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**DETERMINANTS OF COST OVERRUNS IN RURAL ROADS
INFRASTRUCTURE PROJECTS IN KENYA**

LUKALE AGGREY MOYI

**Submitted in partial fulfilment of the requirements for the Degree of
Master of Commerce at Strathmore University**

**School of Management and Commerce
Strathmore University
Nairobi, Kenya**

June, 2018

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ABSTRACT

The increasing frequency and magnitude of cost overruns in the road infrastructure projects over the years as well as its strenuous effects on the scarce resources has been a cause of concern to project stakeholders and researchers across the globe. This research sought to establish the nature and extent of cost overruns in the rural roads infrastructure projects in Kenya, and the determining factors. The study employed a mixed method explanatory design to gain deeper understanding of the concept. Contract data for 68 projects was reviewed and cost overruns computed based on the initial contracted sums against the actual cost and revised contract sums. A survey involving 100 respondents from the subsector was carried out through the use of structured questionnaires. A five point Likert scale was used to capture the significance of various determinants of cost overruns identified from the literature. Multiple regression analysis was carried out on the project data to determine the predictors of cost overruns with Relative Importance Index (RII) and factor analysis being deployed on the survey data in ranking other latent determinants to establish their perceived contribution level to cost overruns. A mean cost overrun of 5.31% and maximum of 24.92% was established. Project size and nature of work were found to have a significant positive relationship with cost overrun. Financial management factors ranked highly with an RII of 0.7373 with labour and equipment group ranking lowest with RII of 0.5839. Factor analysis resulted in extraction of 15 factors from the initial 65 determinants. The findings point to interrelationship among the various determinants implying that no one factor can explain wholly the frequency and occurrence of cost overruns in the road infrastructure. The study recommends a collaborative approach among the stakeholders directed towards effective project management practices with the objective of minimising time and cost overruns in the projects. Improved contract management practices by the implementing agencies and contractors are vital as the consultants are advised to review their methodologies to minimise design changes mid-stream. The findings of this study are limited to the 68 projects reviewed. The reported frequency and magnitude may be affected if the ongoing projects with zero cost overruns were to experience cost overrun at their completion. The study provides a basis for future research into cost overruns in the road infrastructure sector while acting as a motivation for further study on cost overruns from an earned value perspective.

TABLE OF CONTENTS

DECLARATION	i
ABSTRACT	ii
LIST OF FIGURES	vi
LIST OF TABLES	vii
LIST OF ABBREVIATIONS.....	viii
ACKNOWLEDGEMENT	ix
DEDICATION	x
CHAPTER ONE: INTRODUCTION	1
1.1 Background	1
1.1.1 Cost Overruns in the roads projects.....	2
1.2 Problem Statement	5
1.3 Objectives of the Study	6
1.4 Research Hypothesis	6
1.5 Scope and Limitations.....	7
1.6 Significance of the study.....	7
1.6.1 Implementing Agencies	7
1.6.2 Contractors.....	8
1.6.3 Consultants	8
1.6.4 Regulators and policy makers.....	8
1.6.5 Financiers.....	8
1.6.6 Other Government Agencies	8
1.6.7 Academic researchers	9
2 CHAPTER TWO: LITERATURE REVIEW	10
2.1 Introduction.....	10
2.2 Theoretical Framework	10
2.2.1 Psychological Theories.....	10
2.2.2 Agency Theory	12
2.3 Cost Overruns in road construction projects.....	16
2.3.1 The nature and extent of cost Overruns.....	17
2.3.2 Measuring cost overruns.....	18
2.4 Determinants of cost overruns	19
2.4.1 Cost overruns and project attributes	19

2.4.2 Other determinants of cost overruns.....	23
2.5 Summary of literature review.....	26
2.6 Conceptual Framework	27
3 CHAPTER THREE: RESEARCH METHODOLOGY	32
3.1 Introduction.....	32
3.2 Research Philosophy	32
3.3 Research Design.....	33
3.4 Population and Sampling	34
3.5 Data collection Techniques	34
3.6 Data analysis and interpretation	35
3.7 Operationalization of variables	38
3.7.1 Dependent variable	38
3.7.2 Independent Variables	38
3.7.3 Other Latent Variables.....	39
3.8 Research quality.....	42
3.8.1 Objectivity	42
3.8.2 Validity	42
3.8.3 Reliability	42
3.9 Ethical considerations	42
3.10 Chapter Summary	42
4 CHAPTER FOUR: DATA ANALYSIS AND INTERPRETATION	44
4.1 Introduction.....	44
4.2 Sample and data	44
4.3 Occurrence and Extent of Cost overruns in Rural Roads Projects.....	46
4.3.1 Occurrence and Extent of Cost overruns based on contract data	46
4.3.2 Perception of respondents on occurrence and extent of cost overruns.....	47
4.4 Determinants of Cost overruns in Rural Roads Projects.....	48
4.4.1 Checking for multicollinearity.....	49
4.4.2 Test for Autocorrelation	49
4.4.3 Test for Linearity and homoscedasticity.....	50
4.4.4 Checking for outliers	50
4.4.5 Test of normality.....	50
4.4.6 Cost Overruns and Project Attributes.....	51

4.4.7 Multivariate analysis to establish the relationship between the independent variables and the dependent variable.....	53
4.4.8 Other latent determinants of cost overruns.....	55
4.4.9 Factor analysis of cost overruns	64
4.4.10 Chapter summary	68
5 CHAPTER FIVE: SUMMARY, DISCUSSIONS CONCLUSIONS AND RECOMMENDATIONS	70
5.1 Introduction.....	70
5.2 Summary of the study	70
5.3 Summary of findings.....	71
5.3.1 Occurrence and extent of cost overruns in the rural roads infrastructure projects..	71
5.3.2 Determinants of cost overruns in the rural roads infrastructure projects.....	72
5.4 Study Implications and recommendations	75
5.4.1 Implementing Agencies.....	75
5.4.2 Contractors.....	77
5.4.3 Consultants	77
5.4.4 Regulators and policy makers.....	78
5.4.5 Financiers.....	78
5.4.6 Other Government Agencies	78
5.4.7 Academic researchers	79
5.5 Limitations	79
5.6 Areas of further research.....	79
REFERENCES.....	81
APPENDIX I: Questionnaire	89
APPENDIX II: Letter of Authorisation	95
APPENDIX III: Rural Roads network prior to reclassification.....	96
APPENDIX IV: Expenditure on roads F/Y 2011/2012- 2014/2015.....	97
APPENDIX V: World's biggest cost overruns infrastructure projects	98
APPENDIX VI: Cost overruns in Sub-Saharan Africa averages and ranges by country .	99
APPENDIX VII: Average cost per km of a 2-lane road by type of work and type of road, by country	100
APPENDIX VIII: Hierarchical principal agent relationship in road project management in Kenya	101
APPENDIX IX: List of sampled projects	102

LIST OF FIGURES

Figure 2.1: Conceptual framework	28
Figure 4.1: Histogram for Normality	51

LIST OF TABLES

Table 2.1A: Other determinants of cost overruns	30
Table 4.1:Contract Data Profile	45
Table 4.2: Target population for the field survey	46
Table 4.3: Cost overruns in percentages based on project attributes	47
Table 4.4: Comparison of cost overrun in percentages between quantitative and qualitative data	48
Table 4.5:Ranking of causes of cost overrun	49
Table 4.6:Output results for Multi-collinearity	49
Table 4.7: Durbin Watson test for Autocorrelation	49
Table 4.8: Kolmogorov-Sminov and Shapiro Wilk Tests for normality	50
Table 4.9: Regression Model Fitness	53
Table 4.10: Hypothesis testing	54
Table 4.11: Multivariate analysis of project attributes and cost overruns	55
Table 4.12: Regression output for contract data	55
Table 4.13: Cronbach's Alpha test for reliability	57
Table 4.14: Group RII and ranking	58
Table 4.15: Top ten determinants of cost overrun	58
Table 4.16: Relative Importance Index and Ranking of determinants of Cost Overruns	59
Table 4.17:Kaiser-Meyer-Olkin Measure of Sampling Adequacy	64
Table 4.18: Bartlett's Test of Sphericity.....	65
Table 4.19: Factor extraction	66
Table 4.20:Rotated Component Matrix.....	66
Table 4.21: Rotated Component Matrix-continued	67

LIST OF ABBREVIATIONS

AC	: Actual Cost
AfDB	: African Development Bank
AICD	African Infrastructure Country Diagnostic
BAC	: Budget At Completion
CIMA	: Chartered Institute of Management Accountants
CPI	: Cost Performance Index
CV	: Cost Variance
EV	: Earned Value
EVM	: Earned Value Management
KMO	: Kaiser-Meyer-Olkin
Ksh	: Kenya Shillings
PEM	: Public Expenditure Management
PMB	: Performance Measurement Baseline
PMI	: Project Management Institute
PPP	: Public Private Partnership
PV	: Planned Value
RII	: Relative Importance Index
RMLF	: Road Maintenance Levy Fund
RSIP	: Road Sector Investment Programme
SPI	: Schedule Performance Index
SV	: Schedule Variance
TCPI	: To complete Performance Index
USD	: United States Dollar
VOP	Variation of Prices

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DEDICATION

This thesis is dedicated to my family; my dear wife Ruth and my beloved daughters Shirleen, Nicole and Hope for their unwavering love and support.

CHAPTER ONE: INTRODUCTION

1.1 Background

Infrastructure plays an important role in the economy of any country due to the nature of impact it has on the citizen's welfare and investments. The roads subsector particularly is a vital factor in the socio economic development of a country as it facilitates access to markets, which in turn enhances production and increases the level of employment. Further, the development of other sectors such as education, health and other social services depend a great deal on the roads sector. Research has shown that expensive and inadequate infrastructure is responsible for two percentage points in retarded economic growth every year in Africa (Foster & Briceño-Garmendia, 2010). In Kenya the roads transport accounts for 93 % of all freight and passenger traffic with the balance attributed to other modes of transport mainly air sea and water. This underscores the significance of the subsector to the Kenyan economy.

Research suggests that close to 30 % of the productivity handicap faced by Kenya is attributable to infrastructure constraints majorly the power sector closely followed by the transport sector(Briceno-Garmendia&Shkaratan, 2011). It is imperative that the Government consistently increases investment in this sector in order to improve the economic performance of the country. Due to the capital intensive nature of such investment, cost is thus an important determinant on the level of roads network development and has a direct impact on how long the country will take to achieve an adequate and reliable road network and by extension a sustainable economic growth.

Kenya's Road network is estimated at 197,091 kilometres out of which 63,291 are classified while the rest 133,800 are unclassified. Out of this only 14,100 Kilometres are paved with the balance network being gravel or earth standard. Roads are classified into various categories from A to E where class A is International trunk roads while Class E refers to District roads. Rural Roads form the bulk of the Kenyan road network and are currently managed by Kenya Rural Roads Authority. The current road condition assessment reveals a grim picture of the condition of roads in Kenya with 56 % of the roads in poor condition, 33 % in fair condition while only 11 % are in what can be termed as good condition. More investment in the roads is therefore required to bring the condition of the roads to acceptable levels.

Investment in the roads in Kenya is guided by the Roads Sector Investment Programme developed in 2009 (RSIP). The RISIP is a blue print by the Government of Kenya with the main objective being to guide investments, maintenance and rehabilitation of roads in Kenya to global standards and best practices for a period of 15 years (2010- 2024). This was informed by the ambitious growth prospects and economic transformation outlined in the vision 2030 which hinges heavily on quality and adequate infrastructure. Funding of roads infrastructure projects is done through five main sources; The Exchequer comprising government revenues, the Road Maintenance Levy Fund (RMLF), Transit tolls, Agricultural Cess and the Development Partners.

Roads expenditure constitutes about 15 % of the total Public expenditure annually making it one of the largest single element of public expenditure in Kenya (Burgess, Jedwab, Miguel, Morjaria, & others, 2013). Between the financial year 2011/2012 and 2014/2015, the government spend Kenya shillings 408.5 billion on construction and maintenance of roads in the country which gives a mean of Ksh 102 Billion per year. In the financial year 2016/2017 the funding for rural roads network alone amounted to Kenya shillings 65.1 billion both from the government and development partners.

1.1.1 Cost Overruns in the roads projects

Cost is said to be an essential consideration and one of the major constraints in implementation of any project to the extent that cost overruns are sometimes viewed as a major determinant of the success or failure of the project (Wijekoon & Attanayake, 2011). Researchers have termed cost overrun as a common phenomenon in the road projects in the world and is measured by the difference between the final total cost of the project and the original contract amount. The magnitude varies from one project to another and are more prevalent in the developing countries than in Europe and North America (Flyvbjerg, Skamris Holm, & Buhl, 2004;Wijekoon &Attanayake, 2011;Chantal C. Cantarelli, Flyvbjerg, Molin, & Van Wee, 2010). Over the last few decades cost overruns have remained common with some projects recording up to 60 % increase from the original contract sum (Foster & Briceño-Garmendia, 2010). Of even more concern is the fact that historical data shows no improvement in cost performance in the last few decades indicating that no significant learning has occurred in this area (Flyvbjerg et al., 2009).

Researchers have wide-ranging findings on the magnitude and frequency of cost overruns in roads projects as well as the associated factors. In one study the average cost overrun for large scale projects was estimated to range between 20.4 to 44.7 % (Chantal C. Cantarelli, Flyvbjerg, Molin, & Van Wee, 2010). Another study by the African Development Bank (AfDB) found the average cost overrun to be 35 % with some cases recording as high as 50 % and even 100 % (Mthuli, Mugerwa, Lufumpa, & Murinde, 2014). The later also found strong evidence of scale effect where cost overruns were higher in smaller projects- less than 50 kilometres, than in larger projects. This is consistent with the world bank study that recorded 90 % of the road projects having experienced cost overruns averaging 80 % (Foster & Briceño-Garmendia, 2010).

The world's biggest cost overrun recorded in the road infrastructure was 556% which occurred in M50 South East Motorway in Ireland. Others include; Verrazano-narrows bridge in USA at 384%; Guangzhou City Transport Project in China with 335%; Central Artery/Tunnel (CA/T) Boston -Big Dig project in the USA with 324% ; Cuernavaca-Acapulco Toll Road in Mexico with 300%; Humber Bridge in the UK 276% ; Dublin Port Tunnel again in Ireland at 261% and Nanchang jiujiang Highway in China which experienced cost overrun of 255%. (CIMA, 2013). This indicates the prevalence of this problem in the transportation sector and therefore the need to find out why it happens and the remedies.

Kenya Roads Board in its 2015 baseline survey report documents 1333 studies having been done in the sector between 1959 and 2015 (Kenya Roads Board, 2015). However, from the 274 studies sampled by the consultants, none is on cost performance. It therefore emerges that there is little known on the actual cost overruns in this industry in Kenya due to limited research in this area. World Bank policy research working paper no 5596 on Kenya's infrastructure puts the magnitude of cost overruns as high as 80 % attributing it to what is termed as systemic issues (Briceno-Garmendia & Shkaratan, 2011). In yet another study on monitoring the unit costs in the roads projects in sub-Saharan Africa, commissioned by the same bank, Kenya reported zero cost overruns on the entire four bank-financed projects same as Ethiopia and Uganda. Nigeria on the other hand was leading in cost overruns averaging 39% with a high of 56% (Alexeeva, Padam, & Queiroz, 2008). However, it must be noted that this

was reached at after allowing 15% variation which is the bank's maximum allowed for variation orders. This means there was still an element of cost overruns even in the three countries that recorded zero including Kenya. Surprisingly the average unit cost for Kenya in the same study is not consistent with the occurrence of cost overruns reported. While the unit cost for the other countries compare well with each other for works of similar nature, the average cost for rehabilitation and reconstruction works in Kenya was found to be quite high compared to the other countries in the sample.

Researchers in this area have varying observations on different causes of cost overruns. A research done by (Flyvbjerg et al., 2004) found a significant relationship between cost overrun and the length of implementation period of the project. They also found a positive relationship between the size of the project and the magnitude of cost overrun. With regard to the project ownership (government, private) it was found that type of accountability emerged significant as far as the cost overruns are concerned than the project ownership. Due to the numerous factors identified in the literature, some researchers have opted to group similar factors together to explain the causes of cost overruns. Allahaim and Liu, (2012) identified several factors which they grouped into five main categories namely pressure for distorting estimation market volatility, time pressure, novelty and complexity. On the other hand, a study carried out on cost of road infrastructure in developing countries identified five cost drivers in road projects. Among cost drivers identified include; dispersion in unit cost for comparable road work activities, war and conflict, levels of corruption and the level of supervision (Collier, Kirchberger, & Soderbom, 2013). Other researchers have concentrated on identifying the most significant causes of cost overruns. For instance one researcher while undertaking research into factors causing delays in road construction projects in Kenya, concluded that the top five causes of project delays were observed to be slow decision making and bureaucracy in client organization ,payment by client, rain and inadequate planning and scheduling (Atibu, Seboru, 2015). In another study organisation structure, finance, contract management and labor were found to be significant sources of cost overruns in Kenya (Kimani, Zippora, & Michael, 2015). The two studies appear to concur on the causes of cost overruns in Kenya with the only departure being semantics. In yet another study, the researcher observed that variation orders accounted for 70 to 151 % of the cost Overruns in the Kenyan construction projects (Dickson, Munala, & Wanyona, 2015).

The implications of cost overruns in the road infrastructure projects are wide ranging. The most notable effect of cost overrun is the strain on the resources due to additional costs over and above the budgeted costs as well reduced benefits accruing to the intended users. In some cases these costs are passed on to the users leading to higher rental/lease costs. Further, cost overruns have implications to the various parties attached to the project. The inability to deliver value for money brings with it reputational risk to the professionals on the project which may lead to loss of confidence by future clients. The contractor on the other hand loses on the profits in addition to facing reputational risk and possible litigation. The construction industry as whole may suffer devastating effects as increased cost overruns may lead to abandonment of projects. This may have a negative impact on financing future projects with the financiers shunning away from similar projects or charging a higher cost of finance due to presumed additional costs expected as a result of cost overruns.

1.2 Problem Statement

The African Infrastructure Country Diagnostic (AICD) report published in 2009 estimated Kenyan Infrastructure funding gap at USD 2.1Billion (Kenya Shillings 200 Billion) annually with the roads subsector alone bearing a deficit of USD 44 Million equivalent of KSh 44 Billion (Briceno-Garmendia&Shkaratan,2011). Faced with limited resources, the need for new roads and maintenance of the existing ones far outweighs the available funding. The budget is further eroded by consistent escalation in construction costs thereby widening further the already existing funding gap. There is need to ensure that the available resources are managed prudently so as to obtain optimum value from this capital intensive investment. Research shows that the funding gap could be halved by eliminating inefficiencies while adopting appropriate financing strategies and technology (Briceno-Garmendia&Shkaratan, 2011). Most of the road construction projects are characterised by delay in completion, burst budgets reduced functionality and questionable quality(Ministry of Roads, 2006;Briceno-Garmendia&Shkaratan, 2011). Session paper No. 6 of 2006 which initiated reforms in the roads subsector acknowledges the existence of cost overruns in the industry and identified optimal use of available resources as one of the objectives in addition to increasing resources available for investment in the sector (Ministry of Roads, 2006).

Recent studies indicate an upward trend in escalation in road construction cost leading to increased losses to the Government and the taxpayers(Briceno-

Garmendia&Shkaratan, 2011). Given the scarce resources, there has been renewed pressure on government to ensure spending on the development projects is accompanied with appropriate cost control measures. Cost overruns are therefore not the best use of the taxpayers' funds and are detrimental to the economy. The extra money spent as a result of the cost overruns reduces not only the number but also the size of similar projects that can be completed in any fiscal year. Cost overruns on infrastructure projects further reduces the efficiency of available resources and limits the growth potential of the economy (Singh, 2009).

A 2015 report on baseline survey on research undertakings in Road sector in Kenya commissioned by Kenya Roads Board in 2014 documents 1333 studies having been undertaken between 1959 and 2015. A review of 274 listing of studies sampled by the consultant portrays cost performance as an area that has received little or no attention in the studies for over five decades, yet an area of concern for the world at large. Even with the few studies identified, there is no consensus with regard to the magnitude of road cost overruns in Kenya as well as the associated factors. This research seeks to establish the true position of the cost overruns in road construction projects in Kenya, the casual factors and the remedies available to improve cost performance, while contributing to the existing literature on this global phenomenon.

1.3 Objectives of the Study

The main objective of the study is to establish the nature and extent of cost overruns of rural roads projects in Kenya, the determining factors and provide remedies on how best project costs can be managed to attain value for money.

The specific objectives are:

- i. To assess the extent of cost overruns in rural road infrastructure projects in Kenya
- ii. To establish determinants of cost overruns in rural road infrastructure projects in Kenya.

1.4 Research Hypothesis

The study set out to test the following null hypothesis;

H₀: There is no cost overrun experienced in rural roads infrastructure projects

H1₁: Project attributes namely project size, project type, and implementation period, nature of work and contractor nationality have no effect on cost overrun.

1.5 Scope and Limitations

The study mainly focussed on the major rural roads projects implemented by Kenya Rural Roads Authority between 2010 and 2017. The study was limited to projects that involve new construction, rehabilitation and periodic maintenance. Routine maintenance projects, which are numerous with smaller contract amounts were not considered in this study. All projects including completed ones as well as those in progress were considered.

1.6 Significance of the study

Cost overrun has been described as a global phenomenon common in many infrastructure projects around the world and has been constant over the last seven decades (Flyvbjerg, 2005). While there are many researches that have been done on the magnitude and causes of cost overruns, there is little concurrence on the frequency and extent of actual cost overruns in road construction projects and the associated causes. Its occurrence is said to lead to inefficient allocation of resources while causing delays and reducing the benefits associated with the project. Cost overruns also destabilise policy, planning, implementation and operations of the projects as in some cases they constantly increase as the project size increases (Flyvbjerg, 2005).

This research is therefore considered invaluable to various stakeholders. The study is expected to contribute to better understanding of the extent of cost overruns in Kenya and the associated factors. Different stakeholders and industry players including project managers, contractors, implementing agencies as well as policy makers are likely to benefit as they will be able to direct their resources and energies to the particular factors identified thereby reducing rate and magnitude of cost overruns in future projects.

1.6.1 Implementing Agencies

The Implementing agencies may use the study findings to improve on their internal processes and policies regarding contract management and supervision.

1.6.2 Contractors

Contractors are responsible for the actual construction of the road projects ensuring the project is completed within the budgeted time and cost and within the specifications. They manage financial resources, people, material and equipment to deliver the project. The effect of cost overruns on the contractor's bottom line is evident not to mention the reputation risk that eventually may result in poor credit rating by the banks. This study is beneficial to this group especially on the determinants that may be within their control for the purposes of improving on their bottom-line.

1.6.3 Consultants

Consultants are responsible for design and documentation and for supervising the projects during implementation. Based on the findings the consultants may use the study to improve on their methodologies both in design and supervision with an aim of reducing cost overruns.

1.6.4 Regulators and policy makers

These are government watchdogs that monitor the professional conduct of the parties during the implementation of the project. They are also involved in providing policy guidelines that guide the implementing agencies and other parties involved in the road construction and management. The findings of this study provides guidance for the policy makers to direct resources and energies to the specific determinants with an aim of impacting cost performance in future projects.

1.6.5 Project Financiers

Financiers provide funds for the implementation of the project. These include the government of the day and in some cases development partners. It is therefore in their best interest to demand value for money. This study helps them to initiate controls geared towards safeguarding their investments in the road projects.

1.6.6 Other Government Agencies

These include agencies responsible for provision of public utilities such as water, electricity, telephone and Government departments that offer licensing and other related services. Included in this category are Agencies dealing in land and settlement matters, environment and other licensing agencies. Collaboration among these agencies is vital if the project has to be implemented smoothly within the budgeted

time and cost. The study is useful to the government agencies in letting them value the effect of collaborative role in cost performance of the road projects.

1.6.7 Academic researchers

The findings in this study provide additional knowledge to the already existing literature on the cost overruns and thus widening the understanding of cost overruns in the road projects.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter discusses the concept of cost overrun, its existence and measurement. Various theories explaining the existence of cost overruns are explored to gain a deeper understanding of the concept and its occurrence. Further, a review of empirical literature is done to gather more evidence on the existence of this phenomenon in the global arena. Different research findings are interrogated with respect to the magnitude, frequency of occurrence as well as the causal factors. Based on this, the conceptual framework is then developed to guide the study.

2.2 Theoretical Framework

Researchers have varied findings on the occurrence of cost overruns. Part of the reasons for inconsistencies in the findings emanate from diversity of theories, which have been fronted by different authors to explain the phenomenon of cost overruns. Among these are the prospect theory, the forecasting theory, the triple constraints theory and the Agency Theory. The divergence of findings indicates that no one theory can explain the occurrence and causes of cost overruns in totality. However, explanations from different theories can be captured to put together a combination of factors that if considered may explain a good percentage of cost overruns. This study employed a multiplicity of theories to explain the determinants of cost overruns in the road construction industry in Kenya. The various theories can help us appreciate the multitude of factors that affect cost overruns as well as different perspective to view it.

2.2.1 Psychological Theories

Cantarelli, Flyvbjerg, Molin, & Van Wee (2010) use theories from behavioural studies to explain manifestation of cost overruns in the road construction projects. Included in this category are two theories primarily on optimism bias; planning fallacy theory and the prospective theory.

The planning fallacy theory was first proposed by Daniel Kahneman and Amos Tversky in 1979. It is a phenomenon in which predictions about how much time will be needed to complete a future task displays an optimism bias. The definition was expanded in 2003 to include individuals' tendency to underestimate time, costs and risks of future actions while overestimating the benefits of the same actions.

According to Daniel Kahneman and Amos Tversky(1979) this phenomenon occurs regardless of the individual's knowledge that past tasks of a similar nature have taken longer to complete than generally planned. The bias only affects estimates or forecasts about one's own tasks; when outside observers predict task completion times, they show a pessimistic bias, overestimating the time needed. The optimism bias is attributed to the cognitive biases of the forecasters such as scenario thinking, anchoring of estimations and extrapolation of current trends(Cantarelli et al., 2010). The anchoring trap is well explained in the “Hidden Traps in Decision Making” by John S. Hammond and others. According to these authors, the old numbers become anchors which the forecaster adjusts based on other factors. While this approach may lead to reasonably accurate estimate, it relies too much on past events giving little weight to other factors. This may lead to misguided choices especially in a situation where the market place changes rapidly resulting to underestimation of costs and eventually lead to cost overruns. Thus the planning fallacy results not only to time overruns but cost overruns as well with reduced benefits. This theory can be used to explain the occurrence of cost overruns in that the contract price, which is compared against the actual cost to determine the cost overruns, is a function of the Engineers estimates. The engineers estimate on the other hand is a product of estimation and is largely derived from historical data. Cost overruns are likely to occur if the engineer relies too much on the historical information without incorporating other determinants that may affect the cost of the project.

Closely related to the planning fallacy theory is the prospect theory by the same authors Daniel Kahneman and Amos Tversky in 1979.This is a behavioural economic theory that designates the way people choose between probabilistic alternatives that involve risk, where the probabilities of outcomes are known. According to this theory people make decisions based on the potential value of losses and gains rather than the final outcome and evaluate these losses and gains using certain heuristics. Under prospect theory, value is assigned to gains and losses rather than to final assets; also probabilities are replaced by decision weights. The value function is defined on deviations from a reference point and is normally concave for gains (implying risk aversion), commonly convex for losses (risk seeking) and is generally steeper for losses than for gains (loss aversion). Decision weights are generally lower than the corresponding probabilities, except in the range of low probabilities. Like in the

planning fallacy theory, the linking of the optimistic theory to cost overruns can be seen through the engineer's estimates which are the basis upon which bidding is carried out to obtain the lowest evaluated bidder. This optimistic forecast is as result of decision making process involving risk and uncertainties.(Chantal C. Cantarelli et al., 2010)

2.2.2 Agency Theory

Agency theory evolved in economics literature (Alchian & Demsetz, 1972; Fama & Jensen, 1983; Jensen & Meckling, 1976). It delineates relationships between ownership interests (principals) and manager interests (agents) when those managers have been contracted by the owners to perform some type of job. Principals provide capital to the firm thus assuming a level of risk. Fama and Jensen (1983) referred to principals as residual claimants, those entitled to claim the remaining value after capital assets have been used to produce benefits for an organization. Principals expect managers, who are compensated to perform a specific job, to run and control the organization, protect owner interests, and act responsibly as stewards.

Agency theory is based on assumptions that not only are people rational, but they also possess a strong self-interest and are typically risk averse (Eisenhardt, 1988). The agency problem is that ownership goals may differ from those of agents. According to this theory a company is viewed as the result of more or less formal "contracts", in which several groups make some kind of contribution to the company, given a certain "price". Company management tries to get these contributions under optimum conditions for management: low interest rates from bankers, high share prices for stockholders, and low wages for employees.

In these relationships, management is seen as the "agent," trying to obtain contributions from "principals" such as bankers, shareholders and employees. The proponents of Agency Theory suggest that the separation of ownership and control is often the best available organizational design, as the benefits of increased access to capital and professional management typically outweigh the costs associated with delegating control of business decisions to managers (Fama & Jensen 1983). However, in the absence of strong corporate governance systems, public corporations may suffer in performance when self-interested managers pursue their own interests rather than

the interests of shareholders (Jensen 1989). Managers have opportunities for pursuing their own interests because they have been delegated rights through their contracts to control cash flows and information in their firms.

In their 2006 paper titled “A Principal-Agent Theory Approach to Public Expenditure Management Systems in Developing Countries”, the authors Leruth & Paul, (2007), discuss Public Expenditure Management (PEM) system in developing countries using analytical framework based on the principal-agent theory. In this paper, the authors use the principal-agent theoretical framework to clarify issues arising from PEM systems. They note that a chain of Principal –Agent relationship characterises Public Expenditure Management system which in turn exposes the project management to potential principal agent problems. Between creation and implementation, fiscal decisions may go through various stages in which the principal agent problems may distort the final outcome.

In this model the authors depict the Ministry of Finance as the Principal representing the public interest while the line ministries are seen as agents of the Ministry of Finance since they are required to produce a certain level of output in exchange for their budget appropriation. The Head of the line ministry is in turn viewed as a principal with the civil servants as agents. His main objective is to ensure that the civil servants implement the projects as promised to his principal. In the same context the parliament is considered a principal whose objective is to ensure the executive implements the government program. Yet another principal agent relationship exists between the national government and the local (federal) governments.

A closer look at the project management of roads projects in Kenya reveals a hierarchical type of principal–agent relationship in which the Kenyan citizens act as the main principal with the contractor at the far end as the primary agent. In between there is a series of principal-agent relationships resulting from delegated authority by various institutions and the respective managers. The Kenyan citizens collectively act as the principal deriving their mandate from the Kenyan constitution. The constitution bestows the sovereign power to the Kenya citizens allowing them to exercise their power either directly or through elected representatives. The constitution further delegates this power to the state organs and recognizes two levels at which this power

may be exercised; the national government and the county government (Constitution of Kenya, 2010). The citizens as the main principal are the ultimate beneficiaries of the development projects. However, they cannot implement these projects directly and therefore mandates the government of the day to undertake the projects on their behalf as their agent. The Government in turn implements these projects through the line ministries as their agents.

In its bid to improve service delivery and manage performance challenges in the public sector, the Government adopted performance contracting as part of the Public Sector Reforms programme initiated in 1993. The strategy is aimed at enhancing service delivery to the Kenyan citizens, by improving efficiency and effectiveness while reducing costs (Kobia, 2006). Performance contracting is used as a management tool to help the public sector executive officers and policy makers to define responsibilities and expectations between the parties to the contract to achieve common mutually agreed objectives.

At the beginning of every financial year, the government signs performance contracts with the line ministries detailing each party's responsibilities and expectations. These are then cascaded downwards to the state corporations and other agencies under the respective line ministries who further cascades the same to the employees through staff appraisal system. The performance targets form the basis for evaluating institutional performance as well as appraising individual staff performance.

Agency problems arise when the welfare of one party (the principal) depends upon the actions of the other party (agent) in a contractual relationship. The agent is believed to take actions that foster his own self-interest rather than the interest of the principal. The challenge is therefore in finding a way of motivating the agent to act in the interest of the principal rather than in the agent's own interest (Armour, 2009). Agency problems exist nearly in all contractual relationships. Any contractual relationship in which one party promises performance to another party has potential of experiencing agency problems. This is attributed to the information asymmetry between the principal and the agent. It is assumed that the agent commonly has more and sometimes better information than the principal about the relevant facts. The principal therefore is not in a position to guarantee himself that the agent will deliver on the promised performance. With such information asymmetry, the agent has an

incentive to act in an opportunistic manner including under delivering on his performance and sometimes allocating himself part of what is rightly due to the principal (Armour, 2009). The principal then must incur additional costs in monitoring the agent. Agency costs vary depending on the nature and complexity of the task to be undertaken. The more complex the task, the greater the discretion the agent must be given and the higher the monitoring costs to the principal.

The ability of the principal to assure himself of the performance by the agent diminishes further where there are several principals giving rise to coordination costs which in turn limits the principals' ability to engage in collective action. The difficulty in coordination among the principals will lead them to delegate more of their decision making to the agents. Further the more the principals are unable to coordinate the more difficult it is to ensure the agent sticks to the agreed performance. Multiple principals therefore result in increased agency costs.

Agency problems occur in the public sector as much as in the private firms. Public sector principals contract most of the public services to their agents based on the public policies. Hierarchy based organisations such as the public sector are inherently weak in inducing the desired efforts from the people involved. There is conflict between the individual and social objectives almost at every stage of the hierarchy (Singh, 2009). Information asymmetry and conflict of interest arise due to the divergent interests of the principals and the agents. By definition, conflict of interests occurs where an individual or an organization, an agent, has multiple interests and of those interests one could possibly corrupt the motivation for an act in the other (Ittonen, 2010).

In order to maximise efficiency, the principals have to devise appropriate incentives to the managers and monitor their behaviour to ensure minimal resource consumption for the contracted services (Jaffe, et al, 2005). This gives rise to agency costs. Ross, Westerfield and Jaffe (2005) define agency costs as "the sum of monitoring cost of the shareholders and the costs of implementing control devices." According to Attila, (2012), in public service, agency costs arise from many sources: the costs of recruitment, adverse selection, specifying and discerning preferences, providing incentives, moral hazard, shirking, stealing, self-dealing, corruption, monitoring and policing, self-regulation, bonding and insurance, agents who oversee agents, as well as

failures in these costly corrective devices (Shapiro 2005: p 281). Agency costs are necessary to ensure that managers (agents) act in the best interest of the owners (principals) (Jerzemowska, 2006).

However even with agency costs, agency problems can never be perfectly solved, consequently, principals have to experience residual loss. This is the loss of wealth to the principals as a result of the divergent behavior of the agents (Jaffe et al., 2005). From this perspective, cost overruns are seen as part of the agency costs. According to Leruth and Paul, (2007) a number of principal-agent relationships appear in the government operations. They identify mistakes, indifference, passive resistance and implicit opposition as part of the agency problems policies may go through. In this context corruption and bad governance is seen as agency problem arising from asymmetric information and interest divergence between those who perform tasks and those for whom the tasks are performed. Low level of output and by extension cost overrun on the project may be as a result of misbehaviour by the agents or corruption. In the Economic Recovery Strategy for Wealth and employment Creation 2003-2007 the government pinpointed professional incompetence as part of factors contributing to poor project supervision and implementation and promised to address the matter through the Engineers Registration Board.

Taken in the context of Agency theory as applied in the public sector, cost overruns are viewed as part of agency costs resulting from the principal agency problems of information asymmetry and conflict of interest. The theory plays a big role in explanation of cost overruns as it brings out a more general understanding of the occurrence of cost overruns due to the nature of the relationship that exist between the multiplicity of principals and agents in the management of the road projects in the public sector setting.

2.3 Cost Overruns in road construction projects

Wideman, (2003) defines cost overrun as amount by which actual costs exceed the baseline or approved costs. Other researchers have defined cost overrun as excess of actual cost over budget (Tejale, Khandekar, & Patil, 2015; Brunes, Lind et al, 2014; Collier et al., 2013; Cantarelli, Van Wee, Molin, & Flyvbjerg, 2012). Cost overruns have been observed in the road projects with the trend continuing over the last few decades. This puts pressure on the state resource allocations resulting in

reduced benefits to the stakeholders. Faced with limited resources, the need for new roads and maintenance of the existing ones far outweighs the available funding. The budget is further eroded by consistent escalation in construction costs implying that there is need to ensure that the available resources are managed prudently so as to obtain optimum value from this capital intensive investment.

Inconsistencies in the research findings does little to remedy the situation. Different researchers have varying findings on the frequency and extent of occurrence as well as the causal factors although some factors are common across the researchers. The importance cost as a major determinant of project's success means that more attention should be paid to this area for the benefit of all the parties involved in the project management.

2.3.1 The nature and extent of cost Overruns

A review of literature on cost overruns reveals a subject that has received considerable attention over the years, but with varying findings on the magnitude and frequency of occurrence. The existence of cost overruns in infrastructure projects and particularly road transport sector is not contestable. The divergence in findings lies in the magnitude and frequency from one project to another and from one country to another. Singh (2009) conducted a study on the extent, causes and remedies of cost overruns in India. The sample comprised of 850 projects drawn from seventeen infrastructure sectors with a focus on the causal factors behind time and cost overruns. The results indicate that 41.6 % of the projects experienced cost overruns with 56% experiencing delays in completion. The mean cost overrun across the projects amounted to 21 % with the overrun in the road projects amounting to 8 %. The findings on the occurrence of cost overruns is consistent with (Brunes et al., 2014) who carried out a survey of 230 project managers in the Swedish Transport administration and three large construction companies in Sweden. With a response rate of 42%, 52 % of the respondents indicated that cost overruns occurred more often with 44 % indicating that cost overruns occur sometimes. A mean cost overrun of 8 % however differs sharply from findings from other studies.

A report by the comptroller and Auditor General of the Republic of Tanzania on ten major projects implemented by the ministry of Roads notes that out of the ten projects reviewed, 8 had a cost overrun. The magnitude of cost overrun out of this sample was

57% ranging from a low of 9% to a staggering 130%. Only two projects had a cost under run of 2% and 6 %. This is further corroborated by the study undertaken by African development Bank on analysis of unit costs and cost overruns on road infrastructure projects in Africa. The research focused mainly on determining unit costs and prevalence and extent of cost overruns in road infrastructure projects in Africa. The findings indicate a cost overrun of 48 % and under runs of 15 % with a correlation noted between the cost overruns and the project size. Contrary to what other researchers recorded, smaller projects appear to have increased cost overruns translating to higher unit cost per kilometre than larger projects. This they explain may be due to the fact that larger contractors are more sophisticated in their costing or increased efforts by funding agencies on larger projects than smaller projects. The report calls for cautious approach to cost estimation of smaller projects.(Mthuli et al., 2014). In the same report, the researchers found that geographical location of the project and origin of contractor as not significant in explaining the cost overruns.

Data on cost overruns in Kenya is limited due to inadequate research in this area. World Bank policy research working paper no 5596 on Kenya's infrastructure puts the magnitude of cost overruns as high as 80% attributing g it to what is termed as systemic issues. This is consistent with AfDB's research that indicates cost overrun of 90% in the Kenya situation.

2.3.2 Measuring cost overruns

Literature identifies two methods of measuring cost overruns namely Earned Value Management (EVM) and the traditional method. Earned Value Management which is one of the techniques used in the project cost control process defines cost overrun as the difference between the Actual Cost (AC) and the Earned Value (EV) measured by Cost Performance Index (CPI). Earned Value Management is commonly used process for performance measurement. It integrates the project scope, cost and schedule measures to help the project management team assess and measure project performance and progress. It requires the formation of an integrated baseline against which performance can be measured for the duration of the project(Project Management Institute, 2008). Three key dimensions are developed and measured with respect to each project; planned value, earned value and actual cost. In addition variances from the approved baseline are also monitored, these include schedule and cost variances. Researchers have used the concept of earned value with varying but

positive results. It is lauded as one of the best known methodologies to project progress control and reporting and is widely accepted (Czarnigowska, Jaskowski, & Biruk, 2011). The approach is favoured for its ability to predict cost overruns before the end of the project. However earned value management is beyond the scope of this study.

Traditionally, the measurement of cost overrun is derived from its definition. There is not much divergence on the definition with most researchers defining cost overrun as percentage difference between the actual cost and the budgeted cost (Shrestha et al., 2013; Brunes et al., 2014; Collier et al., 2013 & Cantarelli et al., 2012). This approach has however been criticized as it only considers the two dimensions of the project the actual cost and the planned cost while ignoring the third key dimension which is the value of work performed. A project manager who spends the entire project budget is considered cost efficient, which may not be true. This is because the measurement makes no reference to the value of the project (Fleming & Koppelman, 2003). However even with the noted weakness, this approach is widely used in determination of cost overruns and has been commonly used by researchers over time. This research adopted the same measurement in determining cost overruns in the rural road projects.

2.4 Determinants of cost overruns

Literature reports cost overrun as a common and global phenomenon whose occurrence and magnitude varies from one project to another as well as from one country to another. Research is rich with factors associated with occurrence of cost overruns albeit with little convergence in the findings. Each researcher identifies multitude of factors ranging from 40 to a high of 150 factors while grouping similar factors in groups for ease of analysis and ranking. The inconsistencies in the findings make it difficult for literature to guide practice on what factors to consider in addressing the menace of cost overruns in the road construction projects.

2.4.1 Cost overruns and project attributes

A review of literature identified several project characteristics that may have an impact on the occurrence and magnitude of cost overruns. These include project size, project type, funding source, nature of work, Contractor's nationality, contract duration, and deviation of bid price from the engineer's estimates and geographical location of the project.

2.4.1.1 Project size

There is little consensus in definition of project size. Different researchers have defined project size differently with some categorising project size based on the length of the road (Mthuli et al., 2014) while others categorised project sizes using the budgeted cost as the basis (Cantarelli et al., 2012). Given the two different project types being considered by this research, the budgeted cost was adopted and the projects were categorised into three categories; small (Ksh<500m), medium (Ksh<500 >1billion and large (>1billion)

Findings in one research indicate a frequency of cost overrun in the small projects at 6.3% with mean cost overrun of 18.7%. On the other hand 35 % of the medium projects experienced cost overruns while the frequency of cost overruns in the large and very large projects stood at 9.0% and 49.7 % respectively. Mean cost overrun for medium projects was 23.2% large projects 7.0 % and very large projects 10.9 %. Regression line for cost overrun in these studies against the project size indicated that cost overruns decreases with project size. However the relationship appeared weak making the researcher to conclude that there is no relationship between the project size and cost overruns (C.C. Cantarelli et al., 2012). The findings appear to agree with Senouci, Ismail, & Eldin, (2016) on 40 road projects in Quatari.

While undertaking detailed quantitative analysis cost performance for 65 infrastructure projects in developing countries, Gamez & Touran, (2010) noted that 37% of the projects experienced cost overruns. They recorded strong evidence that cost performance varies with project size. They conclude that although different project sizes behaved differently with regard to cost performance, they could not establish a consistent trend (upward, downward) between project size and cost performance. Park and Papadopoulou, (2012) while analyzing causes of cost overruns in the transport infrastructure projects in Asia and assessing their importance and statistical relationship with project size, confirms existence of moderate correlation between cost overrun and project size.

H1₁: Significant positive relationship exists between cost overruns and the project size. Cost overruns increases with project size

2.4.1.2 Project type

Project types are divided into two categories namely roads and fixed link structure (bridges, tunnel). A Study by Flyvbjerg, (2012) carried out in the Netherlands found 62. % of the road projects had a cost overrun compared to 46.7% of the fixed link projects. The percentage of projects with cost under run was almost the same with both project types. 14.3% of the roads projects recorded cost under run while fixed link projects were at 14.4%. The mean cost overrun for the roads projects was 38.7% much lower than the fixed link projects that recorded a mean cost overrun of 62.9%. It is therefore prudent to conclude from these findings that cost overruns is more prevalent in road projects than in fixed link projects although the fixed link projects exhibits a higher magnitude than the road projects. Investigation into 57 Hong Kong mega infrastructure projects found a significant positive relationship between cost overrun and project type with fixed link projects experiencing higher cost overruns (37.48%) than road projects (32.52%) (Huo Tengfei et al., 2018). This is close to the findings of Hickman, Bonilla, Givoni, & Banister, (2015) where they recorded a cost overrun of 37.48% in fixed links higher than 20.4% recorded in the road projects.

H2₁: Significant positive relationship exists between cost overruns and the project type. Cost Overruns are higher in fixed link projects than in road projects

2.4.1.3 Nature of work

The study considers three types of work namely; New construction, rehabilitation and reconstruction and periodic maintenance. Researchers have found varying magnitudes of cost overruns based on the nature of work. In one study, new construction projects exhibited cost overruns of 20% with cost overruns in the rehabilitation projects appearing not significant while cost underrun was reported in the periodic maintenance projects.(Mthuli et al., 2014). This is in contrast with the findings by Senouci, Ismail, & Eldin, (2016) who found no statistical significant relationship between cost overrun and nature of work.

H3₁: Significant positive relationship exists between cost overruns and the nature of work. Cost overruns varies with the nature of work

2.4.1.4 Contract supervision

Contract management and supervision has a bearing on the performance of the contract and the related costs. Contract supervision can either be in-house or

outsourced to consultants. Poor contract management and administration has often been sighted as part of the causes of cost overruns. While outsourcing design and supervision of construction projects has been associated with efficiency, some authors have different opinion linking cost overruns to outsourcing of supervision(Kusnet, 2007). In a report entitled “Highway Robbery II” the authors attribute the cost overruns in the Central Artery Tunnel in Boston –the “Big Dig” project to outsourcing of design, engineering and construction supervision. He notes that outsourcing of designs and supervision results in increased costs, reduced quality and safety and reduced accountability to the public.

H4₁: Significant positive relationship exists between cost overruns and project supervision. Cost overruns are higher in in-house supervised projects than consultant supervised projects.

2.4.1.5 Nationality of contractor

Studies have established relationship between cost performance of the project and the origin of the contractor. A World Bank study on monitoring contracts and unit costs on roads projects in sub-Saharan Africa grouped contractors in three categories mainly local contractors from the respective African country, the Chinese contractors and the European contractors. The study reveals that 43 % of the bank sponsored contracts were awarded to African (local) contractors with the Chinese firms getting 27% and the European firms 17%. Interestingly the study notes while the local contractors out perform their foreign counterparts on the procurement process, they lag behind when it comes to implementation hence cost overruns are more prevalent. The percentage of cost overruns experienced by projects undertaken by local contractors stood at 25% followed by European firms 22% with Chinese firms recording the lowest cost overrun of 14% (Alexeeva et al., 2008).

H5₁: Significant positive relationship exists between cost overruns and the nationality of the contractor. Cost overruns are higher with local firms than foreign firms

2.4.1.6 Contract duration (Implementation Period)

A study on 76 projects by Flyvbjerg (2012) in the Netherlands found a positive relationship between cost overruns and the length of implementation period concluding that the higher the implementation phase the higher the cost overruns. This

contrasts with Gamez and Touran, (2010) who in their analysis of 65 projects in the developing countries concluded that there was no correlation between cost performance and contract duration. These are the same findings by Senouci et al., (2016) in 40 road projects in Qatari. Huo Tengfei et al. (2018) however records that cost overrun heavily depend on the length of implementation phase with cost escalation increasing at a rate of 1.35% for each additional year of implementation.

H6₁: Significant positive relationship exists between cost overruns and implementation period. The longer the implementation period, the higher the cost overruns.

2.4.1.7 Deviation of bid price from the engineer's estimates

Alexeeva et al., (2008) in the study of the unit costs in the road projects in the sub Saharan Africa finds that African firms had a cost advantage over Chinese and European firms when bidding for road construction projects and are closely in competition with Chinese firms. The range between the contract value and project cost estimates are narrower for the African firms than their Chinese and European counterparts and exhibit higher competition. Local firms reported a deviation of 14.7% between the contract value and the cost estimates much lower than the Chinese and European firms who reported a mean deviation of 21.6% and 21.5% respectively. A closer look at this analysis together with the cost overrun findings in the same study reveals an inverse relationship between the bid price and cost overruns.

Holding the engineers estimates as reasonably accurate, experts argue that competitive tenders should result in lower prices and hence lower overruns. One way of measuring competitiveness is through the spread of the bids. For a tender to be considered competitive the lowest three bidders should fall within 10 percent range(Africon, 2008).

2.4.2 Other determinants of cost overruns

Tejale Khandekar and others (2015) carried out a study on analysis of project cost overrun by statistical methods in Pune region in India. Their survey identified 45 common factors causing cost overruns which they ranked based on relative important index value computed on each group of respondents. The ten most factors based on the ranking were material shortage, shortage of labour, late delivery of materials and

equipment, unavailability of competent staff, low productivity level of labours, quality of equipment and raw materials, delay in progress payments, financial difficulties by contractor, poor site management, escalation and fluctuation of material prices and poor communication and coordination by owner and other parties. Chileshe and Berko (2010) listed similar factors including delays in monthly payments to contractors; variations; inflation, and schedule slippage as significantly important. They identified other factors as poor communication, technical complexity and size of the project as not very important but of concern. They also found that project management practices such as value management and risk management were not being practised within the Ghanaian roads sector.

A similar study by (Muianga, Granja, and Ruiz, 2015) in Mozambique identified 95 factors which they classified into eleven categories namely government relations, contractual issues, organisation, management, financing, design and documentation, schedule and control, scope changes, environment and economy materials and labour and equipment. Using statistical analysis, they attached values of importance to each factor with a relevance average set at 2.5. Fifty three factors across the eleven categories were identified as relevant. The study however did not rank the factors nor the group of factors.

In their review of ten major projects implemented by the ministry of Roads, the Auditor General of Tanzania classified causes of cost overruns into two categories; increased costs as result of new design and new specifications and increased costs due to quantities and variation of price factors. While these may explain the occurrence of cost overruns in the road projects, however this appears as a narrow perspective as studies indicate a multiplicity of factors attributable to cost overruns.

Singh, (2009) in his study of extent and causes of cost overruns in 850 infrastructure projects in India divided the causal factors in four categories; technical and natural factors, contractual failures, organisational or institutional failures and economic factors. Included in the technical and natural factors are the cost estimation techniques, technological and material requirements as well as natural factors such as flood and other natural conditions. The contractual failures relate to the ability of the contract to specify every detail of the works that are to be performed by the contractor' in each possible scenario. He refers to this as 'complete-contingent- contracts. He however

notes that in reality it is difficult to develop a contract that describes in detail every possible scenario that may occur during the implementation of the project. This makes the construction contracts intrinsically 'incomplete'. The 'incompleteness' varies as the project complexity increases. Organisational or institutional failures refer to cooperation of several departments within and among various ministries. The hierarchal relationships within these organisations and conflicts between the individuals and the social objectives within the organisation mean that the projects have to face the consequences of many sources of failures within the sponsoring organisations. Included in the economic factors are the state of other infrastructural development and income level.

The results of the above study indicate a correlation between time and cost overruns. He reports that magnitude of cost overrun varies across and within the sectors. The project size was found to be directly related to the percentage of cost overruns. This corroborates with the findings by Cantarelli, et al (2012) who found out that small projects had a mean average of 6.3% with very large projects recording cost overrun of 49.7 %. The medium projects however recorded a cost overrun of 35% compared to large projects mean of 9% indicating a weak relationship between project size and cost overruns. The study further found organisation failures to be a significant cause of cost overruns. The economic performance of the state also turned out to be significant with relatively richer states recording high cost overruns.

Other researchers have identified various factors as causes of cost overruns. Brunet et al., (2014) while undertaking survey of 230 participants drawn from the Swedish Transport Administration and three large construction companies in Sweden, narrowed down the factors to only three; design of the project, misjudged price changes and unexpected technical problems that were difficult to predict. With a response rate of 42%, 65 % of the respondents ranked design changes as significant while 64% attributed cost overruns to technical problems. Only 20% recorded changes in input prices as a major cause of cost overruns.

In their book titled "Understanding and Monitoring the Cost-determining Factors of Infrastructure Projects: A User's Guide", the European union identified design changes, land acquisition problems, poor project management, unexpected ground conditions, inflation, difficulties with contractor, funding problems, exchange rates,

shortages of material and plant and act of God as the main cost changing factors. They give examples of what they term as “poor practice projects” based on the projects sampled. Two of the projects had a cost overrun of 20% another one with 10% and yet another with 36%. Land acquisition costs emerged as a common factor across three projects with design and inflation appearing in two projects. In one of the projects with cost overruns of 20% it was found that the contractor had no experience of particular type of construction while in another it was the implementing authority that had no experience in projects of similar scale and magnitude. They conclude by advising that cost overruns can be reduced with adequate contingency and risk planning as well as good project management which encompass time control, cost control, quality control and change control. These findings are in agreement with Mukuka, Aigbavboa and Thwala (2015. who identified major causes of cost overruns as cost of materials, incorrect planning, wrong method of estimation , poor contract management, and fluctuation of prices of materials. Other factors included environmental factors, construction factors such as design changes, cost estimating factors and financing factors. These are further echoed by Olawale and Ming, (2010) who in their study of inhibiting factors in construction projects in the United Kingdom identified top five factors as design changes, risks and uncertainties, complexity of works, non-performance of contractors and inaccurate evaluation of project duration.

In addition to the common known factors by other researchers, a study on 30 construction projects in Egypt by EL-Kholy (2015) identified 44 factors contributing to high cost overruns out of which 11 factors emerged as significant with a Relative Importance Weight (RIW) of more than 10. These are financial condition of owner, cash flow of contractor, method of procurement, Inflation, competition at tender stage, Currency of contract, project size, delay in design and approval risk retained by client for quantity variations, quality of drawings, and inadequate material testing. Interestingly while other studies have highlighted such factors as design changes, project complexity and weather conditions as significant factors, these factors are ranked low in this research differing from the findings by other researchers.

2.5 Summary of literature review

This chapter was aimed at reviewing the existing literature to gain an understanding of the occurrence of cost overruns in the roads projects. Literature confirms cost overrun as a global phenomenon with varying magnitude and with a myriad of causal

factors. A review of several theories explaining the co-occurrence of cost overruns revealed that there is no one theory which can explain cost overruns exhaustively implying that explanations from a multiplicity of theories can be combined to explain a significant percentage of the concept. Literature has also revealed a relationship between the cost overruns and project attributes with little convergence on the strength of the relationship where this exists.

Numerous factors emerged from the literature as the determinants of cost overruns in road projects with some common factors across researchers; however, there still exist inconsistency in the actual causes of cost overruns and more so in Kenya, a position that renders relevancy to this study.

2.6 Conceptual Framework

The study was guided by a conceptual framework developed based on the variables identified from the literature review. The dependent variable is cost overrun, which is hypothesised that can be explained by project attributes namely: project size; project type; contractor nationality; contract period; project supervision and nature of work. Figure 2.1 below is a graphical representation indicating that cost overrun is affected by project attributes as well as other latent determinants such as contract management and administration, financial management, government relations, environment and economy, labour and equipment, materials and contractor site management practices.

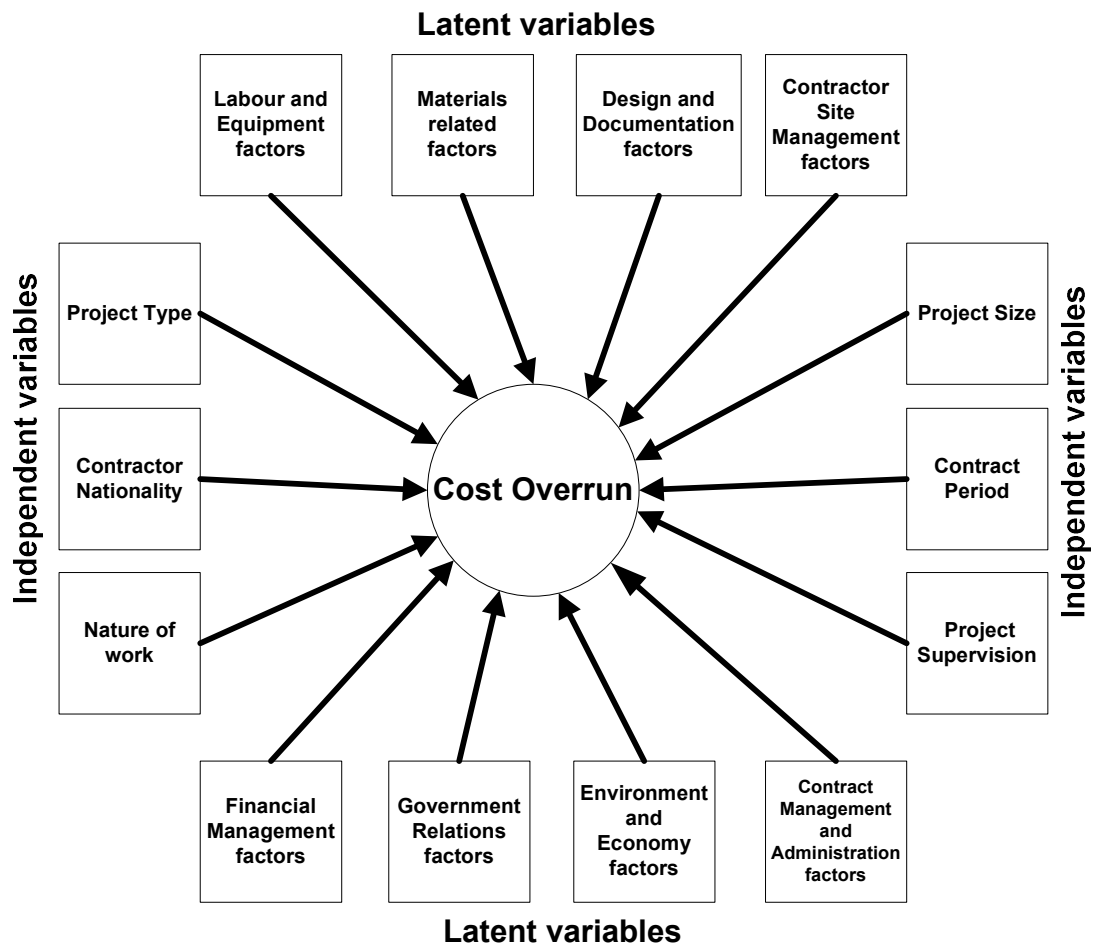


Figure 2.1: Conceptual framework

Mixed method was adopted for the purposes of integrating the quantitative data gathered from the projects with qualitative data gathered through a survey technique. This was based on sixty five factors identified from literature grouped into eight groups of factors based on their nature and similarity. Table 2.1A and table 2.1B below shows the various factors under each of these groupings. This kind of method is used when there is need to gather information about multiple perspectives of the research subject (Mertens & Hesse-Biber, 2012). Quantitative data was gathered from the project files in order to understand the magnitude and prevalence of cost overruns. This data needs to be placed in the context of understanding the various parties involved in project management, their knowledge about cost overruns as well as their perceptions. Qualitative methods are particularly important because these are methods that rely on fieldwork engagement and get close to participants in a way that the secondary analysis of administrative data sets do not (Fielding, 2012).

In this respect, qualitative data is quantified for integration with quantitative data to answer research questions or test hypotheses addressing relationships between independent variables and dependent variable (Fielding, 2012). He further states that rather than mixing because there is something intrinsic or distinctive about quantitative data or qualitative data, the data is mixed so as to integrate the two fundamental ways of thinking about social phenomena. Project attributes extracted from the project data were the subject of multiple regression analysis to determine the direction and strength of their relationship with cost overruns. These together with other determinants identified in the literature were further subjected to survey to professionals to obtain their perception on the effect of these variables on cost overrun in the rural roads projects.

Table 2.1A: Other determinants of cost overruns

Item	Description of Item
1. Contract Management and Administration(CMA)	
CMA1	: Change in the scope of the project
CMA2	: Poor Contract management
CMA3	: Land acquisition
CMA4	: Inadequate project monitoring and control
CMA5	: Delays in decisions making
CMA6	: Unrealistic contract duration and requirements imposed
CMA7	: Fraudulent practices.
CMA8	: Inaccurate quantity take-off
CMA9	: Lack of coordination between parties
CMA10	: Poor supervision by the employer
CMA11	: Obsolete or unsuitable construction methods
CMA12	: Slow information flow between parties
CMA13	: Delay in inspection and approval of completed works
CMA14	: Mistakes during construction
CMA15	: Lack of communication between parties
2. Contractors site management(CSM)	
CSM1	: Inadequate planning and scheduling
CSM2	: Inaccurate Time and Cost estimates
CSM3	: Inadequate project monitoring and control
CSM4	: General Delays
CSM5	: Lack of experience by contractor in the type of work undertaken
CSM6	: Incompetent subcontractors
CSM7	: Contractors' poor site management and supervision.
3. Design and Documentation(DD)	
DD1	: Additional works
DD2	: Incomplete design at the time of tender
DD3	: Omissions and errors in the bills of quantities
DD4	: Mistakes and Errors in design
DD5	: Inaccurate Site investigation
DD6	: Inadequate specifications.
DD7	: Frequent design changes
DD8	: Poor designs and delays in designs
DD9	: Unrealistic contract duration and requirements imposed.
DD10	: Lack of incorporation of risk in cost estimation
DD11	: Delay in preparation and approval of drawings
DD12	: Impractical and complicated design

Table 2.1B: Other determinants of cost overrun (continued)

Item	Description of Item
4. Environment and Economy(EE)	
EE1	: Unforeseen ground condition
EE2	: Inflation
EE3	: Fluctuation of prices of materials
EE4	: Weather conditions.
EE5	: High interest rate charged by bankers on loans
EE6	: Fluctuation in foreign exchange rate.
5. Financial management(FM)	
FM1	: Inadequate budget by the employer
FM2	: Delay in payment by employer
FM3	: Cash flow and Financial difficulties by the contractor
FM4	: Delay in payment to suppliers /subcontractors
FM5	: Contractual claims, such as, extension of time with cost
FM6	: Poor financial control on site
6. Government Relations(GR)	
GR1	: Political Influence
GR2	: Delay in issuance of licences and approvals
GR3	: Bureaucracy in tendering method
GR4	: Relocation of utilities
GR5	: Coordination with other government departments.
GR6	: Practice of awarding contract to lowest evaluated bidder
GR7	: Laws and regulatory framework.
7. Labour and Equipment(LE)	
LE1	: High cost of machinery and its maintenance
LE2	: Equipment availability and failure
LE3	: Shortage of technical personnel (skilled labour)
LE4	: Lack of experience of technical consultants
LE5	: High cost of labour
LE6	: Labour productivity
LE7	: Shortage of site workers
LE8	: Labour Absenteeism
8. Materials (M)	
M1	: Changes in Material Specification and type
M2	: Late delivery of materials and equipment
M3	: Shortages of materials
M4	: Delay in Material procurement

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the research design, the data sources used, the population, the sampling techniques employed as well as the data analysis techniques employed in this study. Data was collected from both primary and secondary sources. Primary data was collected by means of survey through structured questionnaires while secondary data was compiled from contract documents.

3.2 Research Philosophy

Research philosophy refers to a system of beliefs and assumptions about the development of knowledge (Saunders, Lewis, & Thornhill, 2009). Every research involves assumptions which shape how to understand the research questions and the methods to be used in the research. Research philosophy guides the researcher in making the right decisions about the strategy, approach and data collection techniques. The research philosophy adopted by the researcher contains vital assumptions about the way in which the researcher views the world (Saunders et al. 2012). This determines the way the research will be conducted and the methodology employed.

Three types of research assumptions exist namely; ontology, epistemology and axiology. Ontology relates to assumptions about the nature of reality. In business and management these objects include organisations, management, individuals' working lives and organisational events and artefacts. One's ontology therefore determines how one sees the world of business and management and, therefore, one's choice. Epistemology on the other hand concerns assumptions about knowledge, what constitutes acceptable, valid and legitimate knowledge, and how we can communicate knowledge to others (Burrell & Morgan 1979). Axiology deals with the role of values and ethics within the research process. This includes questions about how the researchers, deal with both our own values and those of the participants

Saunders (2016) , proposes seven approaches to research philosophy; these include Positivism, Realism, Objectivism, Subjectivism, Pragmatism, Functionalist and Interpretivism. While noting that there is no one Research philosophy that is better than another he explains that the research philosophy is determined by the research questions that the research seeks to answer. This research adopted interpretivism research philosophy. This is believed to be the most appropriate for business and

management research. According to (Saunders et al, 2012) interpretivism advocates that it is necessary for the researcher to understand differences between humans in the role as social actors. It is the recognition that subjective meaning plays a crucial role in the social actions. Accordingly, it appreciates that human beings create meanings and their social world cannot be studied in the same way as physical phenomena. This lays emphasis on performing research on people as opposed to objects. It is important to note that people under exist with different cultures, under different circumstances and thus create different social realities. This type of research philosophy encourages interactive process between the researcher and the subject with the objective of finding out information pertaining to the subject and understanding the environment in which they operate. It is said to work better with quantitative research, which is one of the methods adopted for this research as it seeks to establish the extent of cost overruns in the rural roads infrastructure projects as well as the related factors

3.3 Research Design

The study employed a sequential explanatory research design involving both quantitative and qualitative data analysis. This falls under mixed method of design, which seeks to take advantage of multiple ways to explain a research problem. The quantitative data and their subsequent analysis provide a general understanding of the research problem while the qualitative data and their analysis refine and explain those statistical results by exploring participants' views in more depth (Tashakkori & Teddlie 1998; Rossman & Wilson 1985; Creswell 2003). Advantages of this method include straightforwardness and opportunities for exploration of quantitative results in more detail. However, the method is not without limitations. Some of the limitations identified are in form of time and cost constraints (Ivankova, Creswell, & Stick, 2006).

The study sought to establish the prevalence and extent of cost overruns in the road projects while delineating the main factors associated with the cost overruns. As such a correlational mode of investigation was used to identify the significant project attributes associated with cost overruns as well as other factors associated with the phenomenon. Quantitative data including initial contract sum, revised contract sum, actual cost, and interest on delayed payments as well as variation of prices for individual projects was collected from the project files and payment vouchers.

Qualitative data on the other hand was obtained based on survey undertaken targeting the various professionals involved in the project implementation, supervision and oversight for the purposes of corroborating the results obtained from the analysis of quantitative data as well as providing detail explanation that may not have been captured by the quantitative data..

3.4 Population and Sampling

The study was based on projects initiated by Kenya Rural Roads Authority from inception in 2009 to June 2017. Ninety projects with a value of Ksh 102 Billion had been undertaken by the Authority within this period. Included in these were 22 projects initiated by the parent ministry and which were at various stages of completion at the time of vesting to the Authority at its inception in 2009. Due to the fragmented nature of the data available on these projects, they were dropped from the study. The resultant sample considered by this study consisted of the remaining 68 projects valued at Ksh 75.6 Billion. These included both completed and on-going projects. On-going projects were included because they provide the best indication of the current prevailing conditions (Foster & Briceño-Garmendia, 2010)

3.5 Data collection Techniques

To address the first objective, which sought to assess the extent of cost overruns in rural road infrastructure projects, initial contract sums as well as revised contract sums and actual costs were collected from project files. Original contract sums were obtained from the signed contract documents while revised contract sums were obtained from appraisal reports. Actual cost for each projects were compiled from payment vouchers and Interim payment certificates. These were used to compute actual cost overruns for each project and as well evaluate the frequency of occurrence. Official access to these documents was sought from the management by use of the introductory letter obtained from the University.

The second objective sought to establish the causes of cost overruns in the road construction projects. To this end, field survey methodology was employed via structured questionnaires. The questionnaires were prepared from the causes of cost overruns identified during the literature review .Distribution of the questionnaires was done through both electronic means as well as hard copies. The questionnaires were designed to capture the general information about the respondents and their perception

regarding the identified factors causing cost overruns. They were issued to professionals in the road subsector involved in the project funding, implementation, supervision and oversight. The respondents had varying level of education and experience and were spread across different organisations in both public and private sectors. The objective was to seek their opinion on the occurrence, extent of cost overruns and the determining factors.

The choice of questionnaire as the tool of data collection was informed by its ability to collect data from many people inexpensively and could be disseminated easily. Questionnaires are also helpful in gathering information that is unique to individuals or a particular situation such as attitude, beliefs and knowledge. The use of questionnaires also protects the privacy of participants as participants can give confidential information while remaining anonymous.(Mathers, Fox & Hunn, 1998).However, the tool has been criticized for its inability to probe responses.

3.6 Data analysis and interpretation

The first objective sought to establish the extent of cost overruns in the roads projects in Kenya. Based on the data collected from the contract documents, payment vouchers and interim payment certificates, the variance between the actual cost and budgeted cost was studied and used to derive the magnitude of cost overruns. The mean, median and mode cost overruns as well as standard deviation were determined and recorded. Data was presented using descriptive statistics (Mean, Mode and Frequency).

The second objective focused on identifying the determinants of cost overruns in the rural roads infrastructure projects. Six project attributes were identified from the literature and were the subject of analysis in this section. The project attributes with respect to each project were documented from the secondary data collected from the source documents. The results from objective one above were subjected to multiple regression analysis establish the significance of each variable with respect to the cost overruns identified with the aim of identifying the most significant attributes.

Analysis was carried out with all the independent variables. The independent variables were entered into the model one by one to determine the relationship between each independent variable and the dependent variable. Regression analysis was carried out to determine the strength and direction of the relationship of the dependant variable and each of the independent variables. The β coefficients were used to determine the

strength and direction of the relationship between the independent and dependant variables.

Several statistical tests were undertaken on the data for validity and reliability. Durbin Watson test was undertaken to check for 1st order autocorrelation. Test for Linearity was undertaken to establish if a linear relationship exists between; a) each of the independent variables and the dependent variable, and b) dependent and independent variables collectively. Further, the data was subjected to

homoscedasticity test by visual inspection of a plot of studentized residuals versus unstandardized predicted values. The data was also tested for multi-collinearity and normality using appropriate statistical tools.

Based on the conceptual framework, the relationship between the variables can be expressed in the following equation;

$$CO = \beta_0 + \beta_1 PT + \beta_2 PS + \beta_3 NW + \beta_4 CP + \beta_5 NC + \beta_6 SP + \epsilon$$

Where

CO: Refers to cost overruns measured by the percentage variance between the actual cost of the project and the budgeted cost.

PT: Project type. Projects are divided into two categories of road projects and fixed link projects (bridges and other structures)

PS: Project size measured by contract sum. Small projects (up to Ksh 500 Million), Medium (Ksh 501 million to 1 billion) and Large (over Ksh 1 billion)

NW: The nature of work. This is categorized into two broad categories; new construction/upgrading, reconstruction/and rehabilitation. Construction and upgrading entails the upgrading of gravel roads to paved standards or adding additional lanes to paved roads. Reconstruction and rehabilitation entails the restatement of the road to its original design standard including structural repairs (Mthuli et al., 2014).

CP: Contract period refers to the contractual period within which the project is expected to be completed normally presented in months.

NC: Nationality of the contractor. Contractors are categorized into two categories local and International depending on where the company is domiciled.

SP: Project supervision: Projects are either supervised by qualified staff in-house or by a consultant appointed by the employer through complete process.

Primary data was collected from professionals in the subsector through structured questionnaires. A total of 65 factors identified from the literature were grouped into 8 categories for ease of analysis. Using a Likert scale of 1 to 5 with 1 representing not significant and 5 extremely significant, respondents were required to indicate to what extent each of the factors contributed to cost overruns in the rural road projects. Cronbach's alpha test was employed in testing the reliability of the scale to capture the effect of the various determinants. Developed by Lee Cronbach in 1951 the test provides a measure of the internal consistency of a test or scale; it is expressed as a number between 0 and 1 (Tavakol & Dennick, 2011). Internal consistency describes the extent to which all the items in a test measure the same concept or construct and hence its interrelatedness of the items within the test. According to Jum C. Nunnally, (1978) instruments used for basic research should have reliability of 0.7 or higher (Tavakol & Dennick, 2011).

Respondents' views from the study were ranked using Relative Importance Index (RII) as indicated in the equation below (Muhwezi, Acai, & Otim, 2014; Megha & Rajiv, 2013).

$$RII = \frac{\sum W}{A * N} (0 \leq RII \leq 1)$$

Where:

W—is the weight given to each factor by the respondents and ranges from 1 to 5, (where “1” is “Not Significant” and “5” is “Extremely significant”);

A —is the highest weight (i.e. 5 in this case) and;

N —is the total number of respondents

Respondents' perceptions on the determinants of cost overruns were further subjected to factor analysis aimed at reduction of the determinants into common factors. Factor analysis is a data reduction technique, which is carried out using a correlation matrix

of variables of interest. A set of variables are combined to a new smaller set of variables called factors. These factors represent a weighted mean of the original data which are latent variables that is variables that cannot be observed. The technique uses principal component analysis and varimax rotation to extract factors subject to KMO, Barlett tests and an eigen value cut off of 1.0.

3.7 Operationalization of variables

This is the process of defining variables into measurable factors.

3.7.1 Dependent variable

Cost overrun which is defined as excess of actual cost over budget, was identified as common phenomenon and varies with the size of the project, project type, project size, among other factors. Cost overruns have been observed in the road projects with the trend continuing over the last few decades. The measurement of cost overrun is represented in the following formula.

$$\text{Cost Overrun} = \frac{\text{Actual Cost} - \text{Budgeted Cost}}{\text{Budgeted Cost}} \times 100$$

3.7.2 Independent Variables

Six variables were identified from the review of literature.

Project type: Projects are divided into two categories of road projects and fixed link projects (bridges and other structures). Road works formed the bulk of the sample with 59 projects while only 9 projects were for fixed link (bridges).

Project size is measured by contract sum. Projects were categorised in sizes based on the contract sum as classification criterion (Cantarelli et al., 2012). Projects with contract sum of up to Ksh 500 million were classified as small. The second category was medium size which consisted of projects with contract sums of more than 500 million up to Ksh 1 billion. Projects with contract sums of over Ksh 1 billion were classified as large. The sample contained 26 small projects, 10 Medium and 32 Large projects.

The nature of work is categorized into two broad categories; new construction/upgrading, reconstruction/and rehabilitation. Upgrading and new construction are similar in nature. They involve the construction of a road from

earth/gravel to bitumen standard, improving capacity, and increasing number of lanes, junction improvements among other activities to carry increased traffic and improve accessibility. It also entails developing existing roads through construction of missing links, capacity improvement measures such as widening, dualling, interchanges, and bus lanes among others. Rehabilitation and reconstruction on the other hand involves maintenance activities to restore and strengthen the pavement to extend the life of the entire road with an aim of forestalling further deterioration (Ministry of Roads, 2015; Mthuli et al., 2014). Sixty two per cent of the projects involved new construction or upgrading while thirty eight per cent was for rehabilitation.

Contract period refers to the contractual period within which the project is expected to be completed normally presented in months. Implementation period ranged between 5 to 36 months.

Nationality of the contractor: Contractors are categorized into two categories local and International depending on where the company is domiciled. Both International and local contractors were involved in the implementation

Project supervision can either be done by qualified staff in-house or outsourced to a consultant appointed by the employer through complete process. Supervision was undertaken by both in-house and outsourced consultants.

In terms of funding sources, only two projects out of the sample were jointly funded by both the Government and Development partners with the rest fully funded by the Government of Kenya.

3.7.3 Other Latent Variables

These impact the relationship between the independent and dependant variables. The review of literature identified 65 determinants that have an impact on cost overruns besides the projects attributes. These were grouped in eight groups based on their nature and similarity.

Financial management: They include contractual claims, such as, extension of time with cost, poor financial control on site, financial difficulties of owner, cash flow and financial difficulties by the contractor, mode of financing, delay in payment to suppliers /subcontractors and delay in progress payment by employer. Inadequate budget provision has an implication on the availability of funds to meet contractual

obligations as and when they occur. Consequently this could lead to delay in payments as supplementary budgetary allocations are sought from the Government. Delayed payments to the contractor will eventually lead to cash flow problems resulting in time overruns as well as interest claims.

Environment and Economy: Included in this group are factors such as unforeseen ground condition, inflation, fluctuation of prices of materials, weather conditions, high interest rate charged by bankers on loans and fluctuation in foreign exchange rate. Unforeseen ground condition has an impact on the cost overruns as it necessitates the change in the scope or even design. Inflation pushes the prices upwards resulting in variation of prices weather conditions may necessitate suspension of works or in works case scenario repeat of some works that eventually results in wastage of materials. High interest rates charged by the bankers filters into the project costs through delayed interest payment by the employer while fluctuation in foreign exchange as the same effect as inflation especially on the imported material and equipment.

Contractors site management: The grouping comprises determinants such as; inadequate planning and scheduling; inaccurate time and cost estimates; inadequate project monitoring and control; general delays; Lack of experience by contractor in the type of work undertaken; incompetent subcontractors; contractors' poor site management and supervision. Effective construction planning and scheduling is the tool to effectively manage risk time and resources. Inadequate planning and scheduling therefore results in lost time and money to the contractor which may eventually end up in the project costs through claims.

Design and Documentation: Quality of design and documentation has a significant impact on the overall project efficiency and the related costs. This grouping has twelve factors namely; additional works; incomplete design at the time of tender; omissions and errors in the bills of quantities; mistakes and Errors in design; inaccurate site investigation; inadequate specifications; frequent design changes; poor designs and delays in designs; unrealistic contract duration and requirements imposed; lack of incorporation of risk in cost estimation; delay in preparation and approval of drawings; and impractical and complicated design.

Government Relations: This comprises of seven factors: political influence; delay in issuance of licences and approvals; bureaucracy in tendering method; relocation of utilities; coordination with other government departments; practice of awarding contract to lowest evaluated bidder; laws and regulatory framework. relocation of utilities more often result in time delays(Adam, Josephson, & Lindahl, 2015). Political pressure may result in commencement of project without adequate designs and sometimes budget. Timely issuance of the relevant licences by the government departments ensures the project runs on schedule.

Contract Management and Administration: This is the largest group among the eight comprising of 15 determinants namely; change in the scope of the project; poor contract management; land acquisition; inadequate project monitoring and control; delays in decisions making; unrealistic contract duration and requirements imposed; fraudulent practices; innacurate quantity take-off; lack of coordination between parties; poor supervision by the employer; obsolete or unsuitable construction methods; slow information flow between parties; delay in inspection and approval of completed works; mistakes during construction; lack of communication between parties.

Materials: Materials management is one of the important aspects of contract execution. Determinants included in this group are; changes in material specification and type; late delivery of materials and equipment; shortages of materials; and delay in material procurement. Late delivery of materials and equipment affects productivity of the projects resulting in time delays and subsequently cost overruns (Memon, Rahman, & Azis, 2011).

Labour and Equipment: This group consists of eight factors namely; high cost of machinery and its maintenance; equipment availability and failure; Shortage of technical personnel (skilled labour); lack of experience of technical consultants; high cost of labour; labour productivity; shortage of site workers; and labour absenteeism.

3.8 Research quality

3.8.1 Objectivity

The conclusions drawn from the interpretation of the results of data analysis were based on the findings derived from actual data, and were free of bias from the researcher subjective or emotional values (Sekaran, 2003)

3.8.2 Validity

Validity refers the extent to which an instrument measures what it is supposed to measure. The appropriate research instruments were adopted based on the literature review and were subjected to validation by selected professionals in the sector as part of the pilot survey to ensure the data collected is valid(Chipimo & Fylkesnes, 2010). The contributions from the professionals were subsequently incorporated in modified questionnaire that was eventually used in the study.

3.8.3 Reliability

Reliability refers to the ability of an instrument to measure consistently. Cronbach's alpha test was employed in testing the reliability of the scale to capture the effect of the various determinants. Cronbach's alpha of more than 0.7 was achieved for all the categories, indicating high level of internal consistency (Tavakol & Dennick, 2011;Nunnally, 1978)

3.9 Ethical considerations

Ethics in research refers to a code of conduct or expected societal norm of behaviour in carrying out the research (Sekaran, 2003). The research was conducted ensuring highest level of standard. Consent for access of data and information was granted by the organisation. Further full consent was obtained from participants before they were allowed to participate in the study. The information obtained from the participants was treated with utmost confidentiality while retaining the anonymity of the participants as well as all other parties affected by the study.

3.10 Chapter Summary

The chapter focused on the research methodology adopted, the research design, the population and sampling, the data collection techniques as well as how data was analysed and the interpreted. A quantitative methodology was used with a casual research design adopted both of which were believed to be appropriate to effectively

address the research problem (Labaree, 2017). From a population of 90 projects, 22 were dropped due to fragmented data available leaving a sample of 68 projects. Contract data for the sampled projects was obtained from contract documents and reviewed. In addition, a survey involving 100 respondents from the subsector was done through the use of structured questionnaires with a response rate of 76%. The collected data was subjected to reliability and validity tests before analysis.

CHAPTER FOUR: DATA ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter presents the results obtained from the data collection and analysis. Project data was extracted from various contract management documents. In addition, structured questionnaires were administered to target professionals working in the roads subsector seeking their opinion on the occurrence, extent of cost overruns and the determining factors. The findings and analysis is presented in the following sections.

4.2 Sample and data

The study focused on 68 projects initiated by Kenya Rural Roads Authority between 2009 and 2017. The initial portfolio consisted of 90 projects with a total value of Ksh 102 Billion. Included in these were 22 projects initiated by the parent ministry and which were at various stages of completion at the time of vesting to the Authority at its inception in 2009. Due to the fragmented nature of the data available on these projects, they were dropped from the population. The resultant sample considered by this study consisted of 68 projects valued at Ksh 75.6 Billion. These included both completed and on-going projects. On-going projects were included because they provide the best indication of the current prevailing conditions (Foster & Briceño-Garmendia, 2010). Table 4.1 below shows the projects profile.

Table 4.1:Contract Data Profile

Parameters	Frequency	%age
Project Type:		
Fixed Link	9	13.24
Road works	59	86.76
	68	100.00
Nature of work:		
Rehabilitation	26	38.24
Construction	42	61.76
	68	100.00
Project Size:		
Large	32	47.06
Medium	10	14.71
Small	26	38.24
	68	100.00
Supervision:		
Consultant	19	27.94
Inhouse	49	72.06
	68	100.00
Contractors Nationality:		
International	14	20.59
Local	54	79.41
	68	100.00
Implementation Period:		
Upto 12 Months	19	27.94
13-24 Months	42	61.76
25-36 Months	7	10.29
	68	100.00

N=68

To supplement project data, 100 questionnaires were issued to professionals in the road subsector involved in the project funding, implementation, supervision and oversight. The respondents had varying level of education and experience and were spread across different organisations in both public and private sectors. The objective was to seek their opinion on the occurrence, extent of cost overruns and the determining factors. Purposive sampling was used with restriction to specific participants who it was believed are best placed to provide the required information due to their involvement in the project management, supervision or oversight. This type of sampling is appropriate when a limited number or category of people have the information that is sought (Sekaran, 2003). The target population consisted 120 elements as per Table 4.2 below with a sample frame of 100 subjects.

Table 4.2: Target population for the field survey

Organisation	Profession				
	Engineering	Finance	Procurement	Other	Total
Kenya Rural Roads Authority	35	12	6	5	58
Regulators and oversight bodies	12	5	-	-	17
Contractors	25	-	-	-	25
Office of the auditor General	-	7	-	-	7
Consultants	9	2	2	-	13
Total	81	26	8	5	120

4.3 Occurrence and Extent of Cost overruns in Rural Roads Projects

Objective 1 of the study sought to establish extent of cost overruns in the rural roads infrastructure projects. Analyses of the data obtained from the sampled projects as well survey from the respondents appear to confirm the evidence in the literature on the existence, frequency and magnitude of cost overruns in the roads projects.

4.3.1 Occurrence and Extent of Cost overruns based on contract data

The study reviewed 68 projects initiated between 2009 when the Authority was conceived and June 2017 with a total value of Ksh 75.6 Billion. The focus was mainly on projects representing capital investments in the roads based on the nature of work. All the projects sampled fell into two categories namely; new construction/upgrading and reconstruction/rehabilitation.

The data comprised of both completed and on-going projects. Cost overrun was computed with reference to the original contract sum as the base as compared to revised contract sums and actual cost of the project as at 30th June 2017. In this context, variation orders within the legally allowable limits that resulted in upward revision of the original contract sum were considered as part of cost overruns.

From the analysis of the 68 projects in the sample, 28 projects experienced cost overruns indicating frequency rate of 41.2%. Out of this, 45% of the road works projects experienced cost overruns compared to 13% of the fixed link projects.

Out of the 40 projects that did not experience cost overruns, 15 of them had an element of interest on delayed payment while 26 had been affected by inflation as evidenced by the additional costs of Variation of Prices (VOP). These two elements are a pointer to the project experiencing cost overruns in future unless the scope is

reduced to absorb the extra costs. The existence of these two elements could double the reported frequency of cost overruns to 82% indicating that 8 out of 10 projects experience cost overruns, a trend that requires further scrutiny to address the problem. Table 4.3 below shows the cost overruns from the project data.

Table 4.3: Cost overruns in percentages based on project attributes

	Mean	Standard Deviation	Maximum
Project Type:			
Fixed Link	0.41	1.16	3.69
Road works	6.06	7.53	24.92
Nature of work:			
Rehabilitation	8.88	8.45	24.92
Construction	3.10	5.38	16.77
Project Size:			
Large	5.19	6.95	21.39
Medium	3.49	6.22	17.52
Small	6.15	7.89	24.92
Supervision:			
Consultant	4.87	7.27	21.39
Inhouse	5.48	7.28	24.92
Contractors Nationality:			
International	4.77	6.22	16.77
Local	5.54	7.51	24.92
Implementation Period:			
Upto 12 Months	6.65	8.29	24.92
13-24 Months	4.79	6.78	21.39
25-36 Months	4.75	6.05	15.00
Overall Data			
	5.31	7.28	24.92

Of the 28 projects that experienced cost overruns, 75% of the projects recorded a cost overrun of more than 10%.

4.3.2 Perception of respondents on occurrence and extent of cost overruns

Primary data was collected from professionals in the subsector through structured questionnaires. The 65 factors identified from the literature were grouped into 8 categories for ease of analysis. Using a Likert scale of 1 to 5 with 1 representing not significant and 5 extremely significant, respondents were required to indicate to what extent each of the factors contributed to cost overruns in the rural road projects.

The respondents were required to indicate the percentage average cost overruns based on their experience in the subsector. Table 4.4 below shows comparison between the cost overruns from the contract data and respondents perception.

Table 4.4: Comparison of cost overrun in percentages between quantitative and qualitative data

	Quantitative Data				Qualitative Data			
	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation
Fixed Link	0	3.69	0.41	1.16	-	95.00	20.31	15.72
Road works	0	24.92	6.06	7.53	-	95.00	26.25	18.75
Overall Data	0	24.92	5.31	7.28	2.00	95.00	23.28	16.06

The result from the respondents’ perception on cost overruns depict a different picture from the project data as shown above. When asked to rate the frequency of occurrence of cost overruns in the rural roads projects, majority of the respondents rated it as a common phenomenon with 47% indicating that cost overruns often happens. This perception seems to support the result from the projects which indicated a frequency of 41%.

The fifth choice on the frequency of cost overruns in the questionnaire was “Never” implying no projects experienced cost overruns. Of interest is the fact that none of the respondents picked this choice. As such, the perception among the respondents implies that road infrastructure projects do experience some level of cost overruns albeit with different frequency and magnitude.

4.4 Determinants of Cost overruns in Rural Roads Projects

The second objective of this study focused on identifying the determinants of cost overruns in the rural roads infrastructure projects. To achieve this, secondary data was analysed using multiple linear regression on the sample selected of 68 projects. Six independent variables representing project attributes identified from the literature were used to carry out a regression analysis against cost overrun as the dependent variable. Further, primary data was collected from professionals in the subsector through structured questionnaires. The 65 factors identified from the literature were grouped into 8 categories for ease of analysis. Respondents were required to indicate to what extent each of the factors contributed to cost overruns in the rural road projects using a

Likert scale of 1 to 5 with 1 representing not significant and 5 representing extremely significant. Table 4.5 below shows the rating for each rank.

Table 4.5: Ranking of causes of cost overrun

Rank	Effect	Explanation
1	Not significant	Cause has no effect on cost overrun.
2	Some effect	Cause has some effect on cost overrun
3	Moderate	Cause has moderate effect on cost overrun.
4	Significant	Cause has appreciable effect on cost overrun.
5	Extremely significant	Cause has a great effect on cost overrun.

4.4.1 Checking for multicollinearity

Table 4.6 below shows all the tolerance values greater than 0.1 with VIF of less than 10. This is way above minimum of 0.1 (Sekaran, 2003) indicating there was no evidence of multi-collinearity.

Table 4.6: Output results for Multi-collinearity

Model	Correlations			Collinearity Statistics	
	Zero-order	Partial	Part	Tolerance	VIF
(Constant)					
Nature of Work	0.063	- 0.292	-0.239	0.611	1.637
Project Type	0.189	- 0.116	-0.091	0.711	1.406
Contractor Nationality	0.162	- 0.003	-0.002	0.847	1.181
Supervision	0.165	- 0.061	-0.048	0.812	1.231
Implementation Period	0.291	- 0.107	-0.084	0.476	2.101
Project Size	0.553	0.555	0.523	0.376	2.657

Dependent Variable: Cost overrun

4.4.2 Test for Autocorrelation

Durbin-Watson test was used to test 1st - order autocorrelation, i.e independence of observations. The results are shown in Table 4.7 below.

Table 4.7: Durbin Watson test for Autocorrelation

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.622(a)	0.387	0.327	98.99890	1.816

a Predictors: (Constant), Project Size, Contractor Nationality, Project Type, Supervision, Nature of Work , Implementation Period

b Dependent Variable: Cost overrun

Durbin Watson statistics of 1.816 was obtained indicating there is independence of residuals (Dufour & Dagenais, 1985).

4.4.3 Test for Linearity and homoscedasticity

Test for Linearity was undertaken to establish if a linear relationship exists between; a) each of the independent variables and the dependent variable, and b) dependent and independent variables collectively. There was linearity as assessed by partial regression plots and a plot of studentized residuals against the predicted values.

Homoscedasticity was assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values in

4.4.4 Checking for outliers

The data was checked for outliers using the studentized deleted residuals. This was done by examining whether these residuals are greater than +3 standard deviations.

4.4.5 Test of normality

Data was tested for normality using Kolmogorov-Sminov and Shapiro Wilk Tests. Table 4.8 below shows the results from the above tests.

Table 4.8: Kolmogorov-Sminov and Shapiro Wilk Tests for normality

Tests of Normality

Variables		Kolmogorov-Smirnov(a)			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Project Type	Fixed Link	0.519	9	0.000	0.390	9	0.000
	Road works	0.353	59	0.000	0.606	59	0.000
Nature of work	Rehabilitation	0.339	26	0.000	0.611	26	0.000
	Construction	0.383	42	0.000	0.550	42	0.000
Project Size	Large	0.315	32	0.000	0.767	32	0.000
	Medium	0.379	10	0.000	0.619	10	0.000
	Small	0.415	26	0.000	0.671	26	0.000
Supervision	Consultant	0.432	19	0.000	0.556	19	0.000
	Inhouse	0.334	49	0.000	0.603	49	0.000
Contractors Nationality	International	0.387	14	0.000	0.669	14	0.000
	Local	0.354	54	0.000	0.529	54	0.000
Implementation Period	Upto 12 Months	0.310	19	0.001	0.772	19	0.003
	13-24 Months	0.369	42	0.000	0.624	42	0.000
	25-36 Months	0.406	7	0.002	0.676	7	0.003

a Lilliefors Significance Correction

From the results, both Kolmogorov-Sminov and Shapiro Wilk Tests returned negative with P Value <.005. Consequently, the data was transformed using log 10 to reduce

the skewness before proceeding with regression analysis. Initial data included all the 68 projects with forty projects having zero cost overruns. The zeros were eliminated as part of data transformation, with the focus remaining on the 28 projects that experienced cost overrun. This resulted in the improvement of data normality. The standardized residuals appear to be approximately normally distributed from the histogram in Figure 4.1 below following data transformation.

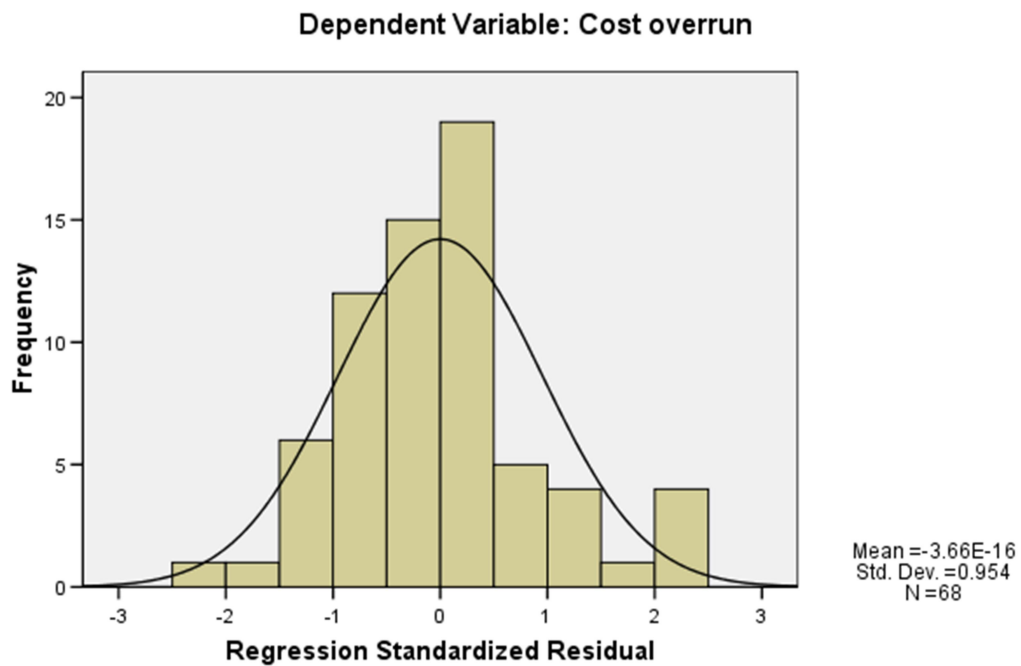


Figure 4.1: Histogram for Normality

4.4.6 Cost Overruns and Project Attributes

Review of literature pointed to existence of a relationship between cost overruns and some project attributes such as Project size, Project type, Nature of work, Nationality of the contractor, Financier, Supervision and length of implementation period. However, there was little convergence on the direction and strength of this relationship. Consequently, the first part of objective 2 was to establish the existence of this relationship in the rural roads projects, its direction and strength, using the contract data from the 68 projects selected.

The aim was to establish what percentage of cost overruns could be explained by these common project characteristics and therefore establish whether these features could be used to predict cost overruns in the road infrastructure projects and how the resultant knowledge could be inbuilt in the planning phase to forestall occurrence of cost

overrun while reducing the magnitude and therefore its perceived negative impact on these projects. This was done through testing of six hypotheses below.

H1₁: Significant positive relationship exists between cost overruns and the project size. Cost overruns increases with project size

H2₁: Significant positive relationship exists between cost overruns and the project type. Cost Overruns are higher in fixed link projects than in road projects

H3₁: Significant positive relationship exists between cost overruns and the nature of work. Cost overruns varies with the nature of work

H4₁: Significant positive relationship exists between cost overruns and project supervision. Cost overruns are higher in in-house supervised projects than consultant supervised projects.

H5₁: Significant positive relationship exists between cost overruns and the nationality of the contractor. Cost overruns are higher with local firms than foreign firms

H6₁: Significant positive relationship exists between cost overruns and implementation period. The longer the implementation period, the higher the cost overruns.

The resultant equation is represented below;

$$CO = \beta_0 + \beta_1 PT + \beta_2 PS + \beta_3 NW + \beta_4 CP + \beta_5 NC + \beta_6 SP + \epsilon$$

Where

CO: Refers to cost overruns measured by the percentage variance between the actual cost of the project and the budgeted cost.

PT: Project type. Projects are divided into two categories of road projects and fixed link projects (bridges and other structures)

PS: Project size measured by contract sum. Small projects (up to Ksh 500 Million), Medium (Ksh 501 Million to 1Billion) and Large (Over Ksh 1 Billion)

NW: The nature of work. This is categorized into two broad categories; new construction/upgrading, reconstruction/and rehabilitation. Construction and upgrading

entails the upgrading of gravel roads to paved standards or adding additional lanes to paved roads. Reconstruction and rehabilitation entails the restatement of the road to its original design standard including structural repairs.(Mthuli et al., 2014)

CP: Contract period refers to the contractual period within which the project is expected to be completed normally presented in months.

NC: Nationality of the contractor. Contractors are categorized into two categories local and International depending on where the company is domiciled.

SP: Project supervision: Projects are either supervised by qualified staff in-house or by a consultant appointed by the employer through complete process.

4.4.7 Multivariate analysis to establish the relationship between the independent variables and the dependent variable

Multiple Regression analysis was carried out with all the independent variables against the independent variable. Table 4.9 below indicates the statistical significance of the regression model.

Table 4.9: Regression Model Fitness

ANOVA ^b						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	377216.8	6	62869.465	6.415	.000 ^a
	Residual	597847.7	61	9800.782		
	Total	975064.5	67			

a. Predictors: (Constant), Project Size, Contractor Nationality, Project Type, Supervision, Nature of Work , Implimentation Period

b. Dependent Variable: Cost overrun

From the regression output in Table 4.10 below, based on the contract data, five items appear to have a negative effect on cost overrun.

Table 4.10: Hypothesis testing

Hypothesis	Variables	Unstandardized Coefficients		t	Sig.	Test
		β	Std. Error			
H ₁	Project Type	-38.191	42.004	-0.909	0.367	Fail to reject
H ₂	Nature of work	-75.293	31.611	-2.382	0.020	Reject
H ₃	Contractor Nationality	-0.768	32.265	-0.024	0.981	Fail to reject
H ₄	Project supervision	-14.184	29.686	-0.478	0.634	Fail to reject
H ₅	Project Size	0.111	0.021	5.215	0.000	Reject
H ₆	Implementation Period	-2.13	2.537	-0.84	0.404	Fail to reject

Dependant variable: Cost overrun

Project Type, Contractor Nationality and Supervision and implementation period appear to have an insignificant negative effect on the cost overruns given the respective P values which are $P > 0.05$. The insignificance of the implementation period stems from the fact that holding other factors constant, the contract period alone may not have an impact on the cost overruns. What may have an effect on the cost overrun is the actual period of implementation, which may be longer as a result of other factors such as change in design, weather conditions and funding of the project. Equally, nationality of the contractor on its own may not have a significant effect on the cost overrun especially if the bidding process was done using an objectively developed criterion. It may be argued that foreign contractors have a higher capacity in terms of personnel and finances. Project supervision is undertaken under curtailed laid down procedures. Project supervisors are selected based on the minimum qualifications indicating that without other factors in play supervision alone cannot determine presence or absence of cost overrun in a project.

The nature of work (new construction/rehabilitation) has a negative but significant relationship with cost overruns indicating cost overruns are higher in rehabilitation projects than in new construction projects.

Project size is the only variable that appear to have a significant positive relationship with cost overruns with a p value of $P < 0.05$ indicating that cost overruns increases with increase in project size. One explanation for this is the complexity of the project which sometimes leads to poor planning and even execution. Lack of capacity has also featured as an explanation for increased cost overruns in larger projects. Another

reason is over optimism and underestimation of the time and cost while overestimating the benefits. The project managers in a bid to justify the huge budget, they may underestimate the cost as presenting the real cost may present the project as “unpalatable”(Huo Tengfei et al., 2018). Siemiatycki & Institute on Municipal Finance and Governance, (2016) terms this as “strategic misrepresentation”

Results from the qualitative analysis however showed a slightly different picture from the contract data analysis. Project type which had a negative relationship and not significant based on contract data was found to have a significant positive relationship with cost overruns indicating that cost overruns are higher in road projects than in fixed link projects. This presented in Table 4.11 below.

Table 4.11: Multivariate analysis of project attributes and cost overruns

Hypothesis	Variable	Quantitative Analysis (Project Data)					Qualitative Analysis (Survey)				
		Unstandardized Coefficients		t	Sig.	Test	Unstandardized Coefficients		t	Sig.	Test
		Std. Error	Std. Error				β	Std. Error			
H ₁	Project Type	-38.191	42.004	-0.909	0.367	Fail to reject	0.152	0.036	4.185	0.000	Reject
H ₂	Nature of work	-75.293	31.611	-2.382	0.020	Reject	-0.006	0.031	-0.186	0.853	Fail to reject
H ₃	Contractor Nationality	-0.768	32.265	-0.024	0.981	Fail to reject	-0.010	0.023	-0.450	0.654	Fail to reject
H ₄	Project supervision	-14.184	29.686	-0.478	0.634	Fail to reject	0.054	0.029	1.864	0.067	Fail to reject
H ₅	Project Size	0.111	0.021	5.215	0.000	Reject	0.013	0.027	0.495	0.622	Fail to reject
H ₆	Implementation Period	-2.13	2.537	-0.84	0.404	Fail to reject	-0.29	0.29	-0.979	0.331	Fail to reject

Further analysis carried out with all the independent variables shows that cumulatively all the variables could only explain 38.70% of the cost overrun with R² 0.387 as indicated in Table 4.12 below

Table 4.12: Regression output for contract data

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.622 ^a	.387	.327	98.99890	1.816

a. Predictors: (Constant), Project Size, Contractor Nationality, Project Type, Supervision, Nature of Work, Implimentation Period

b. Dependent Variable: Cost overrun

4.4.8 Other latent determinants of cost overruns

The six elements from the regression analysis could only explain 38.7% of the cost overruns leaving a gap of 61.3% unexplained. It is therefore evident that there are other factors that affect cost overruns away from the project attributes; Project type,

Project size, Nature of work, Contractor nationality, implementation period and Project supervision. This is what was assessed in the second part of objective 2. Structured questionnaires were administered to 100 professionals in the road subsector both within and outside the implementing agency. Seventy Six questionnaires were received and analysed. Sixty five determinants identified from the literature review were categorised into 8 categories based on their close relations with one another and their perceived effect on cost overruns. The categories included; (i) contract management and administration, (ii)Contractors Site management,(iii)Design and Development ,(iv)Environment and economy ,(v)Financial Management ,(vi) Government Relations ,(vii)Labour and Equipment and,(viii) Materials. Respondents were required to rank the effect of each of the 65 factors on cost overrun using a likert scale of 1-5 points.

4.4.8.1 Test for Reliability

Cronbach's alpha test was employed in testing the reliability of the scale to capture the effect of the various determinants. Cronbach's Alpha was developed by Lee Cronbach in 1951 to provide a measure of the internal consistency of a test or scale; it is expressed as a number between 0 and 1(Tavakol & Dennick, 2011). Internal consistency describes the extent to which all the items in a test measure the same concept or construct and hence it interrelatedness of the items within the test. According to Nunnally (1978), instruments used for basic research should have reliability of 0.7 or higher. Table 4.13 below shows the results from the Cronbach's Alpha test performed on the items in their various groupings. Cronbach's alpha of more than 0.7 was achieved for all the categories, indicating high level of internal consistency (Tavakol & Dennick, 2011).

Table 4.13: Cronbach's Alpha test for reliability

SNo.	Category	Mean	Cronbach's Alpha Based on Standardized items	No. of Items
1	Contract Management and administration	3.38	.914	15
2	Contractors site Management	3.54	.861	7
3	Design and Documentation	3.47	.900	12
4	Environment and Economy	3.59	.877	6
5	Financial Management	3.69	.785	6
6	Government Relations	3.43	.841	7
7	Labour and Equipment	2.92	.897	8
8	Materials	3.13	.856	4

4.4.8.2 Respondents perception on Determinants of cost Overruns

Perceptions from the respondents on the determinants of cost overruns were analysed using Relative Importance Index (RII) and factor analysis.

4.4.8.3 Ranking of Determinants of cost overrun

The respondents answers were ranked using Relative Importance Index (RII) as indicated in the equation below (Muhwezi, Acai, & Otim, 2014; Megha & Rajiv, 2013; Somiah, Osei-Poku, & Aidoo, 2015).

$$RII = \frac{\sum W}{A * N} (0 \leq RII \leq 1)$$

Where

W–is the weight given to each factor by the respondents and ranges from 1 to 5, (where “1” is “Not Significant” and “5” is “Extremely significant”);

A –is the highest weight (i.e. 5 in this case) and;

N –is the total number of respondents

RII aids in finding the contribution a particular variable makes to the prediction of a criterion variable both by itself and in combination with other predictor variables (Johnson & Lebreton, 2004). Individual determinants RII were aggregated to arrive at the RII for the group. The RII for the group is therefore the mean of the RII for the various variables in the group. (Somiah, Osei-Poku, & Aidoo, 2015). Group ranking of determinants of cost overrun is presented in Table 4.14 below.

Table 4.14: Group RII and ranking

Group	RII	Rank
Financial management	0.7373	1
Environment and Economy	0.7180	2
Contractors site management	0.7086	3
Design and Documentation	0.6945	4
Government Relations	0.6857	5
Contract Management and Administration	0.6760	6
Materials	0.6250	7
Labour and Equipment	0.5839	8

The top ten determinants of cost overrun in the rural roads projects identified by respondents are presented in Table 4.15 below. These factors were distributed among the first six groups out of the total eight groups.

Table 4.15: Top ten determinants of cost overrun

Determinants	RII	Rank	Group
Inadequate budget by the employer	0.797	1	Financial management
Change in the scope of the project	0.784	2	Contract Management and Administration
Additional works	0.779	3	Design and Documentation
Delay in payment by employer	0.774	4	Financial management
Poor Contract management	0.771	5	Contract Management and Administration
Political Influence	0.768	6	Government Relations
Unforeseen ground condition	0.761	7	Environment and Economy
Cash flow and Financial difficulties by the contractor	0.753	8	Financial management
Inadequate planning and scheduling	0.750	9	Contractors site management
Inflation	0.745	10	Environment and Economy

With a mean RII of 0.679, all the 65 determinants scored above RII of 0.5 indicating the importance each of these determinants on cost overruns. The results are as shown in Table 4.16 below.

Table 4.16: Relative Importance Index and Ranking of determinants of Cost Overruns

Group	Determinant	N	SUM	MEAN	SD	RII	Rank
Contract Management and Administration	Change in the scope of the project	76	298	3.92	1.21	0.7842	2
	Poor Contract management	76	293	3.86	1.20	0.7711	5
	Land acquisition	76	279	3.67	1.34	0.7342	12
	Inadequate project monitoring and control	76	276	3.63	1.25	0.7263	16
	Delays in decisions making	76	272	3.58	1.08	0.7158	20
	Unrealistic contract duration and requirements imposed	76	269	3.54	1.12	0.7079	22
	Fraudulent practices.	76	258	3.39	1.41	0.6789	36
	Innaccurate quantity take-off	76	255	3.36	1.30	0.6711	40
	Lack of coordination between parties	76	250	3.29	1.14	0.6579	42
	Poor supervision by the employer	76	240	3.16	1.21	0.6316	49
	Obsolete or unsuitable construction methods	76	237	3.12	1.39	0.6237	52
	Slow information flow between parties	76	235	3.09	1.15	0.6184	55
	Delay in inspection and approval of completed works	76	233	3.07	1.27	0.6132	56
	Mistakes during construction	76	233	3.07	1.36	0.6132	56
Lack of communication between parties	76	225	2.96	1.27	0.5921	61	
Contractors site management	Inadequate planning and scheduling	76	285	3.75	1.07	0.7500	9
	Inaccurate Time and Cost estimates	76	277	3.64	1.11	0.7289	14
	Inadequate project monitoring and control	76	270	3.55	1.10	0.7105	21
	General Delays	76	267	3.51	1.16	0.7026	23
	Lack of experience by contractor in the type of work undertaken	76	264	3.47	1.32	0.6947	27
	Incompetent subcontractors	76	263	3.46	1.22	0.6921	28
	Contractors' poor site management and supervision.	76	259	3.41	1.14	0.6816	34
Design and Documentation	Additional works	76	296	3.89	1.13	0.7789	3
	Incomplete design at the time of tender	76	279	3.67	1.20	0.7342	12
	Omissions and errors in the bills of quantities	76	267	3.51	1.25	0.7026	23
	Mistakes and Errors in design	76	266	3.50	1.24	0.7000	25
	Inaccurate Site investigation	76	265	3.49	1.23	0.6974	26
	Inadequate specifications.	76	263	3.46	1.22	0.6921	28
	Frequent design changes	76	260	3.42	1.25	0.6842	31
	Poor designs and delays in designs	76	260	3.42	1.17	0.6842	31
	Unrealistic contract duration and requirements imposed.	76	260	3.42	1.18	0.6842	31
	Lack of incorporation of risk in cost estimation	76	257	3.38	1.09	0.6763	37
	Delay in preparation and approval of drawings	76	247	3.25	1.08	0.6500	44
Impractical and complicated design	76	247	3.25	1.24	0.6500	44	
Environment and Economy	Unforeseen ground condition	76	289	3.80	1.11	0.7605	7
	Inflation	76	283	3.72	1.02	0.7447	10
	Fluctuation of prices of materials	76	280	3.68	1.15	0.7368	11
	Weather conditions.	76	275	3.62	1.21	0.7237	17
	High interest rate charged by bankers on loans	76	256	3.37	1.21	0.6737	39
	Fluctuation in foreign exchange rate.	76	254	3.34	1.11	0.6684	41
Financial management	Inadequate budget by the employer	76	303	3.99	1.09	0.7974	1
	Delay in payment by employer	76	294	3.87	1.08	0.7737	4
	Cash flow and Financial difficulties by the contractor	76	286	3.76	1.01	0.7526	8
	Delay in payment to suppliers /subcontractors	76	277	3.64	1.12	0.7289	14
	Contractual claims, such as, extension of time with cost	76	275	3.62	1.06	0.7237	17
	Poor financial control on site	76	246	3.24	1.09	0.6474	47
Government Relations	Political Influence	76	292	3.84	0.93	0.7684	6
	Delay in issuance of licences and approvals	76	273	3.59	1.09	0.7184	19
	Bureaucracy in tendering method	76	261	3.43	1.17	0.6868	30
	Relocation of utilities	76	259	3.41	1.19	0.6816	34
	Coordination with other government departments.	76	257	3.38	1.06	0.6763	37
	Practice of awarding contract to lowest evaluated bidder	76	250	3.29	1.33	0.6579	42
	Laws and regulatory framework.	76	232	3.05	1.01	0.6105	58
Labour and Equipment	High cost of machinery and its maintenance	76	247	3.25	1.10	0.6500	44
	Equipment availability and failure	76	239	3.14	1.08	0.6289	50
	Shortage of technical personnel (skilled labour)	76	236	3.11	1.14	0.6211	53
	Lack of experience of technical consultants	76	230	3.03	1.15	0.6053	59
	High cost of labour	76	225	2.96	1.21	0.5921	61
	Labour productivity	76	215	2.83	1.12	0.5658	63
	Shortage of site workers	76	193	2.54	1.23	0.5079	64
	Labour Absenteeism	76	190	2.50	1.18	0.5000	65
Materials	Changes in Material Specification and type	76	246	3.24	1.19	0.6474	47
	Late delivery of materials and equipment	76	239	3.14	1.05	0.6289	50
	Shortages of materials	76	236	3.11	1.13	0.6211	53
	Delay in Material procurement	76	229	3.01	1.09	0.6026	60

4.4.8.4 Financial management

Financial Management factor grouping was ranked the first significantly influential determinant of cost overruns with RII of 0.7373. This group also produced the first, fourth and the eighth overall factors influencing cost overruns. The highest ranking factor in this group is inadequate budget by the employer ranked No. 4 overall, followed by delay in payment by the employer (No. 4 overall) and cash flow and financial difficulties by the contractor. It is worth noting that these three factors are interrelated in some way. Inadequate budget provision has an implication on the availability of funds to meet contractual obligations as and when they occur. Consequently this could lead to delay in payments as supplementary budgetary allocations are sought from the Government. Delayed payments to the contractor will eventually lead to cash flow problems resulting in time overruns as well as interest claims. Similar findings were recorded by Akomah and Jackson, (2016) in which delay in payment by the employer was ranked number 1 with RII of 0.881. Further confirmation of inadequate budgetary allocations was found in the 2016 performance report by the Auditor General of Kenya. This he reports leads to accumulation of pending bills which in turn incur interest on delayed payments. The inadequate budget allocation in this report is attributed to the budget being pegged on the National Treasury disbursements rather than the programme of work approved by the project (Office of the Auditor General Kenya, 2016)

4.4.8.5 Environment and Economy

Environmental and Economy factor grouping ranked second with an RII of 0.7180. Included in this group are factors such as Unforeseen ground condition, Inflation, Fluctuation of prices of materials, Weather conditions, High interest rate charged by bankers on loans and Fluctuation in foreign exchange rate. Two of the factors are among the top ten factors overall. Unforeseen ground condition (7) has an impact on the cost overruns as it necessitates the change in the scope or even design. Inflation (No.10) pushes the prices upwards resulting in variation of prices (VOP) factor which was earlier seen from the regression analysis to have a significant positive relationship with the cost overruns. Weather conditions may necessitate suspension of works or in worst case scenario repeat of some works that eventually results in wastage of materials. High interest rates charged by the bankers filters into the project costs

through delayed interest payment by the employer while fluctuation in foreign exchange as the same effect as inflation especially on the imported material and equipment. The findings are in agreement with Akomah and Jackson, (2016) where bad weather and unfavourable site conditions were ranked 2nd with RII of 0.863. In the same study fluctuation in prices was ranked 19th with RII of 0.418 which differs with this study where the same determinant was ranked 11th with an RII of 0.763.

4.4.8.6 Contractors site management

This factor grouping was ranked third with an RII of 0.7086. The grouping comprises determinants such as; Inadequate planning and scheduling; Inaccurate Time and Cost estimates; Inadequate project monitoring and control; General Delays; Lack of experience by contractor in the type of work undertaken; Incompetent subcontractors; Contractors' poor site management and supervision. Effective construction planning and scheduling is the tool to effectively manage risk time and resources. Inadequate planning and scheduling therefore results in lost time and money to the contractor which may eventually end up in the project costs through claims. This factor was ranked 7th by (Memon et al., 2011) while in this study it was ranked 10th.

4.4.8.7 Design and Documentation

Quality of design and documentation has a significant impact on the overall project efficiency and the related costs. Design and Documentation factor grouping ranked fourth with RII of 0.6945. This grouping had twelve factors namely; Additional works; Incomplete design at the time of tender; Omissions and errors in the bills of quantities; Mistakes and Errors in design; Inaccurate Site investigation; Inadequate specifications; Frequent design changes; Poor designs and delays in designs; Unrealistic contract duration and requirements imposed; Lack of incorporation of risk in cost estimation; Delay in preparation and approval of drawings; and Impractical and complicated design. Additional works ranked 3rd overall with RII of 0.7789. In a 2016 report by the Office of the Auditor General, it was reported that there were numerous changes in the designs during project implementation that resulted in contract variations increasing the cost of the projects in addition to time delays. The report records a frequency of 44% in change of designs on a sample of 34 projects across the road agencies. Cost overrun attributed to change in designs according to this report was 11.28% totalling to Ksh 3.7 billion. The report points out inaccurate designs, faulty designs and old

designs as major determinants under this heading(Office of the Auditor General, Kenya 2016)

Like the other determinants, these determinants may be affected and therefore correlated with other determinants. For instance the timing difference between the design and the time of implementation may require the design to be changed due to changes in other conditions over time. This happens for instance, where the design is done but there is no immediate budget (Financial management) to undertake the implementation leading to time lag between the time of design and implementation. In the above mentioned report, the Auditor General noted a lag of five years between the design and implementation in one of the project sampled.

4.4.8.8 Government Relations

Government relations comprised of seven factors: Political Influence; Delay in issuance of licences and approvals; Bureaucracy in tendering method; Relocation of utilities; Coordination with other government departments; Practice of awarding contract to lowest evaluated bidder; Laws and regulatory framework. The group ranked fifth with a RII of 0.6857. Relocation of utilities more often comes with additional costs as this is sometimes not factored in the initial budget and results in time delays most of the times (Adam et al., 2015). Mobilising the contractor back to the site after exiting comes at additional cost in addition to the charges levied by the utility companies for relocating the utilities. Cost is also affected as some of the items may not have been budgeted for in the initial plan. Political influence also known as political input ranked 6th overall as a significant determinant of cost overrun. Political pressure may result in commencement of project without adequate designs and sometimes budget. Timely issuance of the relevant licences by the government departments ensures the project runs on schedule. Unprecedented delays result in time delays and in combination with other factors cost overruns are likely to occur. Bureaucracy in the tendering method sometimes leads to under quoting by the contractors resulting subsequently in variations that lead to cost overruns.

4.4.8.9 Contract Management and Administration

Contract Management and Administration grouping came in sixth with RII of 0.6760. This was the largest group among the eight comprising of 15 determinants namely; Change in the scope of the project; Poor Contract management; Land acquisition;

Inadequate project monitoring and control; Delays in decisions making; Unrealistic contract duration and requirements imposed; Fraudulent practices; Inaccurate quantity take-off; Lack of coordination between parties; Poor supervision by the employer; Obsolete or unsuitable construction methods; Slow information flow between parties; Delay in inspection and approval of completed works; Mistakes during construction; Lack of communication between parties.

Land acquisition was reported by the Auditor General as a major cause of cost overruns in some of the 34 projects sampled. In one case, a total of Ksh 1 Billion was required for land compensation yet this had not been budgeted for in the initial budget. In yet another project, Ksh. 4.7 Billion required for land compensation had not been budgeted for (Office of the Auditor General, 2016)

4.4.8.10 Materials

Materials management is one of the important aspects of contract execution. Determinants included in this group were; Changes in Material Specification and type; late delivery of materials and equipment; Shortages of materials; and Delay in Material procurement. Materials grouping was ranked seventh with RII of 0.6250. While undertaking critical review of literature on cost overruns covering different countries Aljohani et al., (2017) reports poor material management as one of the major causes of cost overrun in fifteen studies out of seventeen with some of the countries including Vietnam, Saudi Arabia, Indonesia, Nigeria, and Ghana. Poor material management result in shortage of material which are then obtained at higher price leading to time and cost overrun. (Aljohani et al., 2017) Late delivery of materials and equipment affects productivity of the projects resulting in time delays and subsequently cost overruns (Memon et al., 2011).

4.4.8.11 Labour and Equipment

Labour and equipment grouping was ranked eighth with RII of 0.5839. The group consisted eight factors namely; high cost of machinery and its maintenance; Equipment availability and failure; Shortage of technical personnel (skilled labour); Lack of experience of technical consultants; High cost of labour; Labour productivity; Shortage of site workers; and Labour Absenteeism. Topping the list is equipment unavailability and failure.

4.4.9 Factor analysis of cost overruns

Relative Importance Index Ranking (RII) listed all the 65 determinants as important with regard to their contribution to cost overruns. Further analysis was therefore necessary and this was done through deployment of factor analysis to extract the independent variables from the list of 65 factors identified. Principal component analysis and varimax rotation was used to extract factors subject to KMO, Barlett tests and an eigen value cut off of 1.0.

4.4.9.1 Sampling adequacy test (KMO and Bartlett's Test)

Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was used to determine whether factor analysis should be appropriate to yield distinct and reliable factors or determine important variables. A value closer to one indicates that there is a strong correlation between the variables hence they can be used to generate factors or constructs variable. Table 4.17 below presents coefficients of of KMO for the 8 groups of determinants.

Table 4.17: Kaiser-Meyer-Olkin Measure of Sampling Adequacy

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		
1	Contract Management and administration	0.792
2	Contractors site Management	0.810
3	Design and Documentation	0.842
4	Environment and Economy	0.857
5	Financial Management	0.740
6	Government Relations	0.779
7	Labour and Equipment	0.837
8	Materials	0.815

The table shows coefficient of KMO is greater than 0.5 indicating that the sample is adequate to proceed with factor analysis.

4.4.9.2 Bartlett's Test of Sphericity

The Bartlett's Test of Sphericity is the test for null hypothesis that the correlation matrix has an identity matrix. The interest is to determine some relationship between variables hence the null hypothesis is to be rejected to conclude that the correlation matrix is not identity matrix. The results for Bartlett's Test of Sphericity are presented in Table 4.18 below.

Table 4.18: Bartlett's Test of Sphericity

Bartlett's Test of Sphericity				
	Group	Approx. Chi-Square	df	Sig.
1	Contract Management and administration	701.793	105	0.000
2	Contractors site Management	237.389	21	0.000
3	Design and Documentation	446.865	66	0.000
4	Environment and Economy	216.978	15	0.000
5	Financial Management	125.712	15	0.000
6	Government Relations	206.885	21	0.000
7	Labour and Equipment	341.093	28	0.000
8	Materials	129.155	6	0.000

From the table above, the p values ($0.000 < 0.05$) indicating that Bartlett's test of sphericity is highly significant. As such, we reject null hypothesis and conclude that factor analysis is appropriate to be carried out.

4.4.9.3 Data screening

Data screening was done to determine the inter correlation between variables of interest. The variables should have a strong correlation but not very strong to avoid multi collinearity effects. Therefore, variables that do not correlate should be removed and variables with correlation coefficient of greater than 90% should be eliminated.

A correlation matrix was run for the sets of determinants relating to each group. The resultant correlation matrices and their significance are shown in appendix. The results show a relationship between the variables. The relationship is statistically significant since the p values are less than 0.05. There was no multicollinearity effect since the correlation coefficients are below 0.9. The determinant coefficient of $0.013 > 0.0001$ which confirms the multicollinearity effect is not statistically significant.

4.4.9.4 Factors extraction

Principal component analysis was used to identify determinants that accounts for more variability and extract new factors based on the total variance explained as shown in the table below.

Table 4.19: Factor extraction

	Group	No. of factors extracted	Total variance explained (%)				Cumulative variance explained
			Factor 1	Factor 2	Factor 3	Factor 4	
1	Contract Management and administration	4	45.84	10.60	9.16	7.11	72.71
2	Contractors site Management	2	54.67	15.99	-	-	70.65
3	Design and Documentation	3	48.12	10.35	8.41	-	66.88
4	Environment and Economy	1	62.22	-	-	-	62.22
5	Financial Management	1	48.73	-	-	-	48.73
6	Government Relations	2	51.53	14.38	-	-	65.91
7	Labour and Equipment	1	58.36	-	-	-	58.36
8	Materials	1	69.93	-	-	-	69.93

There were 15 factors with eigen values greater than 1 as shown in Table 4.19 above.

The variables were further subjected to orthogonal rotation. The Rotated component Matrix represents the rotated factor loadings, which are the correlations between the variables and the factors. The factor column represents the rotated factors that have been extracted out of the total factor.

Table 4.20: Rotated Component Matrix

Group	Determinants	Component			
		1	2	3	4
Contract Management and administration	Delays in decisions making	0.794	0.134	0.175	0.177
	Change in the scope of the project	0.773	0.112	0.089	0.275
	Innaccurate quantity take-off	0.675	0.271	0.184	0.114
	Fraudulent practices.	0.640	0.241	0.424	0.018
	Land acquisition	0.634	0.109	-0.073	0.379
	Lack of communication between parties	0.223	0.853	0.264	0.123
	Slow information flow between parties	0.173	0.815	0.068	0.248
	Lack of coordination between parties	0.258	0.743	0.352	0.069
	Obsolete or unsuitable construction methods	0.192	0.113	0.855	0.166
	Delay in inspection and approval of completed works	-0.040	0.351	0.758	0.163
	Mistakes during construction	0.508	0.185	0.640	-0.011
	Poor supervision by the employer	0.506	0.387	0.508	0.242
	Inadequate project monitoring and control	0.238	0.274	0.068	0.832
	Poor Contract management	0.184	0.456	0.131	0.753
Unrealistic contract duration and requirements imposed	0.327	-0.151	0.382	0.677	
Contractors site Management	Lack of experience by contractor in the type of work undertaken	0.846	0.210	-	-
	Incompetent subcontractors	0.838	0.079	-	-
	Contractors' poor site management and supervision.	0.754	0.330	-	-
	General Delays	0.695	0.372	-	-
	Inadequate planning and scheduling	0.140	0.885	-	-
	Inaccurate Time and Cost estimates	0.219	0.871	-	-
	Inadequate project monitoring and control	0.426	0.622	-	-

Table 4.21: Rotated Component Matrix-continued

Group	Determinants	Component			
		1	2	3	4
Design and Documentation	Inaccurate Site investigation	0.847	0.281	0.029	-
	Mistakes and Errors in design	0.819	0.245	0.198	-
	Frequent design changes	0.819	0.066	0.260	-
	Incomplete design at the time of tender	0.591	0.458	0.260	-
	Inadequate specifications.	0.116	0.813	0.248	-
	Omissions and errors in the bills of quantities	0.187	0.776	0.078	-
	Unrealistic contract duration and requirements imposed.	0.284	0.715	0.235	-
	Additional works	0.343	0.483	0.239	-
	Delay in preparation and approval of drawings	0.119	0.116	0.835	-
	Impractical and complicated design	0.228	0.280	0.775	-
	Poor designs and delays in designs	0.564	0.316	0.576	-
Lack of incorporation of risk in cost estimation	0.172	0.443	0.474	-	
Environment and Economy	Inflation	0.837	-	-	-
	High interest rate charged by bankers on loans	0.835	-	-	-
	Fluctuation of prices of materials	0.828	-	-	-
	Fluctuation in foreign exchange rate.	0.821	-	-	-
	Weather conditions.	0.728	-	-	-
Unforeseen ground condition	0.669	-	-	-	
Financial Management	Delay in payment by employer	0.782	-	-	-
	Inadequate budget by the employer	0.767	-	-	-
	Delay in payment to suppliers /subcontractors	0.739	-	-	-
	Cash flow and Financial difficulties by the contractor	0.712	-	-	-
	Contractual claims, such as, extension of time with cost	0.587	-	-	-
Poor financial control on site	0.572	-	-	-	
Government Relations	Coordination with other government departments.	0.860	0.209	-	-
	Political Influence	0.834	0.125	-	-
	Bureaucracy in tendering method	0.745	0.303	-	-
	Relocation of utilities	0.075	0.928	-	-
	Practice of awarding contract to lowest evaluated bidder	0.210	0.644	-	-
	Delay in issuance of licences and approvals	0.472	0.598	-	-
Laws and regulatory framework.	0.526	0.538	-	-	
Labour and Equipment	Shortage of technical personnel (skilled labour)	0.838	-	-	-
	High cost of labour	0.810	-	-	-
	High cost of machinery and its maintenance	0.788	-	-	-
	Shortage of site workers	0.768	-	-	-
	Lack of experience of technical consultants	0.750	-	-	-
	Labour Absenteeism	0.748	-	-	-
	Labour productivity	0.700	-	-	-
Equipment availability and failure	0.698	-	-	-	
Materials	Shortages of materials	0.884	-	-	-
	Changes in Material Specification and type	0.832	-	-	-
	Late delivery of materials and equipment	0.819	-	-	-
	Delay in Material procurement	0.808	-	-	-

The above matrix gives the correlation of the variables with each of the extracted factors. Usually, each of the variables is highly loaded in one factor and less loaded towards the other factors. To identify the variables, included in each factor, the variable with the value maximum in each row is selected to be part of the respective factor. The values have been highlighted in each of the rows to group the 65 variables

into core factors in each grouping. The highlighted values therefore indicate the combination of the variables in each factor.

4.4.10 Chapter summary

The chapter presented the results of the study guided by the study objectives. Contract data was analysed using regression analysis to determine the significant relationship between the projects attributes and cost overrun. Project size and nature of work were found to have a significant positive relationship with cost overrun. Other factors identified from literature were grouped into eight categories and professionals in the sector asked to give their opinion from which financial management was ranked first with an RII of 0.772. with all the groupings scoring an RII of above 0.500 indicating the significant role each of these determinants play in cost overrun. The 65 determinants were further subjected to factor analysis resulting in extraction of 15 factors.

From the results, no one factor can explain wholly the occurrence of cost overruns. The findings indicate interrelationship among the various factors. Relocation of utilities is closely related to implementation period and lack of coordination between government agencies. Lack of coordination has in some instances resulted in the installation of service utilities in the areas reserved for road expansion when the road is due for expansion the relevant agency not only delays in relocating the structures but in some instances charges for the service. This contributes to overruns in two ways one through the charge levied and two the delay caused in relocating which translates to cost overrun.

Land compensation and political influence are other factors that are closely interrelated. The politicians are known to incite the public to oppose some projects or demand higher compensation which may not have been budgeted for. This leads to delays in the project implementation as well as increased costs due to higher rate eventually agreed on. This can also be linked to the lack of incorporation of risk in the planning stage. While the engineers plan and provide for land compensation the risk of this amount going up due to the political influence is never budgeted for and therefore not included in the estimation. Political expediency may lead to skipping of design

works or tendering without the necessary design works being done which eventually leads to contract variations whose consequences include burst budget resulting in cost overruns.

CHAPTER FIVE: SUMMARY, DISCUSSIONS CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The chapter sums up the study by giving a summary of the findings and the related implications and recommendations to different parties. The limitations encountered are also discussed, ending with areas recommended for further research.

5.2 Summary of the study

Cost is one of the important considerations throughout the projects life cycle and the driving force for project performance. It is therefore one of the project constraint that must be managed well if the project has to be successful. The overruns in the infrastructure projects are not only strenuous on the scarce resources but lead to inefficient allocation of resources while causing delays and reducing the benefits associated with the project. The study aimed at establishing the the nature and extent of cost overruns in the rural roads projects in Kenya, the determining factors and provide remedies on how best project costs can be managed to attain value for money.

The first objective sought to assess the magnitude and frequency of cost overruns in the rural roads. The study considered a sample of 68 projects undertaken by Kenya Rural Roads Authority between 2009 and 2017. Quantitative data including initial project contract sums, revised contract sums, actual cost, Interest, Variation of prices and period of implementation were obtained from original contract documents, payment vouchers and interim payment certificates. Cost overruns for each project were computed with reference to the initial contract sum and the actual cost or revised contract sum where applicable.

The second objective on the other and was to establish the determinants of cost overruns in the rural roads projects. It was hypothesised that project attributes namely; Project size, Project type, Nature of work, Implementation Period, Nationality of the contractor and Contract supervision have influence on project cost performance. A sequential explanatory design was adopted combining quantitative and qualitative data analysis to gain a deeper understanding of the research problem. Project attributes were obtained from project management documents including the

project size, project type, the contractor, the nature of work, implementation period and supervision. Multiple regression analysis was carried out on the data to determine the direction and strength of the relationship between the identified project attributes and cost overruns. The contribution to cost overrun of each of the project attribute as well as the contribution of all the factors put together was established. Statistical tests for linearity, multicollinearity, homoscedasticity were carried out on the data to determine its validity and reliability.

To corroborate the results from the quantitative data, a survey targeting 100 respondents from the subsector was done through the use of structured questionnaires. A set of 65 determinants identified from literature were grouped into 8 groups based on their nature and similarity and respondents asked to rank their effect on cost overruns. A likert scale of 1-5 was used to measure the significance of each determinant to cost overruns. The 65 determinants identified were ranked using the Relative Importance Index to determine the importance of each determinant on cost overruns. Cronbach alpha test was undertaken on the data to determine the internal consistency of the instrument.

5.3 Summary of findings

The section summarizes the major findings based on the data analysed from the contract data and the survey.

5.3.1 Occurrence and extent of cost overruns in the rural roads infrastructure projects

Cost overrun has been termed as a common global phenomenon with the frequency and magnitude varying among projects and from one country to the other (Flyvbjerg et al., 2004; Wijekoon & Attanayake, 2011; Cantarelli et al., 2010). Evidence from the contract data for the 68 projects reviewed appears to confirm this fact going by the 41.2% frequency rate recorded in this study. Interestingly the overall frequency of 41.2% is very close to 41.6 % frequency of occurrence rate recorded by Singh & others, (2009) in a study on the extent, causes and remedies of cost overruns in India covering 850 projects. Cantarelli et al., (2012) however recorded frequency of 62.2% in road projects and 46.7% in fixed links while undertaking study on Dutch infrastructure projects. In yet another study undertaken on 109 projects in Sub-Saharan Africa (Alexeeva et al., 2008), a frequency of 43% was reported for Nigeria,

30% for Mozambique and Ghana, 29% for Madagascar, 10% for Tanzania and Congo, 14% for Malawi and 13% for Zambia. A point to note is that the reported frequency in these countries was over and above the 15% legally allowable contract variation. The implication is that the frequency for some of these countries could have been higher if the 15% contract variation allowance was not taken into consideration.

Further analysis shows that this could double if the effect of inflation on the remaining 26 on-going projects is taken into consideration. The frequency was more in the road works projects than in the fixed links at 45% and 13% respectively, a trend similar to what was recorded by Cantarelli et al., (2012) in Dutch infrastructure projects indicating that the frequency is higher in roadworks projects than fixed links. Office of the Auditor General of Kenya (2016) recorded a frequency of 44.1% attributing the overruns to design changes.

The study established a cost overrun range of 0.00% to 24.92% with a mean of 5.31%.and median of 15% from the actual project data. The highest cost overrun of 24.92% was in the road works projects. C. Cantarelli, Flyvbjerg, Molin, & Van Wee, (2010) recorded a range of 20.4% to 44.7%. Small projects recorded a mean cost overrun of 6.15% with medium and large projects rerecording cost overrun of 3.49% and 5.19% respectively. The magnitude differs from other researchers but the trend is similar to Mthuli et al., (2014) who found that cost overruns were higher in smaller projects than larger projects. The Office the Auditor General recorded a cost overrun as high as 90% with a mean of 11.8%. This corresponds with the 95% highest cost overrun recorded by this study from the respondents.

5.3.2 Determinants of cost overruns in the rural roads infrastructure projects

Project attributes were found to have a significant effect on the cost overruns accounting for overall 38% of the cost overruns. Top among these was the project size which based on the regression analysis was found to explain 30.4% of the cost overruns. It is believed that complexity of the project is directly proportional to the project size (Martin, Pearson, & Furumo, 2005). As such the larger the project the more complex it may be and the higher the chances of cost overruns due to

unquantified risks. There is need to pay special attention to larger projects as part of project management strategy.

Cumulatively, project type, nature of work, contractor nationality and supervision could only explain 7.6% of the cost overrun with only nature of work appearing significant. Two other common elements were observed on the project data; variation of prices and interest on delayed payments. Interest on delayed payments implies that there were delays in meeting contractors' obligations, resulting in contractors levying this interest in accordance with the contract terms and which contributes to cost overruns.

The study further identified 65 other determinants that affect cost overruns based on the ranking from the respondents. These were categorised into 8 groups based on their similarity. Topping the list was the financial management group which had the highest ranking among the respondents. Within this group, there were six determinants related to financial management. Inadequate budget provision; delayed payments by the employer and cash flow difficulties by the contractor were the top three determinants in that order. The three happens to be part of the top ten overall determinants affecting cost overruns. This underscores the role financial management plays in project management process.

Environment and economy came in second in the ranking. Unforeseen ground conditions were the top ranking factor in this group and number seven overall. Among the six factors in this group was inflation. This was seen earlier from the regression analysis as a significant determinant of cost overrun accounting for close to 18% of cost overruns. Other determinants in this group included Fluctuation of prices of materials, Weather conditions, High interest rate charged by bankers on loans and Fluctuation in foreign exchange rate.

The third ranked grouping was contractors' site management. This includes; Inadequate planning and scheduling; Inaccurate Time and Cost estimates; Inadequate project monitoring and control; General Delays; Lack of experience by contractor in the type of work undertaken; Incompetent subcontractors; Contractors' poor site management and supervision. This implies that effective construction planning and scheduling is an important tool in managing cost performance.

The fourth ranked group of determinants was design and documentation. The group had twelve factors. It thus emerges that the quality of design and documentation has a significant impact on the overall project efficiency and the related costs. This is well articulated by the Office of the Auditor General, (2016) report that recorded 44% in change of designs on a sample of 34 projects across the road agencies with accompanying cost overrun of a whopping Ksh 3.7 Billion. The report points out inaccurate designs, faulty designs and old designs as major determinants under this heading. Changes in design happens due to inadequate site investigation which leads to changes in volumes of material and labour which eventually filters into the project cost to result in cost overruns.

Government relations which comprised seven factors was ranked fifth: Political Influence; Delay in issuance of licences and approvals; Bureaucracy in tendering method; Relocation of utilities; Coordination with other government departments; Practice of awarding contract to lowest evaluated bidder; Laws and regulatory framework. Bureaucracy in the tendering methods sometimes leads to under quoting by the contractors resulting subsequently in variations that lead to cost overruns.

Contract Management and Administration was ranked sixth. This was the largest group among the eight comprising of 15 determinants namely; Change in the scope of the project; Poor Contract management; Land acquisition; Inadequate project monitoring and control; Delays in decisions making; Unrealistic contract duration and requirements imposed; Fraudulent practices; Inaccurate quantity take-off; Lack of coordination between parties; Poor supervision by the employer; Obsolete or unsuitable construction methods; Slow information flow between parties; Delay in inspection and approval of completed works; Mistakes during construction; Lack of communication between parties.

Materials grouping was ranked seventh and comprised 7 determinants; Changes in Material Specification and type; late delivery of materials and equipment; Shortages of materials; and Delay in Material procurement. Late delivery of materials and equipment affects productivity of the projects resulting in time delays and subsequently cost overruns (Memon et al., 2011). Poor material management result in shortage of material which are then obtained at higher price leading to time and

cost overrun (Aljohani et al., 2017). This makes materials management as one of the important aspects of contract execution.

Finally Labour and equipment grouping was ranked eighth with RII of 0.5839. The group consisted eight factors namely; high cost of machinery and its maintenance; Equipment availability and failure; Shortage of technical personnel (skilled labour); Lack of experience of technical consultants; High cost of labour; Labour productivity; Shortage of site workers; and Labour Absenteeism. Topping the list is equipment availability and failure.

Deployment of factor analysis saw the 65 determinants reduced to 15 factors. This included four factors in contract management and administration, three factors in design and documentation; two factors in contractors site management and government relations groups. Financial management, environmental and economy, labour and equipment and materials had an extraction of one factor each.

5.4 Study Implications and recommendations

The research established existence of cost overruns in the rural road projects while highlighting project size as a major determinant of cost overruns among others. The strenuous effects of cost overruns on the limited resources are not in doubt, so are the implications to the various parties attached to the project. The project owners, contractors, consultants, financiers, and project management team all have vested interest. There is need for all the parties to focus on project management areas that appear to have the greatest impact on cost performance for the purposes of minimising the frequency and magnitude of cost overruns in future projects. The project owner and the contractor need to manage the associated risks collaboratively if the overall risk of cost overrun is to be lowered.

5.4.1 Implementing Agencies

The research has established a positive relationship between project size based on value and cost overruns implying the larger the project the more likelihood of experiencing cost overruns. Variation of Prices was also noted to be common in the projects that experienced cost overruns, along with financial management factors; contract management factors and design and documentation factors.

The implementing agencies need to take note of these findings and institute proper financial management measures including clearing of contractors' obligations on time to providing adequate budget for the projects. Delayed payment has been termed common in government funded projects due to the bureaucracy in public institutions (Aljohani et al., 2017)

Design changes features not only in this study and many others, but prominently so in the two performance reports by the Auditor General for Kenya (2016) and Tanzania (2010). There is need to emphasize on adequate planning that incorporates relevant risks in the cost estimation with detailed designs that minimises changes in scope and scheduling. Site investigations should be adequately carried out to reduce the need for design changes mid-stream. Further, the agencies may need to invest more in the training of its staff and consultants and contractors on better contract management methods so as to enhance cost performance. Improved quality control measures should be put in place to ensure there is adequate review of the designs prior to commencement of works.

Profiling the risks associated with the construction project is not enough. The risks need to be quantified and their monetary impact on the project established. Cost estimations should be improved to factor the risks identified in the budget of the project to a near-accurate cost of the project. Items such as relocation of utilities and land compensation should be adequately provided for in the initial budget rather than appear as extra costs that then accounted for as cost overruns. The Auditor General reports lack of budgetary provision for land compensation on several projects with figures running in to billions of shillings.

Bid documents should be clear and unambiguous spelling out clearly the roles and responsibilities of the respective parties to forestall the need for addenda. For instance, in the Big Dig project in America, the management consultant was forced to issue Request for Proposal before the designs were complete following a federal funding rule that required spending allotted money by a specific date or lose it altogether. The subsequent changes in the contract document resulting from these incomplete bid documents were later part of the cause of cost overruns (Greiman, 2013).

Contract management including a robust evaluation and monitoring system should be put in place to ensure that likelihood of cost overruns is detected in the early stages of the project implementation and addressed promptly. In the 2016 performance report for the road agencies by the Auditor General, 50% of the projects had extension of time granted with some of the extensions going beyond 100%. This may indicate a problem in the project management and administration which require to be addressed. The National Audit office of the United Republic of Tanzania attributes 13% of cost overruns purely to time delays(Controllor and Auditor General, 2010). Further evidence from this study indicates that there is need to pay special attention when formulating project management team for the larger projects given the significant positive relationship noted between the size of the project and cost overruns.

5.4.2 Contractors

Contractors are responsible for the actual construction of the road projects ensuring the project is completed within the budgeted time and cost and within the specifications. They manage financial resources, people, material and equipment to deliver the project. The effect of cost overruns on the contractor's bottom line is evident not to mention the reputation risk that eventually may result in poor credit rating by the banks. It is therefore in the contractor's interest to ensure that cost overruns are eliminated at least from the contractor's side. Contractors' site management factor grouping was ranked third with inadequate planning and scheduling topping the list in this category followed by inaccurate time and cost estimates and inadequate project monitoring and control. Effective site management is vital for the success of the project. It has been found that most contractors fail on this end as they lack the requisite experience managerial skills to manage the project team(Akomah & Jackson, 2016). Contractor's financial difficulty was identified as one of the determinants of cost overruns. The contractors need to put adequate project financing methods in place to forestall cash flow difficulties during the implementation process.

5.4.3 Consultants

Consultants are responsible for design and documentation and for supervising the projects during implementation. Design changes features prominently in many studies as a major cause of cost overruns. Consultants may need to go back to the

drawing board and improve on their methodologies to minimise incomplete and inadequate designs that require changes in scope midstream. While supervision did not appear to have significant influence on the cost overruns, this is part of contract management that had the highest ranking.

5.4.4 Regulators and policy makers

These are government watchdogs who monitor the professional conduct of the parties during the implementation of the project. They are also involved in providing policy guidelines that guide the implementing agencies and other parties involved in the road construction and management. The findings of this study provides guide for the policy makers to direct resources and energies to the specific determinants with an aim of reducing the frequency and magnitude of cost overruns in future projects.

5.4.5 Financiers

Financiers provide funds for the implementation of the project. These include the government of the day and in some cases development partners. It is therefore in their best interest to demand value for money. Cost overruns are not the best way of utilising tax payers' funds and defeats the very principle of value for money.

5.4.6 Other Government Agencies

These include agencies responsible for provision of public utilities such as water, electricity, telephone and Government departments that offer licensing and other related services. Included in this category are Agencies dealing in land and settlement matters, environment and other licensing agencies. Collaboration among these agencies is vital if the project has to be implemented smoothly within the budgeted time and cost. Depending on the location of the project, some of the public utilities may need to be relocated. Arrangements for relocation need to be made prior to the contractor moving on site to avoid time delays. Existing laws and regulations require approval by the environmental agency prior to commencement of the project to ensure that environmental and social impacts have been identified and adequate mitigation measures put in place. Delays in issuance of such approvals causes time delays with serious ramifications to the cost of the projects.

Land compensation was ranked 12 overall with a RII of 0.734. The Office of the Auditor General, (2016) records land compensation as a major factor contributing to cost overruns. Delays in payment to the awardees translate in delay in completion of

the project which in some instances is accompanied by contractor claims. The land acquisition process was also found to be slow thereby dragging the project implementation progress. A more collaborative approach among these agencies is vital in ensuring the success of the projects.

5.4.7 Academic researchers

The findings in this study provide additional knowledge to the already existing literature on the cost overruns and thus widening the understanding of cost overruns in the road projects. There is still more room for further studies on the subject with regard to the Kenyan context.

5.5 Limitations

The study focused on the projects initiated by the Authority between 2009 and 2017. However, during inception, a number of projects were vested with the Authority at various stages of completion and were completed within the same period. Due to the fragmented data/information on these projects between the parent ministry and the Authority, these projects did not form part of the sample. The exclusion of these projects could have an impact on the research findings.

The target population included both completed and on-going projects. Cost overrun for completed projects was arrived at by considering the actual cost against the initial contract sum while for on-going projects, revised contract sum was considered. It is possible that some of the on-going projects which did not have a revised contract sum could still end up experiencing cost overrun especially given the fact that some had incurred interest in delayed payment and variation of prices indicating that the actual cost for these projects may exceed the budgeted cost eventually. If this happens, the reported frequency and magnitude of cost overruns in this study may be affected.

5.6 Areas of further research

The study employed the traditional approach of actual cost versus budgeted cost in measuring cost overrun. Although famous, this approach has been criticized for ignoring a third and very important dimension- the value of work performed (Fleming & Koppelman, 2003). In this context even the projects that were within the budget could have experienced cost overrun if the value of work done was

considered. Earned value management incorporates the value achieved and the related cost giving the true cost of the project. This line of study needs to be pursued in future studies.

As discussed in section 5.5 above, the sample included both completed and on-going projects. Cost overruns on the on-going projects were assessed with reference to revised contract sums. Where there was no upward revision of the contract sum and the actual cost was within the budget, the project was considered not to have experienced cost overruns. However, it is possible the actual cost for these projects may eventually exceed the budgeted cost as the project implementation progresses leading to cost overruns. There is need to make follow up on such projects.

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APPENDIX I: Questionnaire

Determinants of cost overruns in the Rural Roads Infrastructure Projects in Kenya

Dear Professional,

I am glad to invite you to participate in this survey which seeks your professional opinion on the determinants of cost overruns in the infrastructure road projects in Kenya. The survey is part of a research project aimed at fulfilling the requirements of Masters of Commerce degree at Strathmore University. For purposes of this study, cost overrun is defined as the percentage difference between the actual cost and the budgeted cost (original contract sum) of the project. In this context, variation orders within the legally allowable limits that result in upward revision of the original contract sum are viewed as part of cost overruns.

You are kindly requested to spare a few minutes of your time to complete the questionnaire by writing or selecting from the choices provided as appropriate. The questionnaire is divided into two sections. Section one requires general information of the participant while section two seeks your opinion on the occurrence, magnitude and causes of cost overruns in the road projects. Your participation as a professional in the sector is highly valued.

Please note that the confidentiality of your response is assured.

Thank you in advance

Aggrey M. Lukale
Kenya Rural Roads Authority

* Required

SECTION 1: GENERAL INFORMATION

1. Please indicate your professional background *

Mark only one oval.

- Accounting and Finance
- Engineering and Survey
- Procurement
- Public Relations
- Legal
- ICT
- Human Resource

2. Please indicate (the equivalent of) your highest academic qualification. *

Mark only one oval.

- High School
- Diploma
- Bachelors
- Post Graduate

3. What kind of organization do you currently work in? *

Mark only one oval.

- Government-Implementing Agency
- Contractor
- Consultant
- Government-Auditor
- Government-Regulator
- Other: _____

4. How many years have you been working in the roads sub sector ? *

Mark only one oval.

- Less than Five Years
- 5 - 10 Years
- 10- 15 Years
- Over 15 Years

SECTION 2: OCCURRENCE, MAGNITUDE AND CAUSES OF COST OVERRUNS

5. How would you rate the frequency of cost overruns in the road projects in Kenya Tick as appropriate (choose only one) *

Mark only one oval.

- Always (happens all the times)
 Often (happens most of the times)
 Sometimes (happens sometimes)
 Occasionally (happens at times)
 Never (does not happen)

6 a. From your experience in the roads subsector what are the percentage average cost overruns in the road projects in Kenya *

6 b. What are the percentage average cost overruns in the fixed link projects (Bridges, structures) *

7. On a scale of 1-5, based on your experience in the roads industry to what extent do the following factors contribute to cost overruns in the roads projects in Kenya (Where: 1= Not significant, 2= Slightly Significant, 3= Moderately Significant, 4= Significant , 5 Extremely Significant)

A. Project Attributes *

Mark only one oval per row.

	1	2	3	4	5
Project size(based on value)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Project Type (Roads works/Fixed Link)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nature of work(New Construction/rehabilitation)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nationality of contractor(Foreign/Local)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Implementation Period	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Supervision(In-house/Consultant)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Source of funds (GOK/Development partners))	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

B. Contract Management and Administration factors *

Mark only one oval per row.

	1	2	3	4	5
Inadequate project monitoring and control	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Poor Contract management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Slow information flow between parties	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lack of communication between parties	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lack of coordination between parties	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Delay in inspection and approval of completed works	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Obsolete or unsuitable construction methods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mistakes during construction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fraudulent practices.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inaccurate quantity take-off	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Land acquisition	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Poor supervision by the employer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Unrealistic contract duration and requirements imposed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Change in the scope of the project	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Delays in decisions making	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

C. Contractors site Management related factors *

Mark only one oval per row.

	1	2	3	4	5
Inadequate project monitoring and control	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Incompetent subcontractors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lack of experience by contractor in the type of work undertaken	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
General Delays	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Contractor's poor site management and supervision.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inaccurate Time and Cost estimates	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inadequate planning and scheduling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

D. Design and Documentation related factors *

Mark only one oval per row.

	1	2	3	4	5
Frequent design changes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inaccurate Site investigation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mistakes and Errors in design	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Incomplete design at the time of tender	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Additional works	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Delay in preparation and approval of drawings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Poor designs and delays in designs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Impractical and complicated design	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Omissions and errors in the bills of quantities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Unrealistic contract duration and requirements imposed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inadequate specifications.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lack of incorporation of risk in cost estimation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

E. Environment and economy related factors *

Mark only one oval per row.

	1	2	3	4	5
Fluctuation of prices of materials	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Unforeseen ground condition	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inflation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fluctuation in foreign exchange rate.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
High interest rate charged by bankers on loans	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Weather conditions.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

F. Financial Management related factors *

Mark only one oval per row.

	1	2	3	4	5
Contractual claims, such as, extension of time with cost	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Poor financial control on site	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inadequate budget by the employer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cash flow and Financial difficulties by the contractor	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Delay in payment to suppliers /subcontractors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Delay in payment by employer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

G. Government Relations related factors *

Mark only one oval per row.

	1	2	3	4	5
Bureaucracy in tendering method	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coordination with other government departments.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Political Influence	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Laws and regulatory framework.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Practice of awarding contract to lowest evaluated bidder	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Relocation of utilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Delay in issuance of licences and approvals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

H. Labour and equipment related factors *

Mark only one oval per row.

	1	2	3	4	5
Shortage of site workers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Equipment availability and failure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Shortage of technical personnel (skilled labour)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lack of experience of technical consultants	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
High cost of labour	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
High cost of machinery and its maintenance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Labour Absenteeism	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Labour productivity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I. Materials related factors *

Mark only one oval per row.

	1	2	3	4	5
Changes in Material Specification and type	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Delay in Material procurement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Shortages of materials	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Late delivery of materials and equipment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Thank you for your time in participating in this survey please indicate your email address (for feedback) and submit *

APPENDIX II: Letter of Authorisation



Strathmore
UNIVERSITY

4th February 2016

TO WHOM IT MAY CONCERN

AGGREY MOYI LUKALE-085059

Mr Aggrey Moyi Lukale is a postgraduate student in our Master of Commerce (MCom) programme. In partial fulfilment of the MCom degree, students are required to carry out a research project and write a thesis on a contemporary subject within their field of specialisation. Among other activities, the project involves data collection and analysis.

Aggrey is requesting to gather information to be used in his research. The information he will obtain from your organization will be used for this academic purpose only and will be kept confidential. The results of the survey will be in summary form and will not disclose any individual, company name or company information in any way.

The research study is entitled "DETERMINANTS OF COST OVERRUNS IN THE ROAD INFRASTRUCTURE PROJECTS IN KENYA: EVIDENCE FROM RURAL ROADS PROJECTS."

We hope that your organization can assist by providing information to the above named student.

Yours faithfully,

Josphat Manani
MCOM Coordinator
School of Management and Commerce
Email: jmanani@strathmore.edu

APPENDIX III: Rural Roads network prior to reclassification

No	Class/description	Pavement Type		Total(Kms)
		Paved(Kms)	Unpaved(Kms)	
1	Class D Roads	1,233.28	9,485.38	10,718.67
2	Class E Roads	590.58	26,133.52	26,724.11
3	Special Purpose Roads	100.10	10,405.92	10,506.03
4	Unclassified Roads	700.52	87,725.61	88,426.14
Total(Kms)		2,624.50	133,750.44	136,374.94
%age		1.9 %	98.1 %	100 %

Source: Kenya Rural Roads Authority Annual Report F/Y 2014-2015

APPENDIX IV: Expenditure on roads F/Y 2011/2012- 2014/2015

	KSh Million			
	2011/12	2012/13	2013/14 [*]	2014/15 ⁺
Development:				
Trunk and primary Roads (A,B and C)	44,950.0	65,152.3	43,763.4	59,402.0
Secondary and Minor Roads (D and E)	14,032.3	14,215.6	16,784.0	22,504.4
Miscellaneous Roads (Including Urban)	14,761.6	5,125.8	3,853.0	12,772.3
Total	73,743.9	84,493.7	64,400.4	94,678.7
Recurrent (maint. and repair) ..	17,786.3	24,370.5	23,228.9	25,792.2
Grand Total	91,530.2	108,864.2	87,629.3	120,470.9

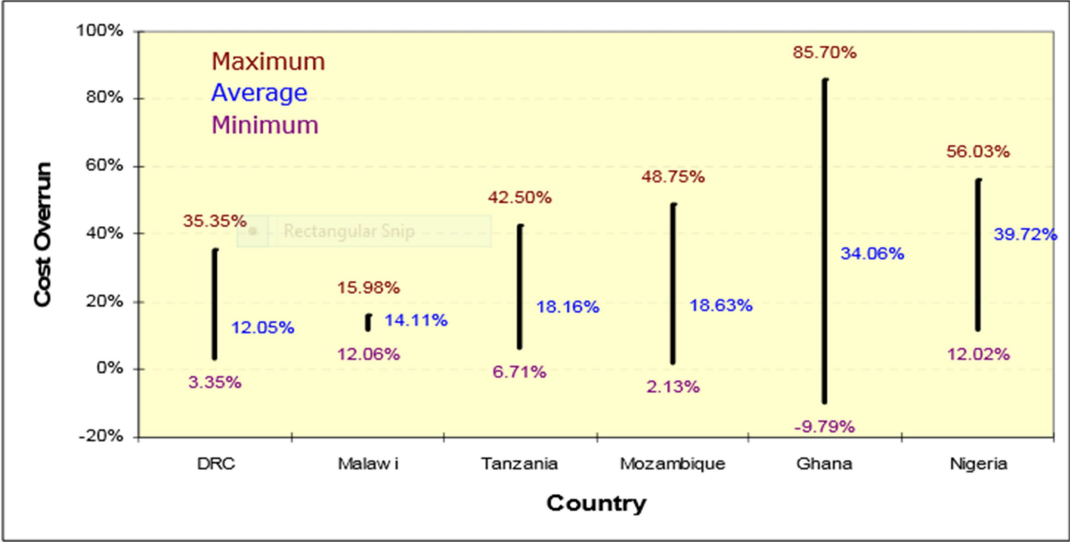
Source: State Department of Infrastructure

APPENDIX V: World's biggest cost overruns infrastructure projects

SN	Project Name	Country	Cost overrun
1.	Nanchang jiujiang Highway	China	255%
2.	Dublin Port Tunnel	Ireland	261%
3.	Humber Bridge	UK	276%
4.	Cuernavaca-Acapulco Toll Road	Mexico	300%
5.	Central Artery/Tunnel (CA/T)Boston -Big Dig project	USA	324%
6.	Guangzhou City Transport Project	China	335%
7.	Verrazano-narrows bridge	USA	384%
8.	M50 South East Motorway	Ireland	556%

Source: CIMA's Financial Management Magazine, February 2013 publication

APPENDIX VI: Cost overruns in Sub-Saharan Africa averages and ranges by country



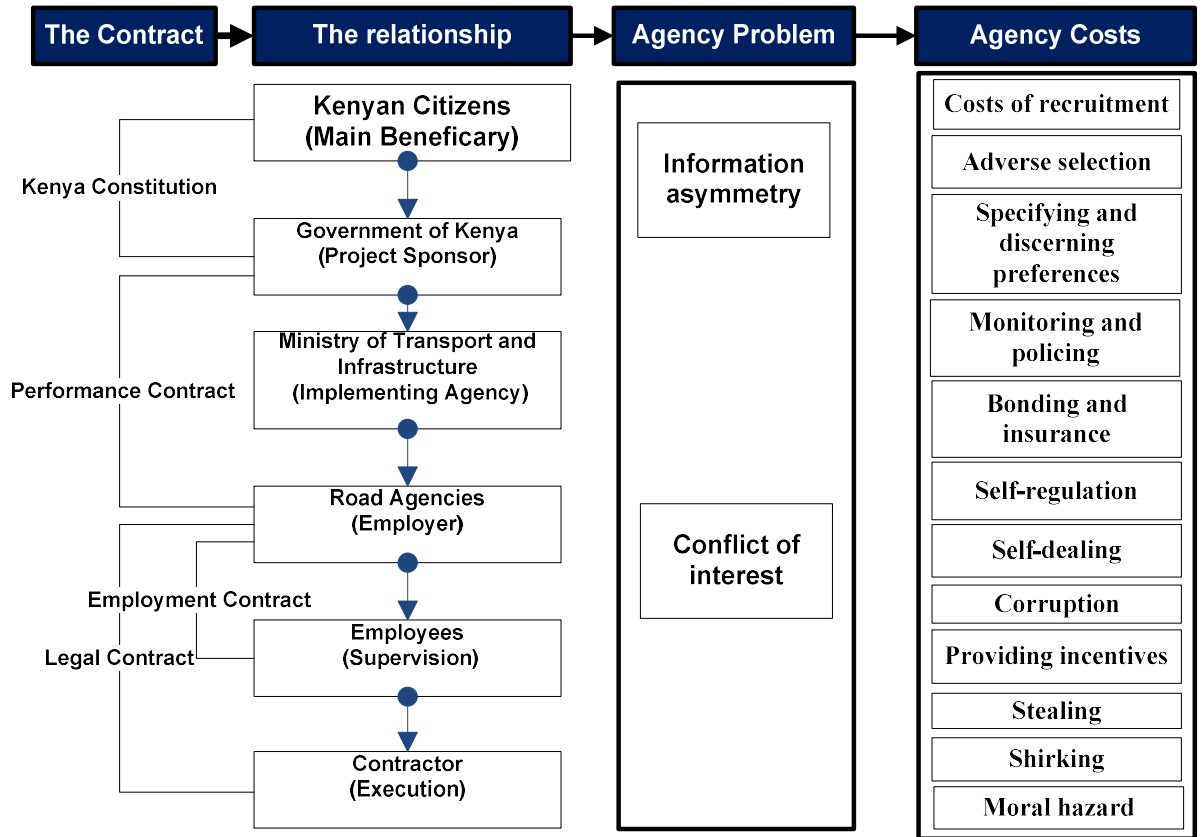
Source: Transport sector Board – The World Bank Group

APPENDIX VII: Average cost per km of a 2-lane road by type of work and type of road, by country

Rehabilitation & reconstruction (2007 US\$/km)		
<i>Country</i>	<i>Inter-urban</i>	<i>Urban</i>
Congo (DRC)	228,872	
Ethiopia	388,207	
Ghana	261,052	
Kenya	955,755	
Mozambique	278,661	
Malawi	420,838	
Nigeria	329,909	1,505,480

Source: Transport sector Board – The World Bank Group

APPENDIX VIII: Hierarchical principal agent relationship in road project management in Kenya



Source: Author

APPENDIX IX: List of sampled projects

No	Project Name	Contract Sum (Ksh)
1	Gatugi-Jn D430 E(552) Iria-Ini, Mugaa-Ini (E1682) Jn E552-Witima-Gikundo-Tambaya, Jn Gichiche-Kiganjo Tbc(E459)-Kariki-Jn D430, Kiinu-Ngaru (E1659)-Konyu-Mucharage-Kairo (E511) Nyamari-Kihuri (Water Treatment (E558)	3,156,933,562.46
2	Ngong - Kiserian (D523)	68,856,150.00
3	Iten - Kapsowar Phase I	656,510,497.00
4	Muthatari-Siakago-Ugweri	1,232,598,289.00
5	Mairi-Makomboki	1,458,937,413.00
6	Umande-Akorino	991,012,360.00
7	Mwingi - Tseikuru Bridge	496,153,997.00
8	Mwingi - Tseikuru Road	1,938,483,758.00
9	Ruiru – Isiolo (D490), Amos Loop And Isiolo – Muriiri – Michimikuru Tea Factory (D485 / E814) Roads	2,996,212,482.82
10	Kima - Emusutswi	68,746,008.00
11	Kimilili - Misikhu Road	498,906,676.50
12	Moi North Lake Road	898,635,071.00
13	Oloitikoish - Hope- Isinya (D523)	125,797,012.00
14	Ukunda - Diani	173,893,632.00
15	Sagana State Lodge Access Road	416,752,920.00
16	D350-C55 Jn Ravine-Saos-Phase I	414,313,683.00
17	Mogonga-Kamagambo	1,724,645,167.00
18	Lake Bogoria-Mugurin-Mogotio	144,695,778.00
19	Kabenes-Kachibora	1,313,914,382.50
20	Amabuko Kimera	411,667,325.00
21	Chesoi-Chesogoch	249,928,235.00
22	Chelolongbei Bridge	210,872,567.00
23	Nyarogi Bridge	79,625,209.00
24	Riruta-Ndunyu	720,990,750.00
25	Thangatha Bridge	82,316,546.00
26	Toku Bridge	346,033,229.00
27	Kimini Mbai River Bridge	57,326,214.00
28	Masariot-Cheptawai-Kipkaren River	1,593,073,494.00
29	Access Igoji Ttc/Kanyakine Market	2,314,390,882.00
30	Kipsonoi-Bridge And Approach Roads	119,214,893.00
31	D350-C55 Jn Ravine-Saos-Phase Ii	404,131,335.00
32	Sulal Bridge (Sotik-Roret-Soko)	97,222,140.00
33	Murang'A Gitugi	2,170,343,325.00
34	Kimathi University-Brookside-Mweiga	1,590,565,622.00
35	Mukurueini – Gakonya (D429 / E559) And Rutune – Mahuaini (E554) Roads (Phase Ii)	974,903,875.00

No	Project Name	Contract Sum (Ksh)
36	Meru – Mikinduri – Maua (D482) Road (Phase Ii)	1,721,871,230.00
37	Eldoret - Ziwa - Kachibora (D328) And Kachibora - Moi'S Bridge (D330 / E334)	1,435,212,465.00
38	Kagere-Munyang-e-Gitugi E571, Ndunyu - Miirini -Gituiga - Kiriaini (D428)	1,734,322,849.00
39	Mukuyu - Githambo - Kiruri (D440)	1,384,237,083.00
40	El Wak - Lafey - Fino (E847)	167,013,900.00
41	Lanet - Elementaita - Mau Narok (D 320) Road	1,026,411,659.50
42	C99 Mumbuni - Kathiani Thwake River	637,194,171.20
43	Sotik - Cheborge - Roret - Kebenet - Sigowet Road (D226)	3,149,152,168.90
44	Kibunja - Molo - Olenguruone (D316)	742,290,293.00
45	Bondo Misori/Kipasi Owinbi Road (D246 / E126 / E139)	2,483,543,548.00
46	Kaharati - Njiris Road	1,651,911,818.50
47	International School - Gathiga Road(E1512)	197,520,711.00
48	Kenchic - Kiawaroga (E428)	69,481,390.00
49	Ngorongo - Githunguri	1,341,270,887.91
50	Zambezi - Karai	179,448,346.00
51	A2 (Gsu) - Kiganjo - Mundoro (D398)	1,375,728,854.00
52	Gatundu - Karinga - Flyover (E496)Phase I	204,727,820.00
53	Maili Tatu -Laare - Mutuate (E817 / D486) And Kk - Njouné Link Roads	799,095,082.82
54	Gede - Watamu (E899P)	174,265,132.50
55	Thogoto – Gikambura – Mutarakwa (D411) Road (Phase Ii)	935,367,390.91
56	Imenti-Kionyo (T52/E779) Kionyo -Chogoria (D474) And Ndagene Loop (T51) Roads	3,502,806,462.00
57	Meru-Marimba (D472) Marimba-Nkubu (D476) And Nkubu - Mitunguu (D475) Roads	3,232,399,768.99
58	Sigalagala -Musoli-Sabatia- Butere Road	1,809,645,663.30
59	Sigiri Bridge	992,546,146.00
60	Giakanja - Tetu Mission Road(D4340)	2,453,093,782.82
61	Nabengele -Rwambwa - Port Victoria	1,488,339,334.00
62	Illulla-Elgeyo Border	2,158,708,496.00
63	Juakali-Sugoi-Elgon Estate	1,350,290,257.00
64	Kiserian - Oloitikoish (D523)	161,599,020.00
65	Mathatani-Kaseve-Kaloleni	1,251,786,885.00
66	Naro Moru-Munyu-Karisheni-Phase Ii	2,064,537,960.00
67	A2 Mathaiti - C70 Munani & Kagiri - Gatitu	1,784,944,852.50
68	Tirap - Embobut - Chesogon	1,803,224,382.82
Total		75,662,594,291.95