DETERMINANTS OF ROAD MAINTENANCE COST: A CASE OF WESTERN KENYA ROAD PROJECTS

BY

EDWIN KIPLAGAT LIMO

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DECLARATION

This research project is my original work and has not been presented for a degree in any other University.

Signature _____ **Date** 30/07/2012

Edwin Kiplagat Limo
L55/66010/2010

This research project has been submitted for examination with my approval as the University of Nairobi supervisor.

Signature _____ **Date** 3-7-2012

Dr. Raphael Ondeko Nyonje (PhD)
Lecturer,
Department of Extra Mural Studies,
University of Nairobi

DEDICATION

This work is dedicated to my family

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LIST OF ABBREVIATIONS AND ACRONYMS

Class A	Strategic Roads
Class B	Regional Distributor Roads
Class C	Local Distributor Roads
Class U	Unclassified, Local Municipal Roads
DFID	Department for International Development
DLOs	direct labour organisations
DN	Defect Number
HM	Highway Maintenance
KeNHA	Kenya National Highways Authority
KERRA	Kenya Rural Roads Authority
KURA	Kenya Urban Roads Authority
MOR	Ministry of Roads
MTP	Metropolitan Transportation Plan
NSRA	Norwegian State Road Administration
ROK	Republic of Kenya
SRMCS	Scottish Road Maintenance Condition Survey
Vpd	Vehicles Per day

ABSTRACT

The extent to which a nation's land mass is covered by road network is an index of the degree of mobility of people, goods and services within the country, and the quality of the network measures the ease and cost of that mobility. The purpose of this study was to investigate the determinants of road maintenance cost: a case of Western Kenya road projects. The study had the following objectives: establish the extent to which procurement process influence road maintenance cost in Western Kenya road projects; determine how categories of contractors influence road maintenance cost in Western Kenya road projects; investigate how availability and cost of materials influence road maintenance cost in Western Kenya road projects; examine how environmental factors influence road maintenance cost in Western Kenya road projects. The study employed descriptive survey research design whose purpose was to determine the influence of the determinants influencing road maintenance in Western Kenya. The target population consisted of 437 contractors, six region managers, 29 road overseers, seven engineers and 12 procurement officers that formed the population of the study from KeNHA, KERRA and KURA. The sample size consisted of 56 contractors, six regional managers, seven engineers, nine road overseers and 12 procurement officers.The respondents were selected through simple random and purposive sampling techniques. The research instruments used were a questionnaire and an interview schedule. The questionnaire contained both open ended questions and closed ended questions. On validity of the instruments, the researcher used content validity while through pilot testing process was carried out to test reliability comparing with a Pearson product moment of 0.5. The researcher then analysed the data and presented the results in form of frequency tables. The findings included: during procurement process, procurement procedures were flouted because firms which were not the most experienced in field of activity were chosen and the time taken between pretender site visit and the signing of contract agreement took long; The class of contractors negatively influenced the cost of road maintenance because the respondents were of the opinion that high class contractors (A to C) did not always quote low prices and contractors with more knowledge and skills in road maintenance did not necessarily quote lower prices and this had significant negative correlation on cost of road maintenance; results on the availability and cost of materials revealed a significant negative correlation on the cost of road maintenance and environmental variables like uncontrollable factors of the environment such as climate, terrain and location did increase road maintenance cost. The study had the following recommendations: the government should have clear procurement procedures which should be monitored to ensure they strictly followed and heavy penalties levied on those found flouting them; road maintenance, especially with respect to the contracting and bidding for civil works, requires the effective evaluation and supervision of contractors and their bids; the government should reduce the tax rate on construction materials, construction plant (machines and equipment used during construction) and service plant (equipment used in the operation of the infrastructure project) and environmental consideration should be included in road maintenance programs and should be looked at from methodological, technical, economical and institutional/contractual points of view. The findings of this study may be useful to the Ministry of Roads, contractors, engineers and other stakeholders in Ministry of Roads in their improvement of policies and practices on road maintenance.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The importance of addressing road maintenance properly is now well understood and is illustrated by the consequence of neglect. For example, the World Bank (Harral and Faiz, 1988) has estimated that of the 85 countries receiving their assistance for roads, the cost of reconstruction has been between three and four times the cost of the preventative maintenance that should have been undertaken earlier. The effect on road users is also significant, with vehicle operating costs increasing by similar or greater amounts. The effectiveness and efficiency of road maintenance can be improved through increased competition, clear separation of client and supplier roles, and the adoption of specific standards and activity definitions. As a result, significant economic benefits can accrue. The Road Management Committee of PIARC has already shown that the majority of periodic maintenance work is undertaken by private contractors and the majority of routine maintenance is carried out by direct labour organisations (DLOs). There is a general perception that DLOs are inefficient whereas private contractors are efficient, and this has created a pressure to make more use of private contractors for maintenance works (Larcher and Miles, 2000).

This study aims at getting better understanding of the importance of having good road conditions for people, companies and societies in rural areas, which are dependent on the low volume roads. In many cases these roads are lifelines for people and societies. Low volume roads in rural areas are often in bad condition. Traditionally the road conditions on low volume

roads have been neglected. The main reason is the economic resources, which are insufficient to cover all the needs. But there are also other reasons why the low volume roads are kept back in the road maintenance programs. Available socio-economic models to describe the maintenance need, normally deal with road user costs consisting of time delay costs, vehicle costs and accident costs. But as the amount of traffic always is the dominating figure in the calculations, the models will favour a very good condition on high volume roads and only keep the low volume roads alive. That will give the highest benefits for the society with the existing models. To change this, in order to give people living in rural areas better life conditions, there is a need for new thinking to find alternative ways to describe the significance of having good road conditions especially in the rural areas (Cunning and Bennathan, 2000). Maintenance at the operational level is optimised through maximising the efficient and appropriate use of the resources of labour, materials and equipment. Depending on the relative costs of labour and equipment, the use either of labor-intensive or equipment intensive operations might be appropriate (Parkman, Madelin, Robinson and Toole, 2002).

Socio-economic considerations in road management can be taken in different ways: Socio-economic models can be used to justify budget levels on road network level; to select maintenance project and to choose between different maintenance alternatives. Policies can be used to aim for a certain road condition standard level, for example, specified target limits for properties like roughness, rutting and bearing capacity, used for instance in routine maintenance contracts; lowest acceptable road condition on certain properties, so called "shame values"; aims for practicability. Usually when talking about socio-economic impact in relation to road condition we are looking at costs for road users and road managers. The road user costs are

related to the road conditions. A road with high roughness and rutting causes bigger costs than an even road. To keep a road in good condition will cause costs for the road manager like rehabilitation costs and costs for normal and routine maintenance. The road managers are aiming for minimising the total costs, which are the sum of the road user costs and the road manager costs. This can be done by using different types of socio-economic models dealing with cost-benefit analyses (CB-analyses) (Robinson, Uno and Snaith, 1998).

The objectives and role of the Kenya Roads Board are defined in the Kenya Roads Board Act, 1999 and as enacted by the Parliament in January 2000. The establishment, powers and functions of the RB are published in the Gazette. There was a prexistent RF in Kenya since 1994 for which the management was to be assumed by the Board on its establishment. The RB has a Chairman appointed by the President from the private sector for a period of three years who is eligible for re-appointment for one further term. The RB has all powers necessary for the performance of its functions under the Act and decides on remuneration to the board members after consultation with the Minister of Finance. The board had its first meeting in July, 2000 and appears to be still in the process of putting its operations on a firm footing. Similar to experience in other countries, it has been easier to set up institutional arrangements but implementation of concomitant policy and legislative framework has been more difficult. This process has been made more difficult by a recent legal challenge to the constitutionality of the Act setting the RB into place (ROK, 2004).

The study was carried out in Western Province which was one of Kenya's seven administrative provinces outside Nairobi. It borders Uganda. It is west of the Eastern Rift Valley and is

inhabited mainly by the Luhya people. Quakerism is widely practised here. Kenya's second highest mountain, Mount Elgon is located in this region in Bungoma District. The Kakamega Forest rainforest is part of the area. In 1999 the total population was of 3,358,776 inhabitants within an area of 8,361 km².The climate is mainly tropical, with variations due to altitude. Kakamega district is mainly hot and wet most of the year, while Bungoma district is colder but just as wet. Busia district is the warmest, while the hilly Vihiga District is the coldest. The entire province experiences very heavy rainfall all year round, with the long rains in the earlier months of the year.

1.2 Statement of the Problem

Road maintenance is key to controlling long-term costs. It costs less in the long run to have good roads than bad roads if you keep up with road maintenance continuously. Deferred maintenance drives up long-term costs by shortening the cycle for rehabilitation, which often leads to pavement failure and eventually complete reconstruction at ten times the cost. Heavy-truck traffic, competence and experience of contractors, procurement process and environmental factors like wet weather comprise the key most critical factors in pavement deterioration (MTP2035, 2006). In simple terms, one fully loaded 80,000-pound truck causes as much pavement wear as 10,000 automobiles. Environment is seldom taken into account in the design and implementation of road maintenance tasks. Therefore, environmental consideration should be included in road maintenance programs and should be looked at from methodological, technical, economical and institutional/contractual points of view (Robinson, Uno and Snaith (1998).

The survey conducted in Kenyan roads indicated that most of the roads are in very poor condition, and require complete rehabilitation. Some roads constructed over 30 years ago have not been rehabilitated for once, resulting in major cracks (longitudinal and transverse), depressions, broken down bridges and numerous potholes that make road transport slow and unsafe (MOR, 2011). Research has shown that proper road maintenance contributes to reliable transport at reduced cost, as there is a direct link between road condition and vehicle operating costs (VOC) (Harral and Faiz, 1988). Road maintenance cost has been attributed to myriad of factors like the type of traffic and the construction industry historically not dealing well with risk, leading to many failed contractors through poor planning, poor budgeting, and poor resource management (Wells, 1986). However, no study has looked at the determinants influencing cost of road maintenance in Kenya, in particular Kenya urban roads authority. It is on the strength of this that this study will be carried out to ascertain the influence of procurement process, categories of contractors, availability and cost of materials and environmental factors on the cost of road maintenance in Western Kenya roads projects.

1.3 Purpose of the Study

The purpose of this study was to investigate the determinants of road maintenance cost: a case of Western Kenya road projects

1.4 Objectives of the Study

The study intended to:

1. Establish the extent to which procurement process influence road maintenance cost in Western Kenya road projects.
2. Determine how categories of contractors influence road maintenance cost in Western Kenya road projects.
3. Assess how availability and cost of materials influence road maintenance cost in Western Kenya road projects.
4. Examine how environmental factors influence road maintenance cost in Western Kenya road projects.

1.5 Research Questions

1. To what extent does road procurement process influence road maintenance cost in Western Kenya road projects?
2. How do types of contractors influence road maintenance cost in Western Kenya road projects?
3. How do availability and cost of materials influence road maintenance cost in Western Kenya road projects?
4. How do environmental factors influence road maintenance cost in Western Kenya road projects?

1.6 Significance of the Study

Infrastructure is a generic term for basic structures and facilities that are essential to the generation of economic growth and development in modern economies. It covers many facilities generally referred to as economic and social overhead capital which include education, water supply, sewage systems, energy, postal and telecommunication services, transport systems, hospitals and roads (World Bank, 1994). The roads in Western Kenya have been plagued by a number of problems, with the major ones being faulty designs, inadequate drainage system and poor maintenance culture, which have significantly reduced the utility of the roads. There are potholes, washing away of pavements, fallen bridges, and others along most Kenyan roads. These problems have made it difficult, expensive and more arduous to move products and services from producers to consumers, farm produce from rural to urban centers, which often lead to loss of man-hours and high cost of goods and services. This does not take into account the man-hour losses in traffic due to bad roads and other emotional and physical trauma people go through plying the roads and the consequent loss in productivity.

1.7 Scope of the Study

The study was designed to determine the determinants influencing cost of road maintenance in Western Kenya road projects. Therefore, the study was limited to Roads Authorities in Western Kenya road projects targeting regional managers, contractors, road overseers, engineers and procurement officers. The study covered the following regional offices: Kenya National Highway Authority (KeNHA), Kenya Rural Roads Authority (KeRRA) and Kenya Urban Roads Authority (KURA).

1.8 Assumptions of the Study

The study encountered the following assumptions: the respondents were cooperate and gave correct and honest answers; Kenya urban roads authority maintains the roads and Kenya urban roads authority encounters challenges in the maintenance of roads.

1.9 Limitations of the Study

Several shortcomings were encountered in the course of research. However, the most notable ones were time, financial constraints, lack of cooperation from respondents due to inexperience in research as respondents and geographical area to be covered was wide.

1.10 Delimitations of the Study

The study was only limited to western region of Kenya covering Western and Nyanza provinces. The Study involved 90 respondents who were randomly selected. Major participants in this study involved employees from Kenya urban roads authority.

1.11 Definition of Significant Terms

Routine Maintenance: Routine maintenance is required to be carried out continually on every road, irrespective of its engineering features or volume of vehicular traffic. Routine maintenance expenses are treated as fixed-cost items in the maintenance budget. They include lane marking, drainage clearing, bridges and culvert maintenance, grass cutting and so on.

Recurrent Maintenance: This is required at intervals during the year. The frequency of this maintenance depends on the topographic and climatic characteristics of the area and the volume of traffic on the road. It involves maintenance of pavements for paved roads, repairing of potholes and grading for unpaved roads.

Periodic Maintenance: This involves major repairs or rehabilitation of those parts of the highway that have deteriorated over the years. The frequency involves intervals of some years. The activities include surface dressing or resealing and re-gravelling of shoulders for paved roads and re-gravelling for unpaved roads.

Emergency/Special Repair: This maintenance is carried out beyond routine, recurrent and periodic maintenance. It is caused mainly by unexpected substantial landslide, when a road is abruptly cut or a bridge washout occurs or it could be due to some seismic factors.

Foreign Exchange Rate (EXR): An over-valued exchange rate or highly distorted foreign exchange rate will discourage exports and negatively affect foreign direct investment. A real

depreciation raises the cost of imported capital goods, and since a large chunk of investment goods in developing countries is imported, domestic investment would be expected to fall on account of significant depreciation. On the other hand, a significant depreciation, by raising the profitability of activity in the tradable goods sector, would be expected to stimulate private investment in this sector but it depresses investment in the non-tradable goods sector.

Road Maintenance Cost: These are the cost involved in repair and maintaining of roads so that they are in good conditions for use.

Defect: means any form of failure in the road surface, including potholes, displaced pavement, cracking and road collapses. These types of failure can be structural and/or visual in nature.

Maintenance with respect to roads is defined to mean repairs to pavement failures. These repairs take the form of pothole patching to heavy patching. The purpose being to make the road trafficable until reconstruction works can be carried out by the Design Section.

Pothole means a whole or bowl-shaped depression in the pavement surface. They are due to the disruption in the surface of a roadway where a portion of the road material has broken away, leaving a hole.

1.12 Organisation of the Study

This study has been organised into five chapters. Chapter one looks at the background to the study on the determinants of road maintenance cost , statement of the problem, purpose of the study, objectives of the study, research questions, significance of the study, assumptions of the study, scope of the study, limitations and delimitations of the study and definitions of significant terms. Chapter two is comprised of literature review that is relevant to the research topic, and includes overview of road maintenance, policies on road maintenance, procurement procedures, categories of contractors, environmental factors, other factors and strategic options for optimal Road Maintenance. Chapter three provides a detailed methodology to be used into this research in terms of research design, target population, sample selection and size, research instruments, validity and reliability of instruments, data collection procedures and data analysis techniques. Chapter four provides data analysis and discussions while chapter five contains summary of study findings, conclusions and recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter comprises literature review that is relevant to the research objectives, and includes overview of road maintenance, policies on road maintenance, procurement procedures, categories of contractors, environmental factors, other factors and strategic options for optimal Road Maintenance. This forms the basis of the study whose purpose is to fill these research gaps.

2.2 Overview of Road Maintenance

World Bank's policy Study Report (1988) on *Road Deterioration in Developing Countries,* showed that, in the 85 countries that had received World Bank assistance for roads, allocations for road maintenance had been so low that nearly 15 percent of the capital invested in *main* roads roughly $43 billion, or about 2 percent of GNP had been eroded by the lack of maintenance. The specific figure for the Africa region was $5 billion, or about 3.3 percent of GNP. As a result, a quarter of the main paved road network, together with a third of the main unimproved network, needed to be reconstructed or would have to receive minimal maintenance. Reconstruction which would cost $40 to $45 billion world-wide could have been avoided by spending a mere $12 billion on preventive maintenance. The study also argued that if countries did not improve road management, the eventual costs of restoration would increase by two- to three times and the vehicle operating costs (VOCs) by even more.

Road transport grew rapidly after World War II and is now the dominant form of transport in SSA. Roads carry 80 to 90 percent of the region's passenger and freight transport and provide the only form of access to most rural communities. To handle this traffic, African countries expanded their road networks considerably during the 1960s and 1970s. They also built new roads to open up more land for development. The result was that, by the end of the 1980s, there were nearly two million km of roads in SSA, including 610,000 km of main roads, 938,000 km of rural roads, and 143,000 km of urban roads. These roads are some of the region's largest assets. Their replacement costs amount to over $150 billion, and required annual expenditures on routine and periodic maintenance to keep them in stable long-term condition are between $1.5 and $2.0 billion (Bahl and Roy, 1992.). In terms of assets, employment, and turnover, particularly with maintenance fully funded, Africa's roads are truly *big business*. They are generally far larger than railways or national airlines.

In spite of their importance, most roads in Africa are poorly managed and badly maintained. Almost without exception, they are managed by bureaucratic government roads departments. The poor state of the road network is reflected in the large backlog of deferred maintenance. It would take nearly $43 billion to fully restore all roads classified as being in poor condition (that is, requiring immediate rehabilitation or reconstruction) (Creightney and Cavelle, 1993). In other words, African countries have spent far too little on routine and periodic maintenance during the past twenty years. As a result, nearly a third of the $150 billion invested in roads has been eroded through lack of maintenance. Africa has been living off its assets. Restoring only those roads that are *economically justified* and preventing further deterioration will require additional annual expenditures over the next ten years of at least $1.5 billion. This amounts to

nearly one percent of regional GDP and would increase current road spending from one percent to nearly two percent of regional GDP. The remaining roads in poor condition will have to receive minimal maintenance or be handed over to lower levels of government and local communities.

The economic costs of poor road maintenance are borne primarily by road users. In rural areas, where roads often become impassable during the rainy season, poor road maintenance also has a profound effect on agricultural output. When a road is not maintained and is allowed to deteriorate from good to poor condition each dollar *saved* on road maintenance *increases* VOCs by $2 to $3.3 (NSRA, 2003). Far from saving money, cutting back on road maintenance *increases* the costs of road transport and raises the net cost to the economy as a whole. It is estimated that the *extra* costs of insufficient maintenance in Africa amount to about $1.2 billion per year, or 0.85 percent of regional GDP. About 75 percent of these costs must be paid with scarce foreign exchange. During preparation of the Integrated Roads Project in Tanzania, it was estimated that the annual economic costs of poor road maintenance were between $100 and $150 million. Likewise, during an RMI workshop in Kenya, it was estimated that the $40 million annual shortfall in road maintenance expenditure increased VOCs by about $150 million per year. In general, road maintenance and rehabilitation projects produce economic rates of return of over 5 percent (de Richecour and Anne, 1994).

The road network makes it easier to move goods and people from one place to another. It is the vital nerve for many people in the world. If the road does not work properly it will affect many urgent things in the society, like business profitability, investments, tourism, service levels and

the social life. The road condition will also have a great impact on the road user in action. It will affect his behaviour on the road for example, make him change speed, force him to do turning movements or even make him take another road if possible. It will also have impact on his economy. A road in bad condition will increase vehicle cost, increase travel time and might even give damage to the carried loads. It will also influence the accident rate and the comfort for the road users. This means that there are many reasons why the socio-economic consequences should be taken into consideration when allocating budgets for roads, when selecting roads for maintenance and rehabilitation and when choosing maintenance strategies for the selected roads (Svante, 2004).

Conventional socio-economic models for road user costs will generally not include costs and benefits for comfort, influence on the social life and for influence on industrial production and investments. These types of costs and benefits are difficult or sometimes even impossible to calculate. The road user cost (RUC) models usually deal with accident costs, vehicle operation costs and travel time costs. Traffic is a significant factor affecting the road user costs. Since 1990, heavy-truck travel has grown at a 50 percent greater rate than automobile travel. Many local agencies have identified wear and tear damage from heavy trucks on arterial streets as a rising factor in poor pavement condition. In Sacramento, trucks commonly use arterial roads due to the lack of cross-suburban freeways (MTP2035, 2006). A big improvement of the road condition on a low volume road will give a small reduction in road user costs for the whole society. A small improvement on a high trafficked road will give a big reduction for the whole society. An optimisation of the socio-economic costs on network level will minimise the total annual costs consisting of road manager costs and road user costs. A network model will

therefore give priority to good road conditions on high trafficked roads to keep the total costs on the lowest level.

Road maintenance according to Central Bank of Nigeria (2003) means the preserving and keeping of road structures as near as possible in their original state. It consists of correcting deficiencies that have developed as a result of age, use and the effects of the elements, and taking steps to prevent or delay the development of other deficiencies (FMW&H). Road maintenance is vital in order to prolong its life. Also well-maintained roads reduce the cost of operating vehicles by providing good running surface. Proper maintenance also keeps the roads open and ensures greater regularity; punctuality and safety of transport services (see Figure 1). Road maintenance is classified into the following categories:

The state of roads in developing nations has remained poor for number of reasons. The number one problem is poor quality roads, resulting from faulty designs, lack of gutters and very thin coatings that are easily washed away by floods and hardly withstand heavy traffic. Second, funding of road maintenance has been grossly inadequate. Third is the excessive use of the road network, given the undeveloped state of waterways and the poor state of the railways, which are alternative transport modes. In particular, the railways serve the purpose of transporting bulky goods, which are not good for road haulage. Fourth, there is lack of articulated programme for road maintenance. Road maintenance decisions are taken at the headquarters and are in most cases influenced by politics and not necessarily on the actual maintenance needs. For this reason most of the roads have been neglected (Research Department, CBN, 2004).

The longer the expected construction period, the more account will need to be taken of expected inflationary price increases over time. This is particularly important where a public authority's expenditure programme is involved. Initial cost estimates will need to allow for the value that will need to be paid at the time the project actually goes ahead. Levels of inflation vary amongst Member States/countries and can be as low as 1-2% or as high as 10% per annum. In some of the States higher inflation rates may be more typically.

The exchange rate is particularly relevant if contracting services or other elements of the project are being purchased from other Member States or from outside the Member States/countries. If exchange rates change beyond the level predicted by the project sponsor (and the companies providing the services) then the cost of the project can increase. It can of course operate in the opposite way where the project sponsor takes advantage of a strengthening of his own currency (Halcrow Group Limited, 2003).

From traditionally standpoint, the real exchange rate had not constituted an important dimension in the analysis of economic growth. The first generation of neo-classical economists did not consider exchange rate in the growth models or in their practical policy incarnations that focused on savings and investment as determinants of growth. The above indicates that these were closed-economy models that dictated that exchange rate; defined as the ratio of relative prices of non-treaded goods (all goods being non-traded in closed economies) had no role in the growth process. The literature on the impact of inflation on economic growth present extremely diverse opinions. In the 1960s, many economists believed in permanent output-inflation

trade-off due to Phillip curve. Contrarily, theoretical arguments from various researchers undermined the above opinion and relief. However, subsequent econometric investigations did not find any significant relationship between inflation and unemployment (Lucas 1990).

However, recent empirical researches detected long-run non-linear relationships between inflation and economic growth. The result of these empirical studies demonstrates that inflation has a negative impact on growth only if it exceeds a certain threshold. Otherwise, inflation has no adverse impact on growth nor accelerates growth. The level of threshold varies from various results obtained from various investigations, however, depending on a sample of countries, time periods and estimation methods. Besides, inflation distorts the tax system, and investors are uncomfortable with it because of money illusion. The level of inflation is positively correlated with its volatility. Greater inflation volatility is consistent with higher inflation rates and hence increase uncertainty and discourages long-term investment (Romer, 1990).

However, inflation possesses economic benefits as well. These benefits rest on three main arguments that favour positive inflation. First, there is a trade-off between inflation, tax and other indirect taxes so that government tax optimization translates to positive inflation. Second, a commitment by the policy makers to maintain low inflation restricts the Central Bank ability to respond to adverse supply shocks. This restriction may have been a major factor leading to stagnation of the Japanese economy during deflation of 1990 (Krugman, 1998). Third, and probably, the most important, inflation serves as a lubricant making nominal prices wages more

flexible (Lucas, 1990). A number of research studies reveal that prices and wages are more rigid in the downward direction than in the upward movement (Cover, 1992).

The lubricant inflation hypothesis is particularly important for fast modernization periods, during quick structural changes, require adequate changes in price proportions. In this case, strong disinflation efforts hamper economic growth. The need to carry out industrial and social policies can also create trade-offs between inflation and growth. Both kinds of policies may be necessary to promote sustainable growth, and both of them bring a risk of inflation. Real exchange rate dynamics, being result of inflation and nominal exchange rate change, attracts additional dimensions into the picture. The traditional theory treats real exchange rate as endogenous: The equilibrium level of real exchange rate is the one that ensures the equilibrium of the balance of payments (Calvo, Reinhart and Vegh, 1995).

In the long run, real exchange rate is believed to be the function of the level of the development of a country. There are several explanations why equilibrium exchange rate in poorer countries is well below Purchasing Power Parity (PPP) rate (Froot and Stein, 1991). References are usually made to Balassa-Samuelson effect (smaller productivity gap between developed and developing countries in non-tradable goods sector than in tradable, but equal wages in both sectors) and to Bhagwati-Kravis-Lipsey effect (non-tradable goods, which are mostly services, are among labour intensive, so if labour is cheap in developing countries, prices for service should be lower) (Polterrovich and Popov, 2006).

The Baassa-Samuelson effect states that, if productivity grows faster in sector producing tradable output (mainly goods) than in sectors producing non-tradable output (mainly services), and if wages are equalized across sectors with the result that economy-wide real wage increase lag behind productivity growth then the real exchange rate (EXR) can appreciate without undermining business profits,. For transition economies, the processes of real exchange rate (EXR) appreciation were studied in Grafe and Wyplosz (1997).

However, there is a lot of evidence that many countries maintain "a disequilibrium real exchange rate that is overpriced or under-priced as compared to the equilibrium level. Resource rich countries often maintain overpriced exchange rate that is imposing constraints on their economic growth. On the contrary, many developing countries (including those rich in resources) pursue the conscious policy of low exchange rate as part of their general export orientation strategy. The argument against a policy of low exchange rate is that it leads to monetary expansion and hence to inflation. Calvo, Reinhart and Vegh (1995) argue that the under-valuation of the exchange rate is inflationary in theory and were inflationary in practice for Latin American countries in the 1980s.It appears, however, that the effect depends on the instrument used to support low exchange rate.

According to Polterovich and Popov (2006), if a country uses foreign exchange accumulation to reach this purpose, then it has a good chance to escape high inflationary pressure. Rodrik (1986), and Polterovich and Popov (2006) developed models demonstrating how disequilibrium exchange rate in the presence of foreign trade externalities could lead to the acceleration of

growth. However, these studies did not consider the problem of inflation in detail. A related problem considered the impact of inflation and real exchange rate on the volatility of growth rates of output.

In a survey of literature, Aghion, Angeletos, Barnerjee and Manova (2004) as cited by (Polterrovich and Popov, 2006) reported a negative relationship between volatility and growth. Thus, policies aimed at promoting growth, if successful, are likely to reduce volatility as well, even though the mechanism of such spin-off is not well understood. There are empirical evidences that fluctuations in real exchange rate are crucial for explaining the volatility in open economies. Calvo and Reinhart (2000) argue that this volatility is much more harmful for developing countries than for developed economies so that fixed exchange rate regime is preferable for developing economies.

In fact, evidence of the link from exchange rate volatility to economic growth is less than definitive. While Ghosh and Wolf (1997) find no relationship between observed exchange rate variability and economic growth for a sample of 136 countries over the period 1960-89, Bailliu, Lafrance and Perrault (2001) report a positive association between a degree of exchange rates flexibility and economic growth. That the association is positive rather than negative leads to the suspicious that the result reflects the growth.

2.3 Procurement Process and Road Maintenance Cost

Project procurement involves selecting a contractor to undertake the construction of the project. The conventional approach to procurement of public sector projects involves advertising for firms to tender for the work. These invitations may be open to all companies or restricted to a shortlist of preferred bidders. All invitations for major projects in the public sector should be advertised in accordance with the Public Procurement Directive. A contractor will submit a tender which sets out the skills and experience of the company in undertaking the particular type of project, their proposed approach to the construction task, and their estimate of the cost of undertaking the work. Under the Roads Act 1993, the Council as the road authority is responsible for the care, maintenance and control of the public road (Lantran, 1990).

Where the private sector is relied on for the construction of roads, it is the bidding and contracting documents which are the foundation of the construction process. In recent years, as the process of contracting has quickly evolved, and contractors have experimented with new ways of acquiring new business and enhancing profit, there is an awareness of the need to refine these basic documents, particularly in the areas of risks and incentives. The construction industry has historically not dealt well with risk, leading to many failed contractors through poor planning, poor budgeting, and poor resource management (Sergio, 1991). On the owner's side, the push to minimize costs is often an absolute goal, regardless of market realities, resulting in impossibly low prices being accepted as part of bids and contracts which give owners all the rights and contractors all of the obligations. Many projects nowadays involve the procurement of contractors on a "design and build" basis where the contractor submits a design

and tender on the basis of a given specification. Some projects may also involve the contractor providing all or part of the finance for building the project and for operating it after completion. Various terms are used to describe these contracts; the most common being Design, Build, Finance and Operate (DBFO). The form of procurement and contract used by the project sponsor can alter the estimated cost of a project. Cost savings may be made by means of lump sum contracts although these are usually marginal in relation to the total project costs. DBFO contracts, which seek to transfer most of the risk of cost over-run from project sponsor to contractor, may in some circumstances yield savings (Lantran, 1993).

Experience shows that problems also arise from premeditated under-estimation of initial costs simply in order to obtain initial approval for a project. This can lead to major projects being approved, and started, in the knowledge that actual costs will be very much higher than the "agreed" estimate. Once started, a high profile infrastructure project is often politically difficult to stop. So, when the true costs do become apparent, it is difficult for authorities to refuse the additional funding required to complete the project (Sergio, 1991). During the development phase, covering both the first and second trial contracts, the works awarded to the small-scale contractors need to be exempted from regular government tender procedures. During the trial contracts, unit rates set by the government should be the basis for payment of works carried out by the contractors. Normally, government tender procedures prescribe that works of the size expected to be awarded to the small-scale contractors after the initial demonstration phase, are awarded after local competitive bidding and the involvement of a government tender board. In order to allow the contracting firms a chance to consolidate them in the market, it is

recommended to obtain a waiver from the standard tender procedures in the initial phase (Lantran, 1990).

It is of vital importance that this exemption is approved before a training programme commences. Since the number of contractors initially trained and qualified to carry out labour-based road works will be limited, it will take some time to establish a fully competitive environment. In order to maintain progress in terms of physical work outputs, it is in the interest of the government to retain all the firms and ensure that they are awarded a steady supply of works. Experience from other programmes has shown that during the first tenders, the contractors will "cooperate" amongst each other when bidding for the works. It is therefore not in the interest of the client to allow the unit rates to be determined freely by the contractors (OECD, 1995).

Once the contractors have successfully completed training, including the completion of the two trial contracts, it is recommended that further works is still awarded based on unit rates fixed by the government. This system could eventually be adjusted to allow variations on unit rates thereby gradually introducing a competitive environment. However, still wanting to secure work to all contractors, the competition aspect could be introduced in the form of awarding the biggest contracts to the lowest bidders. This also emphasises the importance of the government's role in monitoring the productivity rates on site in order to establish real performance and productivity rates as a basis for the calculation of the real costs involved in labour-based road works (Nilsson, 1993).

Contracts management procedures and documents for major works such as road rehabilitation and new construction should follow to the extent possible the existing procedures of the government. For routine maintenance works involving petty contractors, a complete set of simplified contracts documents and procedures are required. For rehabilitation and new construction works, there are at present two standard types of contracts available in Lao PDR which seems to meet the requirements of clarity and simplicity. One has already been used on a number of IDA funded road maintenance projects and the second standard contract is still being prepared within an ADB financed project, developing a Management Information System in MCTPC.

Before contracts are awarded to small-scale contractors to carry out rural road works, it will be necessary to review the new standard contract being developed by the ADB project to ensure that it is appropriate also when using labour-based methods. Furthermore, design standards and full works specifications for all site activities needs to be developed, which should be attached to the works contracts. For routine maintenance works, simple contracts have already been designed and are currently in use by the government. These will need to be reviewed in line with further development of the routine road maintenance system (Vientiane, 1996).

2.4 Categories of Contractors and Road Maintenance Cost

Contractors are practitioners who are authorized are to execute projects conceptualized and designed by consultants and under their supervision. They are typically categorized as local or international, the locals being further categorized as national or regional. Contractors are selected on the basis of price, experience in undertaking particular types of project and their

track record in producing high quality work within budget and on time (ROK, 2004). Problems may arise where there is a high level of development activity being undertaken in a particular region and the better contractors are not available to bid for the work at that time. Alternatively, the tender review process may not have been undertaken by the personnel with the best understanding of the services required. As a consequence, firms which are not the most experienced in that field of activity are chosen, often with implications for the quality and cost of a project (World Bank/OECD, 1990).

Contractors are admitted to practice through the process of fragmented application to, and evaluation by the user Ministry concerned. The process is purely administrative and not leaning on any legislation. Most of the Ministries classify contractors from Class H through Category A. Class H is the lowest categorisation and A is the highest. The definitions of the H to A categories are different in different user ministries, so that the qualification criteria for H-contractors in one Ministry may have no relation to a H-Contractor in another user ministry as each ministry exercises its assigned mandate independent of other ministries. Evaluations are done on the basis of qualifications, equipment, and audited expenditure outturns among other criteria. The evaluations and category assignments done under these schemes are actually done administratively by officers in a given ministry (ROK, 2004 and MOR, 2011).

Delays in project implementation and increases in costs can arise through the use of ineffective or inappropriate labour, or errors in calculating how productive the labour will be. This can happen especially when sub-contractors are used whose quality is not controlled in the main project contract. In most cases there is a trade-off between price, experience and track record

but the desire to accept the lowest tender does not always lead to a project that is completed within time and budget. There are cases of contractors and sub-contractors who go into liquidation during the construction period. This can lead to significant delays and extra costs arising as the project sponsor has to re-tender the remaining work. Identifying a new contractor to complete another contractor's work is difficult because of the possible liabilities that the new contractor would have to accept for another company's work (Ekdahl, 2001).

The size of the contracting firms is important when identifying and selecting appropriate contractors to participate in labour-based road works. The optimal solution is to target contractors who would use labour-based methods as a main source of livelihood. Large contractors are normally not interested in labour-based works contracts since the contracts are considered to be too small. Common selection criteria used for contractors are: ownership of equipment, o supervisory capacity, o access to capital, background of company, that is, track record, o size of company, and residence. Since most small-scale contractors have limited experience from the road sector, most of the contractors selected in other programmes have been recruited from the building industry, others were transport contractors. Before a programme involving the domestic contracting industry is formulated, it is important to identify the various types of contracting firms which operate in the country (Vientiane, 1996).

The petty contractor is generally referred to as a one-man contractor. This category of contractors usually consists of one man firms, sometimes assisted by a limited amount of unskilled workers. They may be labour contractors, usually consisting of a businessman sub-contracted to carry out specific work, relying mainly on unskilled casual labour. Organised local

community groups such as farmers associations and village welfare groups can also be classified as petty contractors. A common feature for this group is that they are not formally registered and do not possess any capital and are therefore extremely vulnerable to cash-flow problems such as mobilisation capital and late payments. The petty contractors normally do not possess any equipment, and lack any means of transport. Due to their lack of mobility, they should be recruited from the vicinity of the work sites. These contractors are mainly used for maintenance works or simple, clearly defined sub-contracts requiring a minimum of skilled labour and equipment. A length man system, securing the routine maintenance of rural roads, may be a potential market for petty contractors. In addition, such firms can be utilised for contracting out masonry works for small bridges and culverts (Vientiane, 1996).

Most domestic small-scale contractors are found in the building construction industry and the transport sector, and are normally registered companies. Often limited, they still possess certain technical and managerial skills. However, experience shows that their organisation requires further training in business management, accounting, mechanical maintenance, road and concrete technology, as well as in labour-based work methods. Their equipment fleet is sparse and often old and poorly standardised. Before they can be awarded road rehabilitation works, it is usually necessary to assist them in the acquisition of additional light construction equipment (that is, hauling and compaction equipment) (Vientiane, 1996).

Similar to the petty contractors, the small-scale contractors are often under-financed and vulnerable to cash-flow distortions. Often, these contractors do not operate their accounts through a bank. In many cases, the local banks do not consider these firms as attractive clients

and therefore do not provide them any services. The main advantage of involving existing small-scale contractors is that this group can provide evidence of entrepreneurial skills through the works they are currently involved in. Although some of these firms are mainly involved in building works, they can provide a business entity, and an established organisation with administrative, financial and technical staff which could be further trained and developed to cater for the requirements of a rural road works programme. After receiving appropriate training and development assistance, these contractors prove to be highly efficient in carrying out both road construction and maintenance works. In other countries, they have shown good entrepreneurial drive, and given favourable conditions for their operation, such as a steady supply of work and regular and timely payment, they can survive as sound construction firms and constitute an important component of the domestic construction industry (Lantran and Morse, 1995).

Large-scale contractors are often subsidiaries of large foreign multi-national companies which have good access to capital, equipment and skilled labour. These contractors participate in international competitive bidding and are often only present in the country while they are carrying out a works contract. Once their assignment has been completed, they leave the country, including evacuating equipment and skilled personnel. Due to this, their involvement provides a minimal technology transfer to the recipient country, resulting in a low sustainability and little institutionalisation of skills and experience. In most cases, they regard the size of labour-based road contracts as too small for their interest. For these reasons, this category of contractors is not regarded the appropriate beneficiary target group for training and development assistance (Rausch, 1994).

While adoption of competitive bidding for road and other civil works has been the norm in most countries of the world, some countries do not have a sufficient industry of independent contractors and road works are mostly done by force account or awarded to state construction agencies on a negotiated basis. In many of these countries, not only are cost high and quality low, it is common for suppliers of construction materials and services to have monopoly power, further increasing inefficiency and lowering quality. In these situations, it is a combination of transferring work from the public to private sector and the introduction of competition into operations that is often the best way to decrease inefficiency and improve quality. Introducing competitive bidding into public works contracts is also often an important first step to this goal. Secondly, the contracting out of the works function requires the introduction of competition into the operation of road agencies themselves, either by the greater use of existing private contractors, or by allowing public sector agencies to compete with the private sector (Lantran and Morse, 1995).

2.5 Availability and Cost of Raw Materials and Road Maintenance Cost

During periods where the level of development activity is unusually high in a particular region, there may be shortages of some construction materials, construction plant (machines and equipment used during construction) and service plant (equipment used in the operation of the infrastructure project). If this was not anticipated in the original cost estimate, delays may occur and/or the prices of these elements increase (Arvidsson and Holmgren, 1999). The road marking sector is facing an imminent crisis resulting from a shortage of base raw materials used in road marking product; this shortage jeopardises both the production of materials and the economics

of the sector and significantly could have major implications for road safety. These raw material shortages are based around the restricted supply/availability of both resin used as binder in thermoplastic and cold plastic road marking materials and the production of high friction surfacing, combined with a similar scarcity of titanium dioxide used to whiten road marking materials in order that they meet their performance criteria (Lee, 2010).

There is grave concern within the road marking sector over restricted availability of both rosin esters, gum resin and hydrocarbon resin materials that are used as binders in the manufacture of both thermoplastic and cold plastic road marking materials and high friction surfacing. This raw material shortage is not just limited to the road marking sector and is impacting upon all polymer manufacturing processes. The major difference in respect to the road marking sector is that these shortages have the potential to have a major impact on the safety of roads. The restricted availability of these raw materials, whereby all UK manufacturers (and it would appear Continental and worldwide manufacturers) of these materials are receiving rationed supplies, is leading to interrupted manufacture of finished materials and therefore a potential restriction in the capacity of the road marking manufacturing sector to meet the demand for finished materials from contractors and their clients within national and local highway authority clients. This shortage of essential raw materials is to be based on the coalescence of a range of factors that individually may not have led to a critical situation but collectively risk interruption of supply of road marking materials in the UK and beyond (Blas and Lee, 2010).

The direct impact of material and plant shortages has been two-fold: the rationing of supply of raw materials to material manufacturers (in the UK this is predominately thermoplastic

manufacturers), leading to interrupted production and reduced volume output. The specific impact is that stocks of thermoplastic materials in the UK which would normally be increasing at this time, to supply the busiest road marking period of May to October, are currently declining. As a result of the interrupted nature of supply of raw materials many manufacturers are having difficulty in both meeting current demand and in predicting how long they can sustain continuity of supply. Some manufacturers estimate that supply may be down to as little as two weeks to satisfy contractual commitments. There are a number of critical situations already starting to develop; for example, a major road in the Republic of Ireland is scheduled to open in three weeks, however, the contractor concerned has no guarantee of supply of materials with which to undertake the work. There is evidence from manufacturers in the UK that this is a situation that is likely to develop here within the next two to three weeks (mid to late May 2010) (ICIS News, 2010).

Increased factory gate prices: with increasing raw material costs related to resin/rosin shortages currently estimated to be running in excess of 60% over 9 months, there is unavoidable pressure on manufacturers to increase their factory gate prices or face financial ruin. At current levels of raw material supply manufacturers indicate that, without intervention at a higher (governmental) level, interruptions to the installation of road markings could start by the middle of May 2010 (UK). Should supply fail then it is possible that other essential road maintenance activities such as surface dressing and resurfacing, particularly vital following our harsh winter may have to be suspended until supply difficulties ease (Lee, 2010).

The level of increases in raw material prices has led to significant upward pressures on factory gate prices and whilst actual increases will be a matter for individual manufacturers as this will inevitably lead to some level of increased cost in road markings as installed. Initial research by the RSMA puts this increased cost in road markings, as installed by contractors, in the range of an estimated 6.2% to 9.5%, which, if not passed onto clients will lead to a substantial level of business failure amongst contractors. Clearly there is pressure in this area as many contractors are working on contracts with restricted capacity (and in some case willingness from clients) to raise output costs. The combination of rapidly escalating fuel prices in part exacerbated by Government's decision to remove the sector's red diesel exemptions in 2008 and material cost pressures will have a significant impact on the sector for the foreseeable future leading potentially to significant business failures across the sector (Peng and Reuters, 2010).

It is hard to provide a specific answer to the question of how long the constraint on supply may last. Increased prices should (in a non-distorted market) encourage a large harvest of Gum Resin in China during the 2010 season. In a perfect environment this would suggest that increased supply should start to reach the UK market place by August 2010 (allowing time for harvest, processing and shipping), notwithstanding the potential of interference in (supply to) the market in order to sustain higher prices this timescale is likely to be insufficient to guarantee uninterrupted supply of road marking materials in the UK for the foreseeable future (Gordon-Walker, Harle and Naismith (2007). In respect to C5 production, as indicated above, the change in processing practice means that the levels of production of this resin are unlikely to reach levels common under heavy oil processing, although production levels should rise significantly now that Exxon have resolved their production problems. It is clear from even a rudimentary

analysis of the available information that presuming supply was to return to normal the issues of cost inflation is likely to sustain and that prices are unlikely to return to the position prior to shortage (ICIS News, 2010).

Sectors similar to the road marking sector have, in recent years, faced similar circumstances not least the high friction surfacing industry where shortages in bauxite supply around the period of the 2008 Olympics have led to discontinuity of supply ever since and a long term significant rise in raw material prices. Such increases in costs have arguably jeopardised the viability of the high friction sector. It is expected that the longer term implications for the road marking sector are likely to include on-going inconsistency in supply and the potential for significant long term price instability. Should supply return to anything approaching what is deemed to be 'normal' levels within the next 6 months then there is an expectation that the price inflation that has seen resin prices double between 2008 and April 2010 will lead to a longer term price far in excess of historic values (Peng and Reuters and Lee, 2010).

The shortage of the resin/rosin raw materials is being exacerbated by a similar constraint in the supply of titanium dioxide to the sector. Initial research indicates that this shortage may also be in small part be due to the control of commodity supply by some nations and corporations however the principal cause is as a result of a fatal explosion at a production facility in Grimsby which resulted in a six week closure of the plant (which only comeback on stream in early April). The Grimsby plant's capacity is 150'000MT per annum across a number of grades – multipurpose, plastics, paper/laminates. UK demand for TiO2 is estimated at approximately 110'000 MT. The impact of these factors has been to see a rise in the cost of this essential raw

material of circa 100% since April 2009, whilst supply has been constrained with manufacturers unable to secure adequate supplies at reasonable cost (Lee, 2010).

Based on the results of the rudimentary survey undertaken by RSMA of manufacturers producing 90% of the road marking materials installed on UK roads shortages of supplied materials will start to impact from late May; with less than 45% of road marking material demand being met by the end of June 2010. This is based on manufacturers still being able to source the resin/rosin raw materials they have been promised by suppliers. The shortage in availability of Titanium Dioxide merely compounds this shortage, although it would appear to have no additional supply impact in its own right on finished product (NSRA, 2002). The escalation in cost of both raw materials, will, according to manufacturers, have an impact on factory gate prices for thermoplastic materials, with an average rise in costs of 20% being a reasonable estimate. This would translate into an estimated rise in application costs of between 6.5% and 9.5% depending on the type of marking being installed (Lee, Peng and Reuters, ICIS News, 2010).

2.6 Environmental Factors and Road Maintenance Costs

Environmental factors affect both maintenance efforts and the deterioration of the paved lanes. Although no clear relationship has been established between the climate factors and the pavement damage, it is believed that these factors do influence the extent of damage (Kazakov, Cook and Roll, 1989). Climate data, extracted from the National Climate Data Center, is a reliable dataset of four important variables: "Minimum Temperature", "Maximum Temperature", "Total Rainfall", and "Total Snowfall" for all the counties under analysis over

the fiscal years 2003 till 2007. Average of snowfall and rainfall is also treated as a new variable named "Precipitation". One other variable extracted from the data is the monthly average of difference between minimum and maximum temperature. This variable which is called "Temperature Difference" aims to capture the effects of freeze and thaw cycles for which the data was not available. Particularly in winter, when a significant thawing (due to high temperature) is followed by full freezing (due to low temperature), water is trapped in the pavement's base, causing volume shift and pavement blow ups (Kazakov, Cook and Roll, 1989). Since the road sections under analysis have not been affected by natural hazards such as earthquake, such these factors do not need to be considered in this analysis.

Significant attention to the road maintenance (highways and bridges) in the last two decades, especially given unfortunate events such as the collapse of a major bridge in Minnesota in 2007, is attributed to the fact that with the construction of the Interstate system, the focus of transportation programs has been moving from capital investment to maintenance and operation (Ozbek, de la Garza, and Triantis, 2008). This change has caused an emerging need for maintenance managers to achieve maximum performance from the existing road systems especially when faced with major budgetary restrictions (TRB, 2006). In these conditions, implementing the efficiency monitoring tools to evaluate the performance of road authorities (districts and counties) who are responsible for the maintenance of the road in their administrative area has significant benefits for the state's Department of Transportation (DOT). From the perspective of top management, a performance evaluation system can differentiate the efficient units (counties or districts) from less efficient ones. This system should track the effects of environmental conditions (climate condition), pavement conditions and/or the effect

of privatization on maintenance effectiveness (Kazakov, Cook and Roll, 1989). As a result, efficiency evaluation can significantly help with budget planning and the design of maintenance policies and best practices.

Road maintenance is a process that is highly affected by the uncontrollable factors of the environment (such as climate, terrain and location) as well as the uncontrollable factors representing the operational difficulties (such as traffic, load, traffic accidents and aging) (Ozbek, 2007). Thus, special attention should be given to the environmental factors when evaluating road maintenance performance since these factors can be the main "cost and process" drivers (Rouse, Puttterill, and Ryan, 1997). As a result, explicit consideration of the uncontrollable factors affecting performance of highway maintenance operations should be an important and essential part of any performance measurement system in this setting.

Location affects project costing via availability and cost of materials and through geographical realities. Availability and cost of materials can affect initial project cost estimates in a number of ways. Consents procedures in particular may be more arduous in some countries, affecting the time it will take to successfully implement a project. Allowance for the costs involved in sustaining a long public consultation exercise is an example. Where major projects are likely to be strongly opposed on environmental grounds, more cost may have to be allowed for environmental mitigation measures.

In geographical terms, construction and material costs, land costs and design standards vary widely across the countries because of the varying distances from suppliers, climate and

weather conditions, and general market conditions. Even within a country, variations will exist depending on whether a project is being implemented in a peripheral or central area, or in an urban or rural context (Ekdahl, 2001). Generally, the more remote a project is, the more expensive it will be because of the cost of transporting construction materials and equipment to the site. In an urban location, land costs are usually much higher (see Figure 2).

A site can be affected by soil and drainage conditions and access restrictions which can affect the original cost estimates. The amount of excavation, piling and foundation activities required are particularly affected by poor ground conditions. Where there is uncertainty about ground conditions, accurate project costing cannot be achieved unless a soil survey is undertaken. This may require the sinking of boreholes to obtain soil samples at different levels beneath the surface (NSRA, 2002).

Ground conditions can be assessed by a desk-based review of relevant published documentation and through the use of trial pits and borehole sampling onsite. However, the actual site conditions for the full extent of a project are not usually determined until construction begins. It is possible those difficult conditions are overlooked by the initial review or that conditions have changed due to adverse weather conditions or changes in sub-soil conditions. Unexpected sub-surface conditions can, at times, require fundamental redesign of projects at great expense. Changes in surface ground conditions can lead to problems in actually moving machinery and supplies around the site, and in undertaking excavations and laying foundations. This can also increase costs and add to the construction time required (Gordon-Walker, Harle and Naismith (2007).

Force Majeure: This term covers a range of events which are also commonly referred to as "Acts of God". They include revolution, war, riot, extreme weather, earthquake, landslip, fire, political and economic instability. Usually, the contractor is required to insure against such events happening. Where they do occur, they will normally lead to significant delays occurring and, consequently, cost increases.

In order to capture the effect of traffic on pavement deterioration, the Annual Average Daily Traffic (AADT) data is used. AADT is the annualized average 24-hour volume of vehicles at a given point or section of highway. It is normally calculated by determining the volume of vehicles during a given period, and dividing that number by the number of days in that period. Obviously, large values for AADT increase the extent of pavement deterioration and require greater maintenance effort. In addition, AADT affects the performance of the maintenance crew due to lane closures, equipment utilization, and scheduling issues. Thus, "Traffic" is considered as an uncontrollable input variable in this paper and captures the operational conditions under which maintenance activities are performed (Saeidah and de la Garza, 2009).

Loads are the vehicle forces exerted on the pavement (for example, by heavy machinery) and obviously cause pavement degradation over time. In order to quantify the load, the concept of Equivalent Single Axle Load (ESAL) has been used. ESAL is a variable used in the department of transportation to convert the pavement loads of various vehicles into the load of an 18,000 pound single-axle load. VDOT publishes the percentages of AADT for six different types of vehicles each year. Multiplying AADT by vehicle distribution percent gives the number of vehicles of each type. These values are multiplied by their corresponding ESAL factors

developed by AASHTO (American Association of State Highway and Transportation Officials) and are added together to form the load corresponding to the traffic being imposed to a specific section of the road (JLARC, 2002).

2.7 Other Factors Affecting Road Maintenance Cost

2.7.1 The Project Specification

The specification defines the physical attributes of a project. With a road, for example, given levels of forecast traffic will lead to specification of the required length, depth and width of the road pavement, the material to be used for surfacing, the number of lanes, bridges and junctions etc. For buildings, the required function and expected occupancy rate will lead to a specification of total floor space and floor plate size, height, internal and external appearance, floor loadings, heating and lighting requirements etc. Generally, the more detailed the specification and the larger the project, the more expensive it will be.

2.7.2 Time Scale

Generally, the longer a project takes, the greater the project costs will be. Project timescales are dependent on the specification of a project. Usually, the larger a project is the longer it will take to implement. This is not always the case; if substantial additional resources are used, project implementation can often be accelerated. In some cases, work on a project may take a lot longer than expected because its phasing is dependent upon other, linking projects or public finance programmes. A project which involves non-continuous phases is usually more expensive than

one undertaken without interruption because of the additional costs involved in re-mobilising plant and contractors.

The overall lack of finance to complete a project, or delays in the payment for services by the project sponsor can lead to significant problems arising. If the costs of a project have increased significantly beyond the original estimate, then work on the project may have to stop or be delayed until additional funds can be found. Funding problems can also arise if funds allocated to one project have been diverted to other projects within a programme of development. If the payment of invoices by a project sponsor is slow, the contractor may begin to commit less resource to a project, and may even cease work if cash flow becomes a problem (Arvidsson and Holmgren, 1999).

In some cases, even when a project is expected to be entirely profitable, project sponsors may understate the availability of local funding simply in order to maximise the level of grant. This can happen with revenue-generating projects particularly. Such practices can reduce the availability of funding for other projects.

2.7.3 Design Changes and Poor Project Management

A change in a project's design can arise for a number of reasons. It may be that the project sponsor wants additional elements to be included in the project or changes to existing ones. Usually, these design changes require additional time inputs from architects and engineers as well as the additional time and cost inputs from the contractor and for additional materials. The role of the project manager or project management team is probably the most important element

in containing the costs of a project. It is often true that a poor project with a good project manager will be completed satisfactorily. But even a good project, if combined with poor project management, will almost always face serious difficulties. A poor project management structure will have an impact at all stages of the construction process leading to: a lack of planning and coordination; poor communication between members of the project team and the project sponsor; failure to identify problems and institute necessary design and programming changes; a lack of control over time and cost inputs (TRB, 2006).

2.7.4 Tax Liabilities

An organisation will be liable to pay tax on its purchases. Some organisations and types of project are not liable to pay taxes, or else these can be reclaimed. Local government projects and infrastructure for public use are examples. Some public or quasi-public sector companies, voluntary and private sector organisations can be liable and these tax costs can have a significant impact on gross construction costs (TRB, 2006).

2.8 Strategic Options for Optimal Road Maintenance

This section review ways in which the cost and time management of projects can be improved by risk management and by more realistic estimation of contingency budgets.

2.8.1 Uncertainty in Project Costing

The preparation of project cost estimates is a difficult task because construction projects are subject to risks and uncertainties, particularly in the early stages when very limited information about the project is available. Yet, the cost estimates prepared at this stage are most important to

the project sponsor because they often form the basis of the bid for funds. As a project progresses, more information becomes available to allow costs to be calculated to a greater degree of accuracy, for example the ground conditions on-site or the specific types of plant or machinery that will be provided. More reliable cost estimates become available after tenders have been received from contractors (UM, 2004).

Nevertheless, many aspects remain uncertain and normal costing practice is to include an extra element to provide "insurance" against cost over-runs. The word "contingency" is usually used to describe this additional cost element, that is, different amounts are typically allowed in different types of projects. The contingency is typically based on a "rule of thumb" calculation, as a certain percentage of the base cost estimate or a lump sum based on the experience of the estimator. A figure of 10% of gross costs is a common allowance. This risk allowance or contingency sum is often calculated only once and is not reviewed again as the project progresses.

The main weakness of this simple approach to contingency costing is that individual risks are not separately evaluated. As a result, a contingency is often set too high for low risk projects, or too low for high risk projects. In addition, it is not always appropriate to carry a specific contingency allowance for the duration of a project since many of the risks become known and can then be eliminated.

2.8.2 Risk and Contingency Planning

By giving greater attention to which cost determining factors are most likely to change, and why, project sponsors should be able to develop more accurate contingency estimates. This in turn should reduce the risk of cost over-runs. Poorly managed risk affects the ability of a project to be completed within time and on budget. On the other hand, the level of risk can often be reduced if project sponsors take the time to identify, assess and manage the main factors leading to cost escalation. Although a potentially complex subject, risk management basically involves three quite simple stages: (i) risk identification: what could go wrong? (ii) risk assessment: it is possible to quantify or at least rank any of the risks? (iii) risk management: what steps can be taken to mitigate or manage these risks in order to prevent cost over-runs? (Olsson, 2002).

Once the risks have been identified and assessed, they must be continuously monitored until the end of the project. Although careful risk assessment typically results in an increase in initial cost estimate, it usually leads to a reduction in contingency. Risk management measures are worthwhile because they lead to a more certain final project cost. Often it is not clear what is actually contained within a project's contingency budget. As noted above, it could just be a general percentage estimate. In careful risk management the contingency allowance for larger projects should cover three main types of contingency:

i. Special risks contingency – an allowance to cover the risks arising from higher land acquisition costs, changes in external factors such as the availability of funds, statutory requirements and force majeure. It can also cover the risk of a project

sponsor changing his mind about the project specification (a fairly common occurrence).

ii. Design contingency – an allowance for use during the technical design process to provide for the risks of changes due to design development or in estimating data.

iii. Construction contingency – an allowance for use during the construction process to provide for the risk of changes due to site conditions or as a result of changed construction methods or poor performance by contractors or sub-contractors.

The use of a better specified contingency will only be effective if suitable project control procedures are in place to control all aspects of project performance. Project control procedures should be organised and managed by the project manager. They should provide essential, coherent management information so that the project sponsor and project manager can react to changing circumstances (UM, 2004).

2.8.3 Project Management

Finally, improved contingency planning can never be a substitute for good project management. The essential elements of good project management are: (i) cost control: managing the design and construction processes to achieve best value for money and ensuring that the final cost does not exceed the budget. (ii) Time control: managing the design and construction processes so that the project is completed on or before the agreed completion date. (iii) Quality control: ensuring that the quality and performance of the completed project meets the project sponsor's original objectives. (iv) Change control: ensuring that any changes that are necessary are achieved

within the approved budget, that they represent good value for money and that authorisation to proceed has been obtained from the project sponsor (Olsson, 2002).

2.9 Conceptual Framework

The Conceptual Framework in Figure 1 shows how the independent variables (determinants ranging from procurement process, categories of contractors, availability and cost of raw materials and environmental factors influence the cost of road maintenance this relationship was moderated by government policies like funding policies and corruption rate. The direction of arrow show interrelationships between determinants of road maintenance cost in Western Kenya road projects.

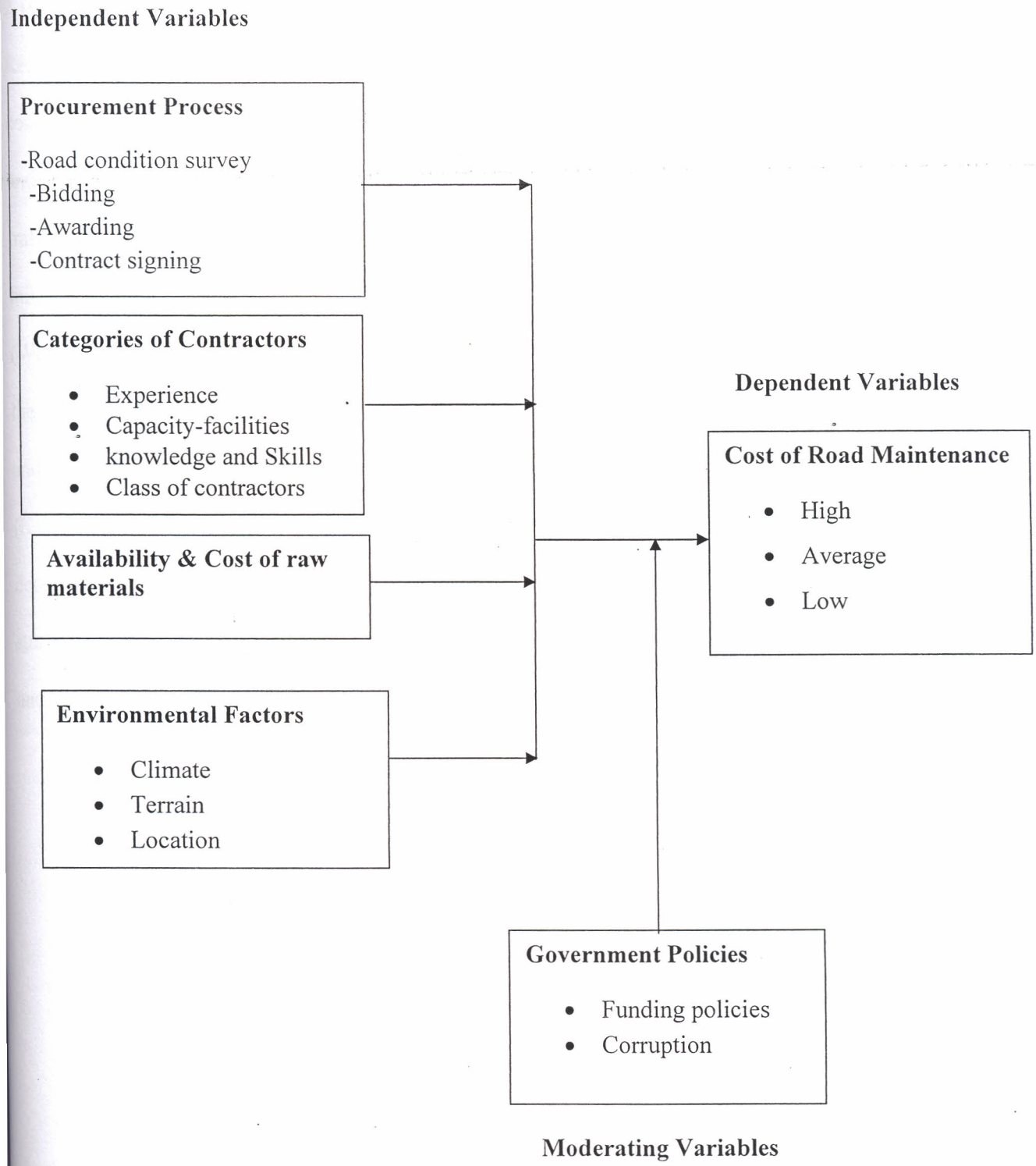

Figure 1: Conceptual Framework showing how Determinants Influence Road Maintenance Cost

2.10 Knowledge Gaps

Research has shown that proper road maintenance contributes to reliable transport at reduced cost, as there is a direct link between road condition and vehicle operating costs (VOC) (Harral and Faiz, 1988). Road maintenance cost has been attributed to myriad of factors like the type of traffic and the construction industry historically not dealing well with risk, leading to many failed contractors through poor planning, poor budgeting, and poor resource management (Wells, 1986). Environmental factors affect both maintenance efforts and the deterioration of the paved lanes. Although no clear relationship has been established between the climate factors and the pavement damage, it is believed that these factors do influence the extent of damage (Kazakov, Cook and Roll, 1989). Furthermore little or no research has been carried out on the determinants of road maintenance cost in Western Kenya Roads Projects, and therefore, this study was carried out to establish the relationship between environmental factors like climate and road maintenance cost.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter consists of the research methods to be used in carrying out the study. It includes research design, target population, sampling procedures and sample size, research instruments, validity and reliability of research instruments, data collection procedures and data analysis techniques.

3.2 Research Design

This study adopted a descriptive survey design. Descriptive Survey research is a research method involving the use of questionnaires and/or statistical surveys to gather data about people and their thoughts and behaviours. A survey is an attempt to collect data from members of a population in order to determine the current status of that population with respect to one or more variables. Yin (1984) argues in favour of the use of descriptive surveys in fact-finding because they provide a great deal of accurate information. The intention of survey research is to gather data at a particular point in time and to use it to describe existing conditions. The descriptive nature of research was used in order to gain information on determinants of road maintenance cost in Western Kenya Road Projects.

3.3 Target Population

The research was conducted Western province having three major regions: KeNHA, KERRA and KURA. KERRA has four sub regions namely Vihiga, Kakamega, Bungoma and Busia. These three regions had a workforce size of 120 contractors and 54 employees: six region managers, 24 road overseers 12 engineers and 12 procurement officers that form the population of the study (Roads Authorities Western Regional Offices, 2012).

3.4 Sample Size and Sampling Procedure

This section was discussed under the sample size and sampling procedure.

3.4.1 Sample Size

In a target population of 491 respondents, a sample size of 90 respondents was obtained using Nassiuma (2000) coefficient of variation.

3.4.2 Sampling Procedures

To ensure appropriate representativeness of all geographical segments of the study area multi-stage sampling will be adopted. The first stage involved cluster sampling aimed at allocation of specific numbers of respondents to each of the regions. This ensured coverage of all the six regions in the study (KURA = one region; KeNHA = one region and KERRA = four regions). The second stage involved proportionate sampling aimed at allocation of specific number of respondents to each region according to the total number of respondents in each of the six regions. This was followed by the selection of individual respondents using simple random

sampling process. Simple random sampling procedure was selected because according to Kathuri and Pals (1993), it allowed for generalization of research findings to a large population with a margin error that is statistically determinable and hence correctable.

The sampling procedure was guided by the general rule in most social science research which suggested that the use of the largest sample will facilitate generalization (Kline 1980). The simple random sampling or probability sampling was used so that each and every one in the target population had an equal chance of inclusion to select respondents from a total population of 491 (Roads Authorities Western Regional Offices, 2012). A census study was done in all the six regions. Stratified sampling was used to determine the number of respondents in the area of study: KeNHA (1), KERRA (4) and KURA (1) as shown in Table 1. The sample size of respondents was obtained using coefficient of variation. Nassiuma (2000) asserts that in most surveys or experiments, a coefficient of variation in the range of $21\% \leq C \leq 30\%$ and a standard error in the range $2\% \leq e \leq 5\%$ is usually acceptable. It does not assume any probability distribution and is a stable measure of variability. The researcher therefore, used a coefficient variation of 21% and a standard error of 2%.The lower limit for coefficient of variation and standard error were selected so as to ensure low variability in the sample and minimize the degree or error.

$$S = \frac{N\,(Cv^2)}{Cv^2 + (N-1)\,e^2}$$

Where S = the sample size

N = the population size (491)

Cv = the Coefficient of Variation

e = standard error

Therefore, the selected sample size will be:

$$S = \frac{1031\,(0.21^2)}{0.21^2 + (1031-1)\,0.02^2} = 90.184 = 90 \text{ contractors}$$

Table 1: Sampling Frame

PERSONNEL	KERRA REGION				KURA	KENHA	TOTAL	SAMPLE SIZE
	Vihiga	Kakamega	Bungoma	Busia				
Regional Manager	1	1	1	1	1	1	6	6
Engineers	1	1	1	1	2	1	7	7
Road overseers	4	9	5	6	3	2	29	9
Procurement officers	2	2	2	2	2	2	12	12
Contractors	100	100	100	100	20	17	437	56
TOTAL							**491**	**90**

Therefore, purposive sampling was used to select all regional managers (6), all engineers (7) and 12 procurement officers and 9 road overseers (30/100 x 29 = 8.7) were selected based on Kothari (2003). According to Kothari (2003), 30% of the sample is a representative of the entire population. Therefore, the remaining (91-34 = 56) sample size of 56 respondents were for contractors who were allocated in each of the six regions using proportionate sampling: Vihiga (13), Kakamega (13), Bungoma (13) and Busia (13) each got 100/437 x 56 = 13 contractors while KURA will get 20/437 x 56 = 3 and KENHA gets 17/437 x 56 = 2.

3.5 Data Collection Instruments

The tools that were used in conducting this research were questionnaire, interviews and documents reviews. The researcher chose this tool because it was familiar to most people. Nearly everyone has had some experience completing questionnaires and it generally does not make people apprehensive. When respondents receive a questionnaire in the mail, they are free to complete it on their own time-table. The questionnaire is a convenient tool especially where there are large numbers of respondents to be handled because it facilitates easy and quick derivation of information within a short time (Kerlinger, 2004). The structured (closed-ended) and unstructured (open-ended) were used so as to get the responses from respondents (contractors, engineers and procurement officers). The closed-ended questions provide a greater uniformity and more easily processed (China and Oteng'i, 2007). The structured questionnaires were accompanied by a list of all possible alternatives from which respondents select the suitable answer that describes their situation by simply ticking (Mugenda and Mugenda, 2003). The questionnaires were administered by the research assistants to avoid misinterpretation of questions by 'drop and pick' technique. The responses were gathered in a standardised way, so questionnaires were more objective. Generally it was relatively quick to collect information using a questionnaire.

The researcher used interview schedules since it provides face-to-face interaction with respondents (regional managers) and enabled the researcher to adapt the questions as necessary, clarify doubts and ensure that the responses are properly understood, by repeating or rephrasing the questions. The researcher can also pick up nonverbal cues from the respondent. This tool also gave the researcher an opportunity to get a chance to probe the key informants on issues

that may not be captured in the questionnaire. Prior to taking part in the interviews, the researcher intends to give respondents an opportunity to adequately prepare themselves for the interview. It is anticipated that this will enable the interviewees to give accurate and relevant information.

3.5.1 Pilot Testing

Before the researcher goes out to collect the actual data, pilot testing was done in KURA in the former Rift Valley Province which were not be used in the final analysis. This helped the researcher to identify the problems that were bound to occur, especially when it came to filling in the questionnaire. This enabled the researcher to make the necessary corrections on the final copies of the questionnaire before they were issued out.

3.5.2 Validity of the Instrument

Validity refers to the degree of accuracy and meaningfulness of inference based on research results. Content validity refers to the degree to which the content of the items reflects the content domain of interest (Miller, 2003). "Validity refers to the degree to which evidence and theory support the interpretations of test scores entailed by proposed uses of tests (AERA/APA/NCME, 2000). Best and Khan (2005) suggest that the validity of the instrument is asking the right questions framed from the least ambiguous way and based on study objectives. Validity of the data will be done using content-related validity. This was done by presenting the instrument to the supervisor to evaluate the applicability and appropriateness of the content, clarity and adequacy of construction of the instrument and suggestions made and

modified appropriately. This measures the degree to which data collected using a particular instrument represents a specific domain of indicators or content of a particular concept Mugenda and Mugenda (2003). The indicators of variables were clearly defined and scrutinized and instruments developed to match them.

3.5.3 Reliability of the Instrument

Reliability of a research tool is realized if it yields consistent information or data after repeat measurements are taken under the same conditions. The tools were pre-tested (pilot testing) with the employees of the department and the data obtained was not included in the final analysis. The sample for pre-testing (piloting) included 10 staff selected from the former Rift Valley Province. The main purpose of pre-testing the questionnaire was to identify any weaknesses and improve them. The pre-test was likely to give an indication of the time required to complete the questionnaire. In this case 15 respondents were retested a second time two weeks later and their consistency between the two sets of the score were computed using Cronbach's alpha coefficient which yielded $\alpha = 0.79$ (Nunally, 1998).

3.6 Data Analysis Techniques

Primary data collected from this study was analyzed using descriptive statistics including cross tabulation and frequency tables, inferential statistics like Pearson correlation coefficient analysis, simple and multiple regression to ascertain whether determinants had influence on the road maintenance cost in Western Kenya Road Projects. Cross tabulation were used to understand two different survey items and how they relate. For instance cross tabulation analysis was used to study relationships between procurement procedures, location, categories

of contractors, and site of roads, nature of procurement/contract, design changes and inappropriate contractors on road maintenance attributes like poor maintenance culture, potholes and cracks, lack of standard designs and poor drainage systems. Data was analyzed by feeding it in a statistical package for social science (SPSS and the outputs on frequency tables, cross tabulation and correlation analysis tables generated. Table 2 gives information on the research objectives, data collection instruments, measuring scales and data analysis techniques.

Table 2: Operational Definition of Variables

Research Objectives	Data Collection Instruments	Measuring Scales	Data Analysis Techniques
To examine how existing road policy influences road maintenance cost in Western Kenya road projects.	Questionnaires and interview guide	Nominal, ordinal and interval	Descriptive statistics like frequencies, percentage and mean. Pearson correlation coefficient, simple and multiple regression
To establish the extent to which procurement process influence road maintenance cost in Western Kenya road projects	Questionnaires and interview guide	Nominal, ordinal and interval	Descriptive statistics like frequencies, percentage and mean. Pearson correlation coefficient, simple and multiple regression
To ddetermine how categories of contractors influence road maintenance cost in Western Kenya road projects.	Questionnaires and interview guide	Nominal, ordinal and interval	Descriptive statistics like frequencies, percentage and mean. Pearson correlation coefficient, simple and multiple regression
To investigate how availability and cost of	Questionnaires and interview guide	Nominal, ordinal and interval	Descriptive statistics like frequencies, percentage and

materials influence road maintenance cost in Western Kenya road projects.			mean. Pearson correlation coefficient, simple and multiple regression
To examine how environmental factors influence road maintenance cost in Western Kenya road projects.	Questionnaires and interview schedules	Nominal, ordinal and interval	Descriptive statistics like frequencies, percentage and mean. Pearson correlation coefficient, simple and multiple regression

3.7 Ethical Considerations

The researcher will ensure that respondents will be treated with utmost respect. Any data collected remained confidential. The researcher ensured there was no discrimination. The researcher will seek approval and permission at the National Council for Science and Technology (NCST) to conduct the study.The information collected will be at no time pegged to a particular individual or organisation instead it will treated with anonymity and privacy. Confidentiality will be observed throughout the study for respondents who may give personal opinions.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION, INTERPRETATION AND DISCUSSION

4.1 Introduction

This chapter presents the results obtained from the study analyzed according to the four objectives of the study, which were to: establish the extent to which procurement process influence road maintenance cost in Western Kenya road projects; determine how categories of contractors influence road maintenance cost in Western Kenya road projects; investigate how availability and cost of materials influence road maintenance cost in Road maintenance cost in Western Kenya Road Projects and examine how environmental factors influence road maintenance cost in Western Kenya road projects. The questionnaire return rate was 100% since all 90 questionnaires which given to the respondents were returned.

4.2 Socio-Demographic Characteristics of the Respondents

4.2.1 Age

The study sought to find out the age brackets of the respondents in Road maintenance cost in Western Kenya Road Projects by asking them to state their age ranges. This was to help determine the age distribution for the respondents. Their responses are shown in Table 3. Results in Table 3 showed that most respondents were in the age brackets of 30-39 years had a score of 60%, 20-29 years had 23.3% and those in the age bracket of 40-49 years had 10%. This indicated that majority of the respondents were mature middle age people who had acquired

adequate experience and understood the determinants of road maintenance cost in Western Kenya road projects.

Table 3: Age Distribution of Respondents in Western Kenya Road Projects

Age distribution in years	Frequency	%
20-29 years	21	23.3
30-39 years	60	66.7
40-49 years	9	10.0
Total	**90**	**100.0**

This was the age group carrying the highest proportion of the population that is actively engaged in road maintenance in Western Kenya road projects. These findings were consistent with the research carried out by Barth *et al* (1993) who found out that on the one hand, older workers were thought to be more reliable and to have better skills than young workers. On the other hand, older workers had higher health care costs, lower flexibility in accepting new assignments and then may be less suitable for training. Therefore, middle age people were preferred. Age alone was found to be a poor predictor of individual performance. There were wide variations although older workers were generally considered to be more consistent, cautious, and conscientious.

4.2.2 Working Experience

The study sought to find out the experience of the respondents this was aimed at determining the number of working years and in turn know how much experience they had been exposed to concerning road maintenance cost in Western Kenya road projects. The results are shown in Table 4. The results illustrated that 76.7% of the respondents had been working for less than 5 years, 10% had been working for a period of 5-10 years, 10% had been working for 11-15 years and 3.3% for more than 16 years. This indicated that most respondents had acquired to some extent some experience, knowledge and skills concerning road maintenance cost in Western Kenya road projects. The results seemed to indicate that experience, knowledge, competencies and skills increase with increase in years of performing the job.

Table 4: Working Experience of Respondents in Western Kenya Road Projects

Years	Frequency	%
Less than 5 years	69	76.7
5-10 years	9	10.0
11-15 years	9	10.0
Above 16 years	3	3.3
	90	**100.0**

The study findings were supported by Bott *et al* (2003) regarding job performance and job experience. The findings showed that job experience impacts on task performance in distinct ways. Based on the assumption that task performance reflects proficiency in carrying out tasks

detailed in a formal job description, it will increase as employees obtain specific job knowledge that allows them to perform the tasks at a higher level (Hattrup *et al.*, 1998).

4.2.4 Educational Level

The study sought to find out formal educational levels of respondents in Western Kenya road projects. This was to determine whether educational levels of respondents had an influence on road maintenance cost in Western Kenya road projects. To help understand this, respondents were asked to state their formal educational level. The results are recorded in Table 5. Results in Table 5 showed that 4.4% of respondents had certificates, 37.8% had diploma education level, 42.2% had degree education level and 15.6% had masters' degrees. This showed that the majority of the respondents of in Western Kenya Road Projects had acquired formal educational levels that aid them in understanding the factors influencing road maintenance cost in Western Kenya Road Projects.

Table 5: Educational level of Respondents in Western Kenya Road Projects

Educational level	Frequency	%
Others (Certificates)	4	4.4
Diploma	34	37.8
Bachelor's degree	38	42.2
Masters	14	15.6
Total	**90**	**100.0**

With reference to results in Table 6, the respondents were asked to indicate whether educational level of respondents determined Western Kenya road projects. The results indicated that the respondents who had acquired KCSE certificate had the following responses: strongly agree (0%), agree (0%), disagree (4%) and strongly disagree (0%). Those respondents who had diploma certificates responded as follows: strongly agree (0%), agree (5%), disagree (19%) and strongly disagree (10%); degree certificate holders had the following scores: strongly agree (0%), agree (10%), undecided (10%), disagree (9%) and strongly disagree (5%); master's holders had: strongly agree (0%), agree (5%), disagree (3%), undecided (6%) and strongly disagree (0%). The results indicated that the respondents had mixed responses on whether educational levels influenced Road Maintenance Cost in Western Kenya Road Projects.

Table 6: Cross Tabulation Results between Educational Level and Road Maintenance Cost

Variables		Educational level of respondents				
	Responses	Others (Certificate) %	Diploma %	Bachelor's Degree %	Masters	**Total %**
Road maintenance cost in Western Kenya Road Projects	Strongly disagree	0.0	10.0	5.0	0.0	**15.0**
	Disagree	4.0	19.0	9.0	3.0	**35.0**
	Undecided	0.0	0.0	10.0	6.0	**16.0**
	Agree	0.0	5.0	10.0	5.0	**20.0**
	Strongly agree	0.0	0.0	4.0	0.0	**4.0**
Total		**4.0**	**34.0**	**38.0**	**14.0**	**100.0**

These findings did not receive full support from the findings of Jackson *et al* (1991) who established that heterogeneity in whether group members had an undergraduate or graduate degree in business administration was associated with turnover at a marginal level of statistical significance. This was because educational diversity may enable a broader range of perspectives to be applied to strategic problem-solving, but this diversity may also result in efficient Western Kenya road projects.

4.3 Procurement Process and Road Maintenance Cost

This section focuses on how procurement process like road condition survey, bidding, awarding and contract signing variables that influence road maintenance cost in Western Kenya Road Projects which was the first objective of the study.

Table 7: Procurement Process and Road Maintenance Cost

Variables	SA	A	U	D	SD
Time taken between pretender site visit the signing of contract agreement takes long and this increases the cost of road maintenance	32(35.6%)	55(61.1%)	0(0%)	3(3.3%)	0(0.0%)
Contract are awarded on the basis of price and experience and tender review process is usually objective	14(15.6%)	66(73.3%)	5(5.6 %)	0(0.0%)	5(5.6%)
Existing procurement process needs to be reviewed in order to reduce the cost of road maintenance	35(38.9%)	37(41.1%)	5(5.6%)	8(8.9%)	5(5.6%)

N = 90

Key: SA = strongly agree, A = agree, U = undecided, D = disagree and SD = strongly disagree

From the results in Table 7, 87% of respondents were of the opinion that time taken between pretender site visit and the signing of contract agreement took long and this consequently increased the cost of road maintenance influence in Western Kenya Road Projects while 3.3% of respondents disagreed. On the question asked whether contract were awarded on the basis of price and experience and whether tender review process was objective, 88.9% of respondents were in agreement, 5.6% of respondents were undecided and 5.6% disagreed. Furthermore, the results further pointed out that existing procurement process needed to be reviewed in order to reduce the cost of road maintenance: strongly agreed (38.9%), agreed (41.1%), undecided (5.6%), disagreed (8.9%) and strongly disagreed (5.6%).

Regression and correlation results in Table 8 revealed that time taken between pretender site visit and the signing of contract agreement took long and this consequently negatively influenced the cost of road maintenance ($B = -0.070$, $p \leq 0.05$ and $r = -0.088$ $p \geq 0.01$); contract were awarded on the basis of price and experience and tender review process was objective, thus, positively and significantly influencing the cost of road maintenance ($B = 0.378$, $p \leq 0.05$ and $r = 0.192^{**}$, $p \leq 0.01$) and that existing procurement process needed to be reviewed in order to reduce the cost of road maintenance ($B = 0.446$, $p \leq 0.05$ and $r = 0.469^{**}$, $p \leq 0.01$) leading to positive and significant reduction in the road maintenance cost in Western Kenya Road Projects.

Table 8: Procurement Process and Road Maintenance Cost

Dependent Variables	Unstandardized Coefficients, 95% confidence level		Standardized Coefficients
	Regression coefficient, B	Std. Error	Pearson Correlation coefficient, r
Time taken between pretender site visit the signing of contract agreement takes long and this increases the cost of road maintenance	-0.070 p≤0.05	0.170	-0.088 (0.412)
Contract are awarded on the basis of price and experience and tender review process is usually objective	0.378 p≤0.05	0.134	0.192** (0.020)
Existing procurement process needs to be reviewed in order to reduce the cost of road maintenance	0.446 p≤0.05	0.099	0.469** (0.000)
Dependent Variable: Road Maintenance Cost **Constant/predictor variable: Procurement Process**			

** *Correlation is significant at the 0.01 level (2-tailed).*
* *Correlation is significant at the 0.05 level (2-tailed).Levels of significance, p-value for correlation coefficients are in parentheses.*

The results therefore, indicated that procurement process were flouted that was why the respondents were of the views that existing procurement process needed to be reviewed in order to reduce the cost of road maintenance. These study findings were consistent with what Vientiane (1996) recommended on awarding of contracts that before contracts are awarded to small-scale contractors to carry out rural road works, it will be necessary to review the new standard contract being developed to ensure that it is appropriate also when using labour-based methods. Furthermore, design standards and full works specifications for all site activities needs

to be developed, which should be attached to the works contracts. For routine maintenance works, simple contracts have already been designed and are currently in use by the government. These will need to be reviewed in line with further development of the routine road maintenance system. Experience shows that problems also arise from premeditated under-estimation of initial costs simply in order to obtain initial approval for a project. This can lead to major projects being approved, and started, in the knowledge that actual costs will be very much higher than the "agreed" estimate. Once started, a high profile infrastructure project is often politically difficult to stop. So, when the true costs do become apparent, it is difficult for authorities to refuse the additional funding required to complete the project (Sergio, 1991).

4.4 Categories of Contractors and Road Maintenance Cost

This section focuses on the analysis of how categories of contractors like experience, capacity of facilities, knowledge and skills and class of contractors influence road maintenance cost in Western Kenya Road Projects which was the second objective of the study.

The results in Table 9 on class of contractors influencing the cost of road maintenance with high class contractors (A to C) quoting low prices showed that: 21.1% of respondents strongly agreed, 12.2% of respondents agreed, 25.6% were undecided, 31.1% disagreed and 10% strongly disagreed. However, results on the capacity and class of contractors being considered in evaluation and award of contracts demonstrated that capacity and class of contractors were considered in evaluation and award of contracts to some good extent: strongly agreed (10%), agreed (56.7%), undecided (22.2%) and disagreed (11.1%). Furthermore, results indicated that contractors with more knowledge and skills in road maintenance did not quote lower prices:

strongly agree (11.1%), agree (4.4%), undecided (18.9%), disagree (55.6%) and strongly disagree (10.0%). The respondents gave varied views on the question asked on whether track record of contractors in undertaking projects and producing high quality work within budget and on time were considered during selection process : strongly agree (15.6%), agree (35.6%), undecided (21.1%), disagree (23.3%) and strongly disagree (4.4%).

Table 9: Categories of contractors and Road Maintenance Cost

Variables	SA	A	U	D	SD
Class of contractors influence the cost of road maintenance with high class contractors (A to C) quoting low prices	19(21.1%)	11(12.2%)	23(25.6%)	28(31.1%)	9(10.0%)
Capacity and class of contractors are considered in evaluation and award of contracts	9(10.0%)	51(56.7%)	20(22.2%)	10(11.1%)	0(0.0%)
Contractors with more knowledge and skills in road maintenance quote lower prices	10(11.1%)	4(4.4%)	17(18.9%)	50(55.6%)	9(10.0%)
Track record of contractors in undertaking projects and producing high quality work within budget and on time are considered during selection process	14(15.6%)	32(35.6%)	19(21.1%)	21(23.3%)	4(4.4%)

N = 90

Key: SA = strongly agree, A = agree, U = undecided, D = disagree and SD = strongly disagree

Results in Table 10 demonstrated the class of contractors negatively influenced the cost of road maintenance with reference to high class contractors (A to C) quoting low prices ($B = -0.030$, $p \leq 0.05$ and $r = 0.060$ $p \geq 0.05$); capacity and class of contractors are considered in evaluation and

award of contracts, thus positively influenced reduction in the cost of road maintenance (B = 0.025, $p \leq 0.05$ and r = 0.064, $p \geq 0.05$); contractors with more knowledge and skills in road maintenance did not necessarily quote lower prices and this did not reduce the cost of road maintenance (B = -0.031, $p \leq 0.05$ and r = -0.260, $p \geq 0.05$). Track record of contractors in undertaking projects and producing high quality work within budget and on time were considered during selection process and this had a positive correlation on the cost of road maintenance (B = 0.127, $p \leq 0.05$ and r = 0.128, $p \geq 0.05$). The findings were supported by Sridhar *et al* (1985) who observed that inaccessibility due to the geographical and urban structure, lack of properly designed collection route system and time schedule, inadequate and malfunctioning operation equipment, open burning of garbage, poor condition of the final dump site, littering of the corner around the skips which encouraged illegal dumping are the main technical problem facing most municipalities.

The findings are supported by ROK (2004) and World Bank/OECD (1990) who noted that contractors were selected on the basis of price, experience in undertaking particular types of project and their track record in producing high quality work within budget and on time Problems may arise where there is a high level of development activity being undertaken in a particular region and the better contractors are not available to bid for the work at that time.

Table 10: Categories of Contractors and Road Maintenance Cost in Western Kenya Road Projects

Dependent Variables	Unstandardized Coefficients, 95% confidence level		Standardized Coefficients
	Regression coefficient, B	Std. Error	Pearson Correlation coefficient, r
Class of contractors influence the cost of road maintenance with high class contractors (A to C) quoting low prices	-0.030 $p \leq 0.05$	0.109	-0.060 (0.957)
Capacity and class of contractors are considered in evaluation and award of contracts	0.025 $p \leq 0.05$	. 0. 198	0.064(0.549)
Contractors with more knowledge and skills in road maintenance quote lower prices	-0.031 $p \leq 0.05$	0.147	-0.260 (0.808)
Track record of contractors in undertaking projects and producing high quality work within budget and on time are considered during selection process	0.127 $p \leq 0.05$	0.116	0.128 (0.229)

Dependent Variable: Road Maintenance Cost
Constant/predictor variable: Categories of contractors

** *Correlation is significant at the 0.01 level (2-tailed).*
* *Correlation is significant at the 0.05 level (2-tailed).Levels of significance, p-value for correlation coefficients are in parentheses.*

Alternatively, the tender review process may not have been undertaken by the personnel with the best understanding of the services required. As a consequence, firms which are not the most experienced in that field of activity are chosen, often with implications for the quality and cost of a project. This explains why the capacity and class of contractors are sometimes not

considered in evaluation and award of contracts leading to increase in the cost of road maintenance. According to ROK (2004) and MOR (2011), evaluations are done on the basis of qualifications, equipment, and audited expenditure outturns among other criteria. The evaluations and category assignments done under these schemes are actually done administratively by officers in a given ministry. This is true on the paper but not in the field where deals are done under tables and firms which are not the most experienced in that field of activity are chosen, thus, increasing the cost of road maintenance.

4.5 Availability and Cost of Materials and Road Maintenance Cost

This section focuses on the analysis of how availability and cost of materials like clear authorities and sanitation rules and organisational capacity influence road maintenance cost in Western Kenya Road Projects which was the third objective of the study. The results on the influence of availability and cost of materials on Road Maintenance Cost in Western Kenya Road Projects in Table 11 pointed out that high costs of materials made it difficult to complete road maintenance in time: strongly agreed (33.3%), agreed (37.7%), undecided (8.5%), disagreed (13.9%) and strongly disagree (6.6%); most contractors did not have adequate plant and equipment leading to high cost of road maintenance: strongly agreed (25.4%), agreed (14.8%), undecided (11.5%), disagreed (45.9%) and strongly disagreed (16.7%); contractors experience shortages leading to high cost of road maintenance: strongly agree (25.6%), agree (51.1%), undecided (4.4%), disagree (18.9%) and strongly disagree (0.0%) and that there was need to look for alternative sustainable raw materials to road maintenance cost : strongly agree (58.9%), agree (26.7%), undecided (0.0%), disagree (8.9%) and strongly disagree (5.6%).

Table 11: Availability and Cost of Materials and Road Maintenance Cost

Variables	SA	A	U	D	SD
High costs of materials make it difficult to complete road maintenance in time	37(33.3%)	46(37.7%)	14(8.5%)	17(13.9%)	15(6.6%)
Most contractors have adequate plant and equipment leading to low cost of road maintenance	31(25.4%)	56(14.8%)	14(11.5%)	18(45.9)	15(16.7%)
We experience shortages leading to high cost of road maintenance	23(25.6%)	46(51.1%)	4(4.4%)	17(18.9%)	0(0.0%)
There is need to look for alternative sustainable raw road maintenance cost	53(58.9%)	24(26.7%)	0(0.0%)	8(8.9%)	5(5.6%)

N = 90

Key: SA = strongly agree, A = agree, U = undecided, D = disagree and SD = strongly disagree

Regression and correlation results in Table 12 showed that high costs of materials made it difficult to complete road maintenance in time in Western Kenya Road Projects and this had a significant negative correlation on road maintenance cost ($B = -0.456$, $p \leq 0.05$ and $r = -0.568^{**}$, $p \leq 0.01$), most contractors did not have adequate plant and equipment leading to high cost of road maintenance ($B = -0.286$, $p \leq 0.05$ and $r = -0.303^{**}$, $p \leq 0.05$); shortages of raw materials had also a significant negative influence on road maintenance cost in Western Kenya Road Projects ($B = -0.220$, $p \leq 0.05$ and $r = -0.201^{*}$, $p \leq 0.05$). Results further indicated that there was need to look for alternative sustainable raw materials to reduce road maintenance cost ($B = 0.135$, $p \leq 0.05$ and $r = 0.175$, $p \geq 0.05$). The results conformed to the findings of Arvidsson and Holmgren (1999) who found out that during periods when the level of development activity was unusually high in a particular region, there may be shortages of some construction materials,

construction plant (machines and equipment used during construction) and service plant (equipment used in the operation of the infrastructure project). If this was not anticipated in the original cost estimate, delays may occur and/or the prices of these elements increase. Furthermore, Lee (2010) noted that the road marking sector is facing an imminent crisis resulting from a shortage of base raw materials used in road marking product; this shortage jeopardises both the production of materials and the economics of the sector and significantly could have major implications for road safety. These raw material shortages are based around the restricted supply/availability of both resin used as binder in thermoplastic and cold plastic road marking materials and the production of high friction surfacing, combined with a similar scarcity of titanium dioxide used to whiten road marking materials in order that they meet their performance criteria.

Table 12: Availability and Cost of Materials and Road Maintenance Cost

Variables	Unstandardized Coefficients, 95% confidence level		Standardized Coefficients	
	Regression coefficient, B	Std. Error	Pearson Correlation coefficient, r	P-value
High costs of materials make it difficult to complete road maintenance in time	-0.456 $p \leq 0.05$	0.117	-0.568**	0.001
Most contractors have adequate plant and equipment leading to low cost of road maintenance	-0.268 $p \leq 0.05$	0.110	-0.303**	0.004
We experience shortages leading to high cost of road maintenance	-0.220 $p \leq 0.05$	0.138	-0.201*	0.050
There is need to look for alternative sustainable raw road maintenance cost	0.135 $p \leq 0.05$	0.107	0.175	0.099

Dependent Variable: Road Maintenance Cost
Constant/predictor variable: Availability and Cost of Materials

** *Correlation is significant at the 0.01 level (2-tailed)*
* *Correlation is significant at the 0.05 level (2-tailed)*

4.6 Environmental Factors and Road Maintenance Cost

This section focuses on the analysis of how environmental Factors such as climatic conditions, location, use of heavy trucks and terrain influence road maintenance cost in Western Kenya Road Projects which was the fourth objective of the study. Results in Table 13 on the influence of environmental factors on road maintenance cost in Western Kenya road projects, disclosed that uncontrollable factors of the environment such as climate, terrain and location did increase road maintenance cost: strongly agreed (52.2%), agreed (32.2%), undecided (11.1%), disagreed (4.4%) and strongly disagreed (0.0%); environmental consideration during tendering led to high

cost of road maintenance: strongly agreed (27.8%), agreed (44.4%), undecided (12.2%), disagreed (10%) and strongly disagreed were (5.6%). The results further pointed out that majority of respondents were of the view that contracts should be given to those contractors who adopt environmentally friendly construction methods: strongly agree (25.6%), agree (57.8%), undecided (5.6%), disagree (11.1%) and strongly disagree (0.0%).

Table 13: Environmental Factors and Road Maintenance Cost

Variables	SA	A	U	D	SD
Uncontrollable factors of the environment such as climate, terrain and location do increase road maintenance cost	47(52.2%)	29(32.2%)	10(11.1%)	4(4.4%)	0(0.0%)
Environmental consideration during tendering leads to high cost of road maintenance	25(27.8%)	40(44.4%)	11(12.2%)	9(10.0%)	5(5.6%)
Contracts should be given to those contractors who adopt environmentally friendly construction methods	23(25.6%)	52(57.8%)	5(5.6%)	10(11.1%)	0(0.0%)

N = 90

Key: SA = strongly agree, A = agree, U = undecided, D = disagree and SD = strongly disagree

With reference to Table 13, environmental variables like uncontrollable factors of the environment such as climate, terrain and location do increase road maintenance cost had a highly significant negative correlation on road maintenance cost in Western Kenya road projects ($\beta = -0.298$, $p \leq 0.05$ and $r = -0.164^{**}$, $p \leq 0.01$). Environmental consideration during tendering led to high cost of road maintenance and this also had a highly significant negative correlation on

road maintenance cost (B = -0.127, p≤0.05 and r = -0.280**, p≤0.01) and contracts should be given to those contractors who adopt environmentally friendly construction methods and this influenced positively road maintenance cost (B = 0.635, p≤0.05 and r = 0.250, p≤0.01).

Table 14: Environmental Factors and Road Maintenance Cost

Variables	Unstandardized Coefficients, 95% confidence level		Standardized Coefficients	
	Regression coefficient, B	Std. Error	Pearson Correlation coefficient, r	P-value
Uncontrollable factors of the environment such as climate, terrain and location do increase road maintenance cost	-0.298 p≤0.05	0.133	-0.164**	0.007
Environmental consideration during tendering leads to high cost of road maintenance	-0.127 p≤0.05	0.112	-0.280**	0.004
Contracts should be given to those contractors who adopt environmentally friendly construction methods	0.635 p≤0.05	0.124	0.250**	0.000

Dependent Variable: Road Maintenance Cost
Constant/predictor variable: Environmental Factors

** *Correlation is significant at the 0.01 level (2-tailed)*
* *Correlation is significant at the 0.05 level (2-tailed)*

The findings were in line with what Kazakov, Cook and Roll (1989) suggested that environmental factors affect both maintenance efforts and the deterioration of the paved lanes. Although no clear relationship has been established between the climate factors and the pavement damage, it is believed that these factors do influence the extent of damage. Climatical changes particularly in winter, when a significant thawing (due to high temperature) is followed

by full freezing (due to low temperature), water is trapped in the pavement's base, causing volume shift and pavement blow ups and this increases road maintenance cost. According to Ozbek (2007), road maintenance is a process that is highly affected by the uncontrollable factors of the environment (such as climate, terrain and location) as well as the uncontrollable factors representing the operational difficulties (such as traffic, load, traffic accidents and aging). Thus, special attention should be given to the environmental factors when evaluating road maintenance performance since these factors can be the main "cost and process" drivers (Rouse, Puttterill, and Ryan, 1997). As a result, explicit consideration of the uncontrollable factors affecting performance of highway maintenance operations should be an important and essential part of any performance measurement system in this setting.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents summary of study findings, conclusions drawn, recommendations based on the conclusions and suggestions for further research.

5.2 Summary of the Findings

The study had the following objectives: to examine how procurement process influence road maintenance cost in Western Kenya Road Projects; to establish the extent to which categories of contractors influence road maintenance cost in Western Kenya Road Projects; to determine how availability and cost of materials influence road maintenance cost in Western Kenya Road Projects and to establish how environmental Factors influence road maintenance cost in Western Kenya Road Projects.

Majority of respondents indicated that majority of the respondents were mature middle aged people who had acquired adequate experience and understood the determinants of road maintenance cost in Western Kenya road projects. This was the age group carrying the highest proportion of the population that is actively engaged in road maintenance in Western Kenya road projects The results illustrated that majority of the respondents had been working for less than 5 years, others for a period of 5-10 years and more than 16 years. This indicated that most respondents had acquired to some extent some experience, knowledge and skills concerning road maintenance cost in Western Kenya road projects. The results seemed to indicate that

experience, knowledge, competencies and skills increase with increase in years of performing the job. Further analysis showed that respondents had different educational levels: certificate, diploma, bachelors' degree and masters' degrees education levels. This showed that the majority of the respondents of in Western Kenya Road Projects had acquired formal educational levels that aid them in understanding the factors influencing road maintenance cost in Western Kenya Road Projects.

The study findings on the influence of procurement process on road maintenance cost in Western Kenya Road Projects disclosed that time taken between pretender site visit and the signing of contract agreement took long and this consequently had significant negative influence on the cost of road maintenance; contract were awarded on the basis of price and experience and tender review process was objective, thus, positively and significantly influencing the cost of road maintenance and that existing procurement process needed to be reviewed in order to reduce the cost of road maintenance. The results therefore, indicated that procurement process were flouted that was why the respondents were of the views that existing procurement process needed to be reviewed in order to reduce the cost of road maintenance .

The class of contractors negatively influenced the cost of road maintenance because the respondents were of the opinion that high class contractors (A to C) did not quote low prices; capacity and class of contractors were considered in evaluation and award of contracts, thus positively influenced reduction in the cost of road maintenance; contractors with more knowledge and skills in road maintenance did not necessarily quote lower prices and this did not reduce the cost of road maintenance. Track record of contractors in undertaking projects and

producing high quality work within budget and on time were considered during selection process and this had a positive correlation on the cost of road maintenance.

Results on the availability and cost of materials revealed that high costs of materials made it difficult to complete road maintenance in time in Western Kenya Road Projects and this had a significant negative correlation on road maintenance cost; most contractors did not have adequate plant and equipment leading to high cost of road maintenance; shortages of raw materials had also a significant negative influence on road maintenance cost in Western Kenya Road Projects. Results further indicated that there was need to look for alternative sustainable raw materials to reduce road maintenance cost.

Environmental variables like uncontrollable factors of the environment such as climate, terrain and location do increase road maintenance cost had a highly significant negative correlation on road maintenance cost in Western Kenya road projects. Environmental consideration during tendering led to high cost of road maintenance and this also had a highly significant negative correlation on road maintenance cost and contracts should be given to those contractors who adopt environmentally friendly construction methods and this influenced positively road maintenance cost.

5.3 Conclusions

The study had the following conclusions:

During procurement process, procurement procedures were flouted because firms which were not the most experienced in field of activity were chosen and the time taken between pretender site visit and the signing of contract agreement took long and that was why the respondents were of the views that existing procurement process needed to be reviewed in order to reduce the cost of road maintenance.

The class of contractors negatively influenced the cost of road maintenance because the respondents were of the opinion that high class contractors (A to C) did not always quote low prices and contractors with more knowledge and skills in road maintenance did not necessarily quote lower prices and this had significant negative correlation on cost of road maintenance.

Results on the availability and cost of materials revealed a significant negative correlation on the cost of road maintenance. Inadequate raw and high cost of materials led to increased cost of road maintenance in Western Kenya road projects.

Environmental variables like uncontrollable factors of the environment such as climate, terrain and location do increase road maintenance cost had a highly significant negative correlation on road maintenance cost in Western Kenya road projects.

5.4 Recommendations

The following recommendations were made based on the findings and the conclusions of the study:

1. Since the study findings showed that procurement procedures were flouted because firms which were not the most experienced in field of activity were chosen and the time taken between pretender site visit and the signing of contract agreement took long. It was therefore, recommended that the government should have clear procurement procedures which should be monitored to ensure they are strictly followed and heavy penalties levied on those found flouting them.

2. Road maintenance, especially with respect to the contracting and bidding for civil works, requires the effective evaluation and supervision of contractors and their bids. Without this ability at tender, marginal or unacceptable bidders can distort the bidding process by excessive underbidding for contracts or future inability to complete.

3. The government should reduce the tax rate on construction materials, construction plant (machines and equipment used during construction) and service plant (equipment used in the operation of the infrastructure project).

4. Environment is seldom taken into account in the design and implementation of road maintenance tasks. Environmental consideration should therefore, be included in road maintenance programs and should be looked at from methodological, technical, economical and institutional/contractual points of view.

5.5 Suggestions for Further Research

The following suggestions were made for further researches in areas which were not adequately underscored by this study:

1. A study should be conducted in other regions to ascertain if same results can be achieved.
2. A study should be carried out on the influence of Government policies on the road maintenance cost in Western Kenya Road Projects.
3. A study should be conducted to establish the other determinants that influence road maintenance cost in Western Kenya Road Projects.
4. A study should be conducted to establish the influence of inflation and exchange rates on the road maintenance cost in Western Kenya road projects

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APPENDICES

APPENDIX 1: LETTER OF INTRODUCTION

April, 2012.

Dear respondent:

I am a postgraduate student undertaking a Master of Arts in Project Planning and Management in the School of Continuing and Distance Education at the University of Nairobi. I am carrying out a study on **the determinants of road maintenance cost: a case of Western Kenya road projects.** I am using the attached questionnaire to collect information for the study. It is my kind request that you fill the questionnaire, providing the relevant information to facilitate the study. Please use the space provided to fill in the information required as objectively and honestly as possible. The information provided will be treated with strict confidentiality for the purpose of this study only.

Thank you.

Yours faithfully,

Edwin K. Limo

APPENDIX 2A: QUESTIONNAIRE FOR CONTRACTORS

SECTION A: BACKGROUND INFORMATION

1. Please indicate the **name** and the **location** of your company

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2. Kindly state your position in the company.....

3. Please indicate the registration class of your company.....

4. Please indicate your age bracket?

20-29 years	[ ]
30-39 years	[ ]
40-49 years	[ ]
Above 49 years	[ ]

5. Please state the number of years the company has been in involved in road maintenance

Less than 5 years	[ ]
5-10 years	[ ]
11-16 years	[ ]
Above 16 years	[ ]

6. Please indicate education level of the top management

PhD	[ ]
Masters	[ ]
Bachelor's degree	[ ]
Diploma	[ ]

Others.....

7. Please fill the table below:

Type of personnel	Number	Educational level (Certificate, diploma, degree, Masters, others)
Head quarter staff		
Site agent		
Assistant site agent		
Surveyor		
Foremen		
Labourers		
TOTAL		

SECTION B: DETERMINANTS OF ROAD MAINTENANCE COST

In this section please tick (√) the most appropriate response for each of the questions in the table below with the scores in the bracket. **Strongly agreed (SA) = 5, Agree (A) = 4, undecided (U) = 3, Disagree (D) =2, and strongly disagree (SD) = 1**

	QUESTIONS	SA	A	U	D	SD
1.	Time taken between pretender site visit and signing of contract agreement takes long and this increases the cost of road maintenance					
2.	Contracts are awarded on the basis of price and experience and tender review process is usually objective					
3.	Existing procurement process needs to be reviewed in order to reduce the cost of road maintenance					
4.	Class of contractors influence the cost of road maintenance with high class contractors (A to C) quoting low prices					

5.	Capacity and class of contactors are considered in evaluation and award of contracts					
6.	Contractors with more knowledge and skills in road maintenance quote lower prices					
7.	Track record of contractors in undertaking projects and producing high quality work within budget and on time are considered during selection process					
8.	High costs of materials make it difficult to complete road maintenance in time					
9.	Most contractors have adequate plant and equipment leading to low cost of road maintenance					
10.	We experience shortages of road construction materials leading to high cost of road maintenance					
11.	There is need to look for alternative sustainable raw road maintenance materials so as to reduce the cost of road maintenance cost					
12.	Uncontrollable factors of the environment such as climate, terrain and location do increase road maintenance cost					
13.	Environmental consideration during tendering leads to high cost of road maintenance					
14.	Contracts should be given to those contractors who adopt environmentally friendly construction methods					

15. Identify some of the factors that influence road maintenance cost in Western Kenya

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16. What are some of the challenges you face when undertaking road maintenance projects in Western Kenya?

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17. What are some of the ways of dealing with the challenges listed in Q.16 when undertaking road maintenance projects in Western Kenya?

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APPENDIX 2B: QUESTIONNAIRE FOR ENGINEERS AND PROCUREMENT OFFICERS

SECTION A: BACKGROUND INFORMATION

1. Please indicate the **name** of your organisation

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2. Kindly state your position in the organisation.....

3. Please indicate your age bracket?

20-29 years [ ]

30-39 years [ ]

40-49 years [ ]

Above 49 years [ ]

3. Please state the number of years you have been working in the organisation

Less than 5 years [ ]

5-10 years [ ]

11-16 years [ ]

Above 16 years [ ]

4. Please indicate your education level

PhD [ ]

Masters [ ]

Bachelor's degree [ ]

Diploma [ ]

Others.....

SECTION B: DETERMINANTS OF ROAD MAINTENANCE COST

In this section please tick (√) the most appropriate response for each of the questions in the table below with the scores in the bracket. **Strongly agreed (SA) = 5, Agree (A) = 4, undecided (U) = 3, Disagree (D) =2, and strongly disagree (SD) = 1**

	QUESTIONS	SA	A	U	D	SD
1.	Time taken between pretender site visit and signing of contract agreement takes long and this increases the cost of road maintenance					
2.	Contracts are awarded on the basis of price and experience and tender review process is usually objective					
3.	Existing procurement process needs to be reviewed in order to reduce the cost of road maintenance					
4.	Class of contractors influence the cost of road maintenance with high class contractors (A to C) quoting low prices					
5.	Capacity and class of contactors are considered in evaluation and award of contracts					
6.	Contractors with more knowledge and skills in road maintenance quote lower prices					
7.	Track record of contractors in undertaking projects and producing high quality work within budget and on time are considered during selection process					
8.	High costs of materials make it difficult to complete road maintenance in time					
9.	Most contractors have adequate plant and equipment leading to low cost of road maintenance					
10.	We experience shortages of road construction					

	materials leading to high cost of road maintenance					
11.	There is need to look for alternative sustainable raw road maintenance materials so as to reduce the cost of road maintenance cost					
12.	Uncontrollable factors of the environment such as climate, terrain and location do increase road maintenance cost					
13.	Environmental consideration during tendering leads to high cost of road maintenance					
14.	Contracts should be given to those contractors who adopt environmentally friendly construction methods					

24. Identify some of the factors that influence road maintenance cost in Western Kenya

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25. What are some of the challenges you face when undertaking road maintenance projects in Western Kenya?

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26. What are some of the ways of dealing with the challenges listed in Q.25 when undertaking road maintenance projects in Western Kenya?

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APPENDIX 3: INTERVIEW GUIDE FOR KEY INFORMANTS

Introduction: Good morning or afternoon sir/madam. Thank you for having granted me permission to interview you. I would like to assure you that I will stick to all ethical codes of conduct with regard to conducting research as stated in my introduction letter.

The Interview Questions:

1. Identify and explain some of the some of the factors that influence road maintenance cost in Western Kenya.
2. What are some of the challenges contractors face when undertaking road maintenance projects in Western Kenya?
3. What are some of the ways of dealing with the challenges listed in Q.2 when undertaking road maintenance projects in Western Kenya so that road maintenance process is improved?

Conclusion: Thank you for your time, I hope your responses to the questions will contribute a lot to my research work.

APPENDIX 4: MAP OF KENYA SHOWING ADMINISTRATIVE DISTRICTS