass(A1/B1)	24	2015	10.4	1,530.65	Complete

Source: KeNHA (2014)

Appendix IV Tables for Analyses

Communalities Matrix	Initial	Extraction
Poor or inadequate specifications in the contract	1.000	.857
Delayed payments to contractors	1.000	.809
Employer cash flow problems	1.000	.697
Increase in scope of work	1.000	.824
Inaccuracy of bill of quantities	1.000	.746
Inadequate planning by the client	1.000	.818
Relocation of services	1.000	.671
Underestimation of project durations	1.000	.697
Unforeseen ground conditions	1.000	.682
Unpredictable weather	1.000	.873
Fluctuations in material, labour and plant costs	1.000	.698
Foreign exchange rate fluctuations	1.000	.812
Delay of access to site	1.000	.744
Poor resource planning by contractor	1.000	.539
Increase in scope of work	1.000	.778
Poor cost control mechanisms	1.000	.760

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

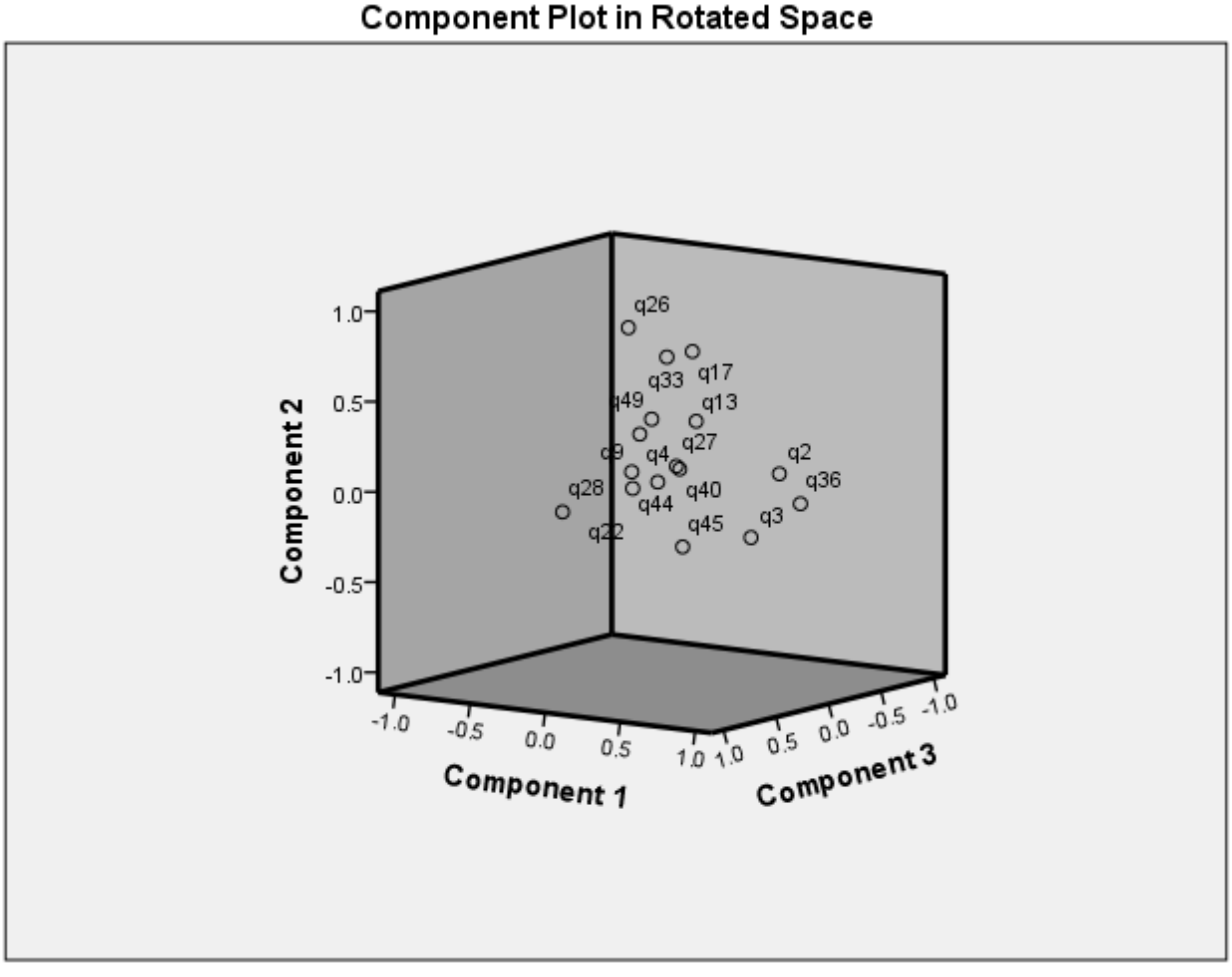
Component Matrix	Component					
	1	2	3	4	5	6
Poor or inadequate specifications in the contract	.383	.248	-.013	-.378	.359	-.614
Delayed payments to contractors	.297	.683	-.319	.208	-.270	.191
Employer cash flow problems	.527	.369	-.195	.413	.105	.251
Increase in scope of work	.570	-.499	.213	.356	-.048	-.275
Inaccuracy of bill of quantities	.782	-.002	-.318	.000	-.180	-.018
Inadequate planning by the client	.558	-.677	-.171	.004	-.078	-.119
Relocation of services	.555	-.417	-.018	.355	-.225	-.109
Underestimation of project durations	.746	.029	.352	-.106	.045	.044
Unforeseen ground conditions	.368	.611	.052	.322	-.168	-.198
Unpredictable weather	.189	.403	.288	.368	.674	.041
Fluctuations in material, labour and plant costs	.321	.336	.326	-.476	-.354	-.155
Foreign exchange rate fluctuations	.125	.212	.705	.021	-.483	.144
Delay of access to site	.570	-.280	-.358	-.192	.108	.405
Poor resource planning by contractor	.618	.259	-.098	-.187	.201	-.066
Increase in scope of work	.242	-.328	.664	.087	.279	.294
Poor cost control mechanisms	.442	.055	.024	-.662	.103	.335

Extraction Method: Principal Component Analysis.

a. 6 components extracted.

Component Transformation Matrix	1	2	3	4	5	6
1	.623	.422	.503	.194	.333	.177
2	-.616	.685	-.109	.241	.279	.055
3	.009	-.319	-.213	.723	-.018	.575
4	.357	.452	-.582	-.251	-.395	.333
5	-.205	-.166	.134	-.564	.360	.681
6	-.249	.137	.578	.020	-.725	.245

Appendix V Component Plot in Rotated Space



Appendix VI Data collection Form and Certificate

UNIVERSITY OF NAIROBI
SCHOOL OF BUSINESS
MBA PROGRAMME

Telephone: 020-2059162
Telegrams: "Varsity", Nairobi
Telex: 22095 Varsity

P.O. Box 30197
Nairobi, Kenya

DATE 21/10/2015

TO WHOM IT MAY CONCERN

The bearer of this letter STANLEY W. MWAWASI

Registration No. D61/70872/2014

is a bona fide continuing student in the Master of Business Administration (MBA) degree program in this University.

He/she is required to submit as part of his/her coursework assessment a research project report on a management problem. We would like the students to do their projects on real problems affecting firms in Kenya. We would, therefore, appreciate your assistance to enable him/her collect data in your organization.

The results of the report will be used solely for academic purposes and a copy of the same will be availed to the interviewed organizations on request.

Thank you.

UNIVERSITY OF NAIROBI
SCHOOL OF BUSINESS
21 OCT 2015
P.O. Box 30197 – 00100, NAIROBI

PATRICK NYABUTO
MBA ADMINISTRATOR
SCHOOL OF BUSINESS