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SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

The Potential of Performance-Based Contracting for ERA Road Projects

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A Thesis submitted to School of Civil and Environmental Engineering, Addis Ababa University, Addis Ababa Institute of Technology, for partial fulfillment of the requirement of Master of Science Degree in Civil Engineering (Construction Technology and Management)

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This is to certify that the thesis prepared by Michael Amde, entitled *The Potential of Performance-Based Contracting for ERA Road Projects* submitted in partial fulfillment of the requirements for the Degree of Master of Sciences (Civil Engineering – Construction Technology & Management) complies with the regulations of the university and meets the accepted standard with respect to originality and quality.

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ABSTRACT

The Ethiopian Roads Authority is responsible for the construction and maintenance of the road network system in the country. ERA is dedicated to reduce cost and time of maintenance activities and to control quality of work as well as keeping the road infrastructure in an efficient state using the traditional methods of contracting. Since 2016, ERA has been contracting out road projects (construction and maintenance) on performance measures as an alternative methods of contracts. This method is named performance based contract (PBC). Starting from 2016, ERA is implementing PBC on three projects at a pilot level those financed by local financer (government and road fund) and one project financed by the World Bank.

Therefore, the aim of this thesis is to examine the potential of this method for improving the road construction and maintenance practice of ERA. In addition, the advantages and disadvantages of the PBC were investigated by analyzing the challenges faced by ERA during the implementation of PBC at the pilot projects. Accordingly this thesis presents reviews of literatures recently produced. It also briefly discusses the problems of traditional methods of contracting in ERA which is supported by a case study. The implementation of PBC in ERA has been reviewed and analyzed.

The thesis examined those implemented PBC projects to identify the benefits achieved and respectively differentiated the negative impacts of PBC and Traditional Contracts on ERA projects. To effect this, a series of questionnaire surveys and interviews were conducted out, which helped to achieved research objectives.

The main contributions of this thesis are: (i) defining PBC and explaining its advantages and disadvantages during implementation in ERA projects; (ii) examining the potential of PBC in ERA; and (iii) analyzing the challenges faced during implementing PBC in ERA. Therefore, the significant achievement of this study was identification of hindrances in establishing PBC in ERA and examining its potentiality and effectiveness. The research recommended that PBC is a better alternative that should be adopted by ERA together with the traditional contract method. The potential of reducing maintenance costs, increasing the quality of works and reducing the chance of corruption are some of the benefits of PBC.

KEY WORDS: Performance-Based Contract (PBC); Traditional Contract Method; Cost Overrun; Time Overrun; Ethiopian Roads Authority (ERA),

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DECLARATION

This thesis is my original work, was not copied, and has not been presented for a degree in any other university and all the sources used have been duly acknowledged.

Michael Amde Abebe

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ACRONYMS

ARWE: Amhara Road Works Enterprise

BOOT: Build Own Operate and Transfer

BOQ: Bill of Quantity

DB: Design Build

DBB: Design Bid Build

DCE: Defense Construction Enterprise

DOT: Department of Transportation

dTIMS: Deighton Total Infrastructure Management System

ECWC: Ethiopian Construction Works Corporation

EOT: Extension of Time

ERA: Ethiopian Road Authority

ERAMS: Ethiopian Roads Authority Management System

ERCC: Ethiopian Road Construction Corporation

ETB: Ethiopian Birr

ETCA: Ethiopian Transport Construction Authority

GDP: Gross Domestic Product

GPOBA: Global Partnership of Output Based Aid

HDM: Highway Development Model

HDM-4: Highway Development Model 4

IDA: International Development Association

IFC: International Finance Corporation

IHA: Imperial Highway Authority

IRI: International Roughness Index

NCHRP: National Cooperative Highway Research Program

OPRC: Output & Performance Based Road Contract

ORWE: Oromia Road Works Enterprise

PBC: Performance Based Contract

PBMC: Performance Based Maintenance Contract

PMS: Pavement Management System

R&D: Research and Development

ROW: Right of Way

RSDP: Road Sector Development Program

RSDP IV: Road Sector Development Program IV

URRAP: Urban Rural Road Access Program

USD: United States Dollar

WB: World Bank

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CHAPTER ONE

INTRODUCTION

1.1 Background

The construction industry is an important part of any economy. Infrastructures delivered by the construction industry and its key allies affect economic growth. Construction, which has the responsibility of creating, defining and maintaining the built environment within which most other social and economic activities take place is one of the most important ways in which societies create new values. The industry provides society with delivery mechanisms for many aspects of economic, social, political, environmental needs making its products essential to mankind's physical and social day-to-day activities (Solomon S. Desta, 2015).

Throughout this industry, infrastructure construction and maintenance plays a vital role for the development of a certain economy; however, its delivery and contracting process is accused for its inefficiency and ineffectiveness. In order to overcome these problems, different organizations and road authorities have been tried to perform different solutions although did not bring a holistic improvement.

It is common for road authorities to adopt the traditional method of road construction contracts that include a typical arrangement of relationships between the Client, the Contractor and the Consultant. The traditional method of road construction contracts has been found ineffective and expensive which caused difficulties in controlling road quality, time to finish, and cost of construction. Escalation of costs, delays in completion of projects and lack of proper training in the public sector have been the main problems associated with traditional method of contracting.

Traditionally, construction procurement methods are defined in an incomplete way. For example, the phrase "general contracting" indicates the separation of design from construction and the liabilities and the payment processes that would be associated with that idea. However, it indicates little about the way in which contractors are selected or how the project is funded (K. Will and H. Shabnam, 2013).

Controlling the cost of construction and maintenance as well as keeping the road infrastructure in an efficient way is a very important issue for a road authority. Road authorities use various traditional methods of contracting for road construction and maintenance such as lump sum contracts, unit price contracts, prime cost contracts, design and build (DB) contracts, design, bid and build (DBB) contracts and build own operate transfer (BOOT) contracts. But in this research, when it says traditional method, it mainly indicates design, bid and build (DBB) contracts.

Various attempts have been made to combat construction's inefficiencies and ineffectiveness. But, each of these strategies has attempted to address the challenges in the industry, they have not taken a holistic process improvement approach and the success they brought is not consistent (Solomon S. Desta, 2015).

While there is a strong need to innovate, the procurement of complex and large-scale infrastructure is often organized in a way that creates obstacles to innovation. Contract clauses and payment regimes may have the unintended consequence of incentivizing and rewarding non-innovative behavior, often because of very real concerns about risk and price, especially in the public sector. One key concern is the meeting of performance requirements. it is clear that the development of innovative solutions may come from the demand side or from the supply side, but contracts and payment mechanisms tend to dictate whether innovations will be encouraged or not. Although Performance Based Contract, (PBC) is widely used in other industry sectors, its application to the procurement of road construction and maintenance work is innovative (K. Will and H. Shabnam, 2013).

The Performance Based Contracts (PBC) has been recognized as an efficient method of contracts addressing the limitations of the traditional contracting methods. Unlike the traditional method of contracting, in PBC, the contractor is generally free to make the decisions of "what to do", "when" and "how" as long as the specified performance measures are achieved. This will lead to assign the responsibility of completing the contract with its risk of failure totally to the contractors. It has been a challenge for contractors to successfully manage the entire risk of projects particularly with limited resources, limited understanding of PBC, lack of skillful staff, and poor management. In addition, unavailability of accurate pavement condition prediction models to understand and predict pavement performance results in a higher risk to the contractor in PBC.

Over the last two decades, many countries have used performance-based contracting (PBC) to manage and maintain roads. The implementation of Performance Based Contracts (PBC) provides additional benefits for the government/road authorities such as cost savings and improved conditions of contracted road assets.

These are also called outcome based procurement, in reference to the competitive procurement processes that result in relationship where payments are made for measured outputs instead of the traditional way where the measurement and payment reflect the quantity of input (World Bank, 2005).

The traditional method of construction contracts has been widely recognized as ineffective and expensive as the client (the road authority) has to supervise and pay both Consultant and Contractor (Pi ero J.C. & Jesus M, 2004).

Sultana, et al., (2013) highlighted problems associated with traditional method, for instance, escalation of cost and time, poor quality of work and inadequate motivation of contractors, no clear risk sharing between the owner and the contractor, and delay in project completion.

In traditional contracts, the client specifies techniques, materials, methods, quantities, along with the time period for the contract. In contrast, in PBC, the client agency specifies minimum performance measures to be met or exceeded within the contract period. PBC is a type of contract in which payments are explicitly linked to the contractor successfully meeting or exceeding certain clearly defined minimum performance indicators (World Bank, 2005).

According to the World Bank report (2005), one of the objectives of the PBC is to encourage contractor innovation and improve quality by applying value engineering and improved efficiency. PBC approach has been successfully used in several highway construction and rehabilitation projects in many countries around the world, for example, Canada, UK, Australia, New Zealand, Brazil, and Argentina.

The Government of the Federal Democratic Republic of Ethiopia through the Ethiopian Roads Authority (ERA) has established a strategy for implementation of Performance Based Contracts (PBC) which increases the efficiency of road asset management operations. Performance Based Road construction Contracts (PBC) is critically important in assuring adequate physical road condition for road users.

The literature review of this research focuses on the introduction of PBC for road infrastructure construction and maintenance. The literature review will discuss the advantages and disadvantages of traditional methods of contracting as well as advantages and disadvantages of PBC.

This research will study the problems associated with the use of traditional methods of contracting in brief and the potential prospects and challenges of implementing PBC in ERA. This research has reviewed as many countries as possible to use their experience of implementing PBC in constructing and maintaining the road infrastructure system.

1.2 Research Problem

ERA is confronted with the challenge of constructing and maintaining the road network at its highest level of service while investing the minimum amount of resource. To achieve this, it requires searching for and adopting efficient and cost effective road maintenance approaches. One such approach is the PBC to help enhance the innovation and technologies related to road maintenance methods, reduction in cost, and substantial shift of risk from client to contractor, and increased overall satisfaction of the road users.

However, there are a number of challenges that could hinder the success of a PBC. For example, these challenges include selecting an appropriate contractor, existing legislation, technical capacity (skills and

expertise) of the road authorities staff to define and monitor the performance standards, means or methodology to measure and report on performance standards, proper evaluation of the existing conditions of assets to establish baseline and performance and payment security, warranties, and penalties. Moreover, there is a lack of pavement condition prediction models to understand and predict pavement condition.

Therefore, there is a great need to develop a comprehensive framework to facilitate the selection of an effective maintenance and rehabilitation program that takes into account possible measures to address the potential challenges.

1.3 Research Questions

Research questions are set to achieve the research objectives, which are as follows:

- Why is ERA adopting PBC as an alternative method for road projects?
- What are the main advantages and disadvantages ERA got from PBC?
- What are the challenges or problems that can be the cause of failure during the implementation of PBC in ERA?

1.4 Research Objective

1.4.1 General Objective

The general objective of this research is to examine the potential of PBC for improving the road maintenance and construction in the Ethiopian Roads Authority (ERA).

1.4.2 Specific Objectives

The specific objectives of this research are;-

- To analyse the benefit that ERA got from the introduction and implementation of PBC. To investigate the disadvantages experienced after PBC implementation in ERA.
- To analyse the challenges or problems faced PBC during its introduction in ERA; and
- To recommend solutions for better implementation of PBC in ERA stating its challenges and potential successes.

1.5 Scope and Limitations of the Research

The Scope of the study will be on federal roads administered by Ethiopian Roads Authority (ERA). So that, the output of this study will not include the roads administered by regional states and city administrations. The Road Asset Management department within ERA is the main target for this study because, this branch is implementer of the Road Maintenance Management System.

The major limitation was that few PBC projects were signed by ERA. One consequence of the above limitation was that, it creates a hindrance in identifying the strong traits and drawbacks of the method on ERA projects. In addition, this method of contract have been implemented recently in ERA, therefore, it is difficult to get accumulated data in the organization.

In addition to these, the data for case study were collected from ERA and it was hard to find relevant written and organized data. The way they archive data is hard to find the required information and the bureaucracy was really challenging in order to get the appropriate data especially, data related with PBC. Completed PBC projects are also limited in number and it makes harder to take the right sample as a case study.

1.6 Importance of the Study

This research will have benefits to implement PBC as a cost and time optimization method for the construction and management of road network system of ERA. This research will be necessary to find out the research gap in implementation of PBC in ERA. However the benefit of the study can be summarized as follows:

- Present an overview of issues that should be considered before introducing PBC.
- Analyse possible challenges that can create hindrance in successful implementation of PBC; and
- Show the benefits of PBC for ERA to improve the road infrastructure maintenance and construction system.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Performance-Based Contracting (PBC) is defined as "a type of contract in which payment for the deliverable is explicitly linked to the contractor's successfully meeting or exceeding certain clearly defined performance indicators" (Sultana M. Rahman A. & Chowdhury S, 2013). The main aspect of PBC is that contractors are paid based on the end result achieved and not by following any specified method of performing the work. Therefore, contractors are paid based on how well they meet the specified performance goals.

The client specifies performance indicators that the contractor is required to meet when delivering maintenance services. Performance is calculated based on several level of services defined through road users perspective, which may include but not limited to, vehicle velocity, rider comfort, and safety.

PBC involves a significant shift away from more traditional approaches to the delivery and maintenance of road infrastructure and associated services by a shift from the situation where the client has responsibility for the design and supervision of construction and maintenance activities to a focus on the key outcomes that the client wishes to achieve and incentivizing the achievement of those outcomes.

2.2 Historic Perspective of the PBC

Paying for services only when they are needed could be a future procurement model for many purchases that include a high level of service over time. The idea of paying for aircraft engines only when they are actually flying came about in the 1960s, when Bristol-Siddeley coined the term "power by the hour". When the firm was purchased by Rolls Royce in 1966, the concept (and the trademark) came with it. Since then, Rolls Royce has continued to offer this service on a range of its engines. In defense and aerospace contracting, many customers and suppliers have recognized that purchasing world-class products is not enough; it is also necessary to provide superior, cost effective maintenance and support services after the product is sold. In those sectors the term is known as "performance-based logistics" and it has become, for example in the US, a standard contract provision for the support of such key sub-systems as aircraft engines and avionics systems. As well as aerospace, performance-based contracting is well established in defense contracting and for complex items of equipment such as medical imaging devices (K. Will and H. Shabnam, 2013).

According to Abdulla Salem, (2014), the development of the PBC in the construction sector, started in the late 1980s to early 1990's. British Columbia, Canada, was first province to contract a PBC in 1988. The National Cooperative Highway Research Program (NCHRP), in the United States of America (USA), produced a report about PBC in maintenance for highways. Based on that report, Performance-Based Maintenance Contracting (PBMC) was first introduced and implemented in British Colombia and then used in Australia, New Zealand, England and Finland. It has become more popular in the USA as well as other countries. Among 38 states in the USA (who responded to the NCHRP survey), 8 of them (including Florida, Maryland, Texas and Virginia) are applying PBMC. As for highway maintenance in other countries, South Africa uses PBMC for 100% of its national roads. In Estonia it is 63% and in Argentina 44% of the road network is being maintained using PBMC (K. Will and H. Shabnam, 2013).

There is an increasing trend in the adoption of PBC worldwide, with various degrees of adoption from countries that are preparing to adopt PBC to countries that are already established in their adoption of PBC. This trend highlights that PBC is an increasingly important maintenance delivery contractual format.

2.3 Key Focus of PBC

Performance Based Contracts essentially are fixed price contracts. But they often do contain a schedule of prices for emergency works. If sections of the road in question are in poor condition, the contract should include the rehabilitation of these sections as well. Rehabilitation works may be carried out following the traditional form in this case, with official design and paid on the basis of unit or alternatively, final design of rehabilitation works can be left to the contractor and payment for these works can be included in the lump sum contract price (Sultana M. Rahman A. & Chowdhury S, 2013).

Based on Kabiri, et al., (2013), the value for money has the potential to be used as a tool to evaluate performance-Based Contracts, determining the level of services and cost saving has its own complications. A guaranteed price, best use of resources as well as increasing administrative efficiencies are factors that cannot easily be reflected in traditional method but are crucial in determining whether the implementation of PBC has a net positive value.

PBC in the road sector has various forms. There are two factors involved in determining what type of PBC for maintenance and construction of highways is needed. The first factor is the scope of the work such as activities and assets and the second is the coverage which addresses the area and the amount of the highway work covered in the contract. For example, in the simplest case, PBC may concern only a single activity like sign replacement, a single asset like bridge maintenance or a set of activities like rest area maintenance. However, more commonly, PBC pertains to a corridor, which is a long section of limited access highway

and the contract will involve everything in the provision of the right-of-way (K. Will and H. Shabnam, 2013).

Other than the type of activities, PBCs differ in terms of payment method. The following list describes the most common methods in performance-based contracting for maintenance based on the National Cooperative Highway Research Program (NCHRP):

i. Fixed-price (lump-sum) plus disincentives (penalties like deductions and/or liquidated damages) and possibly financial incentives.
ii. Cost plus with incentives fees or disincentives/liquidated damages.
iii. Fixed-price or cost plus with an award payment.
iv. Fixed-price or cost plus with an award term.

Although NCHRP provided this list, it mentions that the most common PBC in highway sector is lump-sum payments with penalties for not meeting the specified outputs, with at least one option to extend the contract period, which seems to be the only incentive that is not directly financial. While penalty clauses are not enforceable in many jurisdictions, there are acceptable contractual mechanisms, such as liquidated damages, that achieve a similar end.

2.4 Benefits of Using Performance Based Contracting

A performance-based contract (PBC) differs significantly from a method-based contract that has been traditionally used to maintain roads. In PBC, payments for the management and maintenance of road assets are explicitly linked to the contractor successfully meeting or exceeding certain clearly defined minimum performance indicators. While traditionally, the road agency as a client normally specifies techniques, technologies, materials and quantities of materials to be used, together with the time period during which the maintenance works should be executed. The payment to the contractor is based on the amount of inputs (e.g., cubic meters of asphalt concrete, number of working hours, etc.) (Reini W. Betty S. Vaughan C. & Charles A, 2015).

The client specifies performance indicators that the contractor is required to meet when delivering maintenance services. Performance is calculated based on several level of services defined through road users perspective, which may include but not limited to, vehicle velocity, rider comfort, and safety. For example, the contractor is not paid for the number of potholes he has patched, but for the output of his work: no pothole remaining open (or 100% patched). There are penalties in case of failure to comply with the performance indicators or failure in executing timely actions. Otherwise, the payment can be regularly made, usually in equal monthly installments. PBC for roads can be "hybrid," i.e., combines features of both

traditional method and performance-based contracts. With contractor's initiative in setting out their own work methods, an increase in the efficiency of public funds usage is to be expected and also to encourage technological innovation in the construction industry (Reini W. Betty S. Vaughan C. & Charles A, 2015).

Generally, the owner and contractors are needed to be motivated and share the construction risk, have sufficient skilled staff and efficient management system in order to ensure the successful implementation of a project. This section discusses and analyses the literature on the benefits of PBC over the traditional methods of contracts. The benefits of PBC identified by the literature review are as follows (Sultana M. Rahman A. & Chowdhury S, 2013):

- **Cost savings:** a road authority can save a huge expenditure required for road projects by implementing PBC. As stated by Sultana (2012), a review of evidence reported from around the world indicates that long term PBC are consistently delivering lower costs than any other form of maintenance delivery, and at the same time are generally delivering higher levels of service and a lower level of risk for the owner. In PBC, contractors are paid in equal monthly instalments if they are able to meet the specified performance measures mentioned in the contract. So there is no option to charge for extra work which is common in traditional method of contracts.
- **Reduction of administrative cost and increase in proficiency:** the application of PBC can reduce the supervision costs and increase the efficiency. The road authority has to provide necessary training to the staff and contractors in order to introduce them to the new contracting approach and to improve their quality. If the owner is unable to provide training, they can reform the administration by contracting out to the private sector.
- **Introduction of innovation:** scientists are inventing and improving technologies so that people can utilize time and money more effectively than ever. Construction and maintenance of road infrastructure systems should not be overlooked in using innovative technology for a better economy and smarter community. The contractors will only be motivated to use innovative technologies if it is beneficial to them. Use of specifications based on performance can promote innovation by allowing the contractor to control the materials and methods used. Moreover, successful contractors have long term revenue streams under PBC which motivated them to make long term investment decisions for both research and development (R&D) and training.
- **Reduction of delay and impact on public:** the use of technology under PBMC can help to minimize the impact of highway projects on the public by reducing the unnecessary construction delay. In the long run, it can reduce the bad effects of road construction projects on the public.
- **User satisfaction:** the need for a new contracting approach arises considering many factors, one of which was the satisfaction of road users. Road users or general public never measure the amount

of work done for the maintenance of roads. They consider the outcome of the work. A well maintained road reduces the cost for vehicle maintenance. PBC can help to increase the road safety.

- **Risk sharing by contractors:** a change in the method of specification from work output to performance, allocates the risk exposure of the road authority to the service provider i.e. contractor. Performance based contracts are designed to more closely link the achievement of these functional objectives and the cost of achievement of those standards, removing many of the prescriptive and procedural steps on which more traditional work output based contract types rely.
- **Assurance of quality:** PBC significantly expands the role of the private sector, from the simple execution of works to the management and conservation of road assets. One fundamental feature of the performance-based contract is that the contractor is responsible for designing, scheduling and carrying out the actions s/he believes are necessary in order to comply with the service quality levels stated in the contract. The service quality levels are defined from a road user's perspective and may include factors such as average travel speeds, riding comfort, safety features, etc. If the service quality is not achieved in any given month, the payment for that month may be reduced or even suspended.
- **Availability of initial funding sources:** a review of PBC was approached jointly by the World Bank Group, IDA/IFC secretariat (International Development Association/International Finance Corporation) and the Global Partnership of Output-Based Aid (GPOBA). Since inauguration of the first project using that approach in 2002-03, the World Bank has consequentially increased from 32 projects to around 200 projects all over the world with various funding sources which is anticipated to favors at least 60 million poor people.
- **Sustainable road management system and assurance of long-term funding:** the road authority gets the option for the possibility of long term sustainability using PBC. These types of contracts have exhibited larger reductions in necessary long term expenditure for road maintenance in which proves the method's ability of providing a more sustainable road maintenance and management system.
- **Increase in flexibility:** contractors receive the flexibility in achieving their work target in PBC. This flexibility can be enjoyed either by choosing the desired engineering design and drawing or by using innovative technology.
- **Increase in transparency and reducing the chance of corruption:** a traditional method is more prone to corruption because of the nature of its decision making process. PBC has the potential to reduce the scale of the decision making process by promoting transparency and good governance in road maintenance works.

2.5 Benefits of Using Traditional Methods of Contract

In traditional method the client has the closer control to the work. For example, the consultant team must provide which meet the requirements of the client. Besides, due to the advice and construction expertise that provide by the consultant and the contractor, client may compare and consider which design and budget is more suitable for the project (K. Will and H. Shabnam, 2013).

In traditional method, all tenderers produce a tender base on the same information. Therefore, client may obtain the best or lowest price through competitive tendering. Besides, the construction cost will be more accurate since the tender is bases on the complete design and specifications (K. Will and H. Shabnam, 2013).

In compare with other procurement method, traditional method will be easier to be adopted. It is because this method had been commonly used for a long period of time, so both contractor and consultant team are familiar to solve or face the risks during the procurement state of a construction progress (K. Will and H. Shabnam, 2013).

2.6 Drawbacks of PBC

PBC is still a new approach in the construction industry with some disadvantages which is not an exception. Some of the disadvantages are:

- **High Cost of Tendering:** Preparation of tender documents and also tendering are the costly parts of PBC which require legal and financial advice to support the business decisions in excess of the detailed technical expertise needed to determine a price. This limits the parties able to tender for the contract and raises questions about supporting the cost.
- **Decreased Competition:** the length of PBC also means that the size of the market is reduced for the duration of the contract which in turn decreased the competition.
- **Increased Significance of Poor Contractor's Performance:** The possibility of poor contractor performance exists in all contracts. As with other types of contract remedies exist in PBC to address poor performance. But the consequence of premature termination of contracts is probably harder to handle than for a traditional contract because of the need for costly re-tendering and time.
- **Reduced Ability to Deal with changes:** During the life of a performance contract many factors affecting the contract could change. These could be physical, political or environmental. The lump sum nature of the performance contract means that the ability to deal with such changes is reduced by being locked in to outdated contract provisions.

- **Reduction of Technical Capability:** Road authorities will require a reduced level of technical expertise as the responsibility for design and technical specification is transferred to the contractor. There is a risk that if this downsizing in key technology areas is taken to an extreme level, then that road authority could lose the ability to be an informed purchaser. In addition, if road authorities do not practice sufficient technical skills to keep pace with developing technologies they risk being unable to take advantage of emerging technologies in future contracts.
- **Loss of Control:** A common anxiety amongst road authority's staff about PBC is the loss of control of the network. Ownership passes from the road authorities to the contractor who has the greatest say of work done on the network. The problem is that this loss of control will lead to a reduction of the standard of service provided. It can happen in the premature stage of implementing PBC if the performance measures are inadequately defined.
- **Loss of Innovation to the Public Domain:** The risk of loss of innovation to the public domain is predicted on the assumption that if contractor developed innovation in some way replaces road authority funded research and development. If road authorities continue research and development, any innovations coming out of performance contracts can be considered a bonus. It is likely that ground-breaking innovations will continue to come from a variety of sources.

2.7 Problems of Traditional Methods of Contract

In traditional methods of contracting, the road authority or project owner selects the consultant for the design of the project and the contractors are decided by the competitive bidding procedure. Governments' road authorities in many countries have faced problems regarding routine and periodical maintenance done by an in-house labor force based on the unit price method. Engineering Maintenance is not just cosmetic in nature. Road Maintenance is directed to preserving the value of the roads assets by preserving the durability of the roads and bridges. Without maintenance, the value of these assets will rapidly deteriorate. Moreover, the problems are severe in developing countries as their road authorities are always struggling to manage funding for the maintenance of their roads after the roads are constructed. A single rehabilitation is estimated to cost three to four times the amount that should have been spent on routine and periodic maintenance of roads. If the road network system is not maintained properly national economic growth is probably slowed by about one per cent of GDP each year. The respective government department has to go through a long term step by step process in traditional methods of contracting. Especially in the case of large road maintenance projects where many organizations such as external funding party and consultants are involved and all these factors make it difficult to make the right decisions (Sultana M. Rahman A. & Chowdhury S, 2013).

However, the common problems observed in traditional methods of road maintenance contracts according to different literatures are as follows:

- Escalation of cost and time;
- Poor quality of work;
- Inadequate motivation;
- No proper risk sharing;
- Overhead and supervision cost;
- Delay in project completion;
- High level of political influence and corruption and
- Lack of proper training in the public sector.

2.8 Performance Indicators

Performance indicators/standards help to measure the performance of the contractors' work. Performance standards have to be clearly defined in the contract and objectively measurable to avoid ambiguity. The cost of the road maintenance may vary depending on the road sections, traffic condition of roads, vehicle operating costs and the environment of the country. The application of Highway Design Model (HDM) can also help to set up parameters, for example, International Roughness Index (IRI). Moreover, the application of a minimum acceptable level of performance can be achieved through the implementation of targets based on performance standards. Table 2.1, which is tabulated after presents some typical performance standards and their influence on roads (Sultana M. Rahman A. & Chowdhury S, 2012).

Table 2. 1 Typical Performance Standards and Their Influence on the Roads (Source: Sultana 2012)

Performance Standards	Influence/Effect
International Roughness Index (IRI) to measure the roughness of the road surface	Vehicle operating cost
• Absence of potholes. • Control of cracks and rutting.	Road safety and pavement performance
The minimum amount of friction between tires and the road surface	Road safety
The maximum amount of siltation or other obstruction of the drainage system.	To avoid destruction of the road structure
The retro reflexivity of road signs and markings.	Road safety

Examples of Performance Indicators Applied in Different Performance Contracts in Latin America has been presented in Table 2.2.

Table 2. 2 Examples of Different Standards Applied in Different Countries (Source: Sultana 2012)

Asset Class	Component	Performance Standard
Pavement	Potholes Roughness (asphalt) Roughness(bituminous treatment) Rutting Cracks	No potholes IRI < 2.0 (Argentina), IRI < 2.8 (Uruguay) IRI < 2.9 (Argentina), IRI < 3.4 (Uruguay) < 12mm (Argentina), < 10mm (Uruguay, Chile) Sealed
Gravel surfaces	Potholes Roughness Thickness of gravel layer	No potholes IRI < 6 (Uruguay), IRI < 11 (Chile) 10 cm (Chile, Uruguay)
Shoulders	Potholes Cracks Joints with pavement	No potholes Sealed Vertical alignment < 1cm (Chile, Uruguay), sealed (Peru)
Drainage system	Obstructions Structures	No obstructions. Should allow for unhindered flow of water (Chile, Uruguay) Without damages and deformations (Chile, Peru)
Road signs and markings	Road signs Road markings Retro reflexivity of road markings	Complete and clean (Argentina, Chile, Peru) Complete and visible (Argentina, Chile, Peru) 160 mcd/lx/sqm. (Argentina) 70 mcd/lx/sqm. (Uruguay)
Right of way	Vegetation Foreign elements	< 15cm height (Argentina, Uruguay) No foreign elements allowed

2. 9 Performance Monitoring

Monitoring the performance of the contractor regularly is a very important part of PBC. It will be beneficial in the initial stages of introducing PBC in a country. The monitoring system differs among the road authorities. However, a monitoring system is necessary to maintain the quality of work and also to record the data for future research and development in the road authorities. Sultana et.al (2012) said that the monitoring system may include:

- Contractor's self-control system;
  - ✓ Own organizational structure with qualified personnel;
  - ✓ Verifying continuously the compliance with the service level criteria;
  - ✓ Monthly reporting of compliance to client using standard formats;
  - ✓ Participating in monthly formal inspections.
- Formal monthly inspections;
- Supervisors (formal/informal) inspections;
- Project Managers (formal/informal) inspections and
- Maintaining a record book to follow the comments or complaints of roads users.

At present, road authorities follow the criteria and standards developed for their traditional methods of contracting to evaluate the performance of contractors in maintaining road infrastructure system. These standards vary significantly among the road authorities and some of them have not been properly defined to monitor PBC. The development of revised performance evaluation procedures will assure the reliability of the overall performance, in PBC, identified five components in order to develop a framework for monitoring performance in PBMC which are level of service effectiveness, timeliness of response, safety procedures, quality of services, and cost-efficiency (Sultana M. Rahman A. & Chowdhury S, 2012). Each of them are explained as follows:

- **Level of Service Effectiveness:** This indicates the extent to which the performance criteria and performance targets defined in the contract are being met.
- **Timeliness of Response:** Evaluates the response time of the contractor to service requests related to events or deficient elements in the roadway that need to be attended in a timely manner.
- **Safety Procedures:** Evaluates if a safety program is properly implemented by the contractor. This component is very important to ensure that the roadway users as well as the maintenance crews performing the work are exposed to minimum risk of accidents.

- **Quality of Services:** Assesses the customer perceptions with respect to the condition of the assets and contractor performance. Customers are the ultimate evaluators of the quality of the service provided; therefore, it is extremely important to assess their satisfaction.
- **Cost-Efficiency:** Assesses the cost savings, if any, accrued by the government as a result of engaging a contractor to perform Performance-Based Road Maintenance Services.

2.10 PBC Experience from Different Parts of the World

2.10.1 Performance Based Contracting in Developed Countries

Various State Departments of Transportation (DOT) in USA started to outsource road maintenance works in order to reduce costs, increase efficiency, improve quality, expedite project delivery, spur innovation, enhance risk management, and overcome a lack of expertise. Performance-based contracts were first introduced in the state of Virginia in 1996. Since then, other states, such as Alaska, Florida, Oklahoma, Texas, and North Carolina have started applying PBMC approaches to maintain highways, bridges, tunnels, rest areas, and urban streets. In September 2001, the Oklahoma Department of Transportation (DOT) entered into two five-year contracts valued at approximately US$36 million. The contracts covered routine maintenance, such as pothole and guardrail repair, snow and ice removal, sign repair and litter pickup, but not major items such as pavement preservation or bridge repair. As the contractors failed to meet the required performance, the contracts were cancelled in May, 2002. The main reason was that the DOT had enough expertise, skilled workers, and equipment within the state force to perform maintenance projects and there was a lack of long-term budget commitment from their state governments for road maintenance performed using PBC. Texas DOT also expected savings in their pilot PBMC. However, one of their special areas of concern was the contractor's performance in pavement maintenance (Sultana M. Rahman A. & Chowdhury S, 2012).

In 1995, the construction industry of Australia was introduced to PBC (called performance specified Maintenance Contract, PSMC in Australia and New Zealand) for the maintenance of a large proportion of the arterial road network in Sydney, New South Wales. PBMC is expected to provide a quality road network to road users at a reduced cost, free of the many risks which traditionally, enhance effective road management (Sultana M. Rahman A. & Chowdhury S, 2012). Examples of the results are as follows:

- Sydney, New South Wales → 38% savings.
- Southern Tasmania → 20% savings.
- North Island, New Zealand → 15% savings.
- South Perth, Western Australia → 25% savings.
- Mid North Region, Western Australia → 30% savings

Therefore, the performance-based model is consistently delivering savings in excess of 35 percent compared to in-house operations. Longevity, security and strategically long term view were the beneficial factors of PBC enjoyed by four trialed sites maintained by PBC in New Zealand. Some disadvantages of the PBMC model mentioned were as follows (Sultana M. Rahman A. & Chowdhury S, 2012):

- The critical part of long-term contracts is working to achieve shared goals and respecting each party's individual goals. If any party fails to maintain the harmony, the contract can be a disaster.
- If the right people are not available and a transition period cannot be undertaken the contract is placed under considerable risk. A new person coming into a PBMC in a senior role without understanding the nature of the relationships or the various goals and strategies, can do significant damage. Also the loss of network and systems knowledge can be significant.
- Pavement modeling on long term contracts is critical in terms of understanding the financial cost of maintaining Key Performance Indicators (KPI's) at a particular level and it is a very high risk area if the modeling predictions are not right

2.10.2 Performance Based Contracting in Developing Countries

The applications of PBC have been observed in many developing countries, such as Argentina (1990), Uruguay (1996), Chile (1997), Brazil (1998), Peru, Guatemala, Estonia, Serbia and Montenegro, South Africa, Zambia, Chad, and the Philippines (Sultana M. Rahman A. & Chowdhury S, 2012).

Although PBMC has been successful in the developed countries, it has been observed that the implementation of PBMC becomes challenging for developing countries. high cost of tendering, decreased competition among the contractors, increased significance of poor contractor's performance, reduced ability to deal with changes, reduction of technical capability within the road agency, loss of control of the network, loss of innovation to the public domain are some drawbacks of PBMC (Sultana M. Rahman A. & Chowdhury S, 2012).

The challenges that work as a barrier during the introduction of PBMC in developing countries are as follows: lack of support from government, dependency on external funding, political influence and corruption, lack of experience in introducing PBMC, lack of proper planning, fear of losing job, loss of competition, loss of control of the network, contractors' performance and attitude, challenges in estimating the cost of PBMC (Sultana M. Rahman A. & Chowdhury S, 2012).

CHAPTER THREE

MATERIALS AND METHODOLOGY

3.1 Introduction

Research is an organized and systematic way of fact finding missions that is embarked to find answers to questions about a given issue or explore its practice. Research involves critical investigation of the various aspects of the problem under consideration; understanding and formulating guidelines that govern the research procedure; and developing and / or testing theories for the enhancement of the existing situation, state or process. In this light thus, a research concerns with both what the research explores (the issues, the facts and conclusions) and how the facts are acquired and the conclusions are reached (the methodologies) (Solomon S. Desta, 2015).

3.2 Research Methodology and Design

Research methodology is a way of systematically solving a research problem. This involves various steps that were followed during the study. This chapter discusses the research design and methodology used in acquiring the necessary information to answer the research questions. It specifically presents the research questions, describes research approach and techniques, operationalize variables and indicators, presents sampling techniques in terms of sample size and selection, validity and reliability of the research, data collection methods and data analysis methods.

One of the basic requirements in selecting appropriate forms of research methodology and method as well as controlling the processes is to ensure that the characteristics reflected on the research output are that of the trait of the phenomenon and not methodological artefacts. The purpose of the research (the nature of problem to be solved) has a significant bearing on the methodology that needs to be adopted. For example, such descriptive goals that pose what, who, where, and how many questions would generally be best addressed through surveys and archival studies. In this type of research, what is generally sought is exploration and description of incidences and their frequency without major inclination for causal linkage. When the research goal is to look causal linkage asking the how and why questions (explanatory or predictive in nature), the more appropriate methods would be experiment, surveys, histories or case studies (Solomon S. Desta, 2015).

As presented in chapter One, the major objectives of this research are examining the potential of PBC for improving road maintenance and construction in ERA, analyzing the benefits of introducing and implementing of PBC in ERA, investigating the disadvantages of PBC for ERA and analyzing the

challenges and problems those faced the introduction of PBC in ERA. These objectives, at a general level, call for descriptive explorations of the characteristics of the practice and explanatory investigation to establish causal links between the processes (and challenges) and improved performances.

According to Solomon S. (2015), a case study research can be used for exploratory, descriptive as well as explanatory studies. Case studies are suitable for an explanatory research where 'how' and 'why' issues over which the investigator has little control are investigated and when contemporary phenomena with a real life context are sought, they can also be used in exploratory and descriptive studies.

In this context thus, the most suitable research strategy that combines this research's objectives of exploring and describing the PBC approach in ERA and establishing causal links between issues that are affecting PBC and how that can be mitigated is the case study. These traits of a case study, along with proper design of theory formulation, data collection and analysis techniques will make the strategy the better options for the study. In the wake of these relative appeals of the case study and its relevance for the research questions posed, the study adopts a combination of descriptive and explanatory case study to explore, describe and establish a causal relationship of the PBC, the major challenges and possible mechanisms that would lead to improved performance of construction/maintenance processes.

3.2.1 Research Design

According to Opuch (2016), research design is a plan, a roadmap and blueprint strategy of investigation conceived so as to obtain answers to research questions. It is a procedural plan that is adopted by the researcher to answer research questions objectively, accurately and economically.

This study utilized a cross-sectional survey design which adopted mixed methods. A cross-sectional study predominantly uses questionnaires or structured interviews for data collection with the intent of generalizing from a sample to a population and under the aspect of mixed methods, to provide the best understanding of a research problem. Based on Opuch (2016) mixed methods employs strategies of inquiry that involves collecting data either simultaneously or sequentially to best understand research problem. Both quantitative and qualitative methods were employed to solicit information that cannot be expressed in numerical information about the phenomenon under study to aid establish patterns, trends and relationships from the information gathered. The quantitative methods were administered by the use of questionnaire while the qualitative methods dealt with key informant interview and document review.

This research is an evaluation research with the aim of evaluating the ERA contracting method. It is emphasizing on examining the advantages and disadvantages between the traditional method of contracting and Performance-Based Contracting (PBC) and to recommend possible remedial measures for the main problems of ERA's contracting system.

3.3 Research Approach

Research approaches are plans and the procedures for research that span the steps from broad assumptions to detailed methods of data collection, analysis, and interpretation. This plan involves several decisions, and they need not be taken in the order in which they make. The overall decision involves which approach should be used to study a topic (Solomon S. Desta, 2015).

Normally, there are three research approaches, Qualitative, quantitative and mixed approaches. Mixed methods involves combining or integration of qualitative and quantitative research and data in a research study. In this research, mixed approach is used since this approach helps to inquiry of collecting both quantitative and qualitative data, integrating the two forms of data, and using distinct designs that may involve philosophical assumptions and theoretical frameworks. The core assumption of this form of inquiry is that the combination of qualitative and quantitative approaches provides a more complete understanding of a research problem than either approach alone. Accordingly, quantitative and qualitative data were collected in this research by conducting surveys and interviews. In addition, similar data were collected from secondary sources.

3.3.1 Data Collection Process

A need for collecting data has been identified to achieve the research objective. The aim of data collection is to examine the effectiveness and potential of PBC for ERA projects. Data regarding details of some ongoing and already finished road construction and maintenance projects have been collected, which indicates the need for performing a questionnaire survey and interviews for the detailed analysis.

3.3.1.1 Data Sample Size and Sampling Method

A sample is a finite part of a statistical population whose properties are studied to gain information about the whole. A good sample should be adequate and representative of the underlying population. It is the process of selecting a number of study units from a defined study population.

Often research focuses on a large population that, for practical reasons, it is only possible to include some of its members in the investigation. This research identified a target group for the surveys and interviews of road authority personnel, contractors and other stakeholders. The questionnaire survey has been carried out among these selected target groups. The respondents were selected based on the following criteria:

- Professional background;
- Experience of work;
- Education level and;
- Position of the person in the construction industry.

Simple random sampling was used because of cost-effectiveness and ease of assembling of the sample for selecting respondents other than the staffs of the Asset Management Department in ERA (consultants and contractors) since all of the staff members in this department were respond the questionnaire. A fair way of selecting a sample from a given population was considered since every member will be given equal opportunity of being selected. It will reasonably make generalizations from the results of the sample referring to the population as one of the goals of research is to make conclusions on the population based on the result obtained from the sample. Accordingly, a sample was selected from the number of contractors and their projects.

During sampling, it was observed that there were limited number of PBC projects those were signed between the client (ERA) and the contractors. Therefore, all of the projects were briefly studied while one project was studied in detail.

3.3.1.2 Data Collection Method

Regarding the secondary data collection, there were different data sources explored mainly: documents, archival records, interviews, observations, physical artifacts. While each of these can be used as a standalone data source, as much as possible, it is however advised to use multiple data sources that could be used in 'data triangulation' (Solomon S. Desta, 2015).

This research uses both primary and secondary data. The primary data were collected using three methods but mainly through a survey by administering a questionnaire on selected potential respondents. The questionnaire contains a three parts. Part 1 consisted of five questions on the background of the respondent. These questions were included to acquire data on the education, qualification and experience of the respondents in the field of road construction and maintenance. Part 2 of the questionnaire survey was prepared regarding the traditional method of contracts. It was designed to gain knowledge on the road maintenance works, reasons for variations in cost, quality and time. Thirty questions were included under part 2 of the questionnaire. Part 3 of the questionnaire survey was entirely on Performance-Based Contracting (PBC), its aspects, and potential of the application of PBC in Ethiopia. This part also seeks opinions on the barriers and challenges of implementing PBC in ERA. In depth interview of some of the respondents; and on-site observation of the on-going and a finished construction site and the handed over projects are other sources of primary data. Literatures (thesis, journals, books, etc.) are used as a source of secondary data in addition to the case study.

Documents and archives were used as the major data source and data from interviews were used to fill gaps identified from the documents and to triangulate the data gathered through document analysis in addition to the questionnaire.

Documents and archives, notwithstanding their drawbacks such as irretrievability, reporting bias, biased selectivity and accessibility (Solomon S. Desta, 2015), are important sources of data. Particularly in this case where it can be expected that projects by ERA to be sanctioned, administered and closed formally, the documents and archives concerning the relevant projects can be argued to be of important data source. Therefore, the available documents relevant to the case were collected and relevant data was retrieved.

Interviews provide an opportunity to interact with informants; hence offer distinct advantage for targeted insightful perspective of informants. Parallel with this, one of the most important issues with respect to interviews was the selection of the informant that has important bearing on the information relayed (Solomon S. Desta, 2015). In this study, informants were selected (and re-selected as appropriate) from pools of personnel who are thought to have been well informed about the issue under discussion. Such pool includes the Authority's hierarchy in control (involved in) of the processes. Particularly, interviews are conducted with 'owners' of the major processes

3.4 Research Data Analysis

Analysis of data was done to answer the three research questions of this study. The study used documents and interviews as its main data source. The process of document analysis as a data source generally calls for elements of content analysis and thematic analysis. Content analysis is defined as 'the process of organizing information into categories related to the research problem' while thematic analysis can be defined as a form of pattern recognition within the data, with emerging themes becoming the categories for analysis (Solomon S. Desta, 2015).

Solomon S. (2015) identify two major types of case analysis and display of qualitative data. They are 'exploring and describing' that presents the description of (after exploring) the phenomena under study and 'explaining and prescribing' that presents explanations as to why events happen the way they happen and prescribe potential adjustments to the way phenomena are implemented. Parallel with this categorization, this study first presents description of the practices of the PBC and the challenges in introducing PBC. Then, the study, based on 'best practices' and recommendations in the literature, seeks explanations for the identified 'poor' performances and prescriptions to improve them.

Statistical analysis was needed for the questionnaire survey. After completion of the survey, data were processed and analyzed using the Microsoft Office software MS Excel. Face to face interviews covered issues which were not included in the questionnaire and support the analysis of the survey. Based on the above procedure, all the collected data scrutinized carefully in order to eliminate irrelevant information. Then the relevant data were sorted and organized to simplify data analysis process.

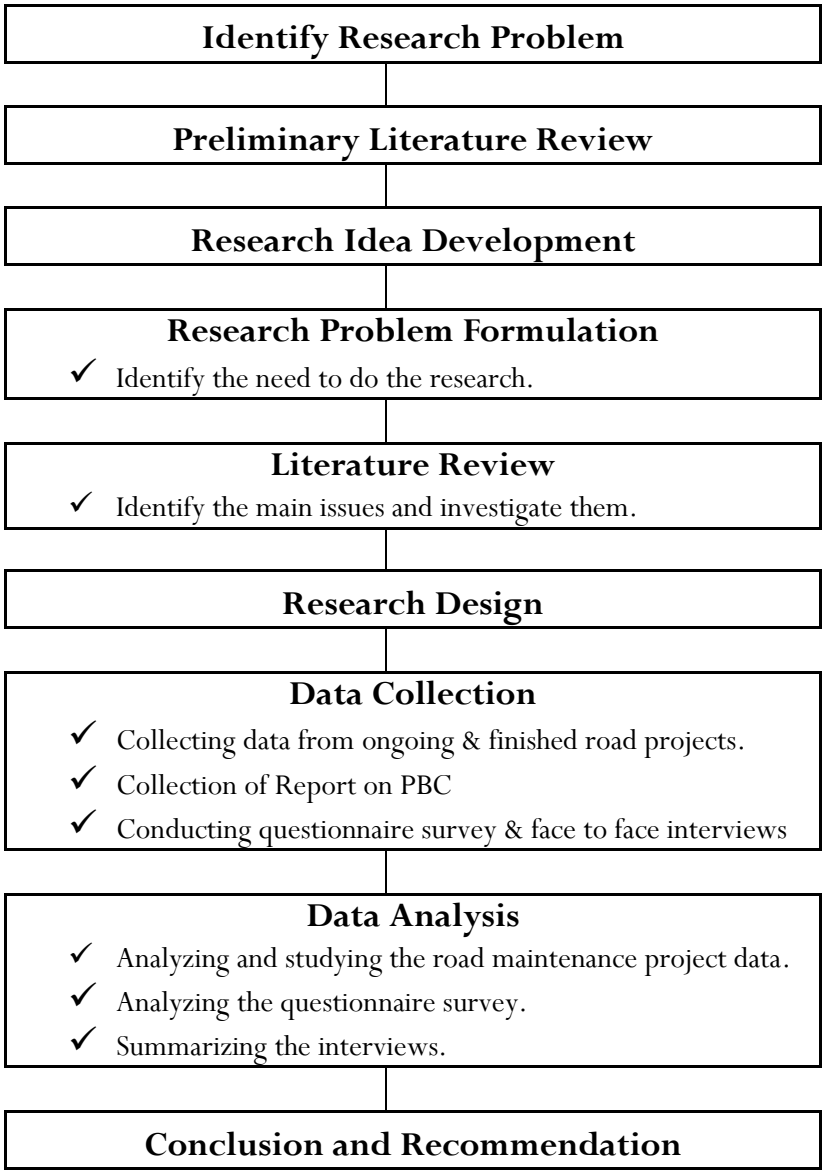

Fig. 3. 1 Research Methodology Flow Chart

CHAPTER FOUR

ROAD MAINTENANCE CONTRACTING IN ERA

4.1 Background of ERA

Following the eviction of the Italian occupiers, the Imperial Ethiopian Government was convinced that a Road Agency solely responsible for rehabilitating/restoring and expanding the road network throughout the country had to be established. Accordingly, the Imperial Highway Authority (IHA) was established under proclamation No. 115/1951 as a semi-autonomous agency with specific duties to plan, design, construct, and maintain roads. Responsibilities for construction and maintenance of roads remained under a single autonomous authority (IHA) for 26 years (1951-1977). The Ministry of Transport and Communication turned out to be the supervising authority of ERA. The Ethiopian Roads Authority has been reestablished under proclamation 133/1978 incorporating, among others, the Rural Roads Department in addition to the Highway Department (Germay G. , 1994).

In 1980, the Military Government that took power in 1974 reformed the agency into the Ethiopian Transport Construction Authority (ETCA) by proclamation No. 189/1980 and became answerable to the newly formed Ministry of Construction. The proclamation enlarged responsibility of the Authority by expanding its task to incorporate the construction of Airports, Seaports, Railways, and Municipal Roads (Germay G. , 1994).

Following the shift from a command-based economy to a market oriented one in 1991, ERA was reestablished by proclamation No.63/1993 with a view to providing a strong administration under the leadership of a Board. As part of its reform, the government assigned administration of rural roads to the regional self-governments and main roads to ERA as part of the Federal Government's responsibility. ERA's role regarding rural roads was then limited to rendering support such as overall network planning, training and technical assistance as required by Regional Governments (Germay G. , 1994).

To cope up with existing situations, ERA was again re-established by proclamation No. 80/1997 with the objective to develop and administer highways, and to ensure the standard of road construction. With the establishment of the new cabinet of Ministers in October 2001, a Ministry of Infrastructure and later on Ministry of Works and Urban Development has been formed with the responsibility of developing the infrastructure of the nation. ERA, which is one of the organizations under the Ministry of Works and Urban Development and accountable to the Board, is responsible for planning and formulating long and short term

plans and programs for road construction, design, maintenance of trunk and major link roads, as well as for administration of contracts (Germay G. , 1994).

Currently, the main responsibilities of ERA are: network planning, management of contract projects and force account operations. The long-term objective is to focus on policy, planning and contract administration and to pull out gradually from direct operational works.

Based on the geographical locations, Ethiopian Roads Authority has classified the countries road network in to five regional areas. These are:

i. Northern ERA Regional areas
   - Gonder District
   - Adigrat District
   - Debre Markos District
   - Combolcha District

ii. Southern ERA Regional areas
   - Shashemene District
   - Sodo District

iii. Eastern ERA Regional areas
   - Dire Dawa District

iv. Western ERA Regional areas
   - Jimma District
   - Nekempte District

v. Central ERA Regional areas
   - Alemgena District

4.2 Road Asset Management in ERA

Based on the organizational chart of ERA, road asset management department is the responsible department to administer the federal road network. Road Asset Management provides decisions with the necessary tools for efficient and sustainable management of roads (ERA, 2017). This department is performing the following tasks;

- Collect and organize data required for road network management,
- Make road condition assessment and gap identification,
- Prioritize and optimize works based on network classification,
- Administer and improve PMS and road classification system,

- Administer and improve Bridge Management System,
- Collect bridge condition data,
- Prepare Bridge maintenance and replacement plan,
- Protect road and bridge from damage due to excessive loads,
- Control and manage the situation that interrupt road transportation,
- Network administration,
- Prepare annual maintenance plan and budget requirement,
- Prepare bid and contract documents related with maintenance
- Administer Road maintenance projects and
- Conduct seasonal Traffic count.

ERA's pavement maintenance management and related works are done under the road asset management department in the name of Pavement Maintenance Management. Before 2016, all of the maintenance works under this department were processed through the traditional contracting method. But in 2016, ERA signed four projects under the PBC method. Most of the traditional contracts were performed by the Ethiopian Construction Works Corporation (ECWC) the then Ethiopian Road Construction Corporation (ERCC) which was under Ethiopian Roads Authority. Based on the Council of Ministers Regulation No 248/2011 ERCC was established on July 08/2011 to carry out mainly road and bridge construction, maintenance and enhancement works. Before ERCC, maintenance was performed as an operation by own force of the Ethiopian Road Authority for 60 years.

Until 2019, there was no attempt from ERA to perform new road construction projects by PBC system. All the four projects those signed through PBC were: maintenance, rehabilitation or upgrading projects. Therefore, this study mainly focus on the works done under the jurisdiction of Road Asset Management department.

In order to know pavement maintenance and contract management system in ERA, knowledge on the pavement management (PMS) of ERA is a prerequisite. In 2011, the ERA started to implement the current pavement management system in order to perform the aforementioned tasks of the asset management department. This PMS is called ERAMS (Ethiopian Roads Authority Management System) which utilizes different user manuals based on the type of software and equipment used to implement the pavement management process. The implementation of the PMS is based on the guidance of those user manuals. Some of the main user manuals are;

- ERA PMS User Manual for dTIMS and HDM-4 Operations; this manual describes the PMS system of ERA in the dTIMS and HDM-4 software applications. It includes database operations in dTIMS and life cycle cost analyses in HDM-4.
- ERA PMS User Manual for HawkEye Data Processing; this manual describes the processes to be followed after a road survey has been completed with the HawkEye equipment. The manual has details on how to process and export the profile and distress data, and how to further manipulate the surveyed road data into the correct format for importing into ERA's dTIMS database.
- Official set of HDM-4 Manuals; this manual suite contains the following documentation on the HDM-4 series: Applications Guide, Software Users Guide, Analytical Framework and Model Descriptions, A Guide to Calibration and Adaptation, Modelling effects.
- WE 751-4-4 Processing Toolkit & Data Viewer User Manual, and WE 751-4-3 Hawkeye Data Viewer Quick Start Guide; this is the official manual of the HawkEye Processing Toolkit application that is used to process and view the ERA's surveyed data.
- dTIMS V8 User Guide March 2011; this is the official User's Guide of the dTIMS software application. It describes all aspects of the dTIMS software application that are necessary to maintain a road network database in dTIMS.

4.2.1 Types of Maintenance in ERA

According to ERA's manual (2013), maintenance types are categorized into six groups based on the cost needed to perform the work;

- **Routine maintenance:** maintenance that needs to be done at relatively short intervals such as cutting grass and cleaning drainage ditches.
- **Emergency maintenance:** maintenance that has to be done immediately as a result of an unexpected problem e.g. clearing a rock fall.
- **Periodic maintenance:** maintenance that needs to be done at longer intervals of, say, 5-10 years e.g. surface dressing. Usually this category excludes structural strengthening.
- **Rehabilitation:** this term is commonly used when structural strengthening is required and includes overlaying.
- **Reconstruction:** this usually means that at least one layer of the pavement needs to be reprocessed.
- **Upgrading:** this usually means that strengthening and some realignment are required.

The costs increase steadily from 'routine maintenance' up to 'upgrading'. As a result the responsibility for each operation may differ. However, it can be seen that there is considerable overlap between the categories

and in the process of keeping the road in good condition. Based on this classification, ERA's PMS is providing the appropriate maintenance strategies.

4.3 Road Maintenance in ERA

At the early 1990s, the road network had generally deteriorated due to several reasons. Therefore, long time neglect of routine and periodic maintenance causes Potholes, ruts, gully, depletion, silting of side drains, and blockage of culverts and bridges, etc. According to Biniyam (2015), the extent of the crisis was fully revealed during the Spanish Consultant financed by European Commission in 1995. At that time, only 11 per cent of the 3,656-km of paved roads were deemed to be in an acceptable condition, 41 per cent was deteriorating fast and the remaining 48 per cent were beyond repair. The 20,156-km of unpaved network was in very bad condition, with only 19 per cent in acceptable condition, 28 per cent in mediocre condition, and 53 per cent in a poor state. However, this severe condition was ameliorated by 2007 whereby 49 per cent of the then 42,429 km was in good condition and 22 and 29 per cents of the total network were in fair and poor condition respectively. In this regard, in 2013, 51 and 27 per cents of the federal road network were in good and fair condition respectively.

Due to the deterioration of the roads, vehicle-operating costs increased highly resulting in increment of transportation costs. The specific cause identified by the Spanish Consultant in 1995 were;

- Civil war that took place in the country for seventeen years (destroyed many infrastructures and create obstacles to perform the appropriate maintenance);
- Financial incapability to fund for the works from the Ethiopian government and unwillingness of the international financers to finance the projects ;
- Organizational limitation in terms of manpower, equipment, technology; and
- Main concern of the organization and the government was to construct new routes;

Based on this study the Ethiopian Government understood the requirement of an appropriate Road maintenance policy and strategy, as a prerequisite for the development of a healthy and dependable Road traffic environment to a country. Based on the Ethiopian Road Fund office report (2001), the absence of integrated maintenance measure and lack of comprehensive approach, in Ethiopia, leads to the accumulation of a huge backlog of Road maintenance work.

Therefore, to overcome this financial problem which encountered to on time road maintenances (routine maintenance), the government planned to collect a certain amount of the maintenance cost from the road users in addition to the government budget. Road maintenance cost, as part of total transport cost, is one major determining factor for the up keeping of Road asset value of a country.

Then, in March 1997, Road Fund Administration organization was established by proclamation no. “66/1997". By a special directive of the Minister of Council, pre-determined proceeds on the rated Fuel levy amount since September/96 was deposited to the Road Fund special account early on. This was made with an intention of giving financial strength and to give chance for maturation of the money in the special account so that non-sustenance will not be a fear during system transformation; i.e. from Ministry of Finance road maintenance budgeting system arrangement to Road Fund maintenance financing. This further proves the commitment of the government towards establishing a strong Road Fund free from fear of non-sustenance and in-stability on the flow of fund on the start of its business. Stated sources of road Fund revenue, as per to the proclamation, are Government budget, Fuel levy, Axle weight based vehicle license renewal fee, overloading fines and any other Road Tariff as may be fixed and approved by necessity. (The FederalL Democratic Republic of Ehiopia Office of the Road Fund Administration, 2001).

Then, the collected budget is distributed for the federal, regional and urban road agencies. According to the road fund data, the following table shows the budget allocated to the federal roads maintenance from 1997 – 2014 (the recent organized available data is the 2014 data until this study is done).

Table 4.1 Road Fund's Maintenance Budget Allocation for Federal Roads (Source: Road Fund)

Year	Routine and Periodic Maintenance			Emergency and other Works		
	Budget (Million)	Disbursement (Million)	% Age Acc.	Budget (Million)	Disbursement (Million)	% Age Acc.
1997/98	158.4	117.9	74.4	10.8	5.6	51.9
1998/99	156.9	123.25	78.7	15.2	12.5	82.2
1999/00	152.0	118.2	77.8	17.0	15.2	82.2
2000/01	114.0	140.4	123.2	70.8	27.8	39.3
2001/02	119.7	176.2	147.2	178.0	31.0	17.4
2002/03	121.5	115.7	95.2	35.1	68.6	195.4
2003/04	127.0	192.8	151.8	163.2.1	140.5	86.1
2004/05	63.5	137.1	215.9	162.2	482.6	297.5
2005/06	144.1	172.5	119.7	112.4	298.4	265.5
2006/07	150.0	230.3	153.5	257.8	394.7	153.1
2007/08	186.7	234.8	125.7	161.3	400.6	248.3
2008/09	227.8	527.8	231.7	200.7	500.7	249.4
2009/10	223.4	516.9	251.5	196.2	491.1	250.3
2010/11	158.9	368.1	231.6	140.0	367.4	262.4
2011/12	426.9	493.1	115.5	320.3	310.9	97.1
2012/13	302.1	440.7	145.8	439.9	410.2	93.2
2013/14	516.8	577.2	111.6	370.9	376.1	101.4

After the formation of the Road Fund organization and implementation of Road Sector Development Program (RSDP) over the past 22 years, the achievement in improving the size and quality of road network is remarkable. The road network of the country increased from 26,550 km in 1997 to 113,066 km in 2016, an average annual growth rate of 8 percent. As a result of the increase in the size of road network, distance to nearest all weather road decreased from 21 km in 1997 to 4.9 km in 2016. Similarly, road density per 1000 sq. km increased from 24.1 km in 1997 to 102.8 km in 2016. The size of paved road network of the country increased from 3,708 km in 1997 to 14,055 km in 2015, an average annual growth rate of 7.7 percent. The condition of the road network also shows significant improvement. The proportion of road network in good condition increased from 22% in 1997 to 70% in 2015 (Ethiopian Roads Authority ERA, 2015) and (The World Bank, 2018).

During the five years (2010/11 – 2014/15) of implementation of RSDP IV, 85,859 km of roads were rehabilitated, upgraded, constructed and maintained of which 13, 632 km (15.9%) of roads were federal roads, 9,814 km (11.4%) of roads were regional roads and 62,413 km (72.7%) of roads were woreda (URRAP) roads. Total disbursement for rehabilitation, upgrading, construction and maintenance of federal, regional and woreda roads in the past five years of implementation of RSDP IV was ETB 156.8 billion, of which ETB 117.9 billion (75.0%) was for federal roads, ETB 12.2 billion (7.8%) was for regional roads and ETB 26.7 billion (17.0%) was for woreda roads (Ethiopian Roads Authority ERA, 2015).

For a long period of time, the majority of the routine maintenance works were done by ERA's own force (in house capacity). But, after the establishment of the then Ethiopian Road Construction Corporation (ERCC), all of the routine maintenance works have been done by this corporation. ERCC was established on July 8/ 2011 based on the Council of Ministers Regulation No. 248/2011 to carry out mainly road and bridge construction and maintenance works. The rest upgrading and heavy maintenance works were going to be performed by different domestic and international contractors. Before 2016, all type of maintenance Works (Emergency, Periodic, Rehabilitation, Reconstruction and Upgrading), except routine maintenance, were performed in accordance with traditional method of contracting. But in 2016, four maintenance projects were signed by Performance Based Contracting system.

Those routine maintenances done by ERCC were performed based on ERA's maintenance requirements that is indicated on the work order given to ERCC in accordance with ERA's manual of Technical Specification for Road Maintenance Works, 2nd Edition.

ERA's Work Orders may not identify the locations of the work items to be carried out, but may state only that a certain type of work is to be carried out in a particular segment of road. In this case, the ERCC is then responsible for determining the order of priority of defects in the segment and for carrying out the specified

quantities of different types of repair (Biniyam Regassa, 2015). Biniyam (2015) emphasized that ERCC conducts maintenance only when it receives a Work Order from ERA. The ERCC shall not exceed the value of the Work Order unless this is authorized by ERA. The contract between ERA and ERCC is not clearly differentiated as either Traditional or PBC, because, the works should be done by following all ERA's planning procedures and guidelines for condition surveys, defect identification, intervention planning, and prioritization tools. Due to this absence of freedom to perform the work as a wish of ERCC, this contract cannot be PBC. In addition, this contract cannot be a traditional type since the client didn't give a detail work description in the same way as it is done for traditional contract and there is no any supervision of the work by the client or by independent consultant. Based on the SMEC report (SMEC, 2014) routine maintenance works are not supervised by ERA or independent consultant, whereas, periodic maintenance works are supervised by independent consultants. Therefore, this contract agreement between ERA and ERCC didn't give a chance to put a clear demarcation as traditional or PBC contract type. Payment for routine maintenance works is issued based on the fixed prices on which ERA and ERCC were agreed in advance. In terms of quality, ERCC's maintenance works are extremely poor since the rate given by ERA is very low. Following this, the quality of the work is unsatisfying. ERCC express its dissatisfaction with the rate but still adjustments are not considered.

4.4 Traditional Contract in ERA

The traditional contract has been widely used for a long period of time in ERA. In this traditional method of contracting, ERA demands from the contractor to execute a work and the extent of the work. The contractor is paid based on the performed work extent according to the contract rates. In this type of contract, the client (ERA) is responsible to supervise the construction and maintenance works executed by the contractors by in house engineers or employed consultants. This method is criticized as an ineffective because it involves cost and time over run on most of ERA projects. Yet the method is still widely used in ERA.

4.4.1 Case Study

In order to show the inefficiencies and ineffectiveness of the traditional method of contracting in ERA, supporting cases were studied from routine, periodic, reconstruction and upgrading maintenance types. This selected cases were financed by local financer (the Ethiopian Government and Road Fund) and international financer (The World Bank).

The following cases are selected from so many projects based on their conditions and capacities that helps to answer the research questions. This case projects were selected from four directions of the country, North, South, East and West of Ethiopia

4.4.1.1 Mekenajo – Dembidolo

Mekanajo-Dembidolo road project was an upgrading project which is located in the North-Western part of Ethiopia in Oromia and Amhara Regional states with a total project length of 181km. It connects the western part of the country with the northern part. This project was financed by the World Bank.

Cost overrun in this project was about 20.5 percent on average. According to the claim document submitted to ERA by the contractor the key reasons being; price escalation due to rising of contractual time, variations due to increase in quantity of work, claims due to delay in Right –Of-Way (ROW) clearance, shortage of cement and fuel, and shortage of key professionals.

Table 4. 2 Mekenajo - Dembidolo Upgrading Project Civil Work Cost Overrun (Source: ERA)

Project Name	Length (kM)	Cost of Signing (ETB, Million)	Actual Disbursement (ETB, Million)	Increase in Cost (%)
Mekenajo - Ayra	52.06	633.53	712.82	12.52
Ayra - Chanka	70.60	669.10	937.65	40.13
Chanka - Dembidolo	65.50	648.60	700.32	7.98
Subtotal	188.16	1,951.23	2,350.80	20.50

Figure 4. 1 below illustrates the Mekenajo - Dembidolo Upgrading Project Civil Work Cost comparing the budget and actual disbursement. Subsequently, Table 4.2 shows that the average cost overrun of the three sections was 20.5 percent.

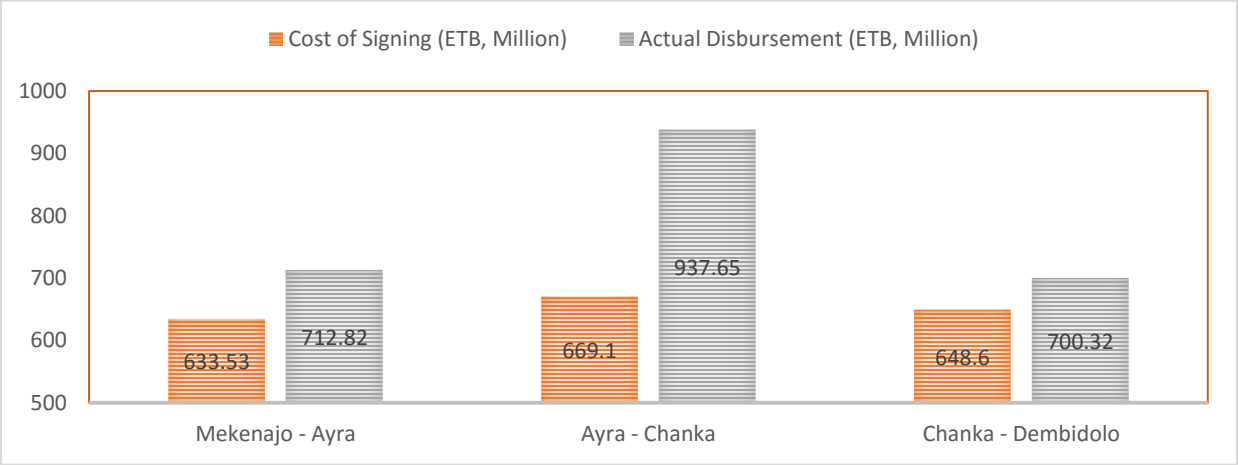

Fig. 4. 1 Mekenajo - Dembidolo Upgrading Project Civil Work Cost Overrun (Source: ERA)

All of the three lots of this project were not completed on original contract time and encountered significant time overruns. Major reasons for request for extension of time (EOT) by contractors and consultants were, rainfall and shortage of construction materials such as cement, shortage of construction engineers, and design problems. Time overrun accounts for 46 percent on average for all contracts.

Table 4. 3 Mekenajo - Dembidolo Upgrading Project Civil Work Time Overrun (Source: ERA)

Project Name	Original Contract Duration (Days)	Revised Contract Time (Days)	Time Elapsed (Days)	Time Elapsed (%)
Mekenajo - Ayra	910	1264	354	39
Ayra - Chanka	910	1531	621	68
Chanka - Dembidolo	910	1193	283	31

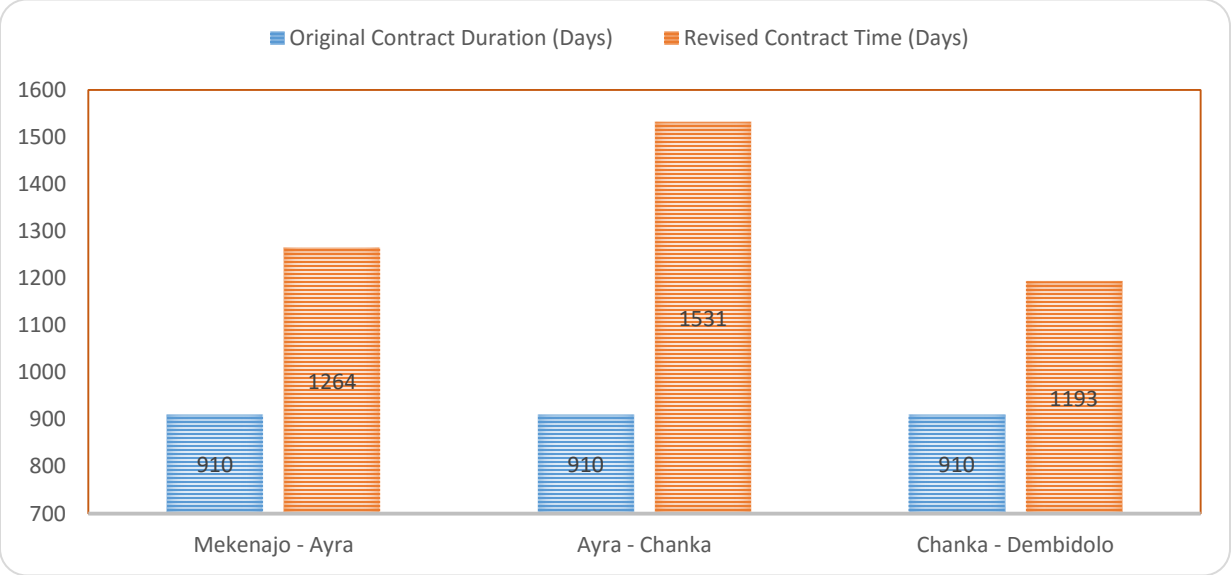

Fig. 4. 2 Mekenajo - Dembidolo Upgrading Project Civil Work Time Overrun (Source: ERA)

4.4.1.2 Wolkite – Hossaina

Wolkite - Hossaina road project is an upgrading project which is located in the Southern part of Ethiopia within the Southern Nations and Nationalities Regional states with a total project length of 121km. This project was also financed by the World Bank.

Cost overrun in this project was about 44.39 percent on average, According to the claim document submitted to ERA by the contractor the key reasons being indicated were the same as the Mekenajo – Dembidolo Project and these were; price escalation due to rising of contractual time, variations due to

increase in quantity of work, claims due to delay in Right –Of-Way (ROW) clearance, shortage of cement and fuel, and shortage of key professionals. Table 4.4 below shows the cost overrun regarding Wolkite – Hossaina road.

Table 4. 4 Wolkite - Hossaina Upgrading Project Civil Work Cost Overrun (Source: ERA)

Project Name	Length (kM)	Cost of Signing (ETB, Million)	Actual Disbursement (ETB, Million)	Increase in Cost (%)
Wolkite - Arekit	60.00	717.44 1	1,105.70	54.12
Arekit - Hossaina	65.50	621.20	827.19	33.16
Subtotal	125.50	1,338.64	1,932.89	44.39

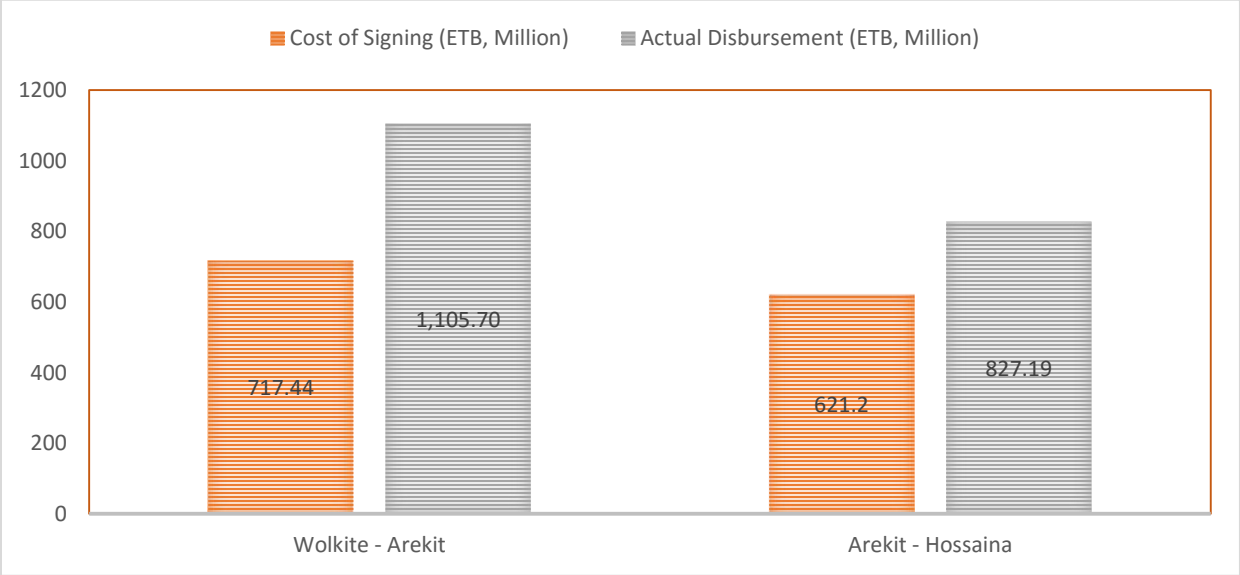

Fig. 4. 3 Wolkite - Hossaina Upgrading Project Civil Work Cost Overrun (Source: ERA)

This project also experienced about 38 percent time overrun on average. Major reasons for the additional time extension request was rainfall and shortage of construction materials such as cement, shortage of construction engineers, and design problems.

Table 4. 5 Wolkite - Hossaina Upgrading Project Civil Work Time Overrun (Source ERA)

Project Name	Original Contract Duration (Days)	Revised Contract Time (Days)	Time Elapsed (Days)	Time Elapsed (%)
Wolkite - Arekit	913	1200	287	31
Arekit - Hossaina	913	1321	408	45

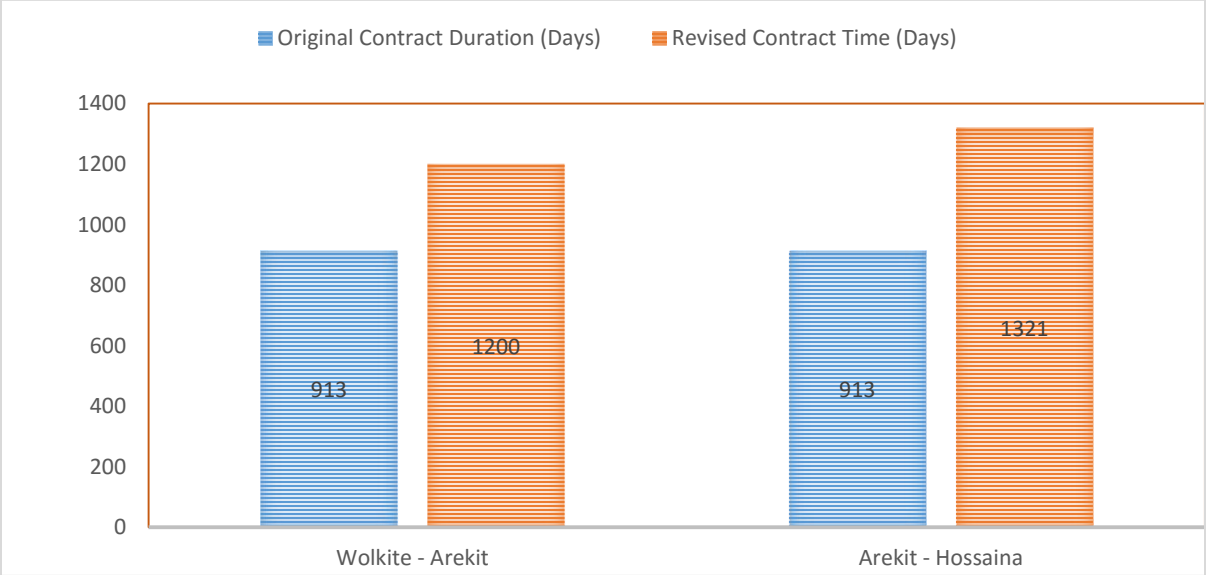

Fig. 4. 4 Wolkite - Hossaina Upgrading Project Civil Work Time Overrun (Source ERA)

4.4.1.3 Hargele – Dolobay – Dolo odo

The Hargele – Dolobay – Dolo odo Road is located in the Eastern part of Ethiopia in Somalia regional state. The length of the project is 60 km. this project was a reconstruction maintenance project financed by the Ethiopian government. Unlike the above projects, Hargele – Dolo odo project didn't cause additional cost due change orders or variations. But the additional amount resulted from the price adjustment made on the contractual unit rates. The cost at the signing was ETB 367.43 million whereas the actual disbursement was ETB 428.72 million with cost overruns of 16.68%.

Conversely, the original contract duration was 1,095 day whereas it was revised at 731 days with time saving of 364 days (33.2%). This project didn't require additional time, rather it was completed before the contractual completion time. Even though the project was completed ahead of time, there were a serious of quality problems.

Table 4. 6 Hargele - Dolobay - Dolo odo Reconstruction Project Civil Work Cost Overrun (Source: ERA)

Project Name	Length (kM)	Cost of Signing (ETB, Million)	Actual Disbursement (ETB, Million)	Increase in Cost (%)
Hargele – Dolobay – Dolo odo	60.00	367.43	428.72	16.68

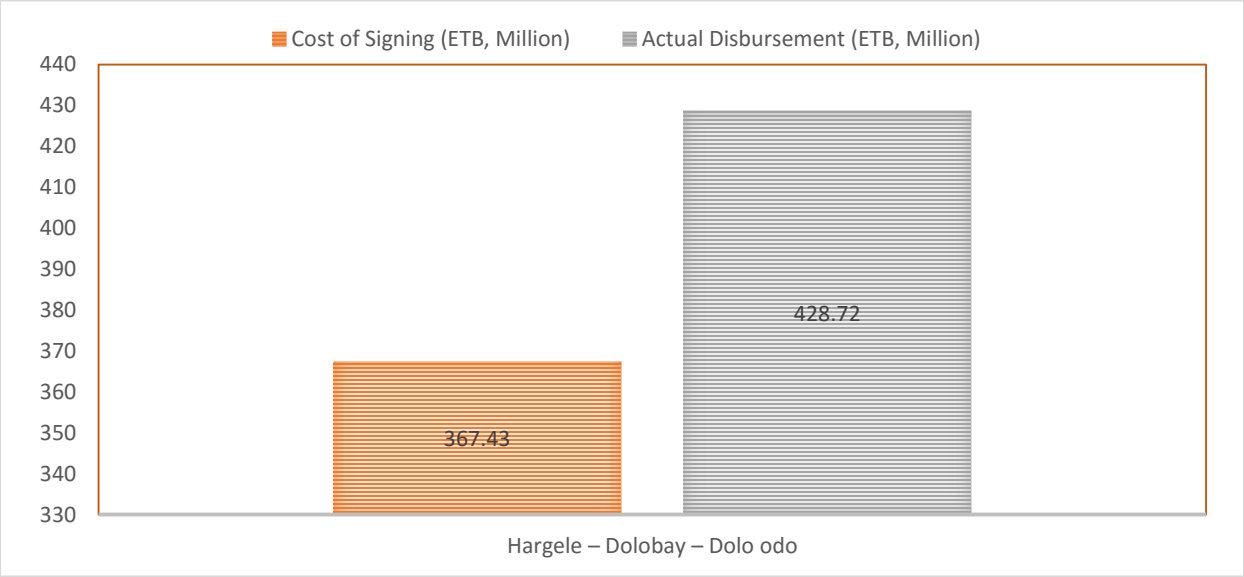

Fig. 4. 5 Hargele - Dolobay - Dolo odo Reconstruction Project Civil Work Cost Overrun (Source: ERA)

Table 4. 7 Hargele - Dolobay - Dolo odo Reconstruction Project Civil Work Time Overrun (Source: ERA)

Project Name	Original Contract Duration (Days)	Revised Contract Time (Days)	Time Elapsed (Days)	Time Elapsed (%)
Hargele – Dolobay – Dolo odo	1095	731	-364	-33.24

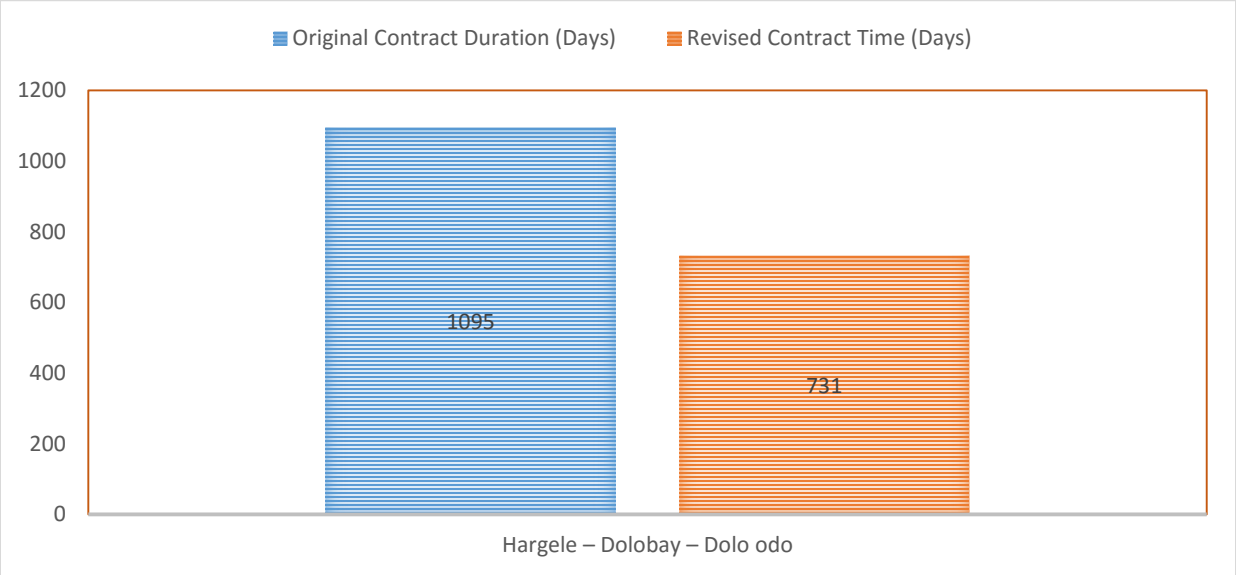

Fig. 4. 6 Hargele - Dolobay - Dolo odo Reconstruction Project Civil Work Time Overrun (Source: ERA)

4.4.1.4 Gore-Gambella

Gore-Gambella Road Reconstruction project is located in the Western part of Ethiopia between Oromia and Gambella Regional states. It is 143.3km and financed by the Ethiopian government. Design changes due to absence of detailed study before design leads to claim and delay and right of way problems in addition to late payments were the main reasons for cost overrun of this project. The cost of signing was ETB 817.57 whereas the actual disbursement was ETB 1,005.00 million that increased by 22.9 percent.

Table 4. 8 Gore - Gambella Reconstruction Project Civil Work Cost Overrun (Source: ERA)

Project Name	Length (kM)	Cost of Signing (ETB, Million)	Actual Disbursement (ETB, Million)	Increase in Cost (%)
Gore - Gambella	143.3km	817.57	1,005.00	22.9

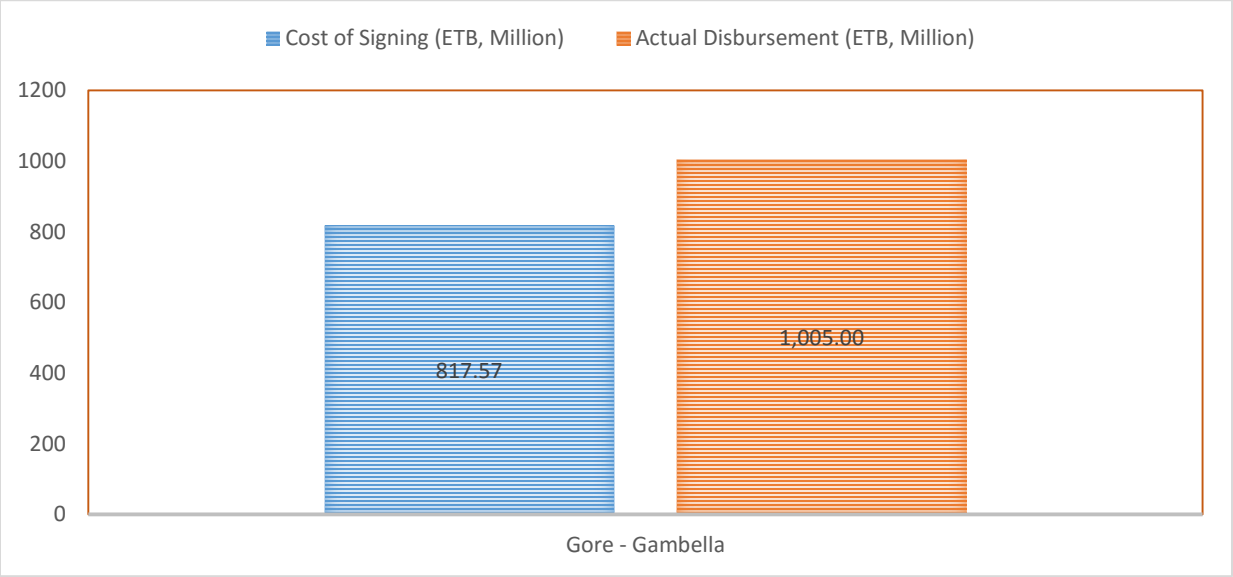

Fig. 4. 7 Gore - Gambella Reconstruction Project Civil Work Cost Overrun (Source: ERA)

In respect of time, the original contract duration was 1,095 days while the revised contract time was 1,596 days which elapsed by 501 days (45.75%). According to the claim document submitted to ERA by the contractor major reasons for the request of the extension of time by contractors and consultants were rainfall and shortage of construction materials in addition to the design change.

Table 4. 9 Gore - Gambella Reconstruction Project Civil Work Time Overrun (Source: ERA)

Project Name	**Original Contract Duration (Days)**	**Revised Contract Time (Days)**	**Time Elapsed (Days)**	**Time Elapsed (%)**
Gore - Gambella	1095	1596	501	45.75

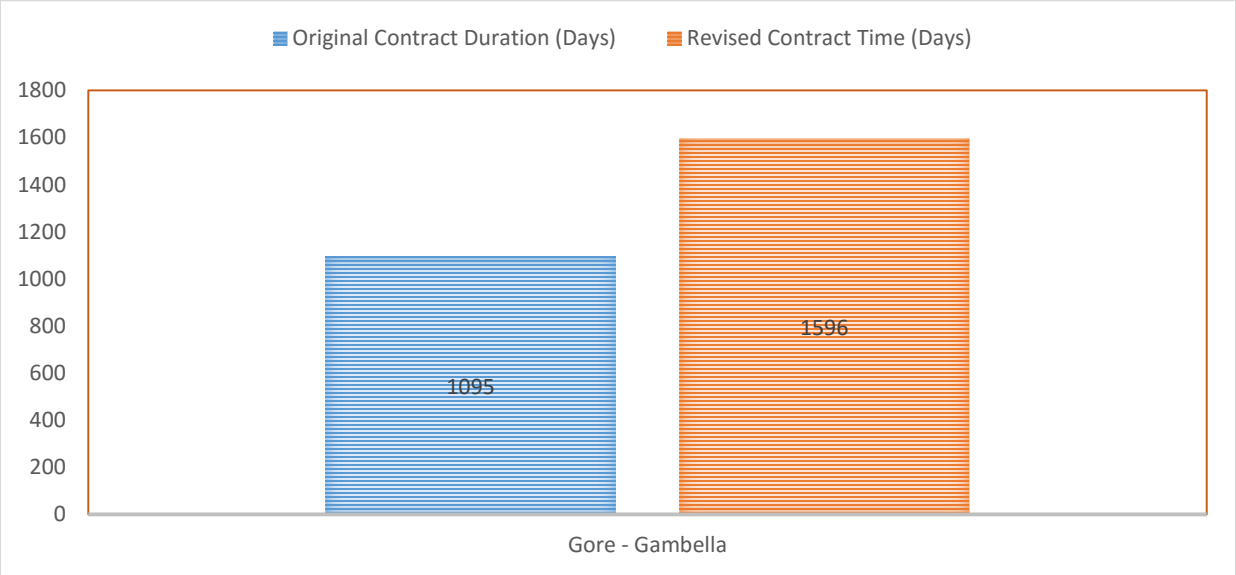

Fig. 4. 8 Gore - Gambella Reconstruction Project Civil Work Time Overrun (Source: ERA)

4.4.1.5 Gonder District Periodic and Routine Maintenance Project

Gonder district is one of the ten districts of the Ethiopian Roads Authority which is responsible for the routes of the northern part of the country mainly includes the Amhara and Tigray Regional sates. In this district, 150 km of periodic and 1,155 km of Routine maintenance works were executed in 2013/14 calendar year. The project financer was Ethiopian Road fund and the contract period was for one year.

Table 4. 10 Gonder District Periodic Maintenance Project Civil Work Cost Overrun (Source ERCC)

Project Name	Length (kM)	Cost of Signing (ETB, Million)	Actual Disbursement (ETB, Million)	Increase in Cost (%)
Gonder District	150	61.50	67.45	9.67

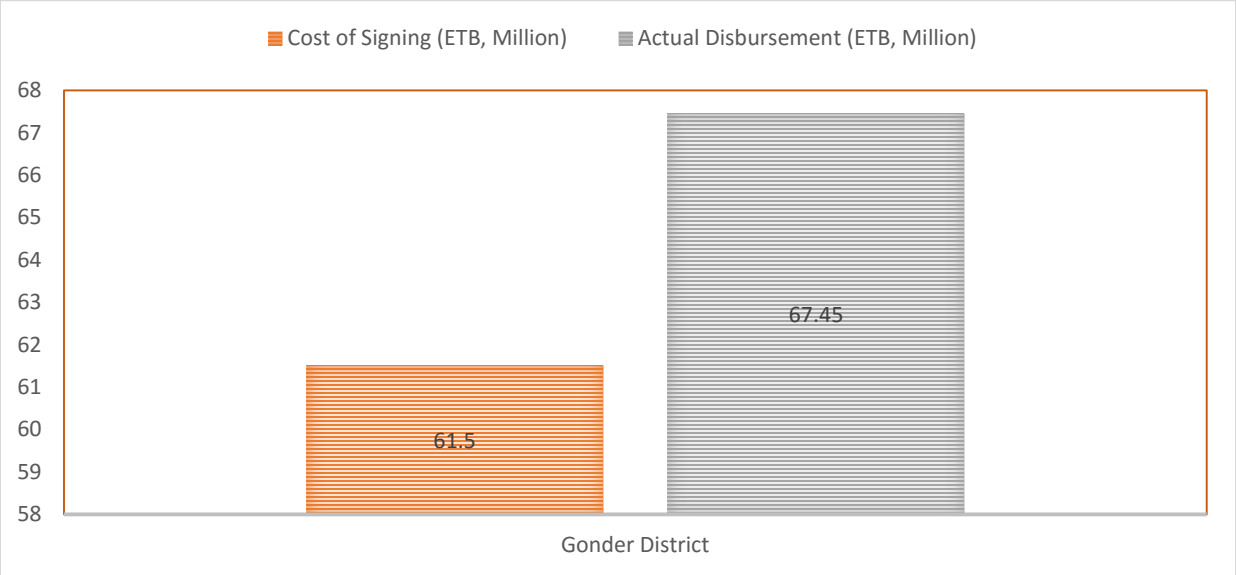

Fig. 4. 9 Gonder District Periodic Maintenance Project Civil Cost Overrun (Source: ERCC)

The project cost at signing was ETB 61.50 million, but, about 5.95 million birr of cost overrun occurred on the periodic maintenance which was about 9.67 percent of the original signing cost of the project.

Table 4. 11 Gonder District Periodic Maintenance Project Civil Work Time Overrun (Source: ERCC)

Project Name	Original Contract Duration (Days)	Revised Contract Time (Days)	Time Elapsed (Days)	Time Elapsed (%)
Gonder District	365	365	0	0

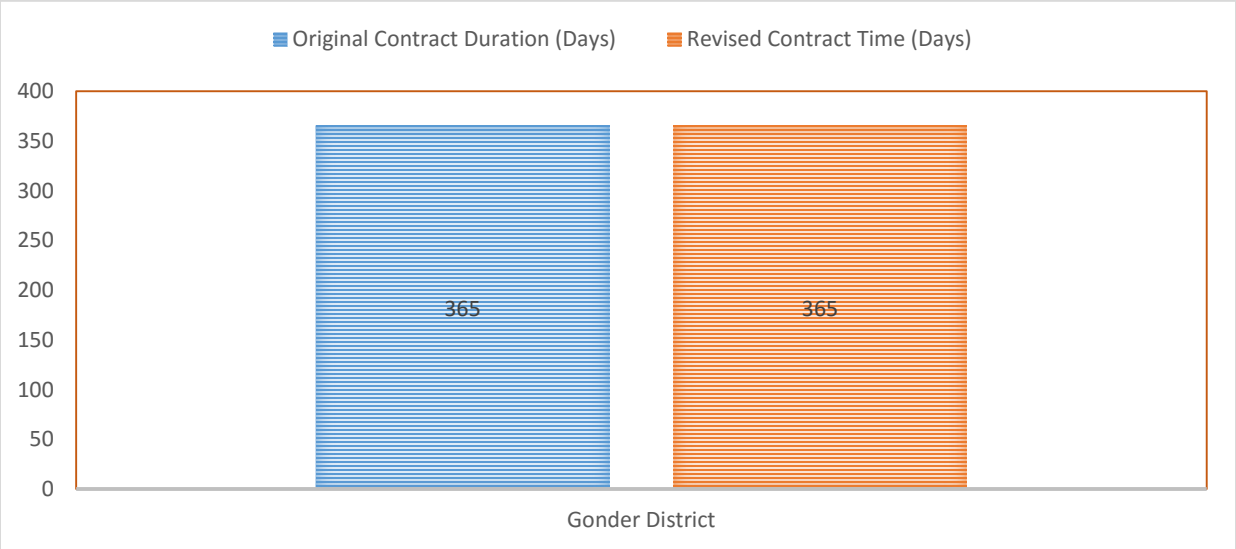

Fig. 4. 10 Gonder District Periodic Maintenance Project Civil Work Time Overrun (Source: ERCC)

Unlike the other projects, time overrun was not entertained on this periodic maintenance project. It was completed in accordance with the agreed contractual period of time.

Table 4. 12 Gonder District Routine Maintenance Project Civil Work Cost Overrun (Source: ERCC)

Project Name	Length (kM)	Cost of Signing (ETB, Million)	Actual Disbursement (ETB, Million)	Increase in Cost (%)
Gonder District	1155	25.20	17.97	-28.69

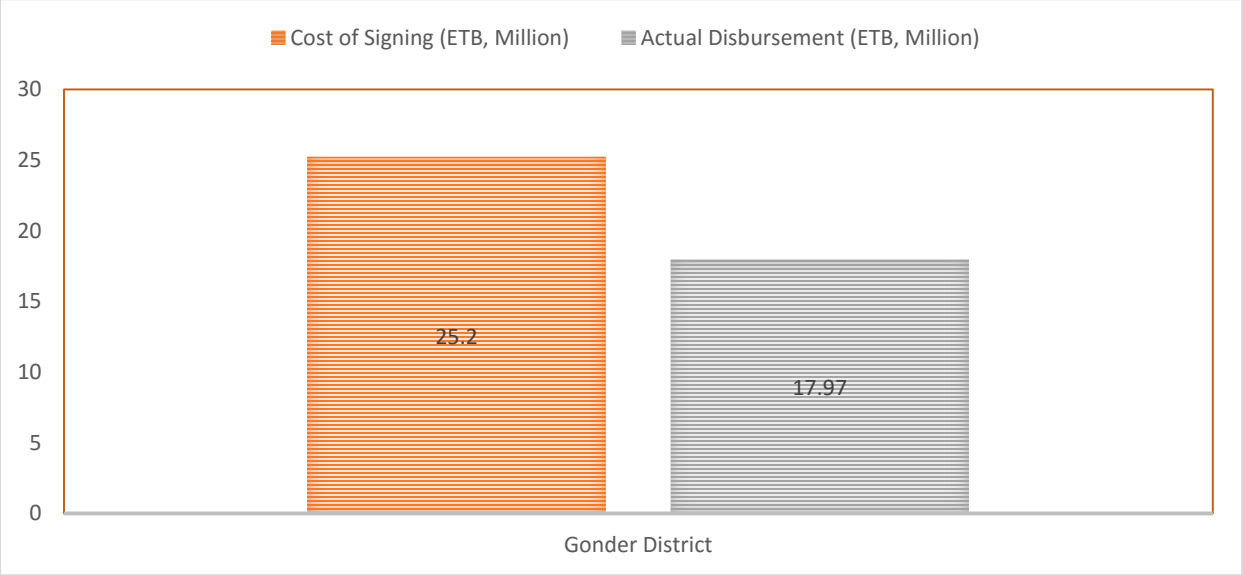

Fig. 4. 11 Gonder District Routine Maintenance Project Civil Work Cost Overrun (Source: ERCC)

Regarding the routine maintenance, the length of the project was 1,155 km and the cost at signing was ETB 25.30 million and the actual disbursement was ETB 17.97 with cost saving of ETB 7.23 million (28.7 %) as provided by the ERCC.

Table 4. 13 Gonder District Routine Maintenance Project Civil Work Time Overrun (Source: ERCC)

Project Name	Original Contract Duration (Days)	Revised Contract Time (Days)	Time Elapsed (Days)	Time Elapsed (%)
Gonder District	365	365	0	0

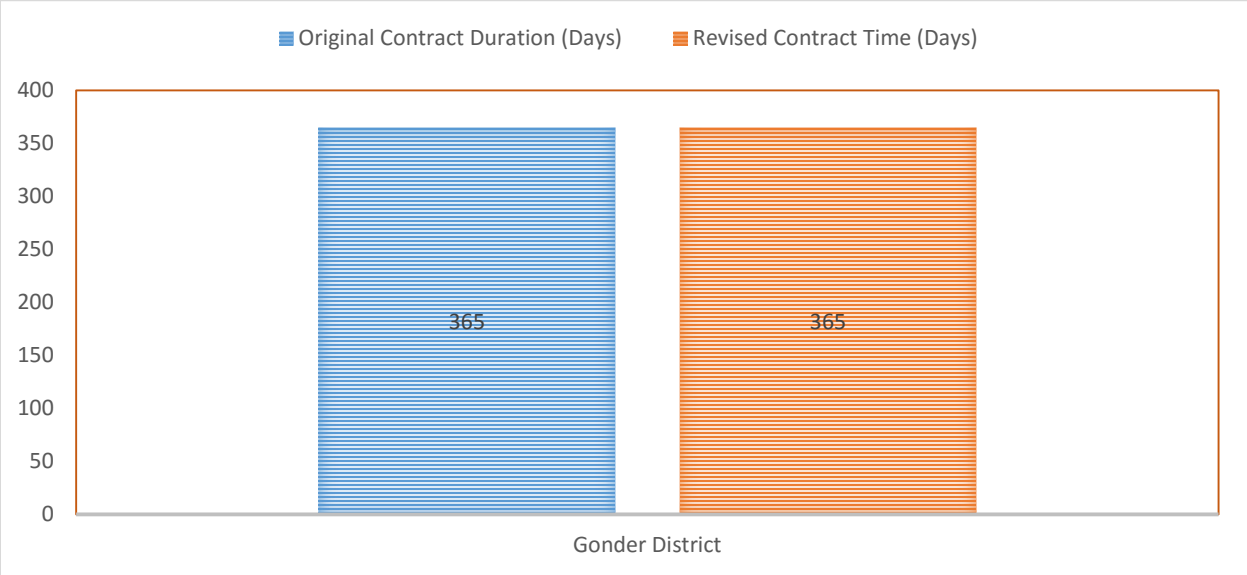

Fig. 4. 12 Gonder District Routine Maintenance Project Civil Work Time Overrun (Source: ERCC)

The same as the periodic maintenance work, time overrun was not entertained on the routine maintenance project. It was completed in accordance with the agreed contractual period of time.

4.4.2 Findings of the Case Study

In view of the foregoing; upgrading, reconstruction and periodic maintenance works highly suffered because of cost and time overruns. In addition, poor cost estimation was experienced in the case of the routine maintenance works. Poor quality of works were the other feature of the maintenance works under the traditional contracting method.

From the above case study projects, the average cost overrun was 14.24 percent. On those five case study projects, ERA incurred additionally 1,248,490,000.00 birr due to the cost overrun. This amount was greater than the costs at signing of the Hargele – Dolo odo and the Gore – Gambella projects combined. Other than the cost overrun, poor budgeting was also another problem of the traditional contracting method which was mainly on routine maintenance projects. Some of the main reasons being identified for the cost overrun were;

- Price escalation due to rising of contractual time of road constructions;
- Variations due to increase in quantity of work;
- Design change;
- Price adjustment;
- Claims due to delay in ROW clearance;
- Shortage of cement and fuel;

- Shortage of key professionals; and
- etc.

On most of the above case study projects, contracts were not completed on original contract time and so significant time overruns were experienced. Time overruns accounted for 407 day on the average on four projects that experienced time overrun. Major reasons for request of extension of time (EOT) by contractors and consultants on the above case study projects were;

- Adverse weather condition like rainfall;
- Additional works;
- Shortage of construction materials such as cement and bitumen;
- Shortage of foreign currency; and
- Design problems - delay in approval of design/design changes.

Following the delay in the project completion time, the client (ERA) incurred additional costs for supervision and overhead expenses since there is no proper risk sharing method in the traditional method. According to the World Bank report (2018), this additional costs incurred for supervision and overhead expense were higher than the cost overruns for civil works in most of the contracts.

Pre-contractual activities are critical to successful implementation of road contracts; but in the above cases, these pre-contractual activities were not managed properly, especially on design and related concepts. Therefore, those projects were affected by low quality of engineering design and scope definition which led to time delays and cost overruns. Even if ERA has established a Quality Control Unit and trained staffs on project management concepts to strengthen review of engineering design documents, it cannot eradicate cost and time overrun from traditionally contracted projects.

In terms of quality, some of the projects in the above case studies had encountered problems, they degraded rapidly in terms of quality within a short period of time. After the completion of those projects, ERA incurred additional cost in order to preserve the roads at service providing level. Generally, the common problems observed under traditional methods of road maintenance contracts in ERA based on the above case studies were;

- Escalation of cost;
- Delay in project completion time;
- Overhead and supervision cost increments;
- Poor quality of work; and
- Absence of proper risk sharing.

4.5 Performance Based Contracts in ERA

4.5.1 Background of PBC in ERA

ERA intended to employ the services of a qualified consulting firm to provide support for the preparation and procurement of a pilot Performance-Based Contract for the management and maintenance of two routes. In order to make practical that intent, ERA took the first initiation in 2011 by employing an Indian and Canadian joint venture consulting company called LEA Associate South Asia Pvt. Ltd. (Indian company) and LEA International Ltd. (Canadian company) in association with United Consulting Engineers Plc. (Domestic company) in order to have studied and prepared a contract document for two projects (Adama – Assela and Butajira – Hossana – Areka routes), those were selected as a pilot projects to implement Performance-Based Contract system for the first time in the history of the organization. ERA gave the contract to those companies under two phases;

- Phase I: - Designing of Output and Performance- Based pilot contracts including preparation of bidding documents, support to ERA during procurement process and providing training.
- Phase II: - Assistance to ERA during contract administration of the pilot contracts, monitoring and evaluation, compiling of lessons learned and preparation of strategic document for scale up of the pilot contracts for wider network.

Following this agreement, the firms concluded the Phase I service for the two road segments and submitted the final tender document. Then, ERA announced a bid to procure qualified domestic contractors. But, none of the domestic contractors had shown interest to participate on the bid. The bid floated repeatedly until 2014, but a single domestic contractor couldn't came up to participate.

To this effect, ERA has faced difficulty to continue Phase II. Therefore, ERA quitted its plan to start PBC at pilot level until 2016. The main reason of the domestic contactors not to participate on the bid was, their fear of the risk they would take under the PBC since it was a new concept and they were financially incapable.

A new strategy was sated in 2016 to practice PBC in a successful manner. This strategy was to shortlist a well experienced and capable public and endowment contractors based on their performance and turnover, and then, have them competed for eight projects. All the necessary bid and contract documents were prepared by in house experts. Those short listed contractors were;

i. Ethiopian Construction Works Corporation (ECWC) the then Ethiopian Road Construction Corporation
ii. Defense Construction Enterprise (DCE)
iii. Amhara Road Works Enterprise (ARWE)
iv. Oromia Road Works Enterprise (ORWE)
v. SUR Construction Enterprise.

Those eight routes were selected in accordance with the service they provide and facilitate connections between different parts of Ethiopia and the capital city Addis Ababa including the industrial centers of the county. Table 4.14 shows those selected routes.

Table 4. 14 ERA Route's Selected for PBC (Source: ERA)

Item No.	Project Name	Length (KM)	Type of Work
1	Adama – Awash	60	Overlay and PBRMC
2	Chancho - Fiche	75	
3	Addis – Gibe, Contract – 1: Addis - Kora	80	
4	Addis – Gibe, Contract – 2: Kora – Gibe River	92	
5	Fiche – Goha tsion	75	Heavy Maintenance and PBRMC
6	Adigudo – Mekelle – Wekero	92	
7	Ambo – Gedo	64	
8	Gibe – Jimma	165	

Based on the new strategy, the above listed contractors participated on the bid and were selected based on the list price they provided. Through the eight projects, only three projects got a feasible price to proceed to the next execution stage. The rest five projects were rejected since the price given by the contractors were extremely expensive compared to the engineering estimation prepared by ERA. Table 4.15 shows those selected roads.

Table 4. 15 Project Signed by PBC System in ERA (Source: ERA)

No.	Project Name	Length (KM)	Contractor Name	Contractual Price (Birr)
1	Adama – Awashe	60	ECWC	1, 363, 644, 000.91
2	Adigudo – Mekelle - Wekero	92	DCE	1, 027,624,000.86
3	Fiche – Goha tsion	75	ARWE	731,698,230.00

Adama – Awash and Fiche – Goha tsion project contracts signed in June, 2016 in a hybrid contract system a combination of the traditional and Performance-Based Contract system for a ten years contract period. Asphalt overlay work, which should be complete through three years contract period, was signed in a traditional contract method and the works (management and maintenance services and emergency work) would be performed for the rest of the seven years in order to keep the route at serviceability level and the contract was signed through PBC system.

Adigudo – Mekelle – Wekero road contract was signed through Performance-Base Contract System which was called Output and Performance Based Road Contract (OPRC) for a seven years period in June, 2016. All the three projects were financed by the Ethiopian government.

In addition to those three projects, one special project was signed in March 2016 through PBC system between ERA and two foreign contractors after they won the bid. These foreign contractors were: IL & FS Transportation Networks Limited – Elsamex S.A (ITNL – Elsamex Joint Venture), Spanish company and JMC Projects (India) Limited, Indian company. The project was Nekemte – Bure upgrading project which is 258 KM long. The source of finance for the project was the World Bank Group. All the necessary bid and contract documents were prepared by a Swiss consultant, Renardet S.A in sub consultancy with United Consulting Engineers of an Ethiopian company.

This agreement (agreement between ERA and contractors) included design, improvement works, and management and maintenance services and emergency works under the upgrading project along the following three lots;

- Lot 1: Nekemte – Anger Gutin - Andhode Section
- Lot 2: Andhode – Agamsa Section
- Lot 3: Agamsa – Bure Section

Lot 1 and 3 were awarded to IL & FS Transportation Networks Limited – Elsamex S.A (ITNL – Elsamex Joint Venture) for eight years contract period. The first three years were for design and upgrading the section and the remaining five years were for keeping the section at its highest service providing level. Lot 3 was awarded to JMC Projects (India) Limited for the same contract period as lot 1 and 3. Currently, the contract with the Spanish company is terminated due to contractual failure of the company in relation to its liquidation as a company. Until the termination, this Spanish company performs only 5km on sub base work. Table 4.16 below shows the three lots of Nekemte – Bure road projects.

Table 4. 16 Three Lots of Nekemte - Bure Route (Source: ERA)

No.	Project Name	Length (KM)	Contractor Name	Contractual Price (Birr & USD)	Contract Duration
1	Nekemte – Anger Gutin - Andhode	86.1	IL & FS Transportation Networks Limited – Elsamex S.A	1,048,885,237.35 Birr and 37,312,292.91 USD	96 months (36 months for improvement works and 60 months for management and maintenance works)
2	Andhode – Agamsa	87.65	JMC Projects (India) Limited	537,642,867.11 Birr and 59,708,347.48 USD	96 months (36 months for improvement works and 60 months for management and maintenance works)
3	Agamsa – Bure	84.56	IL & FS Transportation Networks Limited – Elsamex S.A	1,097,824,632.19 Birr and 33,054,268.18 USD	96 months (36 months for improvement works and 60 months for management and maintenance works)

4.5.2 Implementation and Performance Standards of PBC in ERA

The main objective of Performance-Based Contract is to keep the road at its service providing level for a long period of time in accordance with a predefined performance standards. This performance standard is used to be ensured that the required objective met effectively and efficiently.

According to Zietlow (2004) to define the "right" performance standards or indicators is a rather challenging task since it has to satisfy a set of goals such as:

- To minimize total systems cost, including the long-term cost of preserving road, bridge and traffic assets and the cost to road user, and
- To satisfy comfort and safety of road users.

In addition, to avoid ambiguity, performance indicators have to be clearly defined and objectively measurable (G. Zietlow, 2004). Accordingly, ERA prepared measurable performance standard

specifications which is called Service – Level Criteria, for each PBC system projects. These service level criteria's were included in the bidding document and also considered as part of the contract document. Therefore, any contractor who signed the contract should perform any of the work to attain these service level standards. Then, ERA paid a lump-sum remuneration to the contractor which would cover all physical and non-physical services provided by the contractor except for unforeseen emergency works which were remunerated separately. In order to be entitled to these periodic payments, the contractor must ensure that the road under contract comply with the service levels as specified in the bidding document.

Under PBC system, it is possible that during some months, the contractor will have carry out a large amount of physical works in order to comply with the required service levels with very little works during other months. However, the contractor's periodic payment remains the same, as long as, the required service levels are compiled with. In this type of contract, the contractor is responsible for the detail design of the project and other consequent phases includes within the life span of the project in compliance with ERA's Design Manual. The contractor is not entitled to any additional payment for the design work. The design standards and specifications are recommended by ERA and it should meet at least the minimum specified standards. The bidder can propose higher standards if it serves better optimal programming to meet the contract's performance standards. Under the term of PBC, the contractor is responsible for continues monitoring and control of road conditions and checking the service levels of the road section included in the contract.

The service levels are defined from a road user's perspective and from a strength of the pavement point of view including factors like riding comfort, safety features, residual strength of pavement, etc. If the service level is not achieved within the given period of time, the payment for that period may be reduced or fully suspended. ERA's service level criteria is defined at four levels;

i. Road Usability
    - Road blocks during severe accidents
    - Floods during rainy season
    - Road section Subjected to landslides

ii. Road User Service and Comfort measures
    - Road and lane width
    - Skid Resistance
    - Vegetation control
    - Visibility of road signs and markings
    - Availability of each lane-km for use by traffic

- Response time to rectify defects that compromise the safety of road users
- Attendance at road accidents
- Drainage of the pavement

iii. Road Durability Measures

- Road roughness
- Longitudinal profile
- Pavement strength
- The extent of repairs before extensive periodic maintenance treatment is required
- Functionality of drainage facility

iv. Management Performance Measures

- Delivery of regular progress reports to the road authority
- Inventory updates and other data sharing requirements
- Maintenance history
- Compliance with social and environmental standards

The performance measures define the minimum acceptable service level for the particular road. In setting the measures, various criteria (both technical and practical) needs are carefully considered. However, the most important criteria is affordability of the service level for the targeted road/route. Some of these criteria's are;

- Traffic volume and composition
- Urban vs rural roads
- Flat, hilly or mountainous terrain
- Subgrade quality and type
- Quality of available construction materials
- Capacity of available contractors
- Any environmental constraints, such as protected areas, parks, forest reserves, etc.

Minimum road conditions and service levels are defined through output and performance measures and these are used under PBC to define the desired performance of the contractor. In PBC, the defined performance measures are thus the accepted minimum standards for the quality levels of the roads for which the contractor is responsible. Table 4.17 below show some of the selected specification of the minimum acceptable standards of the four service levels criteria used by ERA for Fiche – Goha tsion road overlay and upgrading project. Subsequently, Tables from 4.17 to 4.20 show: Minimum Service level for some of

Road Users' Service and Comfort Measures; Minimum Service Level for some of Road Durability Measures; and Minimum Service Levels for some Road Management Performance Measures respectively.

Table 4. 17 Minimum Service Level for Usability of the Road (Source: ERA)

Service Problem	Measurements/Detection	Time allowed for Removal
Road blocks during severe accidents	Visual Inspection	3 to 6 hrs. as per severity of accident
Floods during rainy season	Visual Inspection	48 hrs. as per site condition
Road section Subjected to landslides	Visual Inspection	48 hrs. as per severity of landslide

Table 4. 18 Minimum Service level for some of Road User Service and Comfort Measures (Source: ERA)

Item	Service Quality	Measurements/Detection	Time allowed for Repairs or Tolerance Permitted
Potholes	Pothole < 5 nos./km of diameter < 150mm	Visual inspection Rulers measuring/ tape measure the depth, count the number of potholes and measure the diameter of the potholes in the length of 100m/	Within 3 (three) days after detection
Patching	Patches; . Shall be square or rectangular. . Shall be level with surrounding pavement. . Shall be made using materials similar to those used for surrounding pavement. . Shall not have cracks wider than 3 mm	Visual Inspection A ruler or straight edge to check if level with surroundings pavement and a small transparent ruler with millimeter gradation of crack gauge to check the crack width.	Correction of noncompliant patches within 3 (three) days after detection

Table 4. 19 Minimum Service Level for some of Road Durability Measures (Source: ERA)

Item	Service Quality	Measurements/Detection	Time allowed for Repairs or Tolerance Permitted
Maximum IRI for any one km section of existing pavement	Average value for any one km Road Section of existing pavement must be less than the threshold value of IRI 3.5 m/km	Measure with calibrated equipment (Bump integrator or any other more sophisticated equipment better than Bump Integrator)	Within 30 (thirty) days after detection
Maximum IRI for any one km section of newly paved surface	Average value for any one km newly Paved Road Section must be less than the threshold value of IRI 2 m/km	Measure with calibrated equipment (Bump integrator or any other more sophisticated equipment better than Bump Integrator)	Within 30 (thirty) days after detection
Pavement width and lane width	Pavement width must be at least 7 m wide in 2 lane sections and 14 m wide in 4 lane sections and at junctions and other locations as specified in the contract drawing. Lane width must be at least 3.5 m.	Manual measurement using a metallic measuring tape.	Within 3 (three) days after detection
etc.	etc.	etc.	etc.

Table 4. 20 Minimum Service Levels for some Road Management Performance Measures (Source: ERA)

Item	Report Types	Time allowed for Submission
Monthly Report	Improvement Work Report Performance Measures Conformance Report Road Asset Damage and Emergency Works Road Safety report Quality Management System Report Structures Inspections Report Program Report Cash Flow Report	Within 14 days of the end of the month
Initial Contract Area Condition Report	Area where the existing levels are below the required Any area where significant deterioration has occurred	Within 28 days of the start date of the contract
etc.	etc.	etc.

Since PBC is a lump sum price contract, Payments for management and maintenance services shall be a fixed periodic amount subject to reductions based on the compliance record of the performance measures specified in advance for efficient management of the road. Emergency works are paid as approved by the project manager in accordance with the contract. The method of measurement is based on the provisions of contract specifications.

For each road element, one or more performance indicators are identified. For each performance indicator, one or more service levels are specified which must be compiled with. If a road element develops a defect which brings its condition below the service level then the contractor must take action to correct the defect and restore the service level within the time period permitted for correction in days and methods of measurement. Failure to maintain any specified service level within the time permitted is defined as Non – Compliance for which a deduction will be made from payments to the contractor.

In the case of Non – Compliance, a percentage deduction is made from the payment for the kilometer section where the defect occurs. For example on the Nekemte – Bure upgrading project for the failure of the contractor not to fulfill the service level of passenger vehicle riding at a speed of 50km/hr, the deduction is fifty percent from a single kilometer (50% deduction/ km), if the contractor cannot repair within twenty eight days. This is the same for failure of repairing potholes with in twenty eight days.

4.5.3 Benefits/Advantages of PBC in ERA

4.5.3.1 Cost Saving

The main advantage ERA got from Performance Based Road Contract is savings of costs for road maintenance works. Even if no comparable cost analysis has been undertaken due to early stages of the projects, some indicators show possible cost savings. The cost saved from the designing process is one indicator, since ERA is not responsible to design the project rather than providing the required service levels. Some of the Performance-Based Contracts have been awarded for lower prices than some traditional contracts. In addition to that, the nature of the PBC system cannot accommodate time overrun, and therefore ERA is free from additional cost that will be incurred due to time overrun of projects. Since PBC reduces the burden of ERA to administer the contract, ERA also saved a cost from the contract administrative issues.

In traditional contract, the condition of the road significantly deteriorates before the intervention for reconstruction, which is demanding huge additional cost to retain the design life of the road. On the other hand, through PBC, the condition of the road can be preserved to the level of the service requirement by the contractor without adverse deterioration up to the end of service life of the road. Due to this approach, ERA saves a certain amount of cost. Generally, an international experience also shows PBC saves 10% - 40% of the cost (Reini Wirahadikusumaha, 2015).

4.5.3.2 Corruption Reduction

As the construction industry comprises a big and intricate set of activities where several parties like consultant, contractor and government closely work together, corruption is some of the most common problems of that industry. Corruption is the main concern for road ERA, always seeking a better method of contracting to resolve or reduce the effect of this problems. Therefore PBC enhance transparency and thus reduces the rate of corruption. Because of the nature of PBC, the administrative contacts of the client representatives with the contractor are limited. Due to that, the situations those force the contractor to bribe the client representatives in cases related with poor quality of works performance are diminished since poor performance by itself is a headache for the contractor also. Therefore, corruption on ERA's PBC projects is not comparable with the traditional contracting projects, it is much less on PBC projects.

4.5.3.3 Quality Improvement

In terms of quality, the output of the Performance-Based Contract is more satisfying than the traditional one. If the quality of the work performed by the contractor is poor, it will backfire to the contractor. The payment will not be issued for poor quality works since it cannot be attain the required minimum service level standards. In addition to that, the contractor is forced to correct any faults in order to attain the service level. Therefore, the quality of those ERA's PBC projects are unquestionable and much more satisfactorily when compared with the quality of traditionally contracted projects.

4.5.3.4 User Satisfaction

Satisfaction of the user is another benefit of the PBC. In the previous times, ERA receives much more complains from the customers after a certain times of road maintenances due to rapid failure of the roads. In traditional contract, the condition of the road significantly deteriorates before the intervention for reconstruction which is demanding huge additional cost to retain the design life of the road. But in the case of PBC projects, this is no more a problem, since the contractor is striving continuously to attain the minimum service level. Accordingly, PBC projects provide more customer satisfaction to ERA.

4.5.3.5 Implementation of a New Technology

The contractors will only be motivated to use innovative technologies if it is beneficial to them. In Performance-Based Contracting method, the contractor has much responsibility than the client. In the process of fulfilling this responsibility at the required level, the contractor may face profit minimization from the project. Under this situation, the contractor will likely searched a mechanism that helps to fulfill his/her responsibility at the required level and to attain the targeted profit. The use of new technology and innovation may become as a solution and forces the contractor to implement on his/her projects. In this regard, Defense Constriction Enterprise is implementing a new technology on Adigudo – Mekelle – Wekero project for the first time in Ethiopia. This technology is a pavement milling technology which is used to recycle asphalt. The Milling machine is grounded up the existing pavement to be used as reclaimed asphalt pavement (RAP), which can be recycled in the hot mix asphalt by combining with a new aggregate and asphalt binder. By taking this project as a sample, the ERA have planned to implement this technology on other projects, mainly on periodic maintenance projects in the near future.

4.5.3.6 Reduce Project Delay

Extension of time leads to cost overruns during implementation of contract projects. Avoiding project delays is therefore a key for limiting cost overruns. Most of the ERA projects are not completed in accordance with the contractual time which also leads to cost overruns. The implementation of PBC on ERA projects is the key remedial action for the long term deep rooted problem. Under PBC, the contractor

is not paid for the quantity of work executed rather for the service level achieved on a certain section of the road. In order to get the payment, the contractor has to strive to complete the work on the required time which in turn avoids the cost overrun. Even if the ERA PBC projects are not completed yet, progressive work flow is taken place in all the projects.

4.5.3.7 Source of Finance

Informally, most of the international financers show interest to support the next PBC projects in Ethiopia, more than the traditional contract projects. Since the Ethiopian government has problem to finance all of planned PBC projects, the interest of these international financers is a good opportunity. The international experience also shows the growth of the interests of international financers to finance PBC.

According to Sultana (2012), after review of PBMC which was approached jointly by the World Bank Group, IDA/IFC secretariat (International Development Association/International Finance Corporation) and the Global Partnership of Output-Based Aid (GPOBA), financing of PBC projects increased since inauguration of the first project using that approach in 2002-03, the World Bank has consequentially increased from 32 projects to around 200 projects all over the world with various funding sources.

4.5.3.8 Risk Sharing

A change in the method of contracting from the traditional form to Performance-Based Contract, increases the risk exposure of the contractor and reduces risk exposure of the client (ERA).

Performance based contracts integrate all of the components of the road maintenance task (routine and periodic maintenance, rehabilitation, restoration and replacement) necessary for the management of the achievement of the specified performance outcome. This shift in the method of specification, from activity prescription to performance, brings about a commensurate shift in the risk exposure of the road agency. In a work output specification environment, the client is generally responsible for determining the quantity, type and location of work outputs required to achieve the desired performance levels. As the bulk of the performance achievement risk resides with these decisions, the client carries a considerable risk. However, in a performance specification environment the client carries no direct risks arising from these decisions, but will be exposed to a risk premium on service delivery to cover the service provider's increased risk profile. (Sultana M. Rahman A. & Chowdhury S, 2012).

Therefore, ERA is highly benefited from this. As an example on the Nekemte – Bure road project, the contract with the Spanish company was terminated due to contractual failure of the company in relation to its liquidation as a company. Until the termination, this Spanish company performed only 5km sub base work, but ERA is not pay for the executed work since the required minimum service level was not achieved.

4.5.3.9 Flexibility of the Contractor

Those contractors participated in ERA PBC projects have a full freedom to do what they desire in order to achieve the required target of the work. This flexibility can drive the contractor to take the initiation for applying supportive innovative ideas and new technologies. In addition to this, the flexibility can be enjoyed either by choosing the desired engineering design and drawing. However, these PBC projects provide the chance to the state owned locale contractors to build their capacity in terms of design and management.

4.5.3.10 Sustainable Road Management System

According to Sultana *(2012)* the road authority gets the option for the possibility of long term sustainability using PBC. These types of contracts have exhibited larger reductions in necessary long term expenditure for road maintenance which proves the method's ability of providing a more sustainable road maintenance and management system.

If this contract type practiced widely in Ethiopia, the road management system can change in an efficient and effective way. Following this, the fund that allocated for maintenance works will improves the condition of many road sections since financial dissipation is managed properly.

4.5.4 Drawbacks/Disadvantages of PBC in ERA

Even though PBC brought all of the above benefits in ERA, it is still a new approach for the construction industry as a whole and it accounts only three and half years in ERA particularly. Therefore, there are some problems and drawbacks faced by ERA during its implementation. These disadvantages are sated in the issuing sub-sections;

4.5.4.1 High Cost of Tendering

Preparation of tender documents and also tendering are the costly parts of PBC which require legal and financial advice to support the business decisions in excess of the detailed technical expertise needed to determine a price. This limits the parties able to tender for the contract and raises questions about supporting the cost. Preparation of tender documents involves a set of typical contract documents, compilation and verification of asset inventory and condition data (Sultana M. Rahman A. & Chowdhury S, 2012).

Initially, ERA employed a foreign consultant to be paid by a foreign currency for the preparation of a tender and contract document for implementing PBC at pilot project level of Adama – Assela and Butajira – Hossana – Areka routes. Unfortunately, these projects were not implemented because of the absence of interested contractors. Therefore, the finance invested for preparation of the biding and contract document was strayed without any benefit. Then, another document was prepared through in house capacity of ERA in 2016 for those implementing projects. The in house team was preferred in order to minimize the cost. This team includes a large number of different professionals. But the document has some clarification

problems, those became as causes for disputes. However, when comparing the cost of tendering required for the traditional contract and PBC, PBC is highly expensive.

4.5.4.2 Limited Competition

Performance contract works are large by their nature and needs a large amount of money and work experience. But, most of the local contractors including the state owned and the private once, didn't have sufficient financial capacity and the required experience to perform these type of projects. Even if the contractors have the experience but with a limited financial capacities, they cannot get the chance to be supported by the financial institutions of the country. It is due to the limited financial capacity of the institutions. Therefore, if the number of participants on the bid are limited, those participated contractors may get the chance to inflate the project cost. ERA was experienced this problem repeatedly, first, those pilot projects were left down due to absence of interested bidder, accordingly, five projects were dropped due to highly inflated project cost by the participated bidders.

In addition to the capacity problem, PBC transfers most of the risks to the contractors from the client. Therefore, most of the local contractors are refrained from participating on the bid. As a result, the biding process of those ongoing projects took place among limited number of contractors.

4.5.4.3 Contract Termination Disputes

The same as the traditional contract, possibility of poor performance of contractors exists in the PBC projects. But the influence of contractual termination is harder and difficult than the termination in traditional because it takes more time and cost in the retendering process. In PBC, payment is issued for the minimum service levels achieved. But when termination or breach occurs at a certain level of work progress without achieving the required service level, it is highly difficult to quantify the works done and to issue a payment. A similar situation occurred on Nekemte – Anger Gutin - Andhode and Agamsa – Bure Section of the Nekemte – Bure project, when the Spanish company liquidated. This company executed only 5 km in sub base work before the contractual termination was effective. Following this termination, ERA and the company were arguing on the payment issue. The company is claiming a payment for the executed work and ERA refused to pay since it is not achieved in accordance with the required service level.

4.5.4.4 Loss of Control

PBC gives a full right to control the work for the contractor with all of the risks and responsibilities. This snatched the right of ERA to control the work in the same ways as the traditional contracts. The negative effect of losing control felt, when there is a gap on preparation of the contract document that determines the minimum required service level. If the service level and the performance measures are defined inadequately on the contract document that signed by ERA and the contractor, ERA will not have the right

to enforce the contractor to redefine the service levels and the performance measures without the willingness of the contractor.

4.5.4.5 Discourage Local Contractors

Most of the local contractors, especially the private once are financially incapable to participate on PBC projects. It is difficult to get a financial institution to capacitate this contractors in order to strengthen financially and there is no governmental initiation to support them in order to make eligible for PBC projects. Due to these hindrances, all of PBC projects are occupied by the state owned companies and foreigners. This problem is more aggravated if the projects are funded by international financers. Those foreign financers consider mandatory the participation of international firms on the bid before they release the money. All the requirements and standards are set in accordance to the international regulation. Therefore, most of the local contractors, even the "huge" state and endowment owned companies, cannot fulfill those requirements. Because of this, most foreign financed projects are taken by international contractors. This can create another problem on the foreign currency deposit of Ethiopia since expatriate contractors are paid in foreign currencies. In view of the above, the current arrangement of PBC does not encouraged local private contractors.

4.5.4.6 Discourage Researches

ERA has established a Research and Development directorate which is responsible for co-coordinating and managing tasks of the organization. Under this directorate, there is Engineering Research Team to undertake researches in different road related disciplines to assure quality of the work done and introduce efficient technologies to support the core process. In addition to this, ERA financially support different specialization programs in different universities of the country in order to provide well trained professionals in the construction sector.

If PBC is widely implement in future, the benefit of the research directorate and financial support of the specialization, will become less required since contractors participate in the process of developing innovation for their own benefits. Therefore, ERA's effort to fund for research and development will decrease.

4.5.5 Challenges of PBC in ERA

4.5.5.1 Legislative Problems

All local insurance companies provide a guarantee for one year only after the main construction period. Due to this trend, the local contractors participated in the PBC projects usually face a problem to submit a guarantee bond which covers the whole contractual period. This is mostly related to weak financial capacity of the local insurance companies. Therefore, ERA and contractors have agreed to submit the guarantee

bonds phase by phase, for the construction period and separately for maintenance period. In order to reach on this solution, the contract was amended.

4.5.5.2 Absence of Knowhow about PBC

Since Performance Contract is a new concept for Ethiopia, extensive understanding about PBC is not appreciable. Knowhow limitations about the nature and implementation methods of PBC is vastly observed from the contractors side, as an example, a certain contractor who is currently participated in one of the PBC projects submitted a cost of birr 8000/km for a maintenance cost. This problem was solved after the discussion made with the contractor. In addition to this, ERA was faced with some difficulties to find local consulting firms with extensive knowhow about PBC. In addition to this, the consultants are not also interested to participate on this type of projects. Therefore, most of the PBC projects are supervised by ERA in house capacity.

4.5.5.3 Limitation on Availability of Inventory and Condition Data Collection Machines

The PBC maintenance and rehabilitation process uses the inventory data in combination with performance evaluation information, maintenance policies, etc. A list of maintenance and rehabilitation activities needed for the pavement should be identified with their specific location and estimated quantities measure. Therefore, in order to fulfill this requirement, ERA uses a HawkEye system installed vehicles to collect data from different segments and roadway sections. This condition survey data is used to measure the severity and types of distresses available on the road. Based on this data, ERA decides on which roads require maintenance and rehabilitation action. In addition, after the roads are maintained, it needs to check whether the minimum required service level is achieved or not.

ERA has only two Hawkeye installed vehicles for the entire road segment of the federal roads. Out of these two vehicles, the one is not currently providing service due to maintenance and spare part problems. This shortage crates a hindrance on the process of measuring the service levels of maintained PBC projects.

4.5.5.4 Resistance to Cultural Change

ERA implemented traditional method of contract for a long period of time. This has led the Contractors wrong attitude of carrying out maximum amount of works, in order to maximize their turnover and profits. When PBC implemented, it created a complete cultural change in contract administration process of ERA. Accordingly, under PBC, contractors' wrong incentives could not have a place. Due to this, challenge arose in implementation of PBC from different contractors whose benefits were adversely affected. This challenges may be not only from the contractors, but also from different stakeholders those share the wrong benefits from the traditional contract method.

4.5.5.5 Contractors Capacity Limitation

The capacity of the local contractors is limited in terms of finance, experience, staffs, technology, etc. To implement PBC, the contractors must be capable enough to adapt the approach. Unfortunately, the majority of the local contractors as well as the private and state-owned organizations are not capable to the successfully implement PBC in Ethiopia.

4.5.5.6 Funding Problem

In the process of implementing PBC, finance of the project should be secured in advance. However, it is challenging for ERA to secure a large amount of money from the local source to cover long term payment. As a result, the only solution was to find international financers. Even if the financers are willing to finance PBC projects, it is dependent on the debt payment capacity of the country which is getting worse currently due to high national debt accumulation.

4.5.5.7 Political influence and Corruption

According to a research entitled "Diagnosing Corruption in Ethiopia" states that the construction and public works sector is consistently ranked worldwide as one of the most corrupted sector. The traditional contract method is highly suffered by corruption and political influence in ERA. If this trend is continue, it is more challenging for PBC since the contracting amount is larger when compared with the traditional one. In addition to this, corruption will not be a onetime practice like it is practiced in traditional method, but it will continuous throughout the long contract period. Therefore, wide implementation of PBC will suffer by this problem.

CHAPTER FIVE

RESULTS AND DISCUSSIONS OF THE SURVEY

5.1 Introduction

The respondents of the questionnaire to this research were experienced and qualified people of the Ethiopians Roads Authority, different private and state owned contractors and relevant stake holders. All the data were processed and analyzed using MS excel software. This chapter comprises the analysis and findings of the data, survey and interviews. The analysis and findings of the survey have been presented in sections 5.2 to Section 5.4.

5.2 Questionnaire Survey Part – I Respondents' Background

The first part of the questionnaire survey included five questions to keep a record of the respondents' background. The aim of this five questions were; to know the organization where the respondents are working, to know their working position in the organization, to know their education level, their working experience and to know on which type of contract they were engaged. The aim of this part of the survey was to ensure the quality and experience of the participants. The success of Part I was very important for the validity of the answers provided by the respondents in Part 2 and Part 3 of the survey.

Table 5. 1 Respondents' Background Summary

Personal Background	Frequency (No.)	Percentage (%)
Organization		
ERA	15	60
Contractor	8	32
Consultant	2	8
Position		
Top Level Management	5	20
Mid-Level Management	8	32
Bottom Level Management	12	48
Others	0	0
Level of Education		
Master's Degree	8	32
B.Sc. Degree	17	68
Diploma/Technical Certificate	0	0
Experience in the Road Sector		

0 – 5 years	9	36
5 – 10 years	6	24
10 – 15 years	7	28
15 – 20 years	3	12
20 – 25 years	0	0
25 or more years	0	0
Type of Contract the person is working with		
Lump sum	1	4
Bill of Quantities (BOQ)/ Traditional	18	72
Design Bid Build (DBB)	2	8
Built Own Operate Transfer(BOOT)	0	0
Both Lump sum and Bill of Quantity (BOQ) type Contract	3	12
Both Design Bid Build (DBB)and Bill of Quantity (BOQ) type Contract	1	4

Table 5.1 above shows out of the total twenty-five respondents, more than half of the participants (60%) were from ERA and 32% participants were contractors. The rest (8%) were consultants. Most of the participants (68%) have at least a Bachelor's degree 32% of the respondents were MSc holders. Therefore, respondents were highly qualified personnel and mostly civil and construction engineers. Those at ERA had strong educational background before joining the organization.

From the total twenty five respondents of this survey, 20% of them were top level managers, 32% were middle level managers and 48% were bottom level managers. It was also observed that the majority of the respondents (36%) had a working experience that ranges from zero year to five years. 24% had more than five years of experience, 28% of the participants had more than ten years of experience. Only a small group of respondents (12%) had more than fifteen years of experience.

Most of the respondents (72%) were working with bill of quantity (BOQ)/traditional type contract. Only a small group of respondents (12%) were participated on two different contract types at different times. The type of contracts they were participated in different projects were lump sum and BOQ type contract. 8% of the respondents worked on Design Bid Build (DBB) contract type and small group (4%) of the respondents engaged both in Design Bid Build (DBB) and Bill of Quantity (BOQ) contract types. In general, the responses gave an idea on the type of contracts in the road projects of the country. Moreover, it allowed to investigate more on the problems of these traditional methods of contract during the interview. Therefore, these findings ensure the quality of the respondents and also validate the survey and subsequent interviews.

5.3 Questionnaire Survey Part – II Traditional Contract Method

Part two of the questionnaire mainly focused on the traditional contract method. Under this section, different issues like budget, project funding, quality of work, staff skill, risk and cost administration were assessed. The collected data, analysis, results and findings of the survey are presented under this section. The results and findings also support and complement the analysis of the potential of PBC in ERA.

5.3.1 Budget/Cost and Schedule

Budget and Schedule are the main parameters for the success of the project. Under this subtopic, the potential of the traditional contract method to be completed within the assigned budget and schedule were studied. The budget/cost and Schedule part of the survey has five questions. The responses would increase understanding of the trends of expenditure for road projects to some extent.

Table 5. 2 Summary of Responses on Budget/Cost in Traditional Contract

Are cost of the projects remained within budget?		
	Frequency (No.)	**Percentage (%)**
All of them within budget	3	12
All of them exceeds budget	13	52
Some of them within budget and some exceeds budget	9	36
Please rank the reasons for the variation in cost from the most significant to the least significant one.		
Extra works were required by the contractors	Ranked 2 by 7 persons	28
Additional works instructed by the owner/Client	Ranked 1 by 17 persons	68
Interest on late payment	Ranked 3 by 1 Person	4
Other Reasons (Please indicate)	0	0
Were the projects completed by achieving the target?		
Completed by achieving the target	3	12
Almost within the target	5	20
Totally failed to meet the target	17	68
Other Reasons (Please indicate)	0	0
Were the projects completed on time as per the original schedule?		
Completed ahead of schedule	0	0
Completed as per the schedule	6	24
Were not completed as per the schedule	19	76
Difficult to tell	0	0
Rank the following factors that contribute most to projects' failure to complete in scheduled time.		

Ranking	Actors affecting projects' completion within scheduled time	Ranked by Number of Respondents
1	Lack of efficient/competent Contractor	21
2	Extreme site condition like rain, flood etc.	19
3	Modification of plan or design related issues	18
4	Extra work requirements of contractors	14
5	Poor supervision by client (Government/ERA) s	13
6	Delay in payment of contractor	11
7	Shortage of Material, Manpower	11
8	Slow administrative process by Client (Government/ERA)	7
9	Contractual disputes or issues between the parties	5
10	Lack of expert technical personnel by client (Government/ERA)	4
11	Uneven increase/fluctuation of material price	3
12	Poor top management support (Government/ERA)	3
13	Other Issues (Please Specify)	0

Out of the twenty five respondents, 52% commented that all of the traditional contracts exceed the assigned budget amount and 36% believed that some of the contracts were completed within the budget and some exceeds the budget. The rest 12% replied that all of the traditional contract projects were completed within the budget. From those six case study projects (chapter 4), five of them were not completed within the budget that were assigned for the projects. This case study finding is supported by the survey data collected from the respondents. Therefore, it can be concluded from the analysis that most of the projects contracted by a traditional method are not completed within the budget limit.

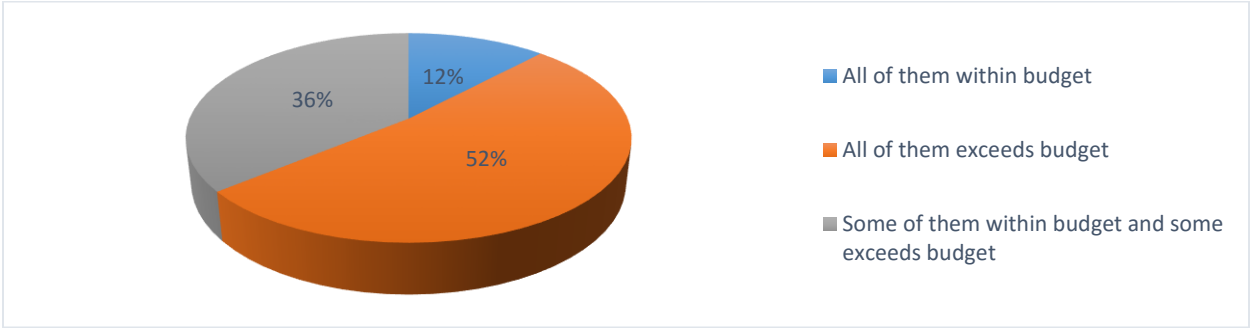

Fig. 5. 1 Survey Result Percentages of Response for Budget/Cost Overruns on Traditional Contract Projects

The main reason that is indicated by the respondents as a cause for the cost overrun was additional work that instructed by the owner/Client. This was accepted by 68% of the respondents. In addition to this, the extra work required by the contractor was also taken as the reason for the cost overrun by 28% of the respondents. The rest 4% represented respondents who expressed interest was paid late that was a reason for cost overrun of the traditional contract projects.

On most of the ERA projects, additional work orders were frequently experienced. These additional work orders were caused by many different reasons, the main one being design change. Since most of the projects' design works were not completed before the starting time of the project, frequent design changes orders were experienced in the middle of the construction period. Following these design changes, additional works were performed to coup up with the new changed design, which was not included in the contract document. Therefore, additional cost was incurred for the additional work which was the main drawback of the traditional contract method. Figure 5.2 below graphically illustrates survey results (%) of responses on reasons of cost overruns regarding the Traditional Contract Projects.

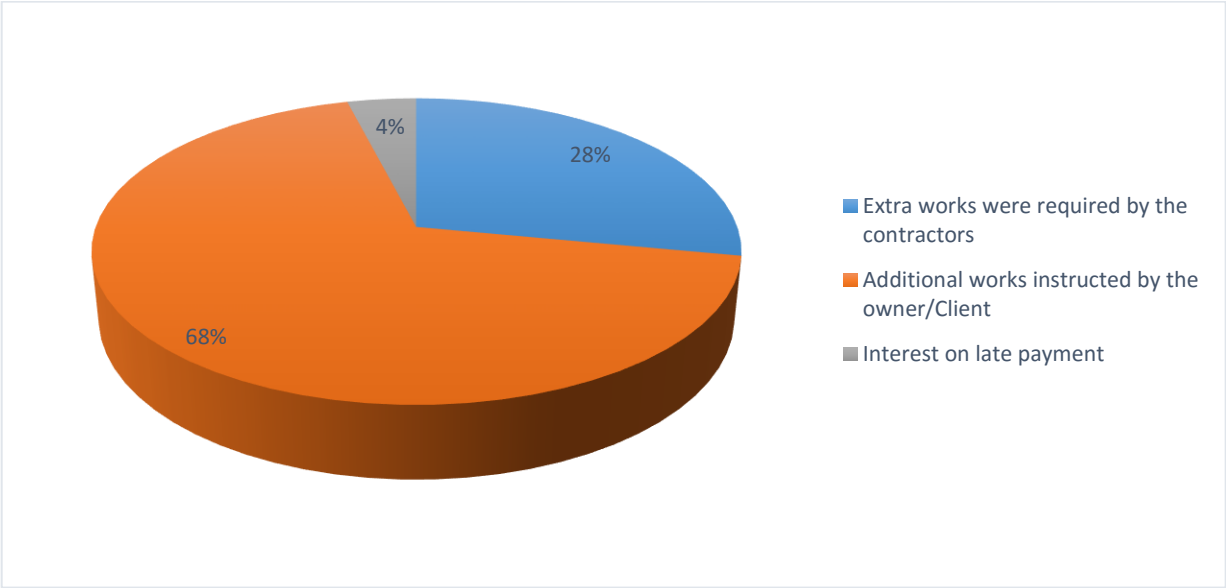

Fig. 5. 2 Survey Result Percentages of Responses for Reasons of Cost Overruns on Traditional Contract Projects

According to the response of the respondents, the target of the traditionally contracted projects did totally fail. It was supported by 68% of the respondents; 20% of the respondents believed that the target of the projects were achieved almost within the target and the remaining 12% respondents agreed that all of projects were completed by achieving the target. If the projects were not complete within the budget, it cannot be said that the targets were achieved. With this understanding, most of the ERA traditional contract projects did not met the target in terms budget/cost and in terms of the time schedule.

This survey also includes questions those related to time schedule and overruns on traditional projects. Based on this, 76% of respondents assured that the traditional contracts were not completed as scheduled. Only 24% respondents believed that traditional contract projects were completed as scheduled. This survey supported the results that observed on the case study projects which described that most of the traditional projects were differentiated by time overruns. Figure 5. 23 below graphically illustrates the survey results (%) of the responses regarding the time overruns of Traditional Contract Projects.

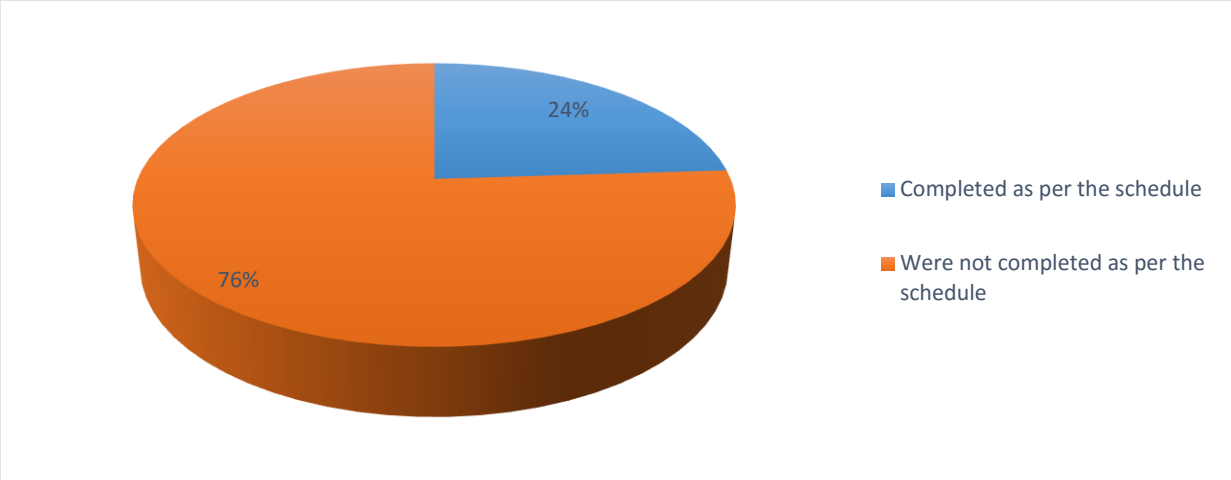

Fig. 5. 3 Survey Result Percentages of Responses for Time Overruns on Traditional Contract Projects

Lack of efficient/competent contractors, extreme site condition like rain, flood etc., modification of plan or design related issues, extra work requirements of contractors are some of the main reasons for time overrun in ERA's traditional contract projects which are ranked by the respondents respectively from top to bottom and are stated as follows:

i. Lack of efficient/competent Contractor
ii. Extreme site condition like rain, flood etc.
iii. Modification of plan or design related issues
iv. Extra work requirements of contractors
v. Poor supervision by client (Government/ERA) s
vi. Delay in payment of contractor
vii. Shortage of Material, Manpower
viii. Slow administrative process by Client (Government/ERA)
ix. Contractual disputes or issues between the parties
x. Lack of expert technical personnel by client (Government/ERA)
xi. Uneven increase/fluctuation of material price
xii. Poor top management support (Government/ERA)

5.3.2 Project Funding

The availability of constant sources of funding is necessary for successful implementation of projects. In this study, the questionnaire survey had four questions regarding project funding. The aim of asking these questions was to acquire knowledge on the availability of funding on road projects within ERA.

Table 5. 3 Summary of Responses on Project Funding in Traditional Contract

Is fund a major issue that delays the progress of the project?		
	Frequency (No.)	**Percentage (%)**
Yes it is	17	68
Is an issue at the early stages of the project	3	12
Is an issue at the later stages of the project	4	16
No, it's not	1	4
Are contractors always paid within the required time?		
Claims are always paid within the required time	0	0
Most Claims are paid within the required time	6	24
Few Claims are paid within the required time	19	76
All claims were paid late	0	0
Indicate your opinion on the sufficiency of funding for road maintenance project provided by the government.		
Available fundings are more than the total funds requested for work	0	0
All funding requested for work are provided	5	20
Half of the funds requested for work are provided	14	56
Very little funding are provided	6	24
Hardly any funding are provided	0	0

Rank the following factors that contribute most to projects' failure to complete in scheduled time.		
Ranking	**Actors affecting projects' completion within scheduled time**	**Ranked by Number of Respondents**
1	Funding unavailability or delays	12
2	Processing of payment is slow or takes time	11
3	Contractors' claims have errors and need clarification	10
4	Client's site officers slow in claim clarification	9
5	Delays in contract payments are quite common	7
6	Intentional or deliberate delay by government workers	5
7	IT or computer system failure	5

As stipulated in Table 5.3 above, the first question of this section investigated if funding was a major issue that delayed the progress of the project and 68% of the respondents confirmed that; 16% respondents believed that funding was an issue at the later stages of the project. 12% of the respondents replied that funding is an issue at the early stages of the project. The rest 4% agreed that funding was not an issue for project delays. Based on this survey results and the desk study done on ERA projects, the availability of funding played a great role on the progress of traditional contract projects. Projects funded by international financers' shows a more progressive performance than the projects funded by the government. Figure 5. 4 below graphically illustrates the survey results in percentages of responses regarding project funding delay issues on Traditional Contract Projects

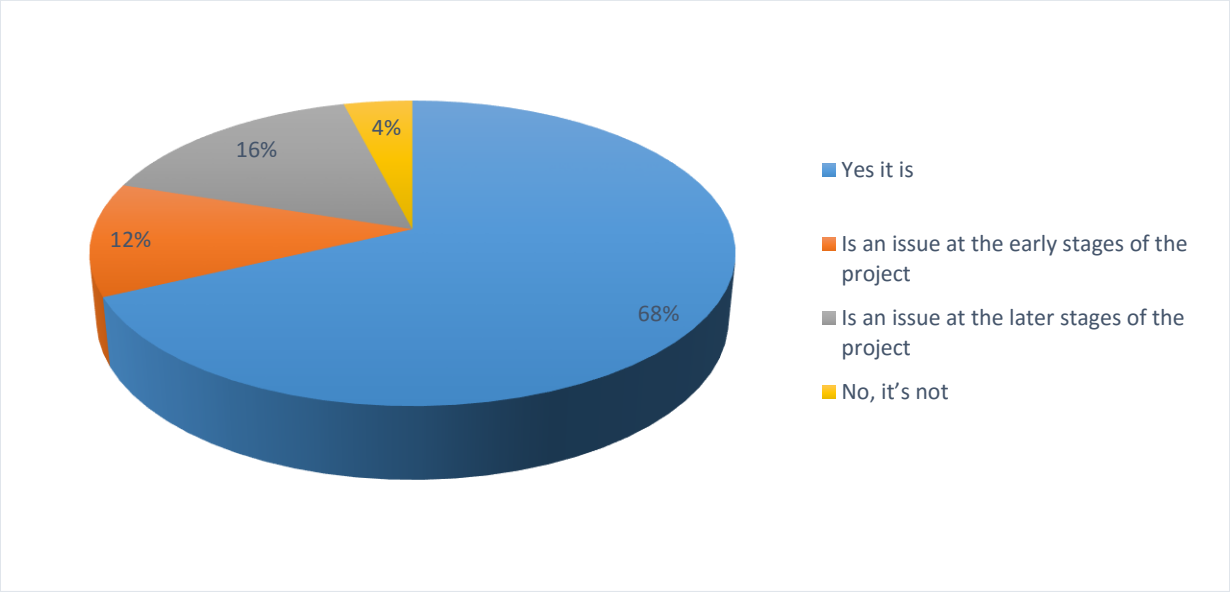

Fig. 5. 4 Survey Result Percentages of Responses for Project Funding Delay Issues on Traditional Contract Projects

In the subsequent question, the respondents were asked whether contractors received the payment within the required time. Most of the respondents (76%) agreed that few claims were paid within the required time, while only a small group of people (24%) stated that most claims were paid within the required time. Therefore, the responses of these two questions infer that funding is indeed a major issue that contributes mostly to the delay of projects in ERA. In addition to this, the main factors on the delay of the contractors' payment are ranked from 1 to 7 as stated below:

i. Funding unavailability or delays
ii. The Process of payment is slow or takes time
iii. Contractors' claims have errors and need clarification
iv. Client's site officers slow in claim clarification

v. Delays in contract payments are quite common

vi. Intentional or deliberate delay by government workers

vii. IT or computer system failure

On the question regarding the sufficiency of funding for road maintenance project provided by the government, 56% of the respondents' answered that half of the fund requested for work was provided; 24% replied that very little funding was provided and only 20% of the respondents replied that all the funding requested for work were provided. Generally, funding is the main hindrance for progressing traditional contract projects in ERA. Figure 5.5 below graphically illustrates the survey results in percentages of the responses regarding the supply of project funding on Traditional Contract Projects

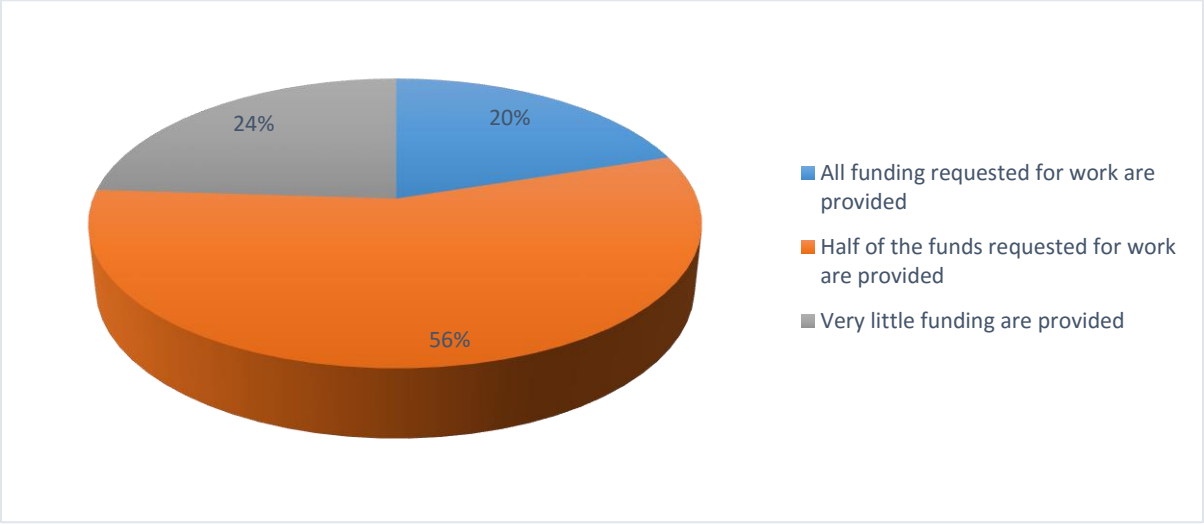

Fig. 5. 5 Survey Result Percentages of Responses for Supply of Project Funding on Traditional Contract Projects

5.3.3 Quality of work

This quality of work survey has seven questions on the quality of work achieved on road projects under the Traditional Contract Method. The first five questions were prepared by rating method using a five point Likert scale method which is widely used to measure attitudes and opinions with a greater degree of nuance than simple yes/no questions. Table 5.4 below shows the summary of responses on quality of works of the Traditional Contracts.

Table 5. 4 Summary of Responses on Quality of Works in Traditional Contract

Statement	Highly Sufficient %	Sufficient %	Average %	Insufficient %	Highly Insufficient %
The level of quality achieved on the projects are considered	4	16	12	68	0
Material quality control on the projects are	8	12	28	52	0
The level of supervision provided by the client to cover contractors site activities is	12	24	40	12	12
The existing quality control policies that addresses all quality control issues are	12	48	24	12	4
The amount of Resource allocated for implementing quality objectives are	0	12	28	52	28

The findings in Table 5.4 can be succinctly presented as follows:

- The majority of the respondents (68%) considered the level of quality achieved on the projects was insufficient. Only a small group of respondents (12%) believed that the level of quality was sufficient while another group marked that the statement is average.
- Almost half of the participants (52%) considered that material quality controls on the projects were insufficient while 28% of the respondents believed the statement was average. Another small group of respondents (12%) stated that material quality control was sufficient and the rest (8%) considered it was highly sufficient.
- Most of the respondents (40%) considered that the level of supervision provided by the client to cover contractors' site activities was average; 24% said it was sufficient and the rest 36% incorporated: highly sufficient, insufficient and highly insufficient.
- Most of the participants (48%) stated that the existing quality control policies that address all quality control issues were sufficient; 24% responded that the existing quality control policies was average; 12% included highly sufficient and insufficient and the remaining 4% responded that it was highly insufficient.
- The majority of the participants (52%) considered that the amount of resource allocated for implementing quality objectives was insufficient; 28% believed it was average and another 28% respondents believe that it was highly insufficient and finally 12% agreed that the amount of resource allocated for implementing quality objectives was sufficient.

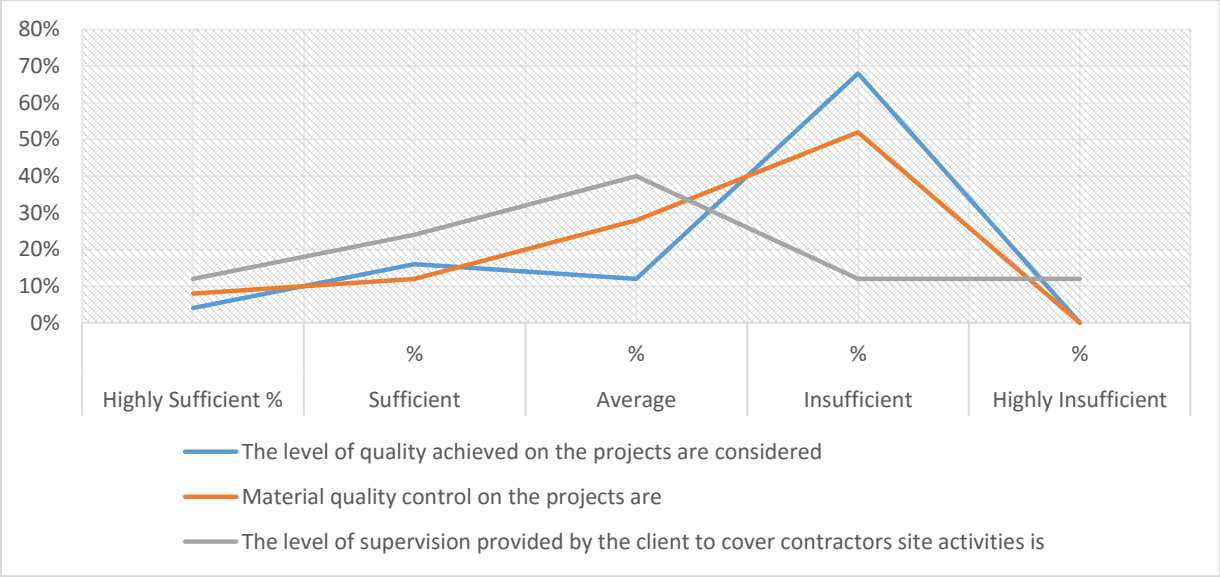

Fig. 5. 6 Survey Result Percentages of Responses for Quality of Work on Traditional Contract Projects

Therefore, it can be concluded that the current level of quality achieved on the projects and quality control of material were insufficient. However, the current level of supervision provided by ERA to cover contractors' site activities was insufficient. The existing quality control policies that address all quality control issues and the amount of resource allocated for implementing quality objectives were sufficient. In addition to these, the amount of resource allocated for implementing quality objectives were insufficient.

Table 5. 5 Summary of Responses on Routine Maintenance in Traditional Contract

Please indicate the time when the first pothole is likely to appear after the defects liability period.		
	Frequency (No.)	**Percentage (%)**
After 6-12 months	12	48
After 1-2 years	3	12
After 5 years	0	0
Depends on the level of traffic	9	36
After a long time	1	4
Indicate how soon road maintenance works will commence after the defects liability period.		
After 3-6 months	2	8
After 6-9 months	4	16
After a year	9	36
As soon as defects start arising	3	12
Whenever funding is received	6	24
Never at all	1	4

Two more non-Likert scale questions were included mainly for routine maintenance works. The respondents indicated the time when the first pothole is likely to appear after the defects liability period. The defects liability period is a part of the construction contract, during this time the contractor is required to repair defects that occur within the project. The majority of the respondents (48%) stated that the time needed for the first pothole to appear was likely to be after the defects liability period of 6-12 months. Another group of participants (36%) indicated that the time needed for the first pothole to appear depends on the level of traffic; 12% of the respondents replied that the first pothole appear after 1 – 2 years after the defect liability period and only 4% of the respondents indicated that the time needed for the first pothole appeared after a long time.

The respondents also indicated the time of commencing the road maintenance works after the defects liability period in the subsequent question. One group of respondents (36%) indicated that the time needed to commence the road maintenance works after the defects liability period is after a year; 24% indicated after the defects liability period whenever fund is received; 16% respondents indicated after 6-9 months; 12% indicated as soon as defects start arising; for the 8% respondents, it is after 3-6 months. Only a small group of participants (4%) believed that the road maintenance works would commence never at all. Figure 5.7 below graphically illustrates the survey results in percentages of the first appearance of potholes after liability period regarding the Traditional Contract Projects. Subsequently, Figure 5.8 graphically illustrates the survey results in percentages for commencement of maintenance works after liability period regarding the Traditional Contract Projects.

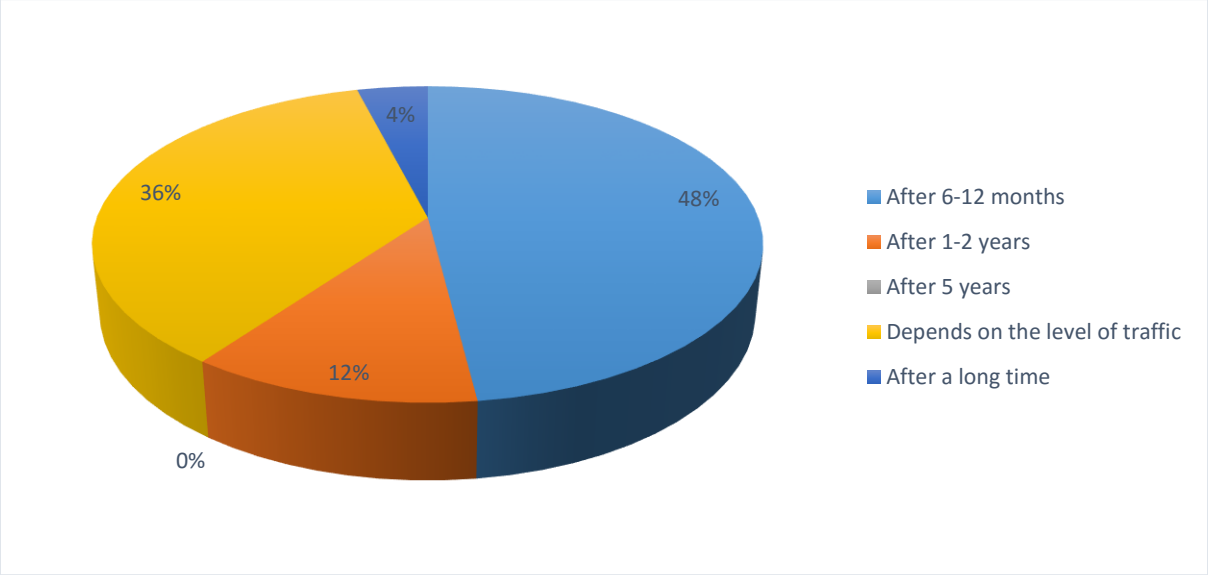

Fig. 5. 7 Survey Result Percentage for the First Appearance of Potholes after Liability Period on Traditional Contract Projects

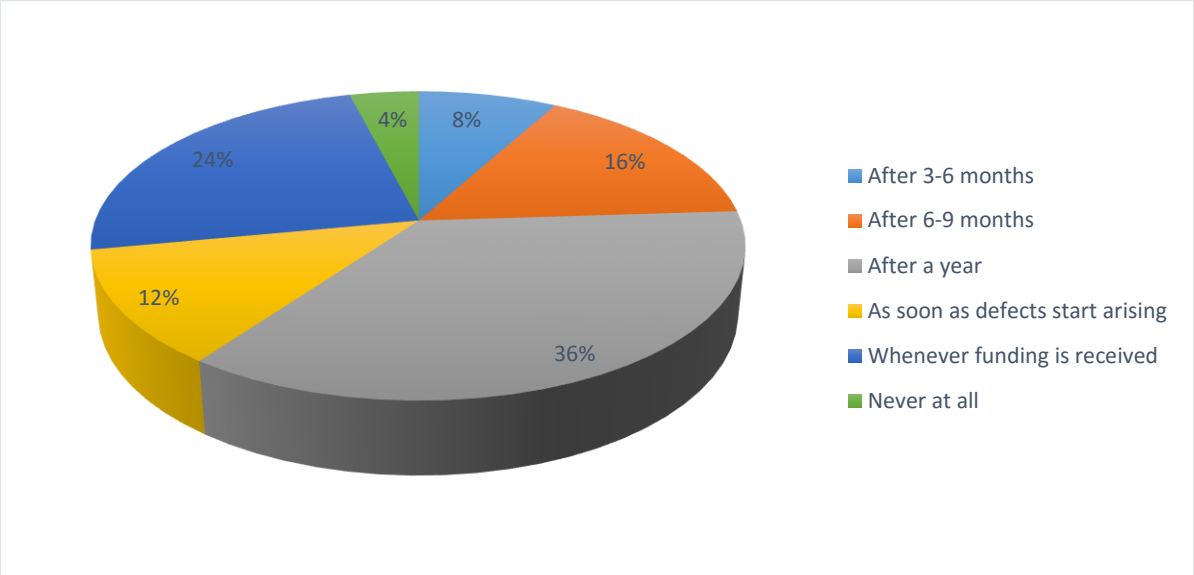

Fig. 5. 8 Survey Result Percentage for Commencement of Maintenance after Liability Period on Traditional Contract Projects

Therefore, majority of the respondents implied that the first pothole is likely to appear after 6-12 months of the completion of the defects liability period. On the other hand, many participants believed that the time of commencing the routine maintenance works after defects liability period varies for different projects is after a year and is dependent on the fund. The survey result shows that under ERA traditional contract projects, due to quality problems, defects appear within a short period of time and the defects are not maintained immediately.

5.3.4 Skill of Staff

Skill of the staffs who participated on projects have a significant role for the success of certain projects. This section has three questions which investigate the skill of staff in ERA. Five point Likert scale has been used for these questions. The results have been tabulated in Table 5.6 below.

Table 5. 6 Summary of Responses on Skill of Staffs in Traditional Contract

Statement	Highly Sufficient %	Sufficient %	Average %	Insufficient %	Highly Insufficient %
The level of skill and experience of the supervisory staff are	0	32	56	12	0
The supervisory staffs' efficiency in achieving project goal are	0	32	44	24	0
The level of training (pre & on the job) for staffs are	0	12	32	56	0

Based on Table 5.6, the majority of the respondents (56%) considered that the level of skill and experience of supervisory staff was average. Other participants (32%) stated that the level of skill and experience of supervisory staff was sufficient and the rest 12% respondents considered it was insufficient. Regarding the efficiency of supervisory staffs, the majority of respondents (44%) considered an average; about one third of respondents (32 %) believed that the supervisory staffs' efficiency in achieving the project goal is sufficient and the remaining 24% respondents believe it was insufficient. Majority of the respondents (56%) stated that the level of training (pre & on the job) for staff is insufficient. another group of participants (32%) considered that the level of training (pre & on the job) for staff is average. 12%s believe it sufficient.

Therefore, it can be concluded from the analysis that many supervisory staff have average level of skill and experience due to lack of training on the job in ERA. There are also some skilled and experienced staff. However, the staff somehow managed to achieve the project goal with all their limitations. Sufficient levels of regular training should be provided to employees to improve the efficiency of ERA. Figure 5.9 below illustrates the survey results in percentages regarding the staff quality on Traditional Contract Projects.

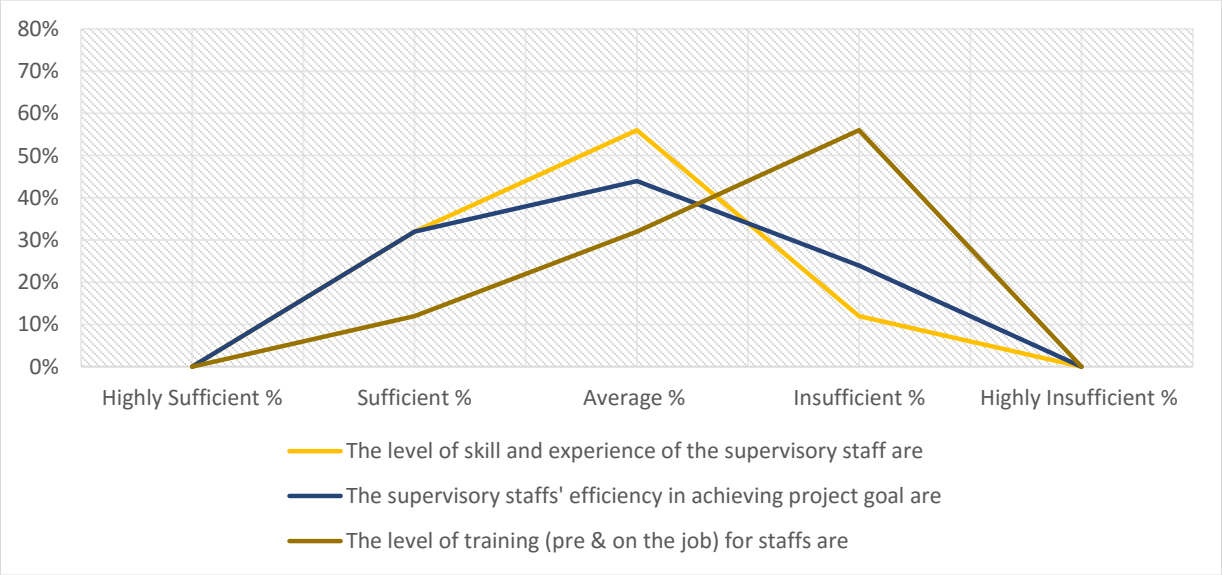

Fig. 5. 9 Survey Result Percentages of Responses for Staff Quality on Traditional Contract Projects

5.3.5 Administrative and Supervision Costs

Proper administration and supervision of a cost is one of the factor that highly influence the project in terms of achieving the targeted goal. It is also the main reason to move from traditional contract method to PBC. Therefore, this survey studied administrative and supervision of the cost under two questions. Five point Likert scale has been used for a single questions. Table 5.7 below shows responses regarding administrative and supervision costs under Traditional Contracts.

Table 5. 7 Summary of Responses on Administrative and Supervision Costs in Traditional Contract

For how many projects are an officer/employee engaged at a time on an average (approximate)?		
	Frequency (No.)	**Percentage (%)**
Less than 5	6	24
Between 5 and 10	3	12
Between 10 and 15	5	20
More than 15	11	44
Total	**25**	**100**

All the twenty five participants of the survey were asked a question for how many projects is a single officer/employee engaged at a time on an average (approximate)? In the responses, 24% participants expressed on less than 5 projects; 12% expressed 5 to 10 projects; 20% expressed 10 to 15 projects, and majority of the respondents (44%) expressed they have more than 15 projects. Based on the survey, employee's participation on many projects can decrease the efficiency of the employee and will affect the progress of administration and supervision of the cost at particular and the project at general. Figure 5.10 below illustrates the survey results in percentages regarding the number of projects per supervisor under the Traditional Contract Projects. Subsequently, Table 5.8 shows the summary of responses regarding supervision costs under the Traditional Contract projects.

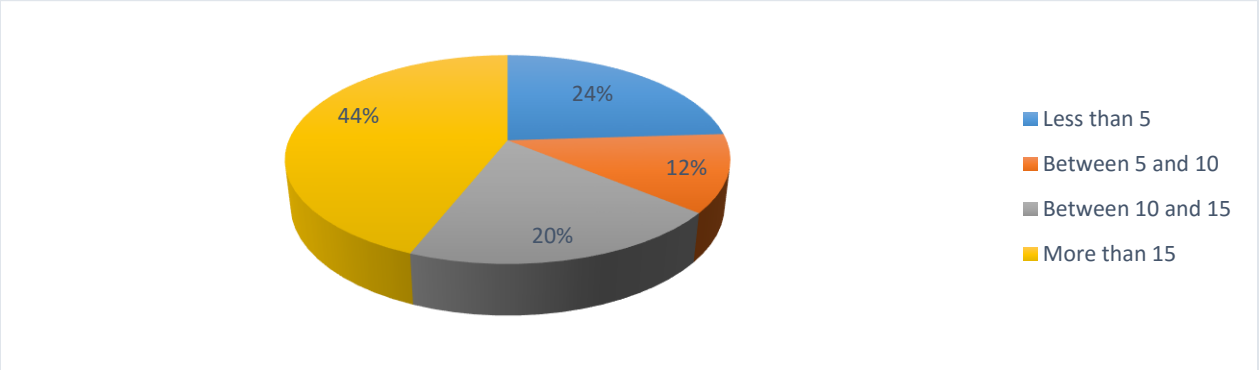

Fig. 5. 10 Survey Result Percentage for Number of Projects an Employee Engaged on Traditional Contract Projects

Table 5. 8 Summary of Responses on Supervision Costs in Traditional Contract

Statement	**Strongly Disagree %**	**Disagree %**	**Average %**	**Agree %**	**Strongly Agree %**
The requirements of clients for project supervision costs a lot of money	4	28	12	52	4

As shown in Table 5.8 above, the majority of the respondents (52%) agreed with the statement that the requirements of clients for project supervision costs a lot of money; 28% of respondents believed that the statement 'the requirements of clients for project supervision cost a lot of money' was disagreed and for 12% respondents, it is average. A minority of respondents (4%) strongly agreed with the statement while another group of people (4%) strongly disagree.

Therefore, supervision costs a lot of money on most of the ERA projects. Specially, big budgeted projects costs a lot of money. This may not be directly related with the amount of remuneration paid for supervisors through the contract time. However, although supervision costs are also high when projects are not completed within the contract period. Following this, the client is forced to incur additional cost that are directly or indirectly related with supervision and administrative cost. Therefore, ERA is incurs a lot of money for issues related with administrative and supervision of traditional contracts. To overcome this problem, PBC is a potential solution. However, this cannot be determined based only on responses of two questions; it however needs further investigation.

5.3.6 Mismanagement/Political Influence/Corruption

Political influence, mismanagement and corruption were the most sensitive issues, mostly experienced on traditional contract projects. In order to study these issues, the survey was planned with four questions in a six point Likert scale. Table 5.9 below shows the summary of responses on mismanagement and related issues regarding Traditional Contracts.

Table 5. 9 Summary of Responses on Mismanagement/Political Influence/Corruption in Traditional Contract

Statement	Strongly Disagree %	Disagree %	Average %	Agree %	Strongly Agree %	Don't know %
in selecting the project (in a priority basis)	0	0	24	48	0	28
during tender stage of the projects	0	0	48	8	0	44
during selection of the contractor in traditional contract	0	8	20	44	20	8
during construction phase	0	0	32	56	0	12

A majority of the respondents (48%) agreed that there is some mismanagement, political influence or corruption in selecting the project (in a priority basis); 24% respondents are neither agreed nor disagreed;

and 28% respondents have replied that they don't know about the availability of mismanagement, political influence or corruption on a priority basis.

In addition, 8% of the respondents agreed that there is some mismanagement, political influence or corruption during the tender stage of the projects; 48% neither agreed nor disagreed and 44% replied that they don't know about the availability of mismanagement, political influence or corruption.

The participants also shared their opinions on the competitive bidding procedure in traditional contracts. Majority of the participants (44%) agreed that the competitive bidding procedure in traditional contracts involves political influence and corruption; 20% of the respondents neither agreed nor disagreed; another 20% of the respondents agreed; 8% of the respondents disagree and the rest 8% respondents replied that they don't know about it.

At the construction stage, the majority of the respondents (56%) expressed that there are some mismanagement, political influence or corruption during the construction stage and 32% of the respondents neither agreed nor disagreed. The rest of the respondents (12%) replied that they don't know about the availability of mismanagement, political influence or corruption during the construction stage. Figure. 5. 11 below shows survey result percentages of responses for availability of mismanagement/political influence on Traditional Contract Projects

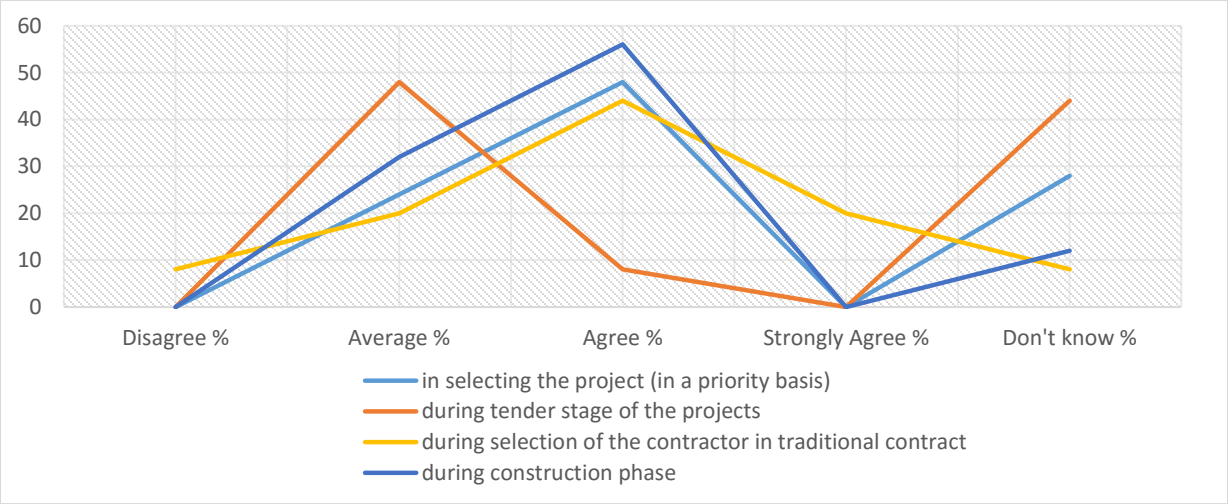

Fig. 5. 11 Survey Result Percentages of Responses for Availability of Mismanagement/Political Influence on Traditional Contract Projects

Based on the above survey, it is evident that mismanagement, political influence or corruption exists severely during selection of the contractors and during construction phase in ERA projects. By its nature, the traditional contract method is prone to corruption and mismanagement. Therefore, PBC will be a solution for these type of problems.

5.3.7 Risk Sharing

This section observes risk related issues if contractors are taking any responsibility for poor works in the current contracting process for ERA projects. The respondents gave their opinions by three statements in a five point Likert scale.

Table 5. 10 Summary of Responses on Risk Sharing in Traditional Contract

Statement	Strongly Agree %	Agree %	Average %	Disagree %	Strongly Disagree %
Contractors do not need to take any responsibility for poor quality of works.	4	0	8	32	56
Client has to take all the responsibilities of the project.	0	24	0	48	28
Sometimes contractors' poor workmanship results to quick deterioration of roads.	60	32	8	0	0

As shown in Table 5.10 above, the majority of the respondents (56%) strongly disagreed with the fact that contractors do not need to take any responsibility for poor quality of works and 32% disagreed. Other participants (4%) strongly agreed that contractors do not need to take any responsibility for poor quality of works. The rest 8% of the respondents neither agreed nor disagreed. Regarding the responsibility if the client, the majority of the respondents (48%) disagreed that the client has to take all the responsibilities of the project. Another group of the respondents (28%) strongly disagreed with the statement that the client has to take all the responsibilities of the project. The rest of the participants (24%) agreed that the client has to take all the responsibilities of the project.

Majority of the respondents (60%) strongly agreed that sometimes contractors' poor workmanship results to quick deterioration of roads and also 32% respondents agreed on it. And only a small group of people (8%) neither agreed nor disagreed with the statement that sometimes contractors' poor workmanship results in quick deterioration of roads. Nobody disagreed with that statement. Figure 5.12 below illustrates survey results in percentages of Risk Sharing on Traditional Contract Projects.

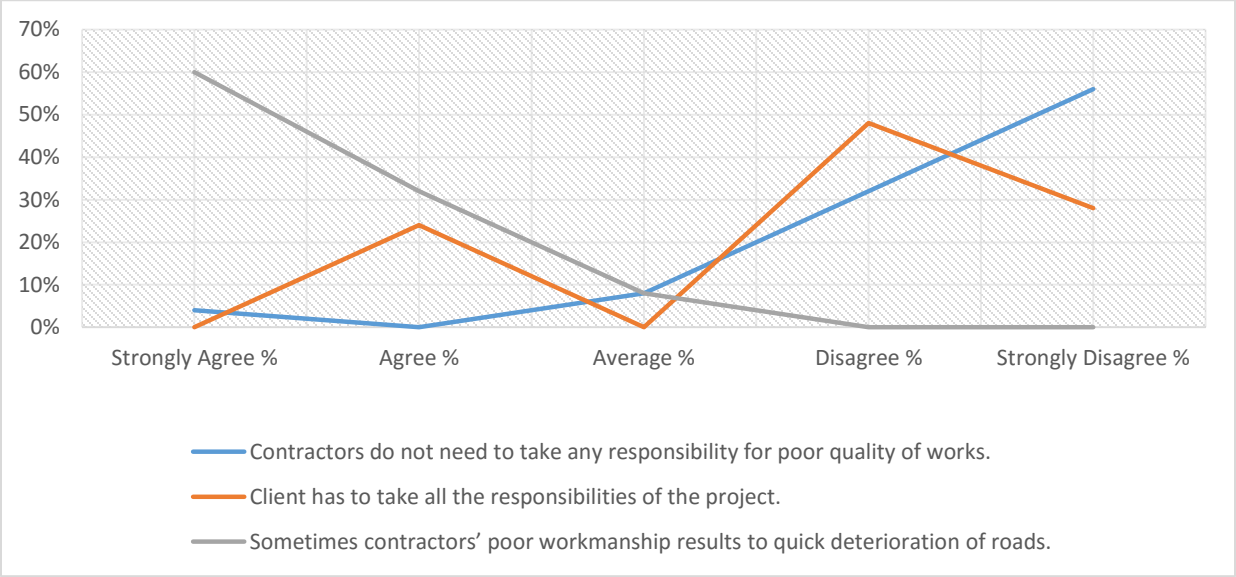

Fig. 5. 12 Survey Result Percentages for Risk Sharing on Traditional Contract Projects

Therefore, it can be concluded that contractors need to take a responsibility for poor quality of works during the defect liability period if the roads deteriorate early. It needs to be stressed that clients or road authorities should not take the major responsibilities for quick deterioration of roads, if contractors handed over the project by not achieving the required standard of the work.

At the last section of Part II, a question was asked to know the opinion of the respondents about the bidding procedure in the Traditional Contract Method. Therefore, the participants of the survey shared their opinion and summarized as the result as presented in Table 5.11 below.

Table 5. 11 Summary of Responses on Nature of Traditional Contract

What is your opinion about the competitive bidding procedure in traditional civil contracts?		
	Frequency (No.)	**Percentage (%)**
Fair bidding procedure based on Quality.	0	0
Influenced by top level management	4	16
No need to ensure quality of contractors in doing similar works in the past.	3	12
Involves political influence and corruption	16	64
Some fair, some influenced	2	8
Other Issues (Please Indicate)	0	0
Total	**25**	**100**

As shown in Table 5.11 above, the majority of the participants (64%) agreed the competitive bidding procedure in traditional civil contracts involves political influence and corruption; 16% of the respondents implied that the process is influenced by top level management, involves political influence and corruption. Another small group of participants (12%) stated that no need to ensure quality of contractors in doing similar works in the past and lastly only 8% of the respondents expressed that the bidding procedure is some fair, some influenced.

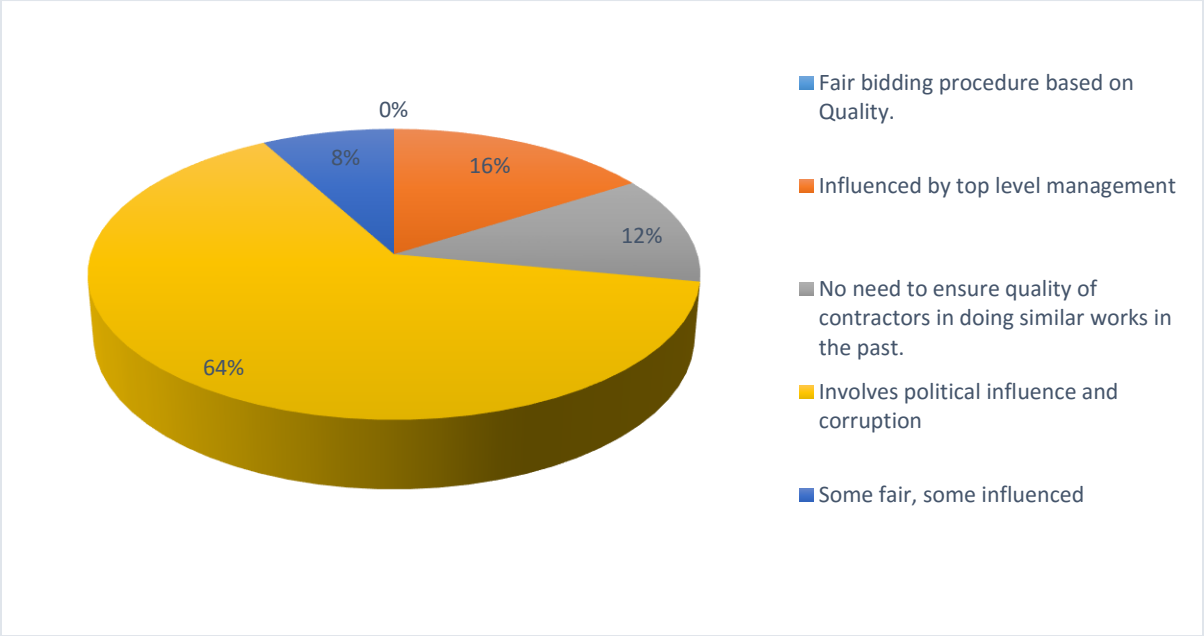

Fig. 5. 13 Survey Result Percentages of Responses for Traditional Contract Method

According to this survey study, the traditional contracting method in ERA is vulnerable for cost and time overrun, struggle with funding, quality and mismanagement problems. This contact method is managed by staffs with limited skills. In addition, the main problem of the traditional method is political influence and corruption. Therefore ERA should take a responsibility to eradicate these challenges.

5.4 Questionnaire Survey Part – III Performance Based Contract

Five point Likert scale is the main method used in part III of the survey in order to gather the opinion of the respondents on various aspects of PBC and to investigate the potential and effectiveness of PBC in ERA. These part contains different aspects related to: risk sharing by contractors, assurance of quality, improving efficiency, introduction of innovative technology, getting expertise, increase transparency, increase customer satisfaction, securing long term funding, fast delivery, achieving cost savings, a better alternative, technical feasibility and potential barriers during the introduction of PBC. The findings from this part will also help to determine the effectiveness of PBC in ERA.

5.4.1 Risk Sharing

The main advantage ERA gets from PBC is risk sharing; contractors and the client share the risk of the road construction and maintenance projects to achieve success through PBC. This section deals with the potential of sharing the project risks between contractors and ERA. Table 5.12 below shows the summary of responses by the respondents regarding risk sharing on PBC projects.

Table 5. 12 Summary of Response on Risk Sharing in PBC

Statement	Strongly Disagree %	Disagree %	Average %	Agree %	Strongly Agree %
Construction project risks should be properly identified and shared between the contractor and the client.	0	0	8	44	48
Risk sharing would bring a sense of discipline and responsibility to the contractor on road contracts.	0	0	8	68	24
Risk sharing would benefit the government to a certain extent.	0	0	24	56	20

From Table 5.12 above it can be observed that 44% of the respondents agreed while 48% strongly agreed that construction project risks should be properly identified and shared between the contractor and the client. Furthermore, 8% of the respondents neither agreed nor disagreed. Almost all the participants (92%) also agreed that risk sharing would bring a sense of discipline and responsibility to the contractor on road maintenance projects. The respondents were asked whether they believe risk sharing would benefit the government and 76% of the participants agreed that risk sharing would benefit the government to a certain extent. No respondent disagreed with any statement of this section rather 24% of respondents replied as average.

Therefore, identifying and sharing the risk of the construction project will improve the quality of works concurrently reducing the time and cost overruns on ERA projects. Since risk sharing is mandatory in PBC, it would also increase consciousness of the contractors to deliver quality of works. Thus, ERA would enjoy the benefit of shifting risk to contractors. Figure 5.14 below shows the survey results in percentage of the responses regarding Risk Sharing on PBC projects

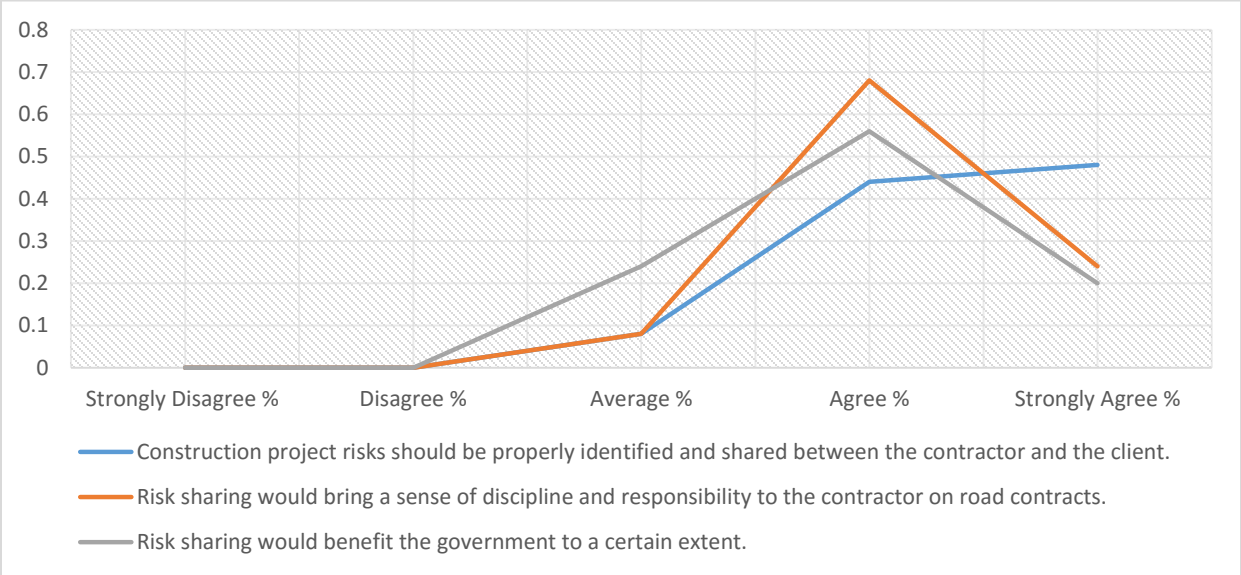

Fig. 5. 14 Survey Result Percentage of Responses for Risk Sharing in PBC

5.4.2 Quality

One of the main target of PBC is to achieve quality of work. To achieve this, the contractors' responsibilities increase from simple execution of works to being designer, project manager and supervisor to match the complexity of the PBC project. This section focuses to survey the opinion of the respondents on the process of assurance of quality on ERA projects.

Table 5. 13 Summary of Response on Assurance of Quality in PBC

Statement	Strongly Disagree %	Disagree %	Average %	Agree %	Strongly Agree %
Setting detailed and prescriptive work methods have not always yield quality output	48	0	32	20	0
Ensuring the quality of the contractor during tendering would help to assure the good quality of work.	0	0	12	56	32
Setting the performance measures of the completed works would help the contractors to do quality works.	0	0	12	68	20

Based on Table 5.13 above, most of the participants (48%) strongly disagreed with the statement that setting detailed and prescriptive work methods have not always yielded quality output. Only a small group of participants (20%) agreed with this statement while for another group of respondents (32%) neither agreed nor disagreed that setting detailed and prescriptive work methods have not always yielded quality output. This section also includes a statement to investigate whether ensuring quality by contractors during tendering would help to assure good quality of work. The majority of the respondents (56%) agreed and 32% strongly agree that ensuring quality of the contractor during tendering would help to assure good quality of work. The rest 12% of the respondents neither agreed nor disagreed. Further, 68% agreed and 20% strongly agree that setting the performance measures of the completed works would help the contractors to do quality works. The rest 12% expressed their opinion as a middle between agree and disagree.

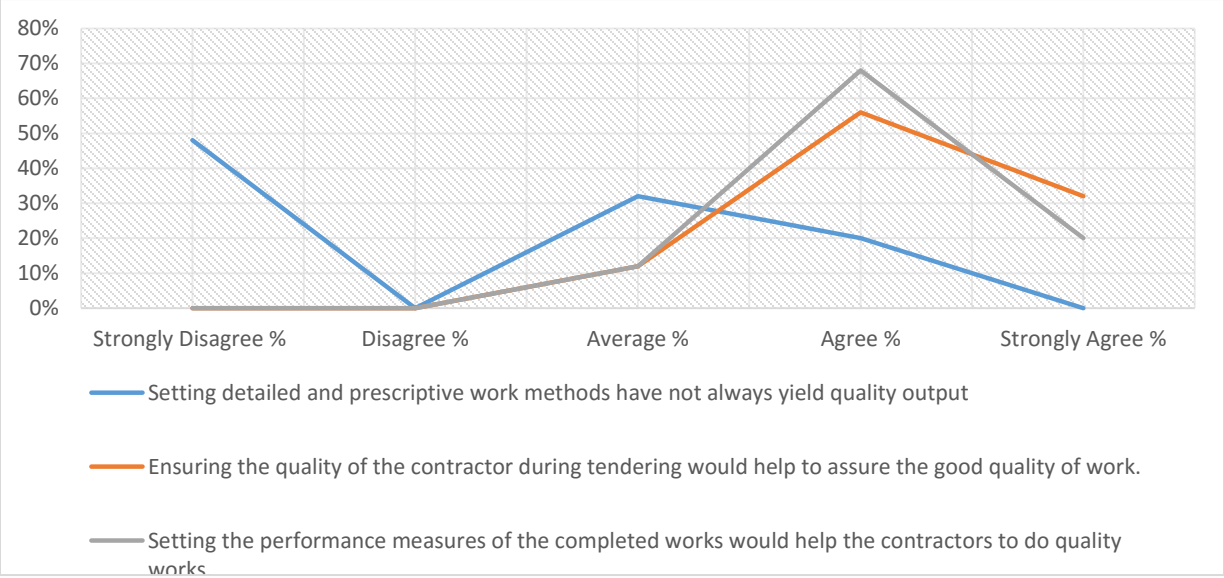

Fig. 5. 15 Survey Result Percentage of Responses for Quality in PBC

Therefore, PBC is the solution for avoiding quality issues on ERA road projects. It can offer ERA and contractors more confidence as shifting towards PBC which requires a massive change in the work culture. It provides a chance for experienced contractors to enjoying the flexibility of choosing work methods at an advanced stage. Setting an acceptable and clearly defined performance measures for works to be executed is necessary to achieve the minimum standard level of service throughout the life cycle of the road.

5.4.3 Efficiency

Efficiency is the ability to avoid wasting of materials, energy, money and time in doing something or producing something. Based on this definition, respondents measure the efficiency of PBC on the current

ERA projects. Table 5.14 below shows the responses of the participants regarding Efficiency on PBC Projects.

Table 5. 14 Summary of Response on Efficiency in PBC

Statement	Strongly Disagree %	Disagree %	Average %	Agree %	Strongly Agree %
The current level of efficiency regarding construction and maintenance by ERA needs improvement.	0	0	20	48	32

Based on Table 5.14, the majority of the respondents (80%) agreed that the current level of efficiency regarding project maintenance of ERA needs improvement. 20% of the participants neither agreed nor disagreed with the statement that the current level of efficiency regarding project maintenance of ERA needs improvement. Therefore, regular training enhances the skill and efficiency.

5.4.4 Innovation and Technology

PBC encourages the development of new technologies and support innovations through different mechanisms. For example, using innovative technology minimizes delay of road works which reduces the impact of delays on the public. Under this section the respondent's opinion is taken in order to know whether traditional methods of contract lack or restrict contractors from introducing new technology and whether PBC would enable the contractor to introduce efficient technology in ERA. Table 5.15 below shows the summary of responses by the respondents regarding innovation ant technology on PBC projects.

Table 5. 15 Summary of Response on Innovation and Technology in PBC

Statement	Strongly Disagree %	Disagree %	Average %	Agree %	Strongly Agree %
The current contracting process lacks or restricts contractor from introducing new technology.	0	20	20	48	12
The long term nature of PBC enables the contractors to introduce efficient technology	0	0	20	48	32

Based on Table 5.15, the majority of the respondents (60%) agreed that the current contracting process lacks or restricts contractor from introducing new technology. Only a small group of respondents (20%) disagreed with the statement that the current contracting process lacks or restricts contractor from introducing new technology. The rest 20% respondents neither agreed nor disagreed. On the other hand, 80% of the respondents agreed that the long term nature of PBC enables the contractors to introduce

efficient technology. There is no respondent disagreed on the issues but 20% respondents replied as it is average.

In traditional methods of contracting, road maintenance projects are awarded to the contractors to complete the work within a short period of time but not expected to improve the service quality of the road. The contractor is interested only to deliver at a certain level just to receive the payment. Under PBC arrangements, projects are awarded for two to ten years. Hence, the contractors could focus on cost saving and profit maximization with quality of works. Therefore, it encourages the contractor to improve the quality of work by introducing innovative technologies. Figure 5.16 below illustrates the survey results in percentages of the responses on Innovation and Technology regarding PBC.

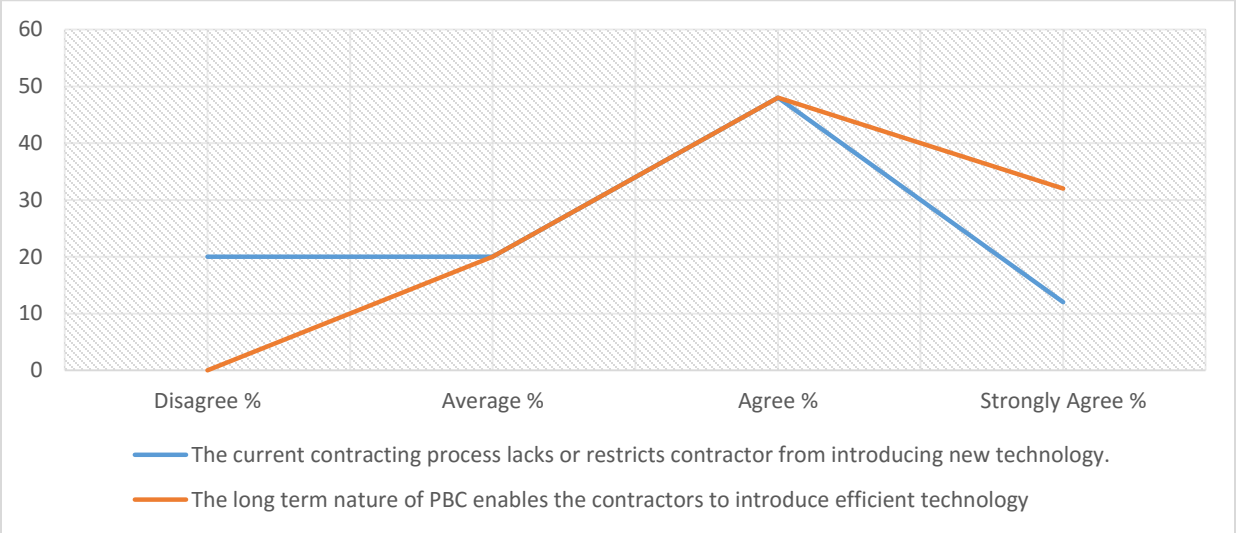

Fig. 5. 16 Survey Result Percentage of Responses for Innovation and Technology in PBC

5.4.5 Expertise

The contractors get more working flexibility in PBC. Therefore, they seek for more experienced and skilled employee who fit the flexible nature of PBC by organizing and managing the wok in order to achieve the required level of service by maximizing the profit of the contractors. This part seeks the opinions of the participants in this regard and the result is described in the following table. The opinions of the participants in this regard and the results are presented in Table 5.16 below.

Table 5. 16 Summary of Response on Expertise in PBC

Statement	Strongly Disagree %	Disagree %	Average %	Agree %	Strongly Agree %
The contractors will get better expert personnel in PBC than current contracting process.	0	0	12	56	32

Based on the fact in Table 5.16, the majority of the respondents (88%) agreed that the contractors would get better qualified personnel in the case of PBC than with the current contracting process and only a small group of respondents (12%) neither agreed nor disagreed with the statement that the contractors would get better expert personnel in PBC than with the current contracting process. Hence, training and academic institutions will increase under PBC than the current contracting practice.

5.4.6 Transparency

Under this section, the focuses of the survey was to observe the level corruption or mismanagement in the contracting processes within ERA. Accordingly, Table 5.17 below shows the results of the survey.

Table 5. 17 Summary of Response on Transparency in PBC

Statement	Strongly Disagree %	Disagree %	Average %	Agree %	Strongly Agree %
PBC can lower the level of possible corruption/mismanagement in the contracting process.	0	8	8	56	28
As PBC is a long term contract, the chance of continuous forced manipulation will be reduced.	0	0	20	68	12

Based on Table 5.17 above, more than half of the respondents (56%) agreed with the statement that PBMC can lower the level of possible corruption or mismanagement in the contracting process; 28% strongly agreed; 8% considered average and the rest 8% the respondents disagreed. 80% of the respondents agreed and the other participants (20%) neither agreed nor disagreed that the chance of continuous forced manipulation will be reduced in long term PBC.

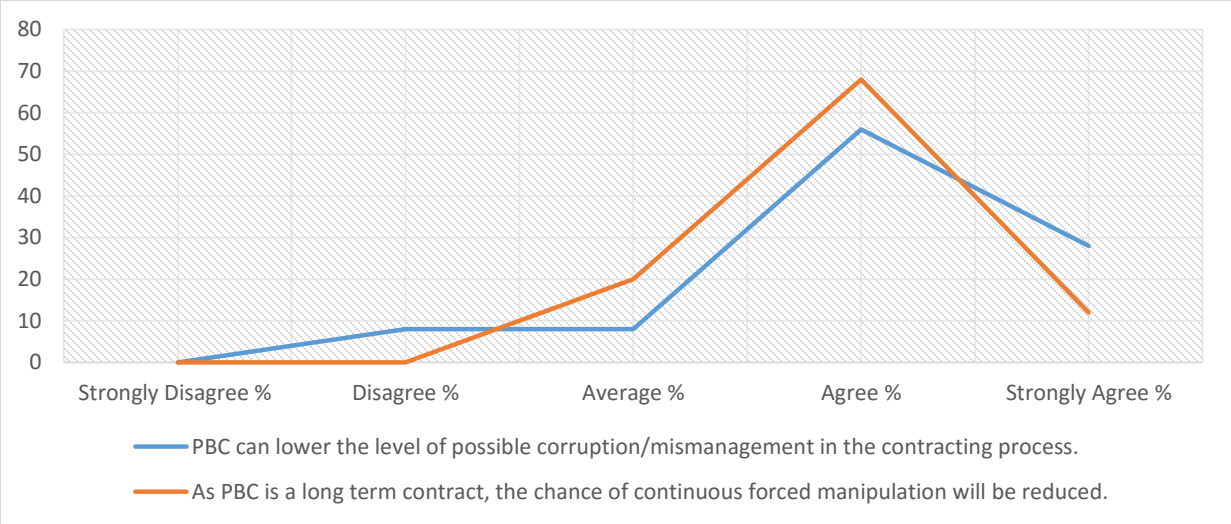

Fig. 5. 17 Survey Result Percentage of Responses for Transparency in PBC

PBC can reduce the forced manipulation, mismanagement and corruption in ERA. Therefore, PBC should be implemented widely in ERA projects to overcome the main hindrances like corruption and mismanagement, since they are repeatedly observed in traditional contract method.

5.4.7 Customer Satisfaction

After improvement of the quality of service under PBC, the road network system is expected to be managed better than the traditional methods of contract. Hence, this section seeks opinions to investigate whether the road authority personnel believe that PBMC would improve the satisfaction of customer or road users. Table 5.18 below shows the summary of responses on customer satisfaction in PBC

Table 5. 18 Summary of Response on Customer Satisfaction in PBC

Statement	Strongly Disagree %	Disagree %	Average %	Agree %	Strongly Agree %
PBC will improve the service quality during the extended period.	0	0	28	56	16
The nature of PBC mainly focuses on customer or user satisfaction.	0	0	24	44	32

Based on Table 5.18 above, most of the respondents (72%) agreed that PBC would improve the service quality during the extended period while 28% neither agreed nor disagreed. Further, the majority of the respondents (76%) agreed that the nature of PBMC mainly focuses on customer or user satisfaction while 24% neither agreed nor disagreed. Figure 5.19 below illustrates the survey results in percentages of the responses on Customer Satisfaction in PBC.

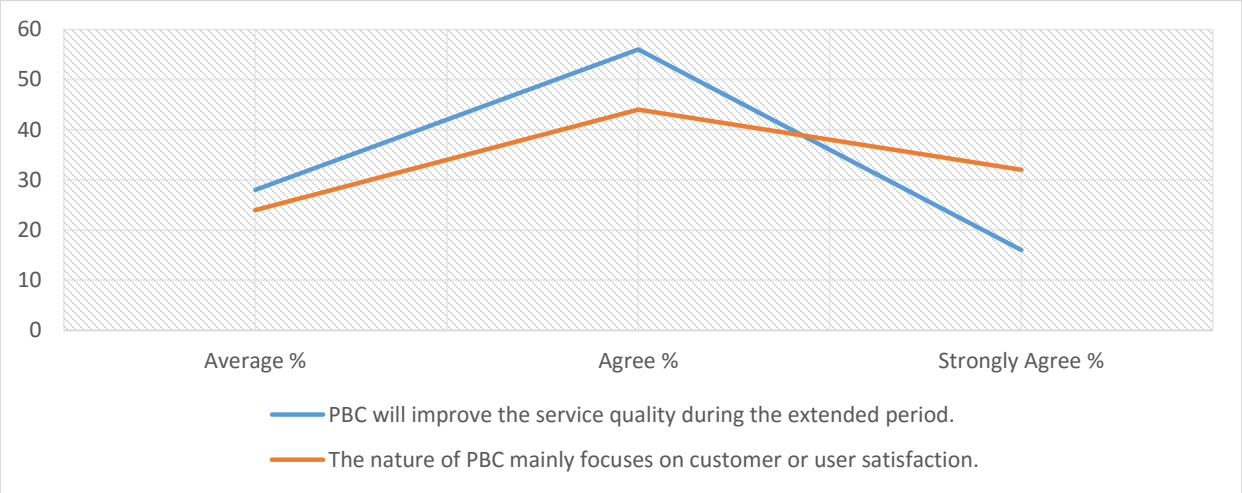

Fig. 5. 18 Survey Result Percentage of Responses for Customer Satisfaction in PBC

Therefore, successful implementation of PBC can improve service quality and customer satisfaction during the extended period. It can be concluded from the above analysis that PBC helps to reduce the road users' cost of vehicle maintenance as the condition of roads would be improved.

5.4.8 Funding

Most of international financial institutions show an interest to fund PBC projects in Ethiopia more than the traditional one. At worldwide stage also, after the inauguration of the PBC, the amount of fund released for PBC projects from the international financers increased every year. This section of the survey keenly observes the opinions on the security of long term funding when implementing PBC for road maintenance. In this regard, 20% of the respondents strongly agreed; 44% agreed, 24% considered average and 12% strongly disagreed.

Table 5. 19 Summary of Responses on Funding in PBC

Statement	Strongly Disagree %	Disagree %	Average %	Agree %	Strongly Agree %
PBC ensures long term road maintenance funding which is difficult in the current contracting process.	0	12	24	44	20

A majority of the respondents (64%) agreed that PBMC would ensure long term road maintenance funding which is difficult in the current contracting process. Minority of the respondents (12%) disagreed that PBC would ensure long term road maintenance funding which is difficult in the current contracting process. The rest 24% neither agreed nor disagreed.

Therefore, even if it is difficult for ERA to secure the total required fund for all PBC projects due to the limited capacity of the country, but international financers are willing to fund for PBC projects assuring long term funding.

5.4.9 Project Delivery Time

In PBC contract, the risk to contractors is greater when compared with the client. In addition to this, payment is guaranteed when the target service level is achieved; if it is not achieved, there is no payment. Due to this, the contractor will not be negligent to contractual delivery time. This section investigates whether the participants believe PBC would deliver the project faster than traditional methods of contracts. Table 5.19 below shows summery of responses on project delivery in PBC

Table 5. 20 Summery of Responses on Project Delivery in PBC

Statement	Strongly Disagree %	Disagree %	Average %	Agree %	Strongly Agree %
PBC will deliver the projects in time or earlier than expected compared to the current method.	0	12	64	12	12
Under a PBC, private sector workers (contractor's staff) would be more motivated than the traditional contracts.	0	0	32	56	12

As presented in Table 5.19 above, the majority of the respondents (64%) neither agreed nor disagreed that PBC will deliver the projects in time or earlier than expected compared to the current method. The reason of this response is that most of the ERA's PBC projects are at the early stages and so the respondents didn't have enough experience about delivery time of PBC projects. Further, 12% of the respondents disagreed; while the remaining 24% agreed. This means that 68% of the respondents agreed that under a PBC project, the private sector workers would be more motivated than the traditional contracts. The remaining 32% neither agreed nor disagreed. Figure 5.20 below illustrates the survey Results in Percentages of the Responses in Project Delivery under PBC.

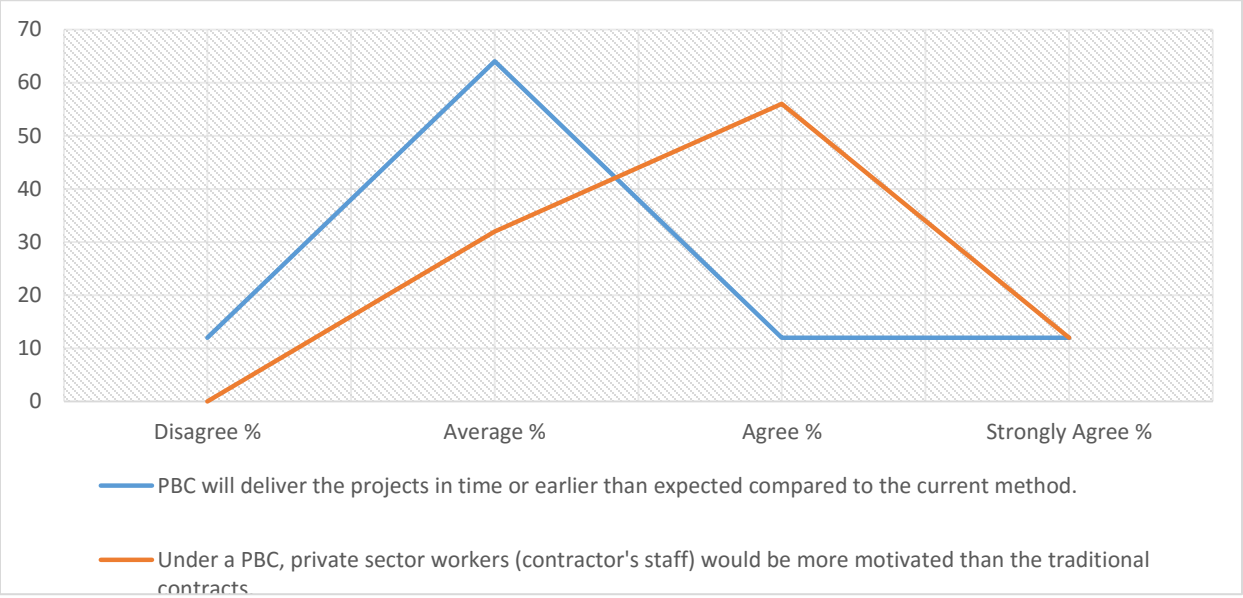

Fig. 5. 19 Survey Result Percentage of Responses for Project Delivery in PBC

Therefore, it can be concluded that use of innovative technology and motivation of the private contractors and their staff will facilitate the fast delivery of work under PBMC

5.4.10 Cost Saving

In this section, two statements were included to investigate if PBC helps in achieving cost savings regarding road maintenance projects. The results of the survey are presented in Table 5.20 below.

Table 5. 21 Summary of Responses on Cost Saving in PBC

Statement	Strongly Disagree %	Disagree %	Average %	Agree %	Strongly Agree %
Supervision and overhead costs would be reduced in a PBC compared to current practice.	0	12	12	64	12
PBC will reduce maintenance costs during the contract duration.	0	12	20	56	12

As presented in Table 5.20 above, the majority of participants (76%) agreed that supervision and overhead costs would be reduced under PBC compared to the current practice. 12% participants considered that the possibility of reduction of supervision and overhead costs in PBC compared to the current practice is average. Another group of respondents (12%) disagreed that supervision and overhead costs would be reduced in PBC compared to the current practice. 68% of the respondents agreed that PBC will reduce

maintenance costs during the contract duration. While another group of participants (20%) said it is average which means they neither agreed nor disagreed or not sure whether PBC will reduce maintenance costs during the contract duration. The rest 12% participants are disagreed. Figure 5.21 below illustrates the survey results in percentages of responses regarding cost saving under PBC.

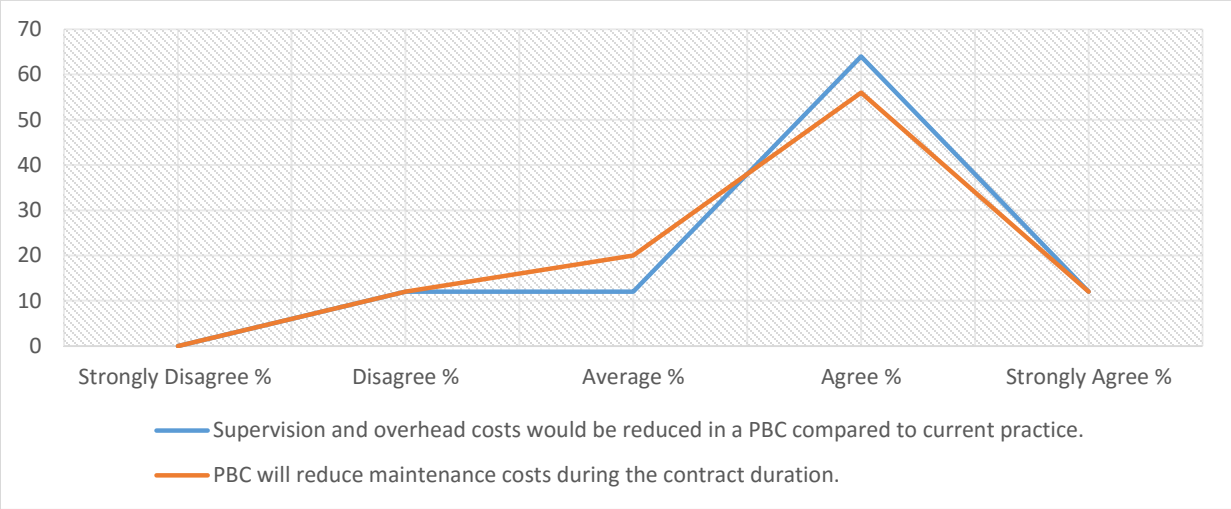

Fig. 5. 20 Survey Result Percentage of Responses for Cost Saving in PBC

Therefore, a majority of the respondents were confident about the cost savings of PBC for ERA projects while the rest of the people either not sure or not confident enough to agree with the above mentioned statements.

5.4.11 PBC as an Alternative

Currently it is difficult for ERA to fully replace the traditional method contract by PBC. Therefore, it is better to use PBC as an alternative. Under this section, opinion of the respondents studied whether they prefer PBC as alternative or not.

Table 5. 22 Summary of Response on PBC as an Alternative

Statement	Strongly Disagree %	Disagree %	Average %	Agree %	Strongly Agree %
PBC is a better alternative that should be adopted in Ethiopia together with the current method.	0	12	32	44	24

Most of the respondents (44% agreed and 24% strongly agreed) agreed that PBC is a better alternative that should be adopted in Ethiopia together with the current method. Another 32% respondents are neither

agreed nor disagreed and the rest 12% respondents are disagreed. It can be concluded that PBC could be an alternative solution to improve the road maintenance of developing countries.

Based on this survey results, it is possible to implement PBC widely in ERA projects as an alternative method of contracting in addition to the traditional method. In PBC, use of performance measures has been counted as a solution to encourage innovation of the contractors in selecting the materials and methods. PBC can also motivate contractors to share risk and responsibility and ensure quality of their performance within a shorter period of time for lesser overall costs.

5.4.12 Technical Feasibility

The main objectives of this research is to examine the potential of PBC on ERA projects. In this section of the survey, the intention was to investigate the technical capability of ERA to adopt PBC.

Table 5. 23 Summary of Response on Technical Feasibility of PBC

Statement	Strongly Disagree %	Disagree %	Average %	Agree %	Strongly Agree %
ERA has good contracting management experience and can easily adopt the PBC concept widely.	0	0	44	56	0
ERA has good knowledge and data of road networks, maintenance needs and costs which can be used to implement PBC.	0	16	32	44	8

As shown in Table 5.23 above, most of the respondents (56%) agreed that ERA has good contracting management experience and can easily adopt the PBC concept and the rest 44% respondents neither agreed nor disagreed. In addition, 52% of the respondents also agreed that ERA has good knowledge and data of road networks, maintenance needs and costs which can be used to implement PBC. 16% respondents disagreed and 32% respondents neither agreed nor disagreed. Therefore, by using its accumulated experience, ERA can implement PBC widely in its future projects. Figure 5.22 illustrates the survey results in percentages of the responses of participants regarding the technical feasibility of implementing PBC at the ERA.

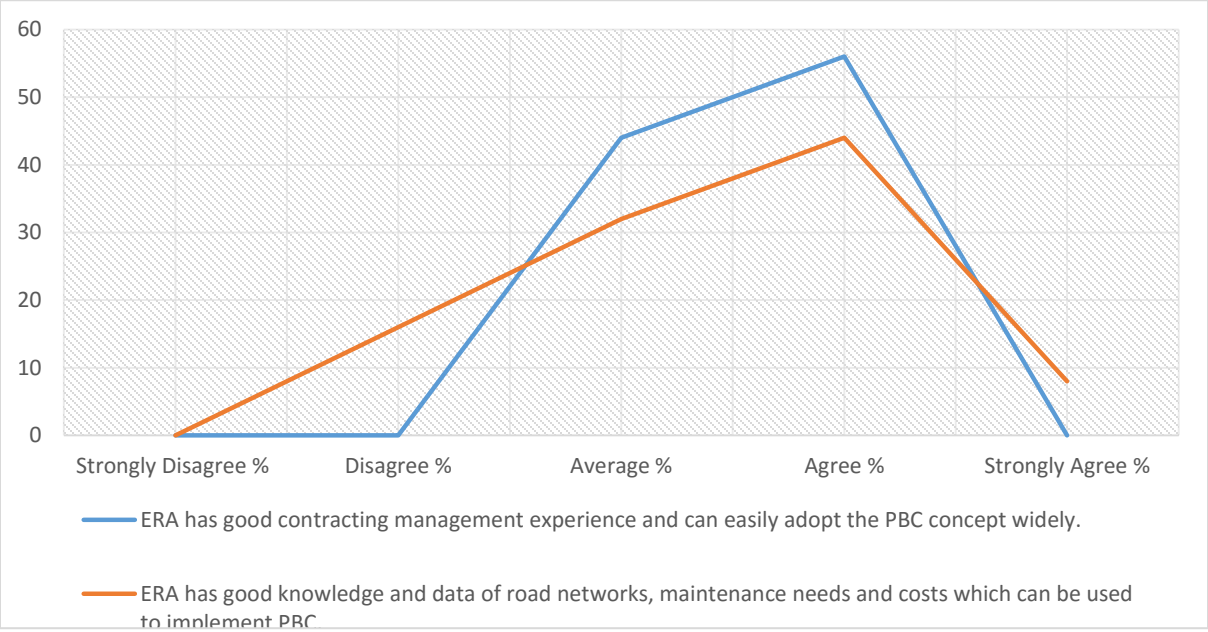

Fig. 5. 21 Survey Result Percentage of Responses for Technical Feasibility in PBC

5.4.13 Barriers

ERA should overcome some barriers or obstacles to success PBC. This part sought opinions on the barriers of PBC and the results are presented in Table 5.24 below.

Table 5. 24 Summary of Responses on Barriers for PBC Implementation

Statement	Strongly Disagree %	Disagree %	Average %	Agree %	Strongly Agree %
Staff attitude on the new work culture would offer resistance to the new concept.	0	20	24	56	0
Skills and staff training will be an area of concern that may cause delay in the success of PBC	0	12	24	64	0
Contractors' capacity and commitment would be a problematic issue of concern in PBC.	0	0	20	56	24
Construction industry in Ethiopia is still underdeveloped to widely implement performance contracts.	0	64	36	0	0
Lack of government's budgetary allocation for the long term commitment could be a problem.	0	0	12	56	32

As shown in the above Table 5.24, most of the participants (56%) agreed that staff attitude on the new work culture would offer resistance to the new concept. 20% respondents disagreed and the rest 24% neither

agreed nor disagreed. A majority of the respondents (64%) agreed that skills and staff training will be an area of concern that may cause delay for the success of PBC. While only few people (12%) disagreed with the statement that skills and staff training would be an area of concern that may cause delay the success of PBC. 24% neither agreed nor disagreed.

Furthermore, the majority of the respondents (80%) agreed that contractors' capacity and commitment would be problematic in PBC implementation. On the other hand, another group of respondents (20%) neither agreed nor disagreed with the statement that contractors' capacity and commitment would be a problematic issue of concern in PBC. In addition, the majority of the participants (64%) disagreed that the construction industry in Ethiopia is still underdeveloped to implement PBC. On the other hand, 36% respondents neither agreed nor disagreed that the construction industry in Ethiopia is still underdeveloped to implement PBC. Lastly, almost all the participants (88%) agreed that lack of government's budgetary allocation for the long term commitment could be a problem during the introduction of PBC while the remaining 12% of the respondents neither agreed nor disagreed.

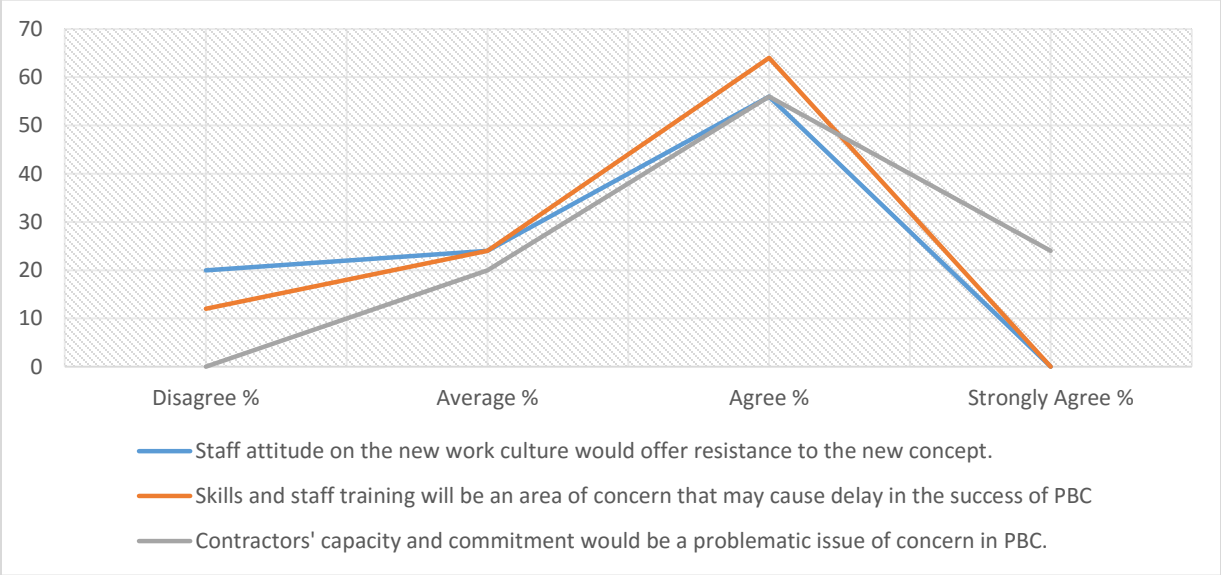

Fig. 5. 22 Survey Result Percentage of Responses on Barriers for PBC Implementation

Therefore, it can be concluded from the above mentioned analysis that the barriers for the success of PBC in ERA are: staff attitude on the new work culture, lack of skills and experience on PBC, training of staff (both ERA and contractors' organization), contractors' capacity and commitment, lack of government's budgetary allocation for the long term PBC, political influence, mismanagement and corruption.

5.5 Summary on Findings of the Survey

Most of the participants of the survey agreed that the traditional contract method that was practiced in ERA for a long period of time was prone for cost and time overrun of projects. Conversely, the majority of the respondents believed that the PBC method can be a solution by saving the financial dissipation caused by cost overrun of projects and to complete projects in accordance to their contractual time. The respondents believed that rather than the direct cost of construction, administrative and supervision costs were prone to overruns in the traditional method than PBC projects.

In terms of quality, the understanding of the majority of respondents is that ERA's projects currently executing under PBC method have more quality than those projects performed by traditional method of contract. In addition to this, the respondents believed that customer satisfaction is more guaranteed by PBC when compared with customer satisfaction in the traditional method. Further, according to the participants of the Survey, PBC is the best method of contracting to enhance work efficiency compared to the traditional method, believing that efficiency comes through contractors' strive that emanates from the nature of the PBC method.

The majority of the respondents generalized that PBC method encouraged the contractor to implement new technologies and innovations in the process of achieving the required service level. Since PBC shifts much of the risk of the project to the contractor forcing to implement new technology and innovation. However, it was negatively responded by the majority of the respondents when it comes to the traditional method. Mismanagement and corruption practices in ERA are strongly associated to the traditional method as responded by the survey participants. Accordingly, they recommend PBC method as a solution to overcome the mismanagement and corruption practices under the traditional method. They also believed that PBC is more transparent method compared to the traditional contract method.

Almost all of the participants of the survey agreed that the traditional method has highly suffered from limited financial capacity of ERA since most of the projects are financed by Ethiopian government. Due to this, most of contractors' payment claims are settled late. To overcome this problems, the majority of the respondents believed that PBC is a solution since the total budget of the project is guaranteed initially. Additionally, the respondents understand that international financers are interested to finance PBC projects than the traditional ones even if it is dependent on the government's financial capacity to pay the loan. The respondents also indicate some hindrance to the success of PBC implementation in ERA, some of them are staff attitude, lack of skills and experience on PBC, contractors' capacity and commitment, etc. Based on the respondents' belief, the current capacity of the domestic private road construction industry and that of ERA is dependable to implement PBC.

5.6 Potential of PBC in ERA

ERA has good potential for the implementation of PBC. Based on the survey results, the construction industry of Ethiopia is capable to host PBC. ERA has many experienced engineers and staff trained for successful implementation of PBC. The ERA have been performing contract management works for more than five decades. Throughout this time, positive and negative challenges were faced and different experiences have been acquired. This available capacity has been tested on those implemented pilot projects. Therefore, the contracting management experience of ERA is capable to widely implement PBC. Generally, the main understanding that was acquired from the survey indicate that PBC has a potential to improve the road construction and maintenance practice of ERA which is characterized by cost and time overruns, poor quality, corruption, etc.

However ERA should give a concern to improve corruption, staff skill problems, contractors' capacity, etc., since the successful implementation of PBC is dependent in tackling those challenges. Funding problem also should be given a great concern. Dependency on the donors or international funding can only be a temporary solution. Rather, it is better to focus on collecting long term funding from the road users and the tax payers. It is better to focus on the source of the local finance since the national debt of the country will not allow anymore to depend on international finance, at list for a certain time. Therefore, finance cannot limit wider PBC implementation in ERA.

The skill gap can also be filled by providing necessary trainings and workshops for the staffs of ERA as well as the contractors. By doing this, it is possible to increase the fertile ground for wider implementation of PBC in Ethiopia. This research suggests that PBC can be a better alternative in Ethiopia which should be adopted together with the traditional method of contracting.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The objective of this research was to examine the potential of PBC to improve the construction and maintenance activities of ERA road projects; to analyze the benefits and drawbacks of PBC and to study the challenges faced during PBC implementation in ERA. In this regard, a case study was conducted to examine the traditional contract method in ERA. The main contribution of this thesis are regarded as (i) defining PBC and presenting its advantages and disadvantages during the implementation of ERA projects; (ii) examining the potential of PBC in ERA and (iii) analyzing the challenges of implementing PBC in ERA. With this understanding, the following conclusions and recommendations are presented in line to meet the main objective.

6.2 Conclusions

Based on the outcomes of the case study, the current traditional contracting method practiced in ERA is suffering from escalation of costs and time, poor quality of work, inadequate motivation, absence of proper risk sharing, high overhead and supervision costs, high level of political influence and corruption and lack of proper training of the staffs.

After identifying the main problems of the traditional method of contract, this study revealed PBC as an alternative method of contracting for ERA road construction and maintenance practice. The main benefits of introducing and implementing PBC are: cost savings, reduction of administrative cost and increase in proficiency, introduction of innovation, reduction of delays to road users, road users satisfaction, risk sharing by contractors, assurance of quality, availability of initial funding sources, sustainable road management system and assurance of long-term funding, increase in flexibility and increase in transparency and reducing the chance of corruption.

Even though PBC has all of the above benefits, it still has some problems and disadvantages faced by ERA during its implementation. These are: high cost of tendering, limited competition, difficult to solve contractual disputes, loss of control, discourage local contractors and researches. When ERA implemented PBC at the pilot project level for the first time, some challenges were faced and they were: legislative problems, absence of knowhow about PBC, limitation on availability of inventory and condition data collection vehicles, resistance to cultural change, contractors' capacity limitation, funding problems, political influence and corruption.

ERA has a potential to implement PBC. This research suggests that PBC can be a better alternative that should be adopted together with the current method. ERA has good contract management experience which accumulated for more than five (5) decades. In addition to this, further experience has been acquired during implementation of the PBC pilot projects. Therefore, ERA can easily adopt and widely implement the PBC method. The surveys also implied that contracting management experience of ERA would not create obstacles to widely implement PBC.

However, ERA should give a concern to improve the challenges faced during the implementation of PBC at pilot project level. The success of PBC is dependent on effectively tackling those challenges; so, ERA should be committed to work on those challenges to reduce the adverse effect. In addition, availability of fund is the main bottle neck for ERA to widely implement PBC. Dependency on development partners can only be a temporary solution. Rather, it is better to focus on collecting long term funding from the road users and the tax payers. It is better to focus on the source of the local finance since the national debt of the country will not allow anymore to depend on international finance, at list for a certain time. Therefore, finance cannot be a hindrance to widely implement PBC in ERA if local source is a focus.

6.3 Recommendations

Based on the findings of the research, the following recommendations were forwarded to successfully and widely implement PBC in ERA.

a. It is better to use a hybrid contract system (PBC and Traditional Method) as practiced on Adama – Awashe and Fiche – Goha tsion projects before widely implement PBC, in order to smoothly transit the change from the traditional method to PBC and to avoid cultural change resistance. Through this practice, the local contractors get a chance to strength their capacity in terms of finance and experience;

b. ERA and the government should take the responsibility to financially capacitate the local contractors to compute with the foreign contractors for those internationally financed PBC projects. This capacity building process benefits the government by saving the foreign currency which is to be paid for foreign contractors. In addition, the government should give an attention to support the local contractors by improving insurance laws and legislations;

c. Workshops and training programs can improve the skill and knowledge gaps of ERA in house staffs, contractors and other stakeholders. Therefore, ERA should give due concern to build the capacity of the staffs and other stakeholders by providing the appropriate trainings and workshops;

d. Securing finance for the entire contract period is critical to success. Before starting any PBC project, ERA should secure the total fund required for the project throughout the contract period; and

e. ERA should evaluate the pilot PBC project contract documents those lead to disputes in order to rectify the ambiguities noted for future procurement of similar projects.

6.4 Further Research Needs

PBC is a new concept globally as well as in Ethiopia. Therefore, in order to benefit more from this method of contracting, more researches should be encouraged. In this regard, the following research areas are proposed:

i. Comparison of cost savings between traditional methods of contracts and PBC method by developing model/s.
ii. Development of performance indicators those are appropriate for Ethiopia/ ERA in effectively managing PBC/Traditional Contract projects.
iii. Study on the idea of capacitating the local contractors in order to handle PBC projects.

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Appendix 1 (Questionnaire Form)

Addis Ababa University

Institute of Technology - School of Civil & Environmental Engineering

Questionnaire Survey

Name of The Project: Examine the Potential of Performance Based Contracting For Road Infrastructure in Ethiopia - Case Study from ERA Projects.

Information for Respondents

Purpose of the Survey: The goal of the survey is to assess the outcome of several road maintenance projects finished under traditional methods of contracting in ERA. Your response will help to evaluate this outcome against its objectives.

Participation: Your participation in this research is voluntary and will involve the completion of a Questionnaire survey.

Confidentiality: The Information will be used for academic purposes only. Your answers will be kept completely confidential. The results will be collected and presented as summaries only, The compiled results of this research may be published in scientific research journals or presented at professionals' conferences. However, the individual respondent, their name or positions will not be identified. The return of this completed survey will be granted as your consent to participate in the survey.

Questionnaire Structure: The Questionnaire contains pages consisting of three main parts. Part 1 solicits background information, Part 2 requests information regarding the current contracting process on past and present road projects.

Ethical Statement: Addis Ababa University conducts research in accordance with the University code of conduct. This study was approved by the Addis Ababa University research Committee. If potential participants have any concerns or complaints about the ethical conduct of the research project, they should contact the School. If you require any further information or have any questions regarding the research, please contact a researcher of the project:

Mr. Michael Amde, M.Sc. Candidate, Phone: +25191223575/, Email: michaelamde@gmail.com

Questionnaire Survey Part 1: Personal Details

1.1 What is the name of the organization?

1. Ethiopian Roads Authority (ERA) ☐
2. Others (Please Specify) .....

1.2 What is your current position? (Please tick or mention your position)

1. Top Level Management (Chief, Additional Chief or Superintending Engineer/Senior Project manager) ☐
2. Mid-Level Management (Executive or Sub-Divisional Engineer /Project Manager) ☐
3. Bottom Level Management (Assistant Engineer/Sub Assistant Engineer/Graduate Engineer) ☐
4. Others (Please Specify) .....

1.3 What is your highest level of education?

1. Master's Degree ☐
2. B.Sc. Degree ☐
3. Diploma/Technical Certificate ☐
4. Other .....

1.4 How many years have you been in the road sector?

1. 0 – 5 years ☐
2. 5 – 10 years ☐
3. 10 – 15 years ☐
4. 15 – 20 years ☐
5. 20 – 25 years ☐
6. 25 or more years ☐

1.5 What is the type of the contract that you are working? (tick as many necessary)

1. Lump sum ☐
2. Bill of Quantities (BOQ) ☐
3. Design Bid Build (DBB) ☐
4. Built Own Operate Transfer(BOOT) ☐
5. Others (Please Specify) .....

Questionnaire Survey Part 2: Traditional Contracting Process

Note: This part consists of 1 section only and has up to 30 Questions (2.1 to 2.30).When rating a statement or question, please use the rating scale as provided in each section.

In the next questions (2.1-2.10) please indicate your answers by a tick (or rank) as applicable.

Budget/Cost and Schedule

2.1 Are cost of the projects remained within budget?

1. All of them within budget ☐
2. All of them exceeds budget ☐
3. Some of them within budget and some exceeds budget ☐

2.2 Please rank the reasons for the variation in cost from the most significant to the least significant one.

1. Extra works were required by the contractors ☐
2. Additional works instructed by the owner/Client ☐
3. Interest on late payment ☐
4. Other Reasons (Please indicate) .....

2.3 Were the projects completed by achieving the target?

1. Completed by achieving the target ☐
2. Almost within the target ☐
3. Totally failed to meet the target ☐
4. Other Reasons (Please indicate) .....

2.4 Were the projects completed on time as per the original schedule?

1. Completed ahead of schedule ☐
2. Completed as per the schedule ☐
3. Were not completed as per the schedule ☐
4. Difficult to tell ☐

2.5 Rank the following factors (as 1, 2, 3... Up to 13) that contribute most to projects' failure to complete in scheduled time (If you want to add any comments please provide in 2.6.13).

1. Lack of efficient/competent Contractor
2. Poor top management support (Government/ERA)
3. Slow administrative process by Client (Government/ERA)
4. Poor supervision by client (Government/ERA)
5. Lack of expert technical personnel by client (Government/ERA)
6. Extreme site condition like rain, flood etc.
7. Extra work requirements of contractors
8. Contract disputes or issues between the parties
9. Delay in payment of contractor
10. Shortage of Material, Manpower

11. Uneven increase/fluctuation of material price
12. Modification of plan or design related issues
13. Other Issues (Please Specify) .....

Project Funding

2.7 Is fund a major issue that delays the progress of the project?

1. Yes it is ☐
2. Is an issue at the early stages of the project ☐
3. Is an issue at the later stages of the project ☐
4. No, it's not ☐

2.8 Are contractors always paid within the required time?

1. Claims are always paid within the required time ☐
2. Most Claims are paid within the required time ☐
3. Few Claims are paid within the required time ☐
4. All claims were paid late ☐

2.9 Rank common factors according to its significance that contributes towards the delay of contractors' payment.

1. Funding unavailability or delays ☐
2. Processing of payment is slow or takes time ☐
3. Contractors' claims have errors and need clarification ☐
4. Client's site officers slow in claim clarification ☐
5. Delays in contract payments are quite common ☐
6. Intentional or deliberate delay by government workers ☐
7. IT or computer system failure ☐

2.10 Indicate your opinion on the sufficiency of funding for road maintenance project provided by the government.

1. Available fundings are more than the total funds requested for work ☐
2. All funding requested for work are provided ☐
3. Half of the funds requested for work are provided ☐
4. Very little funding are provided ☐
5. Hardly any funding are provided ☐

For the next questions 2.11 to 2.15, please indicate your opinion where necessary by circling the number on the rating scale, some questions may require ticks.

Quality of work

	Rating Scale ➨	*Highly Sufficient*	*Sufficient*	*Average*	*Insufficient*	*Highly Insufficient*	*Don't know*
2.11	The level of quality achieved on the projects are considered	1	2	3	4	5	0
2.12	Material quality control on the projects are	1	2	3	4	5	0
2.13	The level of supervision provided by the client to cover contractors site activities is	1	2	3	4	5	0
2.14	The existing quality control policies that addresses all quality control issues are	1	2	3	4	5	0
2.15	The amount of Resource allocated for implementing quality objectives are	1	2	3	4	5	0

2.16 Please indicate the time when the first pothole is likely to appear after the defects liability period. (The defects liability period is part of the construction contract, during this time the contractor is required to repair defects (mainly routine maintenance) that occur within the project).

1. After 6-12 months ☐
2. After 1-2 years ☐
3. After 5 years ☐
4. Depends on the level of traffic ☐
5. After a long time ☐

2.17 Indicate how soon road maintenance works will commence after the defects liability period.

1. After 3-6 months ☐
2. After 6-9 months ☐
3. After a year ☐
4. As soon as defects start arising ☐
5. Whenever funding is received ☐
6. Never at all ☐

Skills of Staff

	Rating Scale➨	*Highly Sufficient*	*Sufficient*	*Average*	*Insufficient*	*Highly Insufficient*	*Don't know*
2.18	The level of skill and experience of the supervisory staff are	1	2	3	4	5	0
2.19	The supervisory staffs' efficiency in achieving project goal are	1	2	3	4	5	0
2.20	The level of training (pre & on the job) for staffs are	1	2	3	4	5	0

Administrative and Supervision Costs

2.21 For how many projects are an officer/employee engaged at a time on an average (approximate)?

1. Less than 5 ☐
2. Between 5 and 10 ☐
3. Between 10 and 15 ☐
4. More than 15 ☐

	Rating Scale➨	*Strongly Disagree*	*Disagree*	*Average*	*Agree*	*Strongly Agree*	*Don't know*
2.22	The requirements of clients for project supervision costs a lot of money	1	2	3	4	5	0

Mismanagement/Political Influence

There are some mismanagement/political influence/Corruption -----

	Rating Scale➨	*Strongly Disagree*	*Disagree*	*Average*	*Agree*	*Strongly Agree*	*Don't know*
2.23	in selecting the project (in a priority basis) ---	1	2	3	4	5	0
2.24	during tender stage of the projects ---	1	2	3	4	5	0
2.25	during selection of the contractor---	1	2	3	4	5	0
2.26	during construction phase-	1	2	3	4	5	0

Risk sharing

	Rating Scale ➨	*Strongly Agree*	*Agree*	*Average*	*Disagree*	*Strongly Disagree*	*Don't know*
2.27	Contractors do not need to take any responsibility for poor quality of works.	1	2	3	4	5	0
2.28	Client has to take all the responsibilities of the project.	1	2	3	4	5	0
2.29	Sometimes contractors' poor workmanship results in quick deterioration of roads.	1	2	3	4	5	0

2.30 What is your opinion about the competitive bidding procedure in traditional civil contracts?

1. Fair bidding procedure based on Quality. ☐
2. Influenced by top level management ☐
3. No need to ensure quality of contractors in doing similar works in the past. ☐
4. Involves political influence and corruption ☐
5. Some fair, some influenced ☐
6. Other Issues (Please Indicate) .....

Questionnaire Survey Part 3: Performance Based Contracting (PBC) Brief Overview

PBC is a new and innovative concept that is output based where payments are based on performance of the contractors. It is the concept of extended contract period (2 to 10 years) and is designed to increase the efficiency and effectiveness of road construction and maintenance operations. Payments are given based on work outputs demonstrated by performance indicators other than measuring the amount of work done. The concept is being embraced by leading international organizations (World Bank, ADB) and is becoming popular in both developed and developing countries. Properly developed and implemented Performance contracts can achieve net savings on road maintenance costs of up to 40% compared to the traditional contracting methods.

Purpose of the Survey: The survey aims to investigate the potential benefits of PBC as well as strategies and policies needed if PBC is implemented for the maintenance and management of government road assets in Ethiopia. Your response will help to evaluate the potential of PBC in Ethiopia.

Please read the following statements and tick an answer which closely represent your opinion.

	Rating Scale ➨	*Strongly Disagree*	*Disagree*	*Average*	*Agree*	*Strongly Agree*	*Don't know*
	Risk Sharing by Contractors						
3.1	Construction project risks should be properly identified and shared between the contractor and the client.	1	2	3	4	5	0
3.2	Risk sharing would bring a sense of discipline and responsibility to the contractor on road contracts.	1	2	3	4	5	0
3.3	Risk sharing would benefit the government to a certain extent.	1	2	3	4	5	0
	Assurance of Quality						
3.4	Setting detailed and prescriptive work methods have not always yield quality output	1	2	3	4	5	0
3.5	Ensuring the quality of the contractor during tendering would help to assure the good quality of work.	1	2	3	4	5	0
3.6	Setting the performance measures of the completed works would help the contractors to do quality works.	1	2	3	4	5	0

Improves efficiency

	Rating Scale ➨	*Strongly Disagree*	*Disagree*	*Average*	*Agree*	*Strongly Agree*	*Don't know*
3.7	The current level of efficiency regarding construction and maintenance by ERA staff needs improvement.	1	2	3	4	5	0

Introduction of innovative Technology

3.8	The current contracting process lacks or restricts contractor from introducing new technology.	1	2	3	4	5	0
3.9	The long term nature of PBC enables the contractors to introduce efficient technology	1	2	3	4	5	0

Get expertise

3.10	The contractors will get better expert personnel in PBC than current contracting process.	1	2	3	4	5	0

Increases Transparency

3.11	PBC can lower the level of possible corruption/mismanagement in the contracting process.	1	2	3	4	5	0
3.12	As PBC is a long term contract, the chance of continuous forced manipulation will be reduced.	1	2	3	4	5	0

	Rating Scale➨	*Strongly Disagree*	*Disagree*	*Average*	*Agree*	*Strongly Agree*	*Don't know*
	Increases Customer Satisfaction						
3.13	PBC will improve the service quality during the extended period.	1	2	3	4	5	0
3.14	The nature of PBC mainly focuses on customer or user satisfaction.	1	2	3	4	5	0
	Secures Long Term Funding						
3.15	PBC ensures long term road maintenance funding which is difficult in the current contracting process.	1	2	3	4	5	0
	Fast Delivery						
3.16	PBC will deliver the projects in time or earlier than expected compared to the current method.	1	2	3	4	5	0
3.17	Under a PBC, private sector workers (contractor's staff) would be more motivated than the traditional contracts.	1	2	3	4	5	0
	Achieves Cost Savings						
3.18	Supervision and overhead costs would be reduced in a PBC compared to current practice.	1	2	3	4	5	0
3.19	PBC will reduce maintenance costs during the contract duration.	1	2	3	4	5	0

	Rating Scale ➨	*Strongly Disagree*	*Disagree*	*Average*	*Agree*	*Strongly Agree*	*Don't know*
	A better alternative						
3.20	PBC is a better alternative that should be adopted in Ethiopia together with the current method.	1	2	3	4	5	0
	Technical Feasibility						
3.21	ERA has good contracting management experience and can easily adopt the PBC concept.	1	2	3	4	5	0
3.22	ERA has good knowledge and data of road networks, maintenance needs and costs which can be used to implement PBC.	1	2	3	4	5	0
	Barriers						
3.23	Staff attitude on the new work culture would offer resistance to the new concept.	1	2	3	4	5	0
3.24	Skills and staff training will be an area of concern that may cause delay in the success of PBC	1	2	3	4	5	0
3.25	Contractors' capacity and commitment would be a problematic issue of concern in PBC.	1	2	3	4	5	0
3.26	Construction industry in Ethiopia is still underdeveloped to widely implement performance contracts.	1	2	3	4	5	0
3.27	Lack of government's budgetary allocation for the long term commitment could be a problem.	1	2	3	4	5	0

End of Survey-Thank You!!!