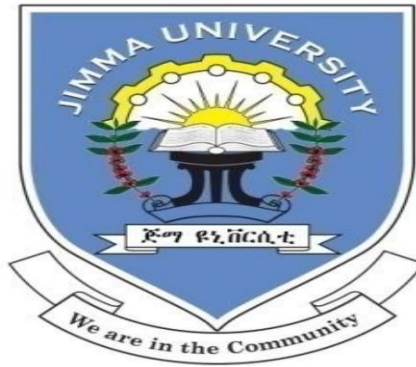


Jimma University
School of Graduate Studies



Jimma Institute of Technology
Civil Engineering Department
Construction Engineering and Management Stream

**ASSESSMENT OF QUALITY CONTROL IMPLEMENTATION ON UNPAVED
ROADS CONSTRUCTION AND MAINTENANCE OF OROMIA ROADS
AUTHORITY**

A Thesis submitted to the School of Graduate Studies of Jimma University in Partial fulfillment of the requirements for the Degree of Master of Science in Civil Engineering

By: Rameta Gelalcha Woyessa

October, 2015
Jimma, Ethiopia

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By: Rameta Gelalcha Woyessa

Advisor: Prof. Emer T. Quezon

Co-Advisor: Engr. Murad Mohamed

October, 2015
Jimma, Ethiopia

DECLARATION

I hereby declare that this thesis:

Assessment of Quality Control Implementation on Unpaved Roads Construction and Maintenance of Oromia Roads Authority is my original work and has not been submitted and presented to any other Universities than the University of Jimma for any type of academic degree.

Name	Signature	Date
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This thesis has been submitted for examination with my approval as university Supervisor

Name	Signature	Date
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External Examine

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ABSTRACT

Attaining good quality in any construction projects such as unpaved roads constructions in particular have positive impacts to end users or society. Assessments of these impacts were undertaken in Oromia Regional State, Oromia Roads Authority.

This research was aimed to assess, identify and document the current status of the unpaved (gravel) roads construction quality in Oromia regional state, under the responsibility of Oromia Roads Authority. This was involved identifying the main problems and point out where the scope lies for improving and by what means this is possible to do.

To begin with, a literature review has been undertaken in order to analyze the status of quality in construction in general and unpaved (gravel) roads construction in particular with regard to quality problems and quality aspects. After having analyzed the data, a questionnaire was designed and distributed to construction professionals, who are working with clients, contractors, consultants, funding agents, consumers (end users) and related stakeholders. The research interview was focused on background of the respondents, quality management system, quality in general and top managements' commitment to quality control in unpaved roads construction. Finally interviews have been conducted with professionals in organizations whom staff has participated in the questionnaire.

After performing the above mentioned activities, the research was suggested the extent of problems that is resulting from inferior quality problems. The research was also indicated possibilities to improve quality related problems in unpaved roads construction. A conclusion was supported by literature reviews (desk studies) as well as research works based on primary and secondary data.

This research hopes that the results are going to give a clearer picture of the quality status and where improvements are needed. The study also tried to assess the need of improving quality management and identified gap in terms of knowledge of quality management and the application of quality management systems within the construction of unpaved roads in the Oromia Region in order to attain more systematic efficiency of its operation. It also tried to point out the roles that should have been played by construction parties in increasing the implementation of quality control, assurance as well as management in unpaved roads construction.

Finally, based on the analysis of the results, recommendations are proposed to enable in minimizing the adverse impact of poor quality management on gravel road construction and favors the construction parties involved for better performance.

Key words: *Quality assessment, Quality control, total quality management (TQM)*

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ABBREVIATIONS

ASQ	American Society for Quality
ERA	Ethiopian Roads Authority
FGD	Focus Group Discussion
FHA	Federal Highway Administration
GOE	Government of Ethiopia
GTP	Growth and Transformation Program
ISO	International standard Organization
KII	Key-Informant Interview
MoWUD	Ministry of Work and Urban Development
NPO	Non-Participant Observation
ORA	Oromia Roads Authority
ORCE	Oromia Roads Construction Enterprise
PAF	Prevention, appraisal failure
PASER	Pavement Surface Evaluation and Rating
PDCA	Plan-do-check-act
PPA	Public Procurement Agency
QC	Quality Control
S.D	Standard deviation
SOEI	Structured Open-Ended Interviews
TQM	Total Quality Management
USDT	United States Department of Transportation

CHAPTER ONE

INTRODUCTION

1.1 Background to the Research

One of the nation's most valuable assets is the network of roads and bridges that link suppliers of goods and services with customers. The nation's wellbeing also depends on the road system's condition, which in turn relates to the quality of construction. A good road network has an important bearing on the economic growth of the country. Rural connectivity is perceived as one of the major component in increasing the agricultural output and earning capacity of the rural population. There is a marked improvement in quality of life by way of better educational facilities, improved health services, improved attendance by the school teachers as well as students. Accessibility also provides improvement in governance and provision of other facilities like post offices, access to police in case of emergencies and other communication system like telephones. Construction of quality roads requires concerted efforts on many fronts. Road quality is all about achieving the shared goal of building, preserving, and maintaining better roadways. Highway quality assurance has evolved over approximately four decades and encompasses all the programs and procedures for controlling and accepting construction quality. For the most part, the procedures in use today are fair and effective, but that was not always the case (US Department of Transportation, 2007)

In developing countries like Ethiopia, road transportation system plays crucial roles as other modes need relatively high investment and technology to achieve. Keeping these in mind, the Government of Ethiopia (GOE), which Oromia regional state contribute major parts, has given emphasis on improving the quality and size of the road infrastructures so that poverty reduction and economic growth will be achieved. These road systems are mostly unpaved roads. Due to this, high consideration should be given to the quality control of the construction and maintenance of unpaved roads in order to achieve sustainable development and growth. Unpaved road constructions and maintenances are also stick with the concept of quality for the satisfaction of their end users and their sustainability. However, most stakeholders of the sector do not exercise their contractual

and legal rights and obligations concerning quality even though it is clearly stated in contract documents. Therefore, it is very crucial to assess quality with respect to conditions of contracts relative to the role of each stakeholder in playing parts in achieving expected quality of works (Ethiopian Roads Authority, 2012).

According to different articles and studies, assuring and/or managing quality in unpaved roads construction and maintenance has the following main purposes:

- a) Provide background information and an introduction to Quality Control and Management and convincing evidence that firms must, as a matter of survival, adopt best quality control and management practices, and
- b) Provide an outline of what steps to be followed to initiate the development of a Quality Control, Assurance and Management System.

Through the application of different quality control mechanisms, one can ensure the quality of product (road) which maintain the life cycle cost of the project and enables accurate maintenance strategies, both periodic and routine, to be developed and implemented. When dealing with the construction of unpaved road works, especially by contract, the need for a Quality Management System is essential. The three parties to the contract, the Client in this context Oromia Roads Authority (ORA), the Engineer (the Consultant) and the Contractor, must all play their part towards effective Quality Assurance and Management System. According to O'Brien, developing project quality control plan will help to give more attention for quality control.

ORA is responsible for managing, maintaining and developing most of the Oromia regional state unpaved roads network to support economic development, growth and poverty reduction in the region, using the budgets allocated from the Government of Ethiopia for the Roads Infrastructure Development Program.

ORA is also mobilizing the community to increase road network coverage under the vision of creating standard, sufficient and sustainable road networks in Oromia with the mission of carrying out road development, creating quality road network, administering

and insuring its sustainability by involving all stakeholders so that the living standard of the people will be boosted.

There is great effort in order to achieve the goals set in Growth and Transformation Programmes (GTP) to connect zones to zones, zone to woredas, woredas to woredas, woredas to Kebeles and Kebeles to Kebeles by Oromia Roads Authority. These works are being implemented through private contractors, government contractor (Oromia roads construction enterprise (ORCE)), small scale enterprises (URRAP) and by Woredas own force and community participation. Due to this large scale unpaved roads construction, issues related to existing quality and its control has been evaluated and new operation scenarios are developed for the future use. The output of the study will help to maximize the economic, social and environmental benefits of the society.

1.2. Statement of the problem

In any activity, producing an end product or service by maintaining a given minimum quality standard is the final goal. Quality deviation and mismanagement affect all engineering and construction activities, with its services, personnel, client, contractors and end users. When public budget is financed or invested to road construction, quality issues have to be raised higher, gaps due to quality should be narrowed and quality must be improved and defects and reworks reduced. In doing so, there will be better effectiveness and efficiency to the public budget and to the road construction sector.

According to Ethiopian Roads Authority (ERA) Quality Manual, 2012, quality principles in roads construction will have a goal of increasing efficiency and reduce wastage in the stages of planning, designing, and implementation of the Ethiopian roads construction programme. In order to achieve this goal, quality management should be implemented successfully. This research has been assessed and investigated the implementation of quality principles within Oromia Regional State by conducting interviews with concerned stakeholders, inspecting visually and reviewing different literatures.

The research has obviously observed that there are gaps in terms of knowledge of quality management and the application of quality management systems and there are some

occurrence of quality failures throughout unpaved roads construction and maintenance processes. Failures and errors in unpaved roads construction and maintenance have many manifestations and their reasons and responses (effects) also vary greatly. Therefore, the possibilities to have less cost, less time and increased productivity or output by improving quality status of the above mentioned construction works and problems due to quality defects have been assessed schematically. Hence need comes to develop optimal application of quality management system for future plan.

1.3. Research Questions

Research questions were formulated in order to form the research direction and to set its demarcation. The research questions that kept in mind are:

1. Are the quality of work given proper attention within unpaved roads construction and maintenance in Oromia Roads Authority activities or projects?
2. What are the effects of inferior quality in unpaved roads construction and maintenance and how to improve it?
3. Are there any gaps in the implementation of quality control and management system in unpaved roads construction and maintenance?
4. What are the possible measures to improve the quality control implementation of unpaved roads construction and maintenance?
5. How is quality management system applied?

1.4. Research Objectives

1.4.1. General Objective

The main objective of this research is to assess the implementation of quality control, assurance and management and to point out effects of quality deviation in unpaved road construction and maintenance within Oromia Roads Authority contract works and to perceive the real application of the best practices.

1.4.2. Specific Objectives

The specific objectives of this research were:

1. To assess quality control implementation and its importance on unpaved road construction and maintenance
2. To identify the effects of inferior quality in unpaved road construction and maintenance
3. To identify the possible measures to improve quality control and assurance based on the status and quality of unpaved road construction and maintenance
4. To assess the gaps in the use of quality control and management system in unpaved roads construction
5. To assess how quality management system is applied while constructing unpaved roads in Oromia regional state

1.5. Significance of the study

The rationale aim to conduct this research was to assess the quality control implementation of unpaved roads construction and maintenance in Oromia Roads Authority and to increase knowledge and awareness of quality related matters in unpaved roads construction and maintenance. The basic importance of this study is directing problems caused by quality defects and related issues that has resulted in reworks with possible suggestion of solution. It also has illustrated the system of quality controls and managements in the unpaved roads construction and maintenance, as well as identifying the main problems that roads construction and maintenance have with quality. In addition, the research has examined where the scope lies for improving and identifying barriers that might be standing in the way of quality improvements in Oromia Regional State, Oromia Roads Authority in compliance with the different literatures and how to handle the deficiencies that may result. The other significance is that it can be a base for future investigation related to quality deviation, unqualified and non-usable roads.

1.6. Scope of the study

This study had been focused on the assessment of quality control, quality assurance and quality management and its implementation on unpaved road construction and maintenance in Oromia Regional State, focusing on project works of ORA. The study also covered major aspects that parties (client, contractors, consultants and others) have been followed on how they perceived implementation of activities in order to achieve the best quality works in unpaved roads construction and maintenance.

The research has been focused on shading light on how unpaved road construction and maintenance is standing in relation to quality assurance, quality management as well as controlling quality and quality related matters. This was involved analyzing the quality status theoretically as well as catching a best experience and views of a construction parties which has involved in controlling quality related matters and their use of quality management system and procedures. The magnitude and extent of quality problems was mapped along with human aspects. The study area is limited to Oromia regional state and project works that is being owned and funded by Oromia Roads Authority only.

1.7. Research Limitations

The limitations of this thesis is that no major quality case study yet has been published that has been performed focusing on unpaved roads construction quality control neither at federal level nor regional level. Therefore results from other countries were evaluated and transferred by the researcher to ORA, so that it deals with unpaved roads construction and maintenance. The study area is limited to project works in Oromia regional state that is owned and funded by Oromia Roads Authority only. Works that are being executed by Federal Government is not assessed in this study.

The sampling method and size also has a limitation. The methods used were based on non-probability sampling techniques, which are not representative of the entire population and could therefore cause sampling bias. Bias refers to a constant difference between the results from the sample and the theoretical results from the entire population.

CHAPTER TWO

LITRATURE REVIEW

This chapter outlines the theoretical background for this thesis. The main topics are quality in general (concept of construction quality), concept of quality control in construction works, characteristics of unpaved roads construction and maintenance and its quality control.

2.1 Introduction

Ensuring quality of works and products has been said to be comprised of different reasons. It is known that in road construction quality control and assurance, the contractor/s earn more money when produce a good quality product, while road owners (end users) will save more money in future maintenance costs if the quality is built into the roads(pavements). These show us that project owners (end users) need a delivery of highly qualified and standardized product before or within a schedule. Quality control and quality assurance plays a major role in achieving and demonstrating whether these standards are going to be met. Even though more advanced engineering works are being executed using computer technology, construction failures are occurring drastically (Ortega & Bisgaard, 2000).

Errors, defects, risks and failures are common in roads construction activities and processes. These things are usually connected with failures in meeting the given quality standards or non-conformity. Errors, defects and quality failures are occurring throughout the construction activities, and can cause several problems. Some of these problems can be inefficiency, cost overrun, reworks, irresponsibleness and non performance, which makes the product non durable.

Many researches show that quality issues have to be increased by the concerning party/parties in order to minimize construction work errors, defects and reworking. These can be achieved through strategic quality management methods which are proven to be efficient in other sectors by improving to construction activities and making it to be used effectively.

2.2 Quality Management System

2.2.1 Definition of Quality

Different disciplines have different meaning for quality depending on their view perception. The International standard Organization (ISO) which is a framework to guide organizations towards improved performance, in its ISO 9000:2000 second edition, 2000-20-15 under 3.1 terms relating to quality, defines quality as the degree to which a set of inherent characteristics or distinguishing features that fulfils a given requirement.

Similarly the ISO 8402-1986 standards defines Quality as ‘the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs’.

Likewise American Society for Quality (ASQ) stated that quality is not a program; it is an approach to business. It is a collection of powerful tools and concepts that is proven to work and also defined by the customer through his or her satisfaction.

Quality includes continuous improvement and breakthrough events and has tools and techniques that are applicable in every aspect of the business. It is aimed at performance excellence; anything less is an improvement opportunity and increases customer satisfaction, reduces cycle time and costs, and eliminates errors and rework. Results (performance and financial) are the natural consequence of effective quality management.

A Quality management system consists of set of processes. These processes will ensure that the attainment of defined quality standards for the provision of provided services and products by the project or a construction company (Harris et al., 2006). Quality management is considered to be based upon three pillars which are time, cost and needs or expectations. Quality management is all about defining the need of the customer within the given time and cost (Chung, 2007). A Quality management system consists of two main components, the first being the framework for guiding quality related actions by all employees (design of quality system) and the second, means of assessing how well these actions will be carried out (delivery of quality system). Companies are increasingly

being persuaded to adopt quality management systems in order to meet the globalized marked demands (Yasamis et al., 2002).

2.2.2 Total quality management

Total Quality Management is a management approach that originated in the 1950's and has steadily become more popular since the early 1980's. It is a management system for a customer focused organization that involves all employees in continual improvement of all aspect of the organization. TQM uses strategy, data and effective communication to integrate the quality principles into the cultural and activities of the organization (Abdul Razzak Rumane, 2011).

The following are some of the advantages of implementing TQM in the organization

- Achieving customer satisfaction
- Continuous improvement
- Developing teamwork
- Establishing vision for the employees
- Setting standards and goals for the employees
- Building motivation within the organization
- Developing corporate culture

Strange and Vaughan (1993), addressed the reasons why implementation of TQM in the construction industry is challenging. They stated the reason for the challenge is the point of view, or 'paradigm', that construction leaders have about their industry. The construction leaders, they argued, believe in what can be called the five "cant's" (Strange and Vaughan, 1993):

1. One can't apply industrial management solutions to construction, because of the unique nature of the construction industry.
2. One can't do statistical analysis of construction processes, because they are unique and non-repetitive.

3. One can't invest in training at the job level, because individual employment is short-term, the people have no company loyalty and the environment is too difficult
4. One can't spend money on management programs, because there will be too much competition and the margins won't allow it.
5. One can't take time away from doing the work for seminars, retreats or symposia

Total quality management can be considered to have two main components: quality control and quality assurance. Quality management is focused not only on product quality, but also the means to achieve it (its methodology). Total quality management therefore uses quality assurance and control of processes as well as products to achieve more consistent quality (Chung, 2007).

Quality control (QC) is a procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of the client or customer. Quality control refers to the process, most often implemented in manufacturing, of monitoring the quality of finished products through statistical measures and an overall corporate commitment to producing defect-free products. Quality control principles can also be utilized in service industries (Abdul Razzak Rumane, (2011)).

Quality control ensures the completion of the project according to the plans, specifications. Often, modification requested by the owner or unexpected circumstances may necessitate reassessing In addition, the project must meet the minimal standards for materials and workmanship. This ensures that the project conforms to the design standards. This means samples are taken and statistical methods are used as criteria for accepting or rejecting materials. Evaluation and inspections of completed work usually take place at various stages throughout the project and prior to issuing payouts. Regardless of the quality control system employed, make the requirement clear measurable and verifiable for all parties involved n the project.

Construction projects have project managers who are responsible for personnel, cost control, time management, and quality control. Many owners, architects, engineering organizations and contractors have their own quality-control process, personnel or inspectors. They must have knowledge of procedures and quality standards (Harold Kerzner,(2003)).

In construction activities, conditions of contracts address the concept of quality control knowing that it is a very important concept for the construction industry and to give emphasis on quality of works in order to reach the intended purpose. For instance, the Public Procurement Agency (PPA) condition of contract of the Federal Democratic Republic of Ethiopia under sub-clause 33.1 states the following:

“The Engineer shall check the Contractor’s work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor’s responsibilities. The Engineer may instruct the Contractor to search for a Defect and to uncover and test any work that the Engineer considers may have a Defect.”

Quality assurance is one of the main elements of total quality management that focuses on a systematic process of checking, verifying or determining whether a product or service being produced is meeting specified requirements, standards and customers expectations. Today's quality assurance systems emphasize catching defects before they get into the final product.

Quality assurance in construction projects covers all activities performed by the consultant, contractor, sub-contractor and suppliers to meet clients’ objectives as specified and to ensure that the project is fully functional to the satisfaction of the client or end users.

Quality assurance is important in construction industry because of the risk involved in any projects. The risk involved in not completing the projects on time will be high, because many external factors will affect the performance of the projects. It is vital that a built-in quality assurance system is developed to avoid any inefficiency that could result in poor quality of products and service being delivered to the customer. Everyone

involved in the construction business has, in different ways, will be benefited from a common approach to quality work. Systematic quality work reduces the costs of failure in one's own work and in the final product. A contractor's in-house quality assurance system is of utmost importance; it prevents problems and their reoccurrence and will allow his or her clients to relax.

2.2.3 Concept of construction quality

Construction quality can be illustrated as one part of a triangle as seen in figure below. The contractor has to attain the cost level as planned; meet the scheduled deadlines while achieving the required quality level. There must be a balance amongst those three aspects because they define the project scope. However, quality may be the first of those components to be disregarded in favor of increased cost savings and time reductions (Chini & Valdez, 2003).

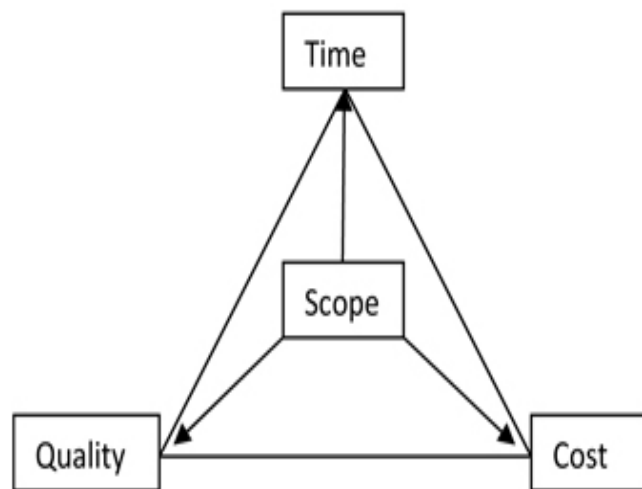


Figure 2.1 Construction triangle

Quality must be involved in all phases and stages of construction, as construction projects and quality are inseparable to each other. This means that a construction project cannot exist without fulfilling quality and quality in construction cannot exist without a project. According to Harris et al, 2006, aspects involved in the concepts of construction reflects the product features, processes of production and organization, as well as company business or industry issues. This can be seen in figure 2.2



Figure 2.2 Aspects in construction quality (Harris et al, 2006)

2.2.4 Performance of Quality

Performance can have different meaning based on its context. Generally, performance represents the results of activities. Doing the right things and doing things right can be measure of effectiveness. Different dimensions, such as quality, productivity, profitability, safety, timeliness, growth, attendance and satisfaction have been attributed to performance. These functions can be interpreted as functions of each other. In general, performance frame works requires the following (Yasamis, Arditi, & Mohammadi, 2002):

- Combined criteria
- Stages (level) of analysis

- A kind of performance that needs certain focus
- Short or long time frame
- Quantitative versus qualitative and objective versus subjective system of measurements

According to Philip Crosby, (1996), quality is the conformance to requirement, being measured and stated by a given terms. On the other hand, W.E. Deming (1986) stated that quality is a relative term that depends on the satisfaction of a customer or end user. In the same manner, some works by Joseph M. Juran shows us that quality is fitness for use as well as meeting customers' (end users') need by eliminating/reducing failures (Juran, 2005). Based on these premises, therefore, it can be said that quality is meeting customer's or end user's satisfaction by providing a service or a product with the specified requirements which is suitable for the reason it is proposed for.

Quality performance is result oriented and needs evidence of quality awareness within the operations and outputs of a contractor. The quality performance is defined over the long-term for the effects to be permanent (Yasamis et al., 2002).

A comprehensive view of construction quality framework model is shown in Figure 2-3. This model on one hand deals with the service received by the owner and on the other hand, the product received by the end-user. The model furthermore frames the related aspects of the construction project and its aspects to the corporate quality culture in the contracting company. Quality is the red thread that goes through all stages and aspects of the construction process, whether it is at the corporate level or project level. Quality is therefore a concern for all the parties involved in every stage of the construction process (Yasamis et al., 2002). It can be visualized using chart below.

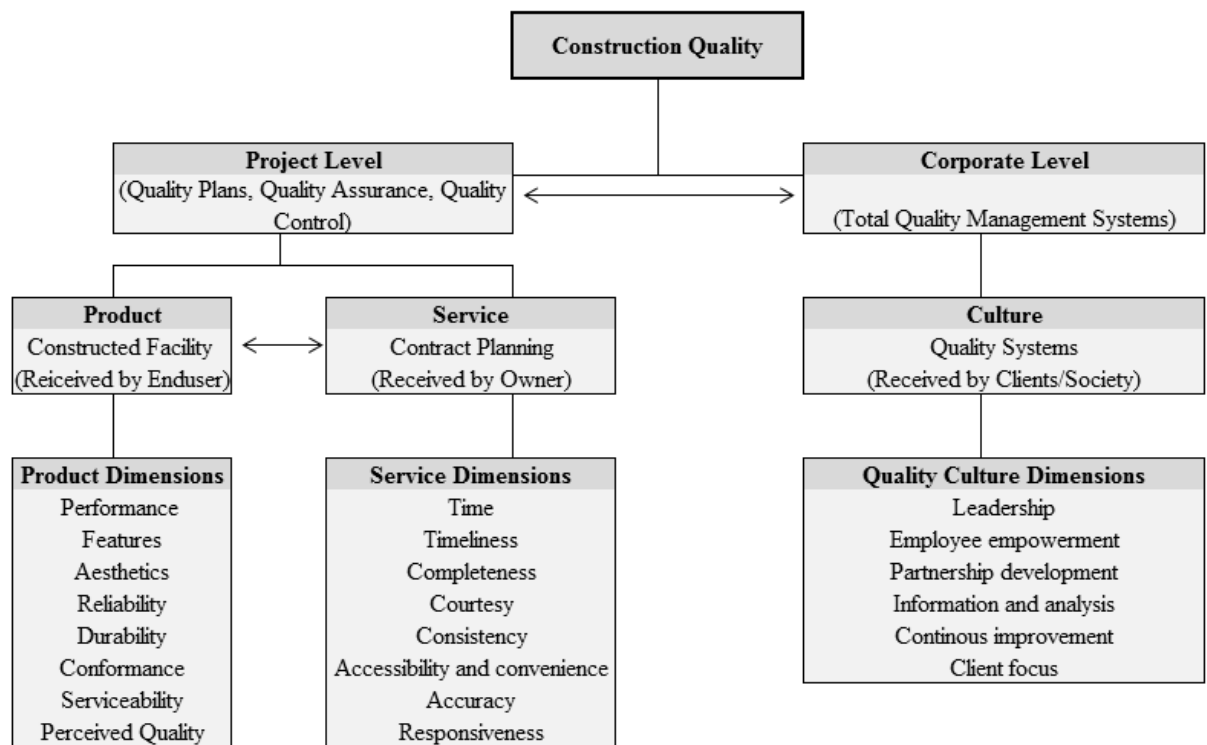


Figure 2.3 Construction quality framework model (Yasamis et al., 2002)

2.2.5 Quality control in construction works

According to Lambeck, R. and Eschemuller, J., 2009, Quality control (QC) is a process of inspecting and confirming that the finished installation or works has indeed met the design specifications enumerated in the contract documents.

Quality control represents increasingly important concerns for project managers. Defects or failures in constructed facilities can result in very large costs. Even with minor defects, reconstruction may be required and facility operations impaired. Increased costs and delays are the major result. In the worst case, failures may cause personal injuries or fatalities. Indirect costs of insurance, inspection and regulation are increasing rapidly due to these increased direct costs. Good project managers try to ensure that the job is done right the first time and that no major accidents and defects occur on the project.

As with construction cost control, the most important decisions regarding the quality of a completed facility are made during the design and planning stages rather than during construction. It is during these preliminary stages that component configurations, material specifications and functional performance are decided. Quality control during construction consists largely of insuring conformance to these original designs and planning decisions.

When conformance to existing design decisions is the primary focus of quality control, there are exceptions to this rule. First, unforeseen circumstances, incorrect design decisions or changes desired by an owner in the facility function may require re-evaluation of design decisions during the course of construction. While these changes may be motivated by the concern for quality, they represent occasions for re-design with all the attendant objectives and constraints. As a second case, some designs rely upon informed and appropriate decision making during the construction process itself. For example, some road construction methods depend on soil conditions in order to determine equipments going to be used. Since such decisions are based on better information concerning actual site conditions, the facility design may be more cost effective as a result. Any special case of re-design during construction requires the various considerations that should be followed in design and construction process.

According to Chris Hendrickson (1998), when the conformance is the measure of quality during the construction activity, the specification of quality requirements in the design and contract documentation becomes extremely important. Quality requirements should be clear and verifiable, so that all parties in the project will understand the requirements for conformance.

In order to control quality during construction a variety of different organizations/methods are possible. One common model is to have a group responsible for quality assurance within an organization. In large organizations, departments dedicated to quality control and assurance might be assigned with specific individuals to assume responsibility for these functions on particular projects. For smaller projects, the project manager or an assistant might assume these and other responsibilities. In either

case, insuring qualified construction is a concern of the project manager in overall charge of the project in addition to the concerns of personnel, cost, time and other management issues.

Inspectors and quality assurance personnel will be involved in a project to represent a variety of different organizations. Each of the parties directly concerned with the project may have their own quality inspectors, including the owner, the engineer/architect, and the various constructor firms. These inspectors may be contractors from specialized quality assurance organizations. In addition to on-site inspections, samples of materials will commonly be tested by specialized laboratories to insure compliance. Inspectors to insure compliance with regulatory requirements will also be involved. Common examples are inspectors for the local government's infrastructure department, for environmental agencies, and for occupational health and safety agencies.

It has to be emphasized that quality control is the major issue that every project team has to focus on, because it can step up productivity.

According to Ethiopian Roads Authority (ERA) quality policy, the consultant is responsible for professional quality, technical accuracy and coordination of all surveys, designs, drawings, and specifications and other services furnished by the Consultant under its contract. The consultant also has to provide a quality control plan that describes the procedures to be utilized to verify, independently check, and review all design drawings, specifications and other documentation prepared as a part of the contract. The Quality Control Plan may be one utilized by the Consultant as part of the firm's normal operation or it may be specifically designed for the given project.

2.3 Characteristics of unpaved roads construction and maintenance

According to United States Federal Highway administration, 2000, unpaved road is a road made from the native material of the land surface through which it passes, which is sub grade material. Unpaved roads are suitable for areas which are underdeveloped economically and cannot be able to construct paved roads. More than 90% of global roads are unpaved roads (Skorseth and Selim, 2000). They serve remote areas and a few

vehicles. Unpaved roads with hard surface are usually made from gravels and aggregates. This research focused on the quality control, implementation and assessment of unpaved roads made from gravels and aggregate.

Unpaved roads usually take their characteristics from the soils they made from and their geology they pass through. This characteristics may be sandy, stony, rocky, or have a bare earth surface, and will have different characteristics based on its moisture content. Unpaved roads are common in rural areas of many countries and also in urban areas of developing countries such as Ethiopia.

According to different literatures, unpaved roads demonstrate a variety of conditions. A newly constructed or well maintained unpaved road will have excellent surface condition and provide smooth and safe traffic. However, the unpaved roads will be deteriorated very quickly because of traffic, weather condition, bad habit of driving etc. Excessive use of roads and heavy traffic during planting in spring and summer and harvest in fall will damage roads more quickly and frequently. Significant rainfall will wash away gravel from road surface, which will result loss of adequate crown. Water trapped on roads will produce potholes. Heavy traffic, bad driving habit such as excessive acceleration will tend to damage roads and develop ruts, aggregates will corrugate. Disturbances to unpaved road surfaces and ditches, and poor road surface drainage always results in deterioration (damage) of the road surface. These damaged roads, if not promptly repaired, tend to be degraded more quickly with severe weather and traffic. In general, distresses on roads will create difficulty to local community in day-to-day commune, transport of goods, and seasonal farming practice. In addition, the deteriorated roads pose a major challenge in traffic safety.

Due to the nature of gravel (unpaved) roads and their variability, evaluation and rating them require a different perspective than similar evaluations of asphalt or concrete pavements. Unpaved road condition will be related to several factors such as structural integrity, structural capacity, roughness and rate of deterioration (Eaton and Beaucham, 1992). Direct measurement of all of these factors will require expensive equipment and highly trained personnel. However, these factors can be assessed by observing and

measuring the distress of the surface. Commonly used evaluation approaches are based on Gravel Pavement Surface Evaluation and Rating (PASER) Manual (Walker et al., 2002) from Wisconsin Transportation Information Center and Unsurfaced Road Maintenance Management (Eaton and Beaucham, 1992) from US Army Corps of Engineers. These documents have identified various types of distresses of unpaved roads and suggest measurement methods for each individual type of distress.

2.3.1 Quality Management in Unpaved Roads

It is known that road construction is a major part of construction industry. All characteristics that are in construction industry in general exist in unpaved roads construction. Therefore, this research believes that all quality related characteristics in construction industry applies to unpaved road construction.

Quality management practices have evolved dramatically since they first emerged. Initially quality management was primarily involved in the quality monitoring of production, i.e. to separate defective products from the satisfactory products. Later, the concept of quality control evolved with testing the product. Subsequently, attempts were made to ensure the quality with quality assurance by considering quality cost, reliable technology and eliminating defects. Nowadays, the emphasis is on strategic methods that involve ensuring quality within all elements of the organization. Quality requires commitment of all parties involved (Arditi & Gunaydin, 1997).

According to researchers such as Ortega & Bisgaard, 2000, quality related problems in construction will rise from the quality management of the project. Quality management in deferent industries has suggested that it is possible to have successful outcome by doing so. Following these tools will also have similar effects with the above mentioned (Pheng &Teo, 2004).

Harris et al., 2006, on the other hand, state generally that managing quality of construction activities are increasing and intended to have positive effect in producing competent product to end users. Quality management is a process to achieve the best quality for manufactured products or service by using procedures that continually meet

the defined requirements and expectations of the customer with minimum cost. This will be achieved by defining and implementing fixed work processes right from the start and monitoring them with inspections and statistical quality control techniques (i.e. sampling).

Customer (end user) satisfaction will be the key factor that drives stakeholders towards improved quality and competitive marketplace. Customer (end user) satisfaction will be considered to affect the customers' retention which affects profitability and competitiveness (Kärnä, 2009).

Several studies have shown the way quality management will be successfully implemented in the construction industry. Studies and researches by Pheng & Teo (2004) show that implementation of total quality management (TQM) have successful effects in achieving qualified output. The results showed that there were a reduction in cost of attaining quality, better employee job satisfaction due to less defects and client complaints, recognition by clients, work carried out correctly right from the start, subcontractors with proper quality management systems and closer relationships with subcontractors and suppliers (Pheng & Teo, 2004). The other study by J. Egan, 1998, also showed that it is possible to achieve better performance and reduce quality failures, if the industry is prepared to challenge the poor quality arising from the existing working practices and continuously and sustainably improvement is attainable.

2.3.2 Quality Cost

Quality cost is a price that paid for total quality related all items. It is the cost that ensures good quality and rectifies poor quality. It is a measurement that can provide the management team with information about process failures and activities that need to be redesigned to prevent reoccurrence. By doing so, the information can be used to help transfer lessons learned to the next project. Crosby (1996) explains that the term has negative reaction to quality professionals. Quality professionals seemed to become defensive about the term since, according to Crosby, they felt that the quality cost was being blamed on them.

Some methods to collect and classify quality cost are either cost of conformance or non conformance. Conformance cost includes cost due to training, indoctrination, verification, validation, testing, inspection, maintenance and audition. Non-conformance costs are costs due to rework, material waste and warranty repairs. The most widely accepted method of determining construction quality cost is the traditional prevention appraisal failure (PAF) model which classifies quality costs as prevention cost, appraisal cost and deviation cost (Love & Irani, 2003).

2.3.3 Deming's Education

A scientist, known as W. E. Deming (b.1900, d. 1993) taught statistical process control techniques in Japan and by that, contributed to the rapid revitalization of the Japanese economy after destruction by World War II (Anderson, Rungtusanatham, & Schroeder, 1994). They used his ideas and were successful in implementing them. They were known for their cheap and poor production before, but after having seen possibility to increase quality, as well as increasing profit, they became successful to raise the quality level in their country. Deming returned to the U.S. and in 1986 he published a book called "Out of the crisis" where he presented 14 points that he believed would save the U.S. from industrial doom at the hands of the Japanese. These points are the base for today's total quality management. Deming's points 14 points are as follows (Deming, 1986):

1. Create constancy of purpose for improvement of product and service.
2. Adopt the new philosophy.
3. Cease dependence on inspection to achieve quality.
4. End the practice of awarding business on the basis of price tag alone. Instead, minimize total cost by working with a single supplier.
5. Improve constantly and forever every process for planning, production, and service.
6. Institute training on the job.
7. Adopt and institute leadership.

8. Drive out fear.
9. Break down barriers between staff areas.
10. Eliminate slogans, exhortations, and targets for the work force.
11. Eliminate numerical quotas for the work force and numerical goals for management.
12. Remove barriers that rob people of pride of workmanship.
13. Institute a vigorous program of education and self-improvement for everyone.
14. Put everybody in the company to work to accomplish the transformation.

Deming also proposed a model known as Plan-Do-Check-Act (PDCA) which is an iterative method of four steps management system to control and gain improvement of processes and products in business as shown in figure below (Love & Smith, 2003).



Figure 2.4 PDCA model

Plan: is to design or revise the business process components that improve the results.

Do: Is implementing the plan and measuring its performance.

Check: This is to assess the measurements and report results to decision makers.

Act: Changes needed will be decided in order to improve the process.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research area and the methods used. A research method is seen as a process applied to collect information that helps to make better decision (Creswell, 2003). There are different research methodologies such as qualitative, quantitative, quasi experimental etc used in scientific researches. Creswell (2003) highlights that quantitative studies usually entails closed end questions, generates numerical data that is analyzed statistically, often by relating variables in the study and tests, validates or verifies theories or explanations. This research work has assessed the quality control, assurance and management in Oromia regional state focusing on the project works of Oromia Roads Authority. The research started with problem identification and goes through the consequences of the problems, which has been done through desk study, literature review, formal and informal discussion with professionals that are taking part in construction of gravel (unpaved) roads in Oromia region by triangulation. Triangulation is a combination of different methods, and it is used in order to deal with this subject matter. This approach is chosen in order to gain a broader and more complete understanding of the phenomenon. This is to check the result of quantitative method with qualitative or vice versa (Robson, 2002).

Triangulation uses complimentary methods to enhance interpretability. It is primarily based on quantitative study where the interpretation of statistical analysis is enhanced by a qualitative narrative account. Conversely, a qualitative account is the major outcome of the study, it can be enhanced by supportive quantitative evidence used to buttress and clarify the results. Quantitative questionnaires were prepared and used for collecting facts and sets of facts by gathering data on the topic, both by literature search and questionnaires and qualitative interviews.

3.2 Description of the Study Area

This research work has been conducted in Oromia Regional state. According to Central Statistical Agency of Ethiopian, 2007 data, this region has total area of 284,538 square kilometers with population of more than 27 million. This region has seventeen administrative zones (Arsi Zone, West Arsi Zone, Bale Zone, Borena Zone, Guji Zone, East Hararge Zone, West Hararge Zone, East Shewa Zone, West Shewa Zone, North Shewa Zone, South West Shewa Zone, Jimma Zone, Ilu Ababor Zone, East Wolega Zone, West Wollega Zone, Kelleme Wollega Zone and Horo Guduru Wollega Zone) and three Municipal special zones (Jimma special zone, Adama special zone and Finfinne Zuria special zone).



Figure 3.1 Map of Oromia Regional State

The Oromia Roads Authority (ORA) is responsible for Constructing, developing, managing and maintaining most of the Oromia regional state unpaved roads network to support economic development, growth and poverty reduction in the region, using the budgets allocated from the Government of Ethiopia for the Roads Infrastructure Development Program.

According to sources from information and communication department of Oromia Roads Authority its organizational structure starts at regional level and distributed to zonal administration and woreda (district level).

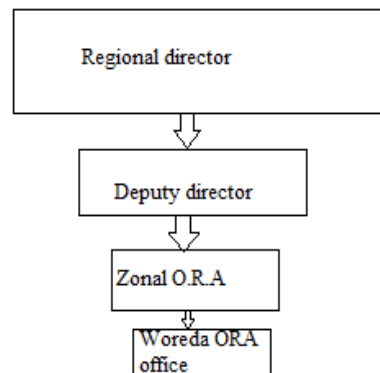


Figure 3.2 Organizational structures of ORA

Oromia Roads Authority is also mobilizing the community to increase road network coverage under the vision of creating standard, sufficient and sustainable road networks in Oromia with the mission of carrying out road development, creating quality road network, administering and insuring its sustainability by involving all stakeholders so that the living standard of the people will be boosted. This research has investigated the quality implementations and status of Unpaved roads within Oromia region from head office of Oromia Roads Authority to Woreda (Ana) or district road authority offices.

3.3 Sampling Selection and Its Targets

The research and study areas as well as its respondents for this thesis have done through either standardized or random sampling techniques. A study area and key informants were selected purposefully. Other respondents were also selected by using random sampling technique. The first step is the selection of unpaved road construction projects

within Oromia region, which is in progress. The existence of poor quality control, management and assurance on unpaved (gravel) road construction of sample projects under a serious condition was studied with up-to-date recommendations.

In the same manner, key informants were also selected purposively as they are deeming to provide data that could not be otherwise generated. Finally, other respondents were selected randomly.

3.4 Data and Data Sources

In order to achieve the stated objectives primary and secondary data were utilized in this study. The primary data were generated mainly by the tools such as, questionnaires, in-depth interview, key informant interview, focus group discussion and non-participant observations. The secondary data were collected from different materials such as, books, journals, magazines, published and unpublished materials and online sources. Data gathered from primary are further substantiated and triangulated by secondary data sources.

3.5. Research Instruments/Tools and Data Collection Techniques

3.5.1. Structured Open-Ended Interviews

Kitchin and Tate, (2000), stated that an interview plays big role in qualitative data gathering tool that allows the investigator to come up with rich and varied data. Interview data is always inter-subjective; so that it always made out of dialogue (Crang and Cook, 2007).

From the various types of interview, the one used in this study was the structured open ended interview. In this type of interview, a serious of highly structured and standardized open ended questions were asked to all interviewees. This was resulted in ensuring comparability of responses.

3.5.2. Key Informant Interviews (KIIs)

KIIs are aimed in obtaining special knowledge on a given issue/s (Mikkelson, 2005). In this study, Stake holders (Client (ORA top managers), contractors, consultants, funding

agencies and others) that are taking part in Oromia Roads Authority (ORA) project works were contacted as key informants.

Issues accessed via key informant interviews were mostly related to assessment of implementation of quality control and management on unpaved road construction, institutional cooperation and relationships among regional and federal governments, participation of contractors on the design of unpaved road construction, overall efforts made by the top managers during the construction of unpaved roads with a good quality and follow up and evaluation mechanisms to have a qualified product.

3.5.3. Focus Group Discussion (FGD)

According to Patt, (2000), FGD has been proven instrument to illustrate and explore the inter-subjective dynamics of thoughts, speech and understanding of the members of a group. According to Kitchen and Tate, 2000, FGD may be consisted of three to ten individuals discussing on a particular topic under a guidance of a moderator who promotes interaction and directs the conversation. Based on this premise, this study uses three to eight individuals from different active construction sites to make them discuss on a given issues. This is because, firstly, this instrument can enable to gain data that could not be generated using a one-to-one interview. Secondly, it also helps to verify the data dug out from other sources.

3.5.4. Non-Participant Observations

Observation entails the systematic noting and recording of events, behaviors and artifacts in a social setting (Kitchen and Tate, 2000). Observation focuses upon people's behavior in an attempt to learn about the meanings behind and attached to actions. Rather than asking people about their views and feelings, what they are doing was watched and listened (Ibid). The main purpose of having observation in this study is to triangulate or ascertain the existing observable structures with the information generated through the structured open ended interview, key informant interview and focus group discussion.

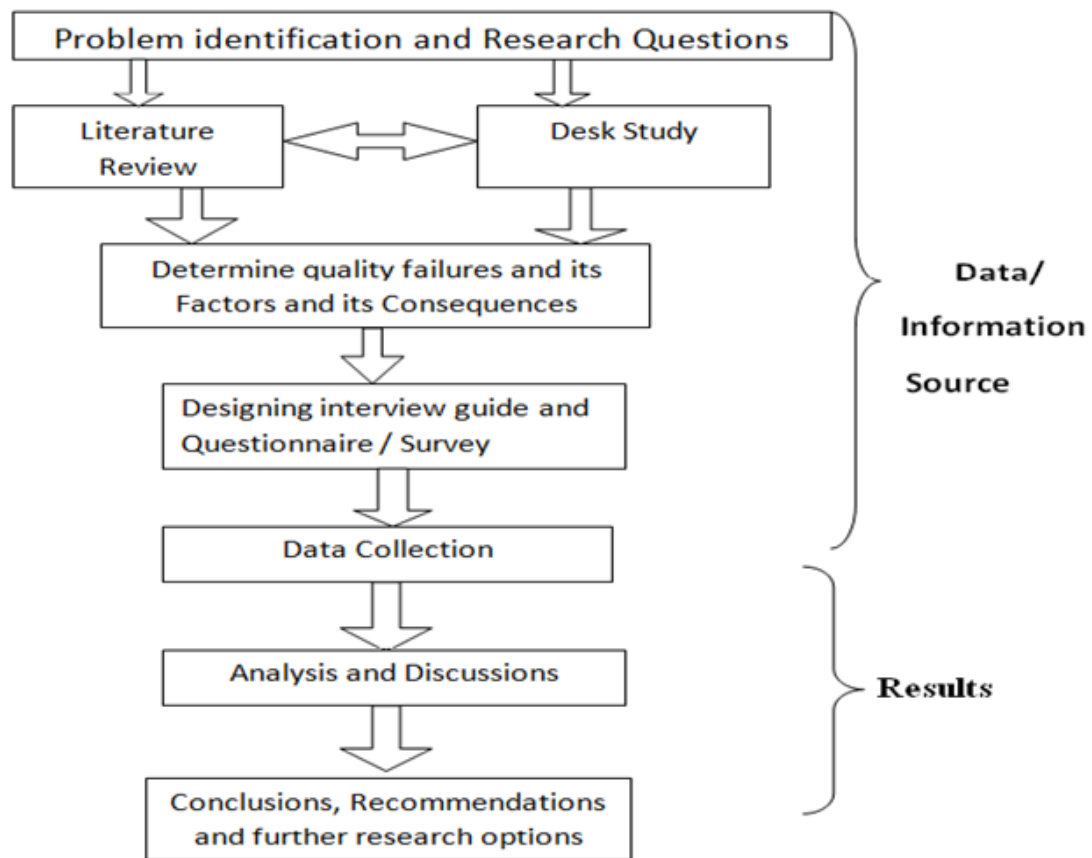


Figure 3.3 Research methodology

3.5.5 Data Quality Assurance

During the data collection process strict data collection methods were followed in order to be accurate and conscious. In addition to this data is neat and clear and ensured with confidentiality according to Jimma University's ethical consideration.

3.6 Independent and dependant Variables

A research method is seen as a process applied to collect information that helps to make better decision (Creswell, 2003). There are different research methodologies such as qualitative, quantitative, quasi experimental etc used in scientific researches. Using principles of Kumar and Phrommathed 2005; Rea and Parker 2012, survey and co relational research design were adopted for this study. This is because gathering, describing tabulating and interpreting data as well as establishing relationship between two or more variables were involved.

3.6.1 Independent Variable

The independent variable in this study entails the quality control, quality management practices and quality assurance in order to construct unpaved roads.

3.6.2 Dependant Variables

The dependent variable that is made up in this study entails the quality defects, errors, rework, defect liabilities and quality product for end users.

3.7 Research Design

In order to produce a given scientific research, its methodology plays a crucial role. In most scientific research cases, two procedures/methods will be followed-qualitative or quantitative (Teddlie & Tashakkori, 2008). So, the methodology that has been followed by this research was based on either quantitative methods or qualitative methods. Quantitative methods are gathering input data, analysis of gathered data, interpretation and presenting them with numerical information and investigating the relation between them. Narrative information is gathered, analyzed, interpreted and presented through qualitative methods.

Generally, intensive field works and data collection were done through different techniques namely Structured Open-ended interviews (SOEI), focus group discussion (FGD), Key-Informant Interview (KII) and Non-Participant Observation (NPO).

The combination of qualitative data collection tools in separate method has ended up blurring into one another in research practice (Crang and Cook, 2007). Hence, the combination of in-depth interview of road construction project stakeholders, FGD, non-participant observation and key-informant interview with necessary attachments were utilized in this study. Conclusions are then drawn from these sets of facts.

According to Straus and Corbin, (1998), research approach that will be preferred to collect data about human life realities, experiences, behaviors, emotions and feelings, organizational functions, social movements, cultural phenomena and their interaction with nature is qualitative approach.

Issues such as the nature of the existing practices of quality management on unpaved road construction, the causes and impacts of poor quality control and management on unpaved road construction were best addressed by relying on data collected from the top managers and experts experiences, feelings, behaviors, and even on the wider economic, socio-cultural and institutional realities and contexts related to the above mentioned under concern is going to be explored through this research.

As the focus of this research is to point out the best practice/s to assure quality of unpaved roads construction, both methods will be used to optimize the output of this research.

3.7.1 Design of Questionnaires

Using questionnaire survey for this research is appropriate tool because it is better way to collect information that best describe, compare and predict opinions, attitudes, values, knowledge/skills and behaviors of the participants or activities. Fink, 2002, categorized survey design either as experimental or descriptive.

Descriptive questionnaire was used in this research in order to produce information on groups and phenomena that is existing. An appropriate sample of populations was formed and respondents were asked to give their answers in a standardized manner. It is expected that the questionnaire as a whole gives a good indication and information regarding the subject matter and could therefore provide meaningful results on the subject. Information and data that were collected previously through literature research is used to design questionnaires so that it describes the topic of the research and question asked deeply and briefly.

Sample populations and respondents for this research were chosen from project owner (Oromia Roads Authority) engineers, contractors, consultants, funding agencies and related firms. The questionnaires were focused on:

- Background of the participants /respondents
- Quality system in general and unpaved (gravel) road construction quality control
- Quality aspects and

- Characteristics involving firms (company)

Most of the questionnaires that respondents asked and responded to are five point Likert scale to measure their positivity or negativity towards the statement. These questionnaires were used to provide a deeper understanding of quality in general, quality status and quality systems. The targeting organizations were divided to three groups based on their number (size) of employees: small (1-30 employees); medium (31-99 employees); and large (with more than 100 employees). In the large organizations around 15% of the employees were surveyed; whereas in the medium organizations; the ratio was raised to 30% to capture the variety and for the small organizations (enterprises), more than 70% of the employees were targeted.

3.7.2 Sample from Respondents

Based on convenience sampling, part of populations which are convenient and easily available were selected so that it is:

- Easy to carry out with few rules to follow
- Individuals in the organization will help to achieve the research goal
- Needs less cost and time when compared with probability sampling

Some of the disadvantages for this type of sampling is that convenience sampling often suffers from a number of biases so it is unlikely to be representative of the population and undermines the research ability to make generalizations from the sample to the population studied.

Certain details that could reflect the whole organization was sought so that it helps to obtain organizational structure. The sample included CEO, deputy CEO, project managers, construction engineers and general employees and they came from different departments of the organizations with a breadth of education that was considered to reflect the organization as a whole. Most employees chosen were linked directly to construction. Some major support department staff was also contacted. In a few cases, with the medium and small organizations, the list of appropriate recipients was provided by the organizations themselves.

3.7.3 Research Questionnaire Implementation

The questionnaire was presented to respondents by hard and soft copy. The hard copy was presented to correspondents who have no access to computer. This helps correspondents who spend most of their times on site because they can fill the form (questionnaire) being where ever they are. The soft copy was prepared using fillable micro soft word for correspondents who have access to computer and spend most of their time with computer. This helps to get the response from the managers and it is easy to send back the result using the attached e-mail. Both of the questionnaire formats took correspondents 7-10 minutes.

3.7.4 Data Analysis

The questionnaires were presented to the respondents based on the literature review presented in chapter 2. In most of the questionnaires, respondents were asked to give their responses against a five-point Likert scale so that participants are able to specify their level of agreement or disagreement with a statement. Another version used in the research was a Likert scale going from poor to excellent. The Likert scale has proven to be very useful in measuring whether people have a positive or negative attitude towards an object or a statement, and is therefore suitable for this research. The rest of the questions were questions about participants' background and their definitions of quality terms. In those questions, the respondents were asked to check boxes and/or write alternative answers.

The collected data were analyzed further using Excel and its statistical functions such as pivot tables. Graphs, tables and figures were also created in Excel. Even though the sample size is small, it is a reasonable indicator of how matters stand.

As interview is method of qualitative research, data acquired have to be analyzed and processed in order to make meaningful. According to Denzin, 1989 and Esterberg, 2002, qualitative research is a creative process. Generally, analyzing qualitative data involves several stages. First, some way is sought to physically manage or organize the data in the research. Then one must be immersed in the data and become familiar with what has been gathered and in what context it is related to the data retrieved from the quantitative

research. After the required data are found, the researcher generates themes or categories or identity patterns to the data. Finally, a way of presenting the analysis to others was found (Esterberg, 2002). These stages were applied to this research and were followed during the data analysis.

3.7.5 Design of the Interviews Questions

In order to get detail understanding about the research topic, interviews were carried out. There are several types of interviews, such as structured, semi-structured and unstructured. For this research, semi-structured interviews were chosen because semi-structured interviews are less rigid than structured interviews. In semi-structured interviews, the goal is to explore a topic more openly and to allow interviewees to express the opinions and ideas in their own words. According to Esterberg, 2002 semi-structured interviews, the researcher needs to listen carefully to the participant's responses and to follow his or her lead. The author has predetermined questions in mind, but is able to modify the order based upon the interviewer's perception of what seems most appropriate. Phrasing of questions can be changed, explanations given and for some interviewees, when applicable, some questions can either be omitted or added to the interview (Robson, 2002).

Based upon the literature research and the questionnaire results questions were prepared. The main questions or topics that were kept in mind while interviewing:

- If there is quality management system that controls the unpaved road construction activity in the given institution and when it was implemented,
- Benefits of quality management system,
- Disadvantages of quality management system,
- Training and education given to the stake holders /workers on the quality system,
- Level of satisfaction among the users with the quality management system,
- Collection of quality cost incurred,
- Status of quality control while constructing unpaved roads.

3.7.6 Sample from Respondents

The interviewees were selected with a purposive sampling, where the researcher chooses the sample based on their position and significance in their corresponding firm and to the study.

3.7.7 Interview implementation

Those interviewed were first contacted in order to arrange an appointment. The interviews were then conducted either face to face or via phone. The interviews were recorded in order to ensure that no information got lost; the highlights were then subscripted. Keeping the main topics in mind as guidance, other questions were allowed to originate or propagate from main questions.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

This chapter presents the research results or findings and discussion. As mentioned in chapter three, data were collected through questionnaire and interview to perform this research work.

4.1 Results from Questionnaire

This sub chapter presents the results achieved from questionnaire on unpaved or gravel road construction quality control, quality management and quality aspects at Oromia Roads Authority. Firstly, the characteristics and background of the respondents had been described and, secondly, descriptive statistics was introduced. Most of them required the respondents to give their answers on a Five-Point rating (or Likert) scale as it is very widely used approach.

If the mean values are greater than 3.0, it is assumed and interpreted as a positive response towards the statement or the question. When the mean values are between 2.5 and 3 it was assumed and interpreted as a neutral response. Finally, when the mean values are below 2.5, it is assumed and interpreted as a negative response.

Mean and standard deviations tend to be invalid parameters when the work is descriptive statistics, such as the Likert scale, because it is ordinal which cannot fit to distribution curve properly. Despite this, standard deviations can be used as measure of consistency. According to Sclove, 2001, a rough guide for a Five-Point Likert scale response distributions with standard deviation below 1 can be called consistent. More appropriate tools for analyzing data from ordinal scales are nonparametric procedures which based on the rank, median or range. They are appropriate for analyzing these data as distribution free methods such as tabulations and frequencies (Allen & Seaman, 2007).

The questionnaires are presented in hard copy and soft copy to respondents in English. It was sent to employees in 10 organizations that are taking part in unpaved (gravel) roads construction within Oromia Regional State, Oromia Roads Authority. Their selection was

based on representativeness of the organizations and their geographical distributions. Large organizations are running multi projects within the region with uniform work procedure. Their activities are highly centralized and receive similar work order and directions. These procedures can help this research to be called representative to some extent. Numbers of medium and small organizations or enterprises are determined based on the selection criteria followed by Oromia Roads Authority. Most of them share and have similar company characteristics. Therefore, the selected organizations can be representatives of the other organizations that are working on the projects. From these organizations, six of them were construction firms and four of them were engineering firms or consultants. The organizations were defined in size categories: small (1-30 employees); medium (31-99 employees); and large (with more than 100 employees). Of the four engineering or consulting firms, there was one large, one medium-sized and two small enterprises or organizations. Of the six contractor firms participating, there were two large, two medium-sized and two small enterprises or organizations.

Responses from each organization were collected separately in order to compare them internally to each other. Each organization was allotted a distinctive abbreviation that consisted of three letters. The first letter stands for the type of organization, “C” for Contractor firms and “E” for engineering or consulting firms. The second letter reflects the organization size: ‘S’ for small, ‘M’ for medium and ‘L’ for large. The third letter is a number that identifies the organizations. The abbreviations listed in Table 4-1 are used to distinguish between organizations.

Table 4.1 Respondent

ID	Engineering firm	Contractor
Small	ES1	CS1
	ES2	CS2
Medium	EM1	CM1
		CM2
Large	EL1	CL1
		CL2

The questionnaire was sent to a sample of 50 people. 10% of the sample consisted of females and 90% were males. Of the sample, 20 (40%) were employed with engineering firms and 30 (60%) with contractor firms. The response rate was 38% amongst the engineering firm’s employees and 62% amongst the contractor firm’s employees. A total of 35 people answered the questionnaire, providing a response rate of 70%. It was not mandatory to answer all the questions. Most of the questions were answered by all the respondents; the lowest response rate to a single question was 46 responses.

Table 4.2 Number of Response

Firm	Sample	No. of questionnaire responded	Sex		Response rate %
			Male	Female	
Engineering	20	13	11	2	38
Contractor	30	22	19	3	62
Total	50	35	30	5	100

The questionnaire is divided into four parts depending on the nature of the questions. The first part concerns the respondents’ background, the second part covers existence or non-existence of a quality system within the organization, whilst the third part addresses quality aspects and opinions about quality in general. The fourth and last part addresses participants’ aspects with company characteristics.

4.2. Background of the respondents

Respondents were asked about their background. These questions included participants’ gender, age and length of work experience in the construction of unpaved roads construction, educational background as well as their field of work. Figure 4-1 shows participants age distribution and Figure 4-2 shows the length of their work experience related to this subject.

4.2.1 Age distribution Among Respondents

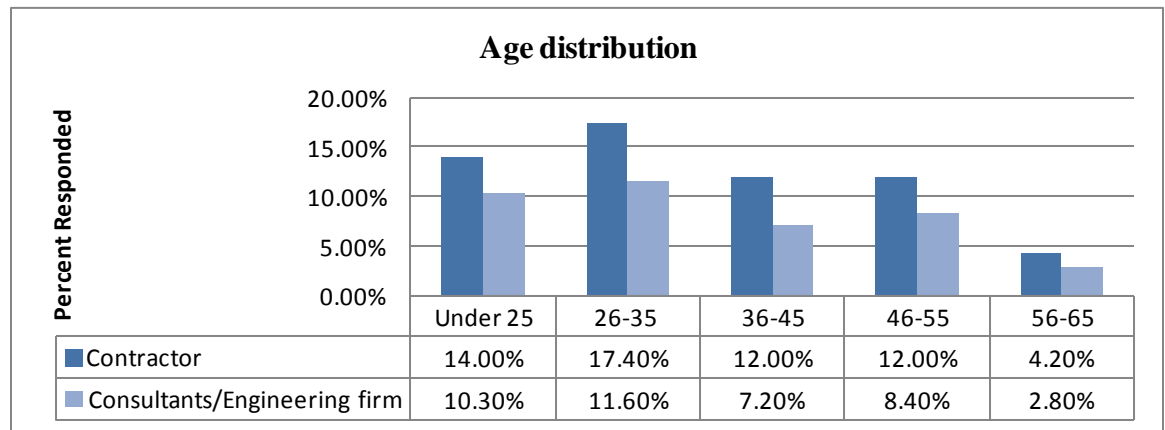


Figure 4.1 Age distribution

From the respondents that answer back the questionnaire which categorized into five parts, most respondents fall in the age limit of 26 to 35 years with 29%. Professionals who are under the age of 25 were second largest respondents of this questionnaire.

4.2.2 Work experience in the construction of unpaved roads construction:

Among professionals who worked on unpaved roads construction activities, most of them (46%) have work experience less than 5 years. This is directly related to the capacity of the country to produce engineering professionals in the past years.

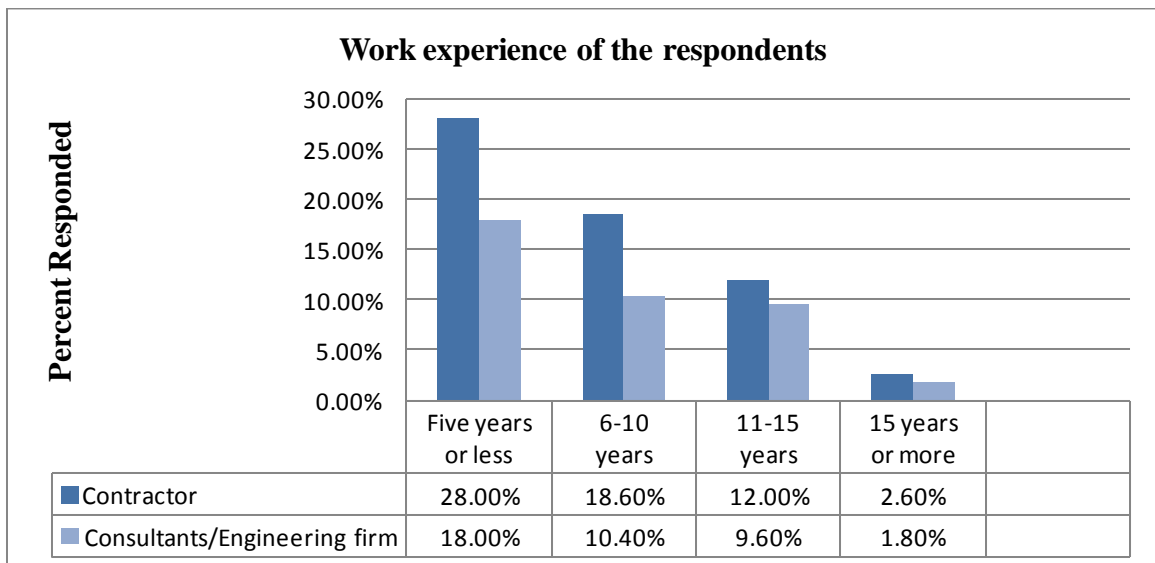


Figure 4.2 Work experience of the respondent

According to Ethiopian economic association, 2014, Ethiopia is registering considerable growth in construction industry recently. Therefore, more experienced professionals are expected in the near future.

4.2.3 Education of the Respondents

The other things that participants asked were their educational background. This was done by indicating their highest educational level. Civil engineers with B.Sc degree were those who mainly responded to the survey (25.7% or 9 people for contractors and 14.28% or 5 people for engineering or consulting firms). 28.57% or 10 people of the correspondents from both firms were other engineering B.Sc such as construction engineering and management highway engineers, hydraulics engineers etc. More details can be seen from chart below.

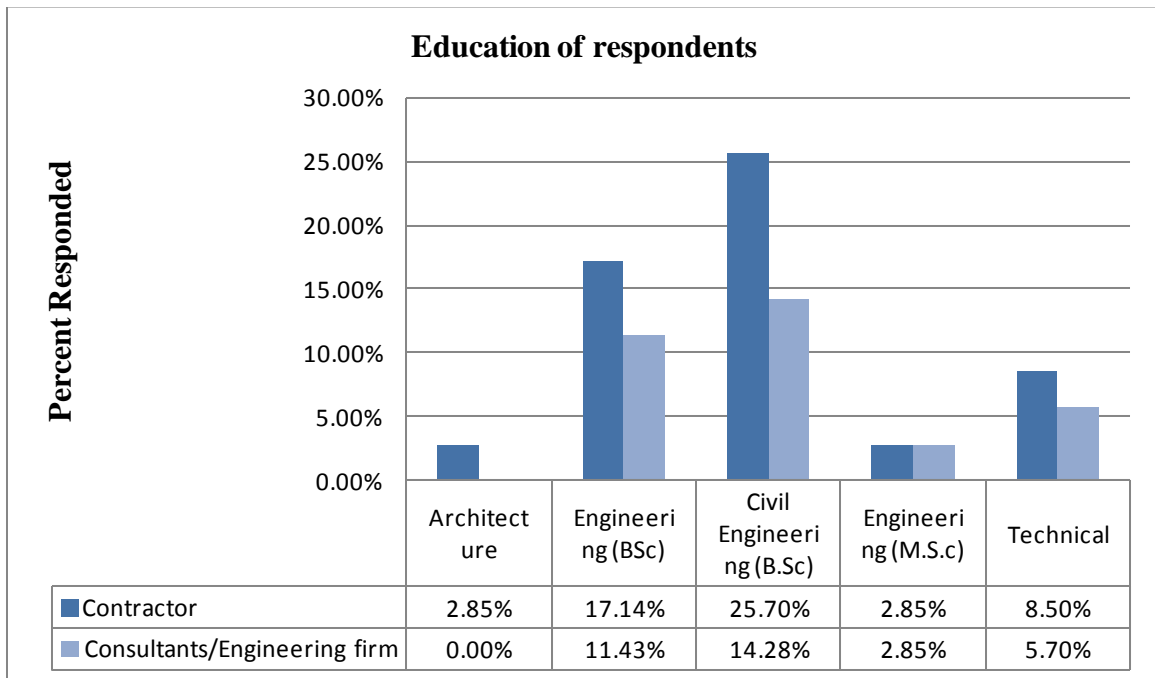


Figure 4.3 Educational background

4.2.4 Field of work/title/position

Participants were also asked about their title (position)/field of work in their organization. The distribution can be seen in Figure 4-4. Most of the respondents were Construction/Site/Office engineer (31.5%) for both contractor and consultant next were

those involved in Project management/Supervisor/Resident engineer (22.9%), Owner/CEO/Section (department) head (19.9%), Superintendent/foreman (8.5%), Material engineer/Quality controller (8.5%), Surveyor/Technical persons and others (11.4%).

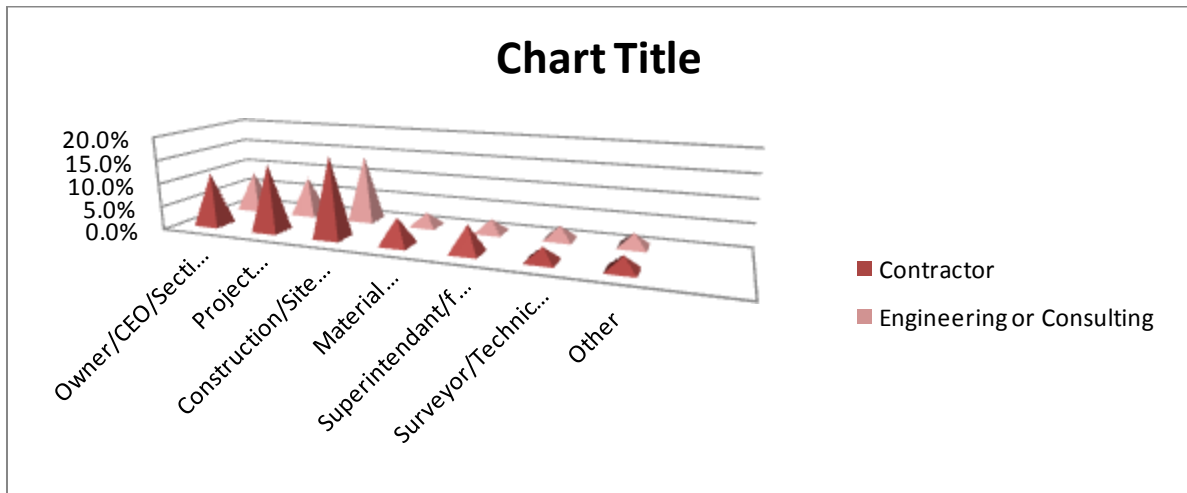


Figure 4.4 work title/position of correspondents

4.3 Quality management system

In this part of the research, respondents' view towards the quality management system is identified. Respondents were asked whether there was a quality management system within their organization or not. If there, they were forwarded to a new page containing questions regarding the quality management system, if they replied there was not, they were forwarded to a different page containing questions regarding the absence of the system. The participants who answered 'I don't know' skipped both of the above mentioned pages.

The other questions presented to the participants were a quality type or system in their institution. Most of the respondents who are at management level knew what type of system should be in place in their organization, but there was some confusion amongst contractor CS1 and CS2 and engineering firm Es1 and ES2 employees. The contractor CL1 and CL2 has a quality system within the organization, but 30% of the respondents responded that the quality management system is following some international standards. Two thirds of EL1 and EL2, knew rightfully that the organization has to follow some

standard rather than certified ISO 9000 quality system but one third thought they were following a quality system within the organization.

4.3.1 Frequency of Training within Construction Firms

Participants were asked how much training they had received from their employer to learn to implement the quality system in their work. They were asked to answer on a scale from 1 (No training) to 5 (Comprehensive Training).

4.3.1.1 Frequency of Training with Contractor

Professionals on the side of contractor were asked whether they received training from their employer to have awareness to implement the quality system on their work or not with the scale 1 (no training to 5(comprehensive training). 16% have not taken training, 20% have taken insufficient training, 18 % have satisfactory awareness, 25% have taken good training and 21% have taken comprehensive training. This result is shown in figure 4.5. From this, we can learn that more than half of the participants answered this question either on a negative or a neutral scale (16+20+18=54%). This could indicate that the organizations that were part of this research are not putting enough emphasis on teaching their staff to use the quality management system.

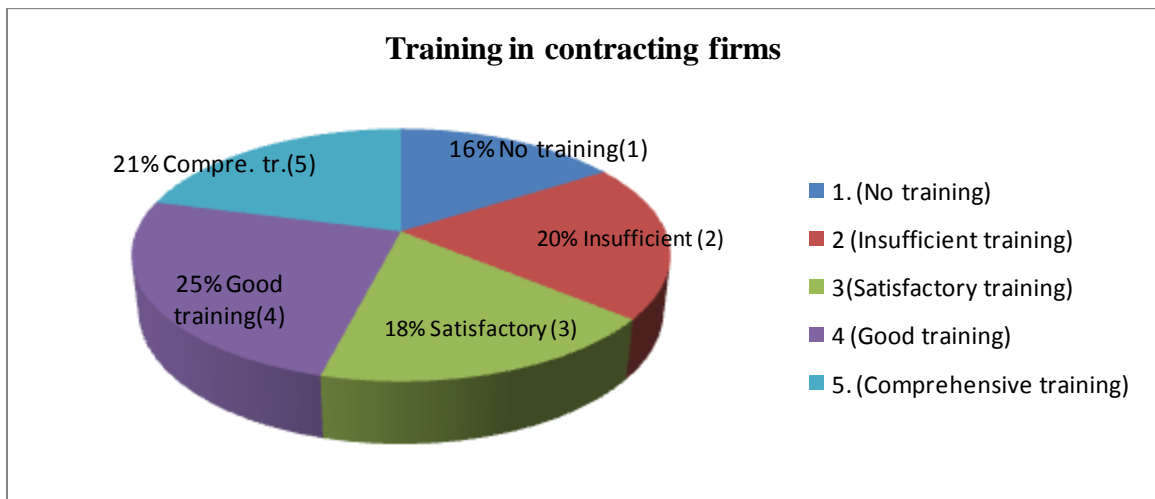


Figure 4.5 Amount of training in contractors

4.3.1.2 Frequency of training in Consulting or engineering firms

Professionals on the side of consultant were also asked whether they received training from their employer to have awareness to implement the quality system on their work or not with the scale 1 (no training to 5(comprehensive training). 10% have not taken training, 15% have taken insufficient training, 18 % have satisfactory awareness, 30% have taken good training and 32% have taken comprehensive training. This result is shown in figure 4.6. From this, we can learn that considerable amount of the participants answered this question either on a negative or a neutral scale (10+15+18=43%). Even though this result is better than that of contracting firm, still works have to be done in the future.

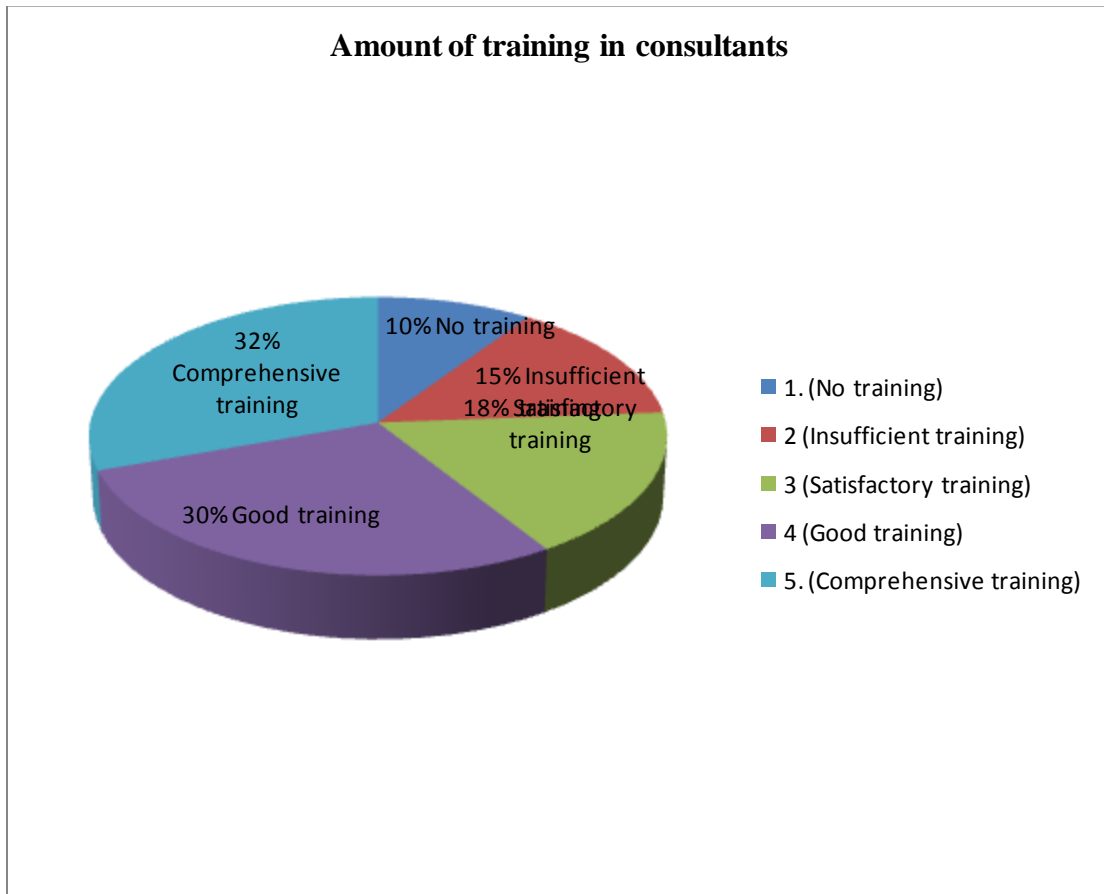


Figure 4.6 Amount of training in engineering firm

4.4 Commitment of Top Management for Quality

The other issue that participants asked was the extent of their agreement towards commitment of top management in quality management system. The average rating was 3.94 (with a standard deviation of 0.80). A total of 70% of participants were positive towards the statement, 27% were neutral and 3% disagreed with the statement for both contractor and consultants.

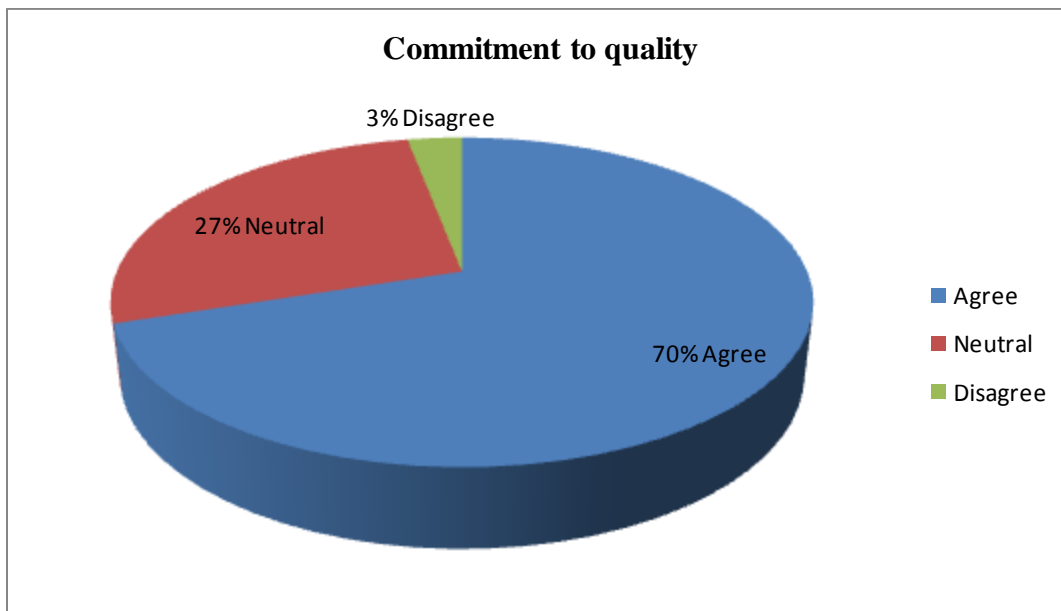


Figure 4.7 Commitments to quality

4.5 Quality in general

This section aims to identify aspect of quality in general. Different questionnaires related with quality aspects were presented to participants. Questionnaire was presented to correspondents to define quality from lists. 19 correspondents (54.3%) said that quality is to meet end users' demand and satisfaction. 12 people (34.3) stated that quality is to guarantee that the product has no problem or will not fail, 3 correspondents (8.6%) selected quality is looking good, works good or making their company's name on finished product.

4.5.1 Quality indicators

Different issues that affect road construction quality were listed with grades 1 to five. 1 represents poor and 5 represents good. Participants were asked to grade a list of eleven factors on how they would indicate good quality performance. The ratings can be seen in Table 4-2. From these results, it can be interpreted that participants have a positive view towards almost all of the factors, except for quality award.

Table 4.3 Quality indicators

Rank	Indicator of quality	Rating	S.D
1	Client satisfaction	4.2	0.95
2	Management commitment to quality	4	0.93
3	Skilled work force	3.9	0.87
4	Certified quality programs such as the ISO 9000	3.8	0.99
5	End user/public/Customer satisfaction	3.8	0.89
6	Regular inspections	3.7	0.91
7	Training and education	3.7	0.94
8	General construction standards	3.6	0.89
9	The amount of rework due to error/defect	3.3	1.12
10	The length of warranty the companies can give on their work	3.1	0.97
11	Quality awards/recognition	2.8	0.97

Figure 4.8 shows how rating between contractor firms and engineering firms varies for each of the factors. Most of the cases there were similarities/coherence in their rating, but the contractor firms' employers were, in most cases, rating the factors a little bit higher than the engineering firms' employers.

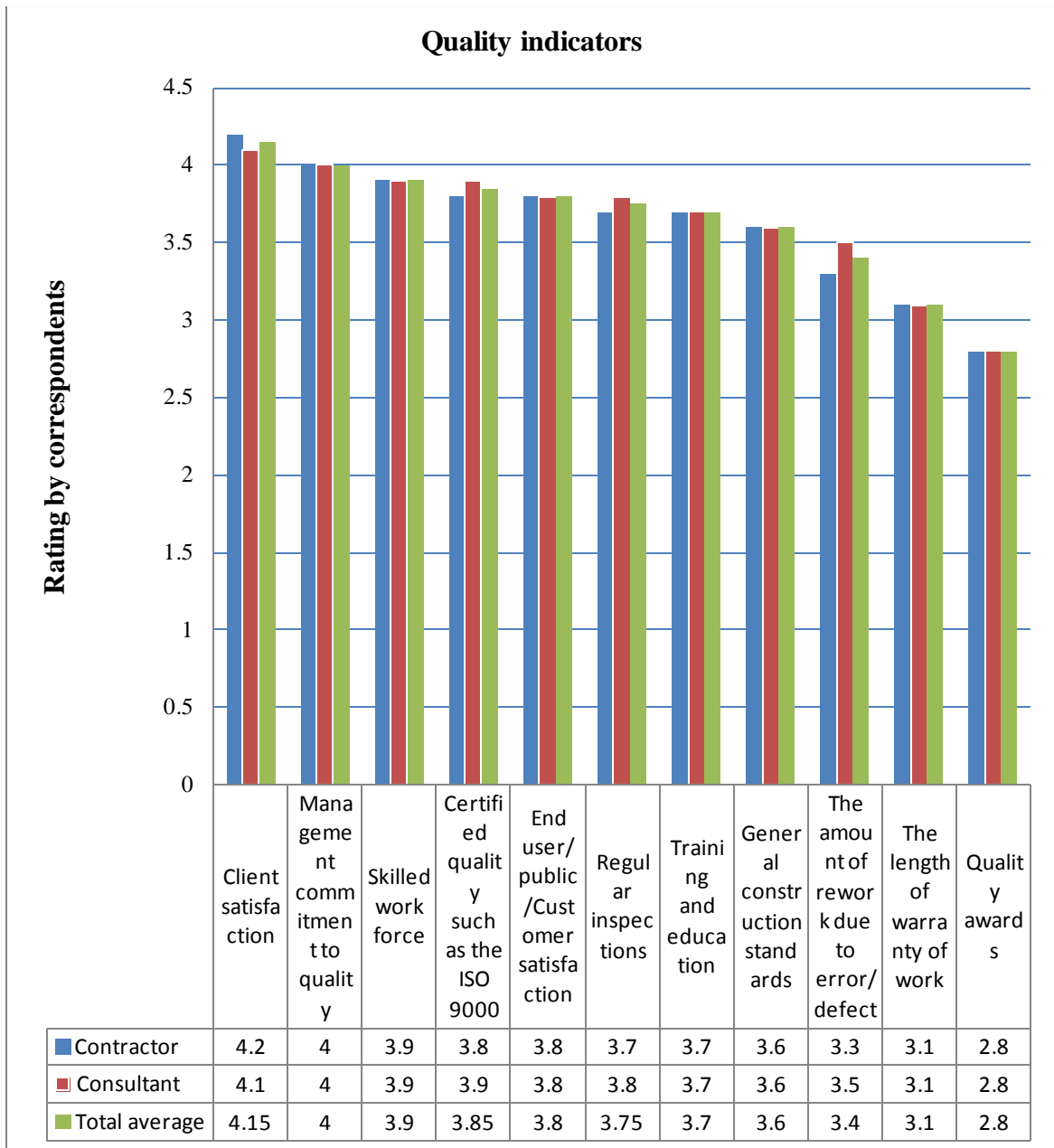


Figure 4.8 Quality indicators with rate

4.5.2 Cost of Quality

Questionnaire was presented to respondents to define cost of quality from lists. There were 22 respondents (62.8%) said that cost of quality is cost incurred due to material testing. Six (6) people (17.14) stated that quality cost is prevention and assurance cost,

while five (5) people (14.3%) said that quality cost involves cost due to appraisal and two (2) respondents (5.7%) said that quality cost is cost of defects/error.

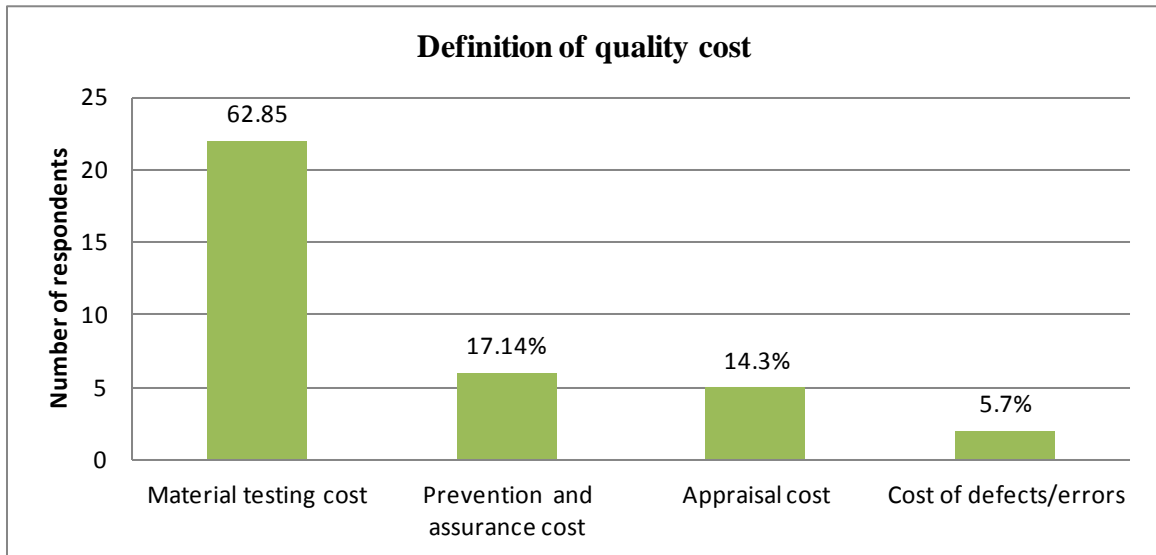


Figure 4.9 Definition of quality cost

In the next question, respondents were asked if the cost of quality was being included in contract document and collected at their work place. As seen in Figure 4-10, 20% said 'yes' to this questions, 80% either did not know whether or not the quality cost was being collected or answered that this was not the case.

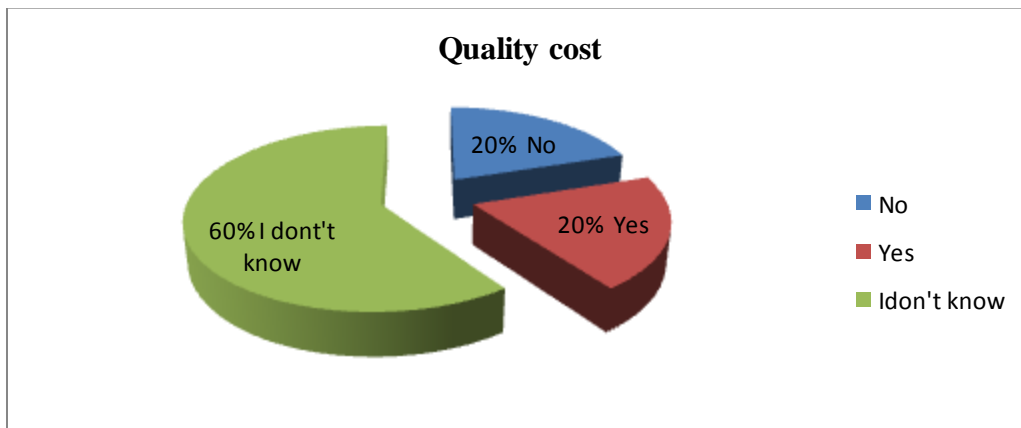


Figure 4.10 Quality cost

4.5.3 Status of Quality and Safety in Unpaved Roads Construction

Participants were asked to rate the status of quality and safety in unpaved roads construction. The scale was from 1 (Very bad – Serious Problems) to 5 (Very good – No problems). As shown in Table 4-4, the contractors’ employees rated the safety status at 2.71 on average and the quality status a little lower at 2.51. Even though both the ratings can be interpreted as positive outcomes, nearly half of the employees are under unsafe condition and believe that quality status needs improvements. The engineering firm’s employees rated the safety status at 2.81 and the quality status at 2.82. This result again shows that works have to be done for safe work and improved quality. The results also show that the contractor’s employees rated both quality and safety slightly lower than those working in the engineering firms.

Table 4.4 Safety and quality status

Group	No.	Safety status		Quality status	
		Mean	S.D	Mean	S.D
Contractor’s employee	22	2.71	0.7	2.6	0.6
Consultant’s employee	13	2.51	0.75	2.5	0.9
All participants	35	2.61	0.74	2.55	0.75

4.5.4 Quality Improving Factors

This part is intended to point out the effect of company characteristic to improve road construction quality. Participants were asked to rate the status of quality and safety in unpaved roads construction. The scale was from 1 (Less important) to 5 (Very necessary /important). The factors from the sample date are ranked in table below based on results from correspondents. Their rating was taken as mean of correspondents response.

Table 4.5 Quality improving factors

Rank	Factors	Mean	S.D
1	Employee involvement	4.6	0.55
2	Management commitment	4.6	0.58
3	Skilled work force	4.5	0.67
4	Communication between managers and employees	4.5	0.64
5	Training and education	4.4	0.65
6	Subcontractors involvement	4.4	0.66
7	Organizational work habit	4.4	0.59
8	Well defined roles and responsibilities	4.3	0.7
9	Clearly defined quality goals and objectives	4.3	0.66
10	Review/analysis used to improve performance	4.3	0.62
11	Regular inspection and audits	4.2	0.75
12	Incentives for good quality performances	4.2	0.73
13	Regular discussion	4.1	0.77
14	Criteria used in pre-qualification in bidding process	3.8	0.8
15	Written program or policy	3.8	0.9
16	Certified program	3.5	0.94
17	Increased use of special soft wares	3.4	1
18	Increased use of strategic methods	3.3	1.02

4.5.5 Causes and effects of defect/error

Participants were asked to list some of the cause and effects of defect/error. Most correspondents listed that causes and effects of defect while constructing unpaved roads are reworks, cost overrun, project delivery delay and social crises.

4.6 Results from Interview

Interviews were conducted in order to add more information to data gathered by questionnaires. It was made in similar fashion to the questionnaires (interviewing

managers in the concerning organizations especially the large contractors (CL1 & CL2 and the large engineering firms (EL1 & EL2)).

4.6.1 Why is quality management system required?

According to responses from interviewees from first large contractor (CL1), the motives to implement quality management system are mostly based on market demand. This is because most project owners (clients) needs certified construction contractor/consultant. Therefore, quality management system is wanted for certification so that they can compete in the market.

Respondents from second large contractor said that their experience of operation made them to follow certain criteria of their organization. These criteria force them to have a uniform work habit so that quality achieved.

Respondents from engineering firm (EL1 and EL2) said that the clients (project owners) wanted them to implement the required quality system. They also said that the licensing agency (Ministry of Work and Urban Development/ MoWUD) made them to follow a given standard according to the law of the country.

4.6.2 How is quality management system useful?

Interviewees mentioned that when quality management system is in place, information flows and its access, competitiveness, values and coordinated work experience were increased.

4.6.3 Awareness creation

Even though there was difference in amount of trained people in each organization, all of them agreed that guidance towards quality management system, increasing training frequency and amount of training, education and short training as well as sessions will be required so much.

4.6.4 Is Quality Management System (QMS) so costly?

The interviewees were asked their views about quality cost and their organization's expenditure towards quality cost. The following responses were received.

- Whenever the cost of mistakes errors and reworks, both direct and indirect are registered, they believed that it costs them more than expenditure for quality system.
- All agreed that there should be appropriate tools and registration processes to record available costs that will incur due to quality management system additionally.
- Improvements are needed within the contractor firms and consulting firms in relation to incurred quality cost, especially if they seek to comply with their quality system demands.

4.6.5 Is there any disadvantage to implement quality management system?

Neither the quality managers nor project managers see any disadvantages or inhibiting factors if quality management system is implemented. Despite, the quality managers identified the human factor as a barrier to successful use of their system because

- There are some people that were opposed to the system because they wanted to carry out their work in their heads and felt that the system is getting in the way of doing so.
- There are always individuals who thought that the system was making them do excessive and unnecessary paper work.
- Some individuals did not find the quality management system completely applicable to their work because the work principle in their company itself is better if implemented.

4.6.6 What is quality status in general?

Participants were asked about their organization's quality status in general. All of them agreed that quality status need to be improved because:

- They believed that the quality management, status and control are not achieved yet.
- Clients are the major one to judge the status of quality rather than general rule.

- Economic factors are determining the final product rather than quality. This was mostly manifested in small enterprises such as URRAP.
- Failure in achieving quality products can open door to bad working habits such as corruption.

4.7 Discussion of the Research Result

From this research, it can be said that there are problems in implementing the required quality standard in construction of gravel or unpaved roads within Oromia Region. The result shows that when there is better quality management system in place, there is increased in public satisfaction for end product. The researcher found out that there are gaps observed to use and implement the knowledge and best practices to achieve quality end product and follow best quality management systems. It has also pointed out that quality status in general needs to be improved.

4.7.1 Research findings

In order to give answers to questions raised in chapter one under research questions, answers can be formulated and further discussions can also be presented according to the data gathered and analyzed in relation to the earlier researches. This can be done using the research questions as follows.

4.7.1.1 Are the quality of project works given proper attention on unpaved roads construction and maintenance in Oromia Roads Authority activities/projects?

This research showed that issues related to quality are not given proper attention because quality status need to be improved, a given general rule (such as quality standard) should be fulfilled. Other issues such as safety and quality status is poor, top managements' commitment to quality is poor, awareness creation or training status is low and other constraints such as budget shortage are hindered it. The data and information that gathered from research correspondents found quality to be inadequate. The research also revealed that there is no quality assurance department within Oromia Roads Authority itself in order to control either contractors or consulting firm. The research also indicated that all construction professionals interviewed for this research had pointed out that

quality was lagging behind and need to be improved. They also suggested that the quality concerns have to be increased because the projects are getting bigger and more complex.

4.7.1.2 What are the effects of inferior quality in unpaved roads construction and maintenance?

As it was discussed in costs of quality management system, most quality defects, and their causes are not registered properly. However, most respondents has revealed that reworks, cost overrun, project delivery delay and social crises are the major effects that caused by defects and errors while constructing unpaved roads. Literature reviews also support the research result. There was increasing emphasis amongst professionals asked on the necessity of quality management, control and improvement within Oromia Roads Authority (ORA). This research also suggested that problems that are responsible for the largest part of the defect cost occur in the design phase and in the construction phase. Their reasons both lie in the field of project management and construction execution. Several researches found the total cost of quality rectification problems to range from 3.4% to as high as 12% of the project's value. Generally, this research suggests further research on the extent of quality failures and non-conformance in road construction projects, both during the design phase and during execution.

4.7.1.3 Are there any gaps in the use of quality control and management system in unpaved roads construction and maintenance?

According to this research, there are considerable quality management and control gaps. The study also suggests that there are gaps to use and implement the knowledge and best practices in order to achieve quality end product and follow best quality management systems at Oromia Roads Authority to construct unpaved or gravel roads. The research revealed that there seems to be a gap in training the employees by their employer in the implementation of the quality management system.

4.7.1.4 What are the possible measures to improve the quality control implementation of unpaved roads construction and maintenance?

This research suggested that construction parties that specialize in gravel roads construction see quality to be inadequate. Therefore there must be struggle to

improvement. The research also revealed that professionals who are concerned with quality system want to see clear improvements in their organizational operations after having implemented new work methods based on better quality management. Their experience replicates the findings of other similar research that presented in the literature review as it suggested that there are clear improvements in project performance based on cost, time and quality after overcoming challenges existing with working practices. It is known that things do not change overnight, so, more emphasis have to be put on raising quality, as the quality culture would slowly begin change for the better. According to this research, there was higher satisfaction by employees by the training received with the employers of the contracting as well as engineering firms. Therefore, training and education on quality system have to be increased.

4.7.1.5 How is quality management system applied?

The use of quality management systems is becoming more common in road construction, though it is not as widespread as in other industries. Many engineering firms especially the larger ones are becoming internationally certified because lack of quality end product has no compromise. In this research, also there are indications that contractors are lagging behind in having certified quality management system. This is because project owners (clients) in this case Oromia Roads Authority have not been setting unconditional demands on contractors for a certified system. This research believes that this scenario could be changed if more responsibility is set by law for hiring capable professionals for each aspect of the construction project.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The purpose of this research was to assess unpaved roads construction quality, quality aspects, quality control and the problems that are occurring with quality. The research revealed that quality implementation while constructing and maintaining unpaved roads in Oromia Region is inadequate. Issues related to quality are not given proper attention, its status need to be improved, Safety and quality status is poor, awareness creation or training status is low, quality was lagging behind, no quality assurance department.

A gap was identified in terms of knowledge of quality management and the application of quality management systems. The research discussed the use of quality management systems in terms of effectiveness and utility to contractors and consulting firms within the Oromia Roads Authority as it was identified to be improved, in terms of operation, effectiveness and implementation. The research showed that there are positive attitude with the employees to have training on quality management, therefore, the employers have to work on increasing training and education for their workers. Furthermore, the study found that there is a gap in the use and implementation of quality management, quality management systems and quality control system and the knowledge about these matters is also inadequate.

This study revealed that the quality indicators such as client satisfaction, management commitment skilled work force training and education were being underestimated. Very few construction organizations seemed to show interest and put effort into collecting information and data on defect, error and failures in quality and its effect, extent and cost incurred due to them and, from that, gaining knowledge on the extent and effect of quality failures.

In this research, most of participants in the research correctly connected the term quality cost to material testing, prevention cost, cost due to appraisal and cost of defects/error, but most of them did not realized that deviation cost was a part of the term. Furthermore,

many participants connected the quality cost with quality assurance. This result indicates that knowledge on quality related matters need to be improved.

The main problem of the construction parties involved in project works of Oromia Roads Authority is that culture of implementing quality principles, procedures and assurance (control) are underestimated. This suggests us that more emphasis have to be put on raising quality, improve quality management system, increasing quality demands and increasing the use of quality management systems, improve knowledge on these matters and better quality culture to have better end product. Even though the project owner (Oromia Roads Authority) is a key player in increasing the use of quality management systems and setting rule for it, this research showed that it is not fully realized the values and benefits of dealing with parties with certified quality management systems as there is no department that deals with quality control and management within it.

5.2 Recommendations

This research has been explored the quality control implementation on unpaved roads construction and maintenance at Oromia Roads Authority. Based on the results obtained, some options are recommended so that public interest is going to be fulfilled.

Quality issues have to be prioritized, increased and improved to ensure high-quality road construction, and shares information on innovations in materials, equipment, construction practices and methods, contracting methods, pavement design, safety features, materials quality control, or construction management. There should also be quality management department within Oromia Roads Authority so that this department determines whether a quality process is being implemented as intended and is producing the desired result.

Effects of quality failures or inferior quality should be identified and have to be well documented. This will help to transfer information about best practices as well as work methods and problems occurred from the completed projects. Implementation of best practices in quality management, control and assurance should be increased to bring major changes for quality control staff and their work philosophy. This major changes of staffing and philosophy helps to put more responsibility with the contractor for quality

assurance and quality control. These changes will also compel contractors to offer long term warranties for their work, and force them to develop and use new equipment and new ways of providing improved roads for society.

In order to improve road construction quality, extensive training and education on quality control and management should be given to the professionals frequently. These training may focus on advanced unpaved road design, improved and locally available materials, improved road construction processes, repair and rehabilitation methods, workforce and enhanced user satisfaction.

The other thing that this research recommends is that there should be legal enforcement for construction parties to have standardized certificates such as International standardizations Organization (ISO) system. These Standards are designed as ISO 9000 series to help organizations meet the needs of the end users/customers or other stakeholders. They are formworks to guide organizations for improved performance and deals with basic requirements for quality management systems that organizations should follow such as customer focus, public involvement, continual improvements etc.

Finally, future researches should be conducted on the extent of quality failures, how to minimize it and reduce the gaps in relation to road construction projects, both during the design phase and during execution. These researches have to be conducted through cooperation, partnerships and funding agreements with highway agencies, consultants, universities, professional associations, and other organizations that have specialized interests and skills.

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APPENDIX-DESIGNED QUESTIONNAIRES

የተከበራችሁ ሁሉ!

ስሜ ራመታ ገላልቻ ወዬሳ ይባላል። በጅም ዩኒቨርሲቲ የኮንስትራክሽን ኢንጅነሪንግና ማኔጅመንት የማስተራተኛ ተማሪ ነኝ። በአሁን ጊዜ ለምርቃቴ እንዲረዳኝ ”*Assessment of Quality Control implementation on Unpaved Roads Construction in Oromia under Oromia Roads Authority.*” በሚል ርዕስ ምርምር (research) እየሰራሁ እገኛለሁ። እርሶም ያዘጋጀሁትን መጠይቅ ፎርም በመሙላት እንዲተባበሩኝ ቢታላቅ አክብሮት እጠይቃለሁ።

Dear Correspondent,

My name is Rameta Gelalcha Woyessa and I am a student in Construction Engineering and Management at Jimma University, Institute of Technology. I am doing my master thesis with the title “*Assessment of Quality Control implementation on Unpaved Roads Construction in Oromia under Oromia Roads Authority.*” The research aims to assess the quality control status, explore views towards quality and the use of quality management system with its implementation in unpaved roads construction and maintenance in Oromia regional state, focusing on project works in progress under Oromia Roads Authority (ORA). It is estimated to take around 7-10 minutes to complete the research and responses will not be traced back to organizations nor individuals. The research will be open until 1st January, 2015. I hope to have positive reactions

Rameta Gelalcha

E-mail: rametag@gmail.com

Phone: +251912153958

Personal background questions

Gender Male Female

How old are you? Under 25 26-35 years 36-45 years 46-55 years

56 years and above

How long have you been working with unpaved roads construction? 5 years or less

6-10 years 11-15 years 16-20 years 21 years or longer

Where do you work? Engineering firm Contractor

Client(Counter engineer) Other

If other please specify: [Your comment please](#)

How many people are currently employed with your company?

1-20 21-40 41 or more

What is your educational background? Please choose your highest level!

MSc. in Engineering MSc. in Architecture Construction Engineering

Highway Engineering BSc in Engineering Geotechnical Engineering

Structural Engineering

TVET College Secondary school graduate Other

If other please specify: [Your comment please](#)

What is your work title/position? Owner/CEO/Section (department) Head

Project manager/ Supervisor Construction engineer

Site/Office engineer

Material engineer Quality controller Super intendant Foreman

Surveyor Safety manager Technical person Consultant Other

If other please specify: [Your comment please](#)

Is there quality management system in your company recently? Yes No

I don't know

Questions concerning quality management in your company/organization:

What is the system that your organization/company follows?

- Quality management system within the organization/company
- ISO Quality management system
- I don't know Other

If other please specify: [Your comment please](#)

Have you received training from your employer to have awareness to implement the quality system on your work? Please use the following scale!

	1	2	3	4	5	
No training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Comprehensive training

How much would you agree that the quality system is useful to your work?

- Totally disagree Disagree Neutral Agree Totally agree

How much would you agree that the quality system is easy to use in your work?

- Totally disagree Disagree Neutral Agree Totally agree

How much would you agree that the top management system is committed to following the quality system?

- Totally disagree Disagree Neutral Agree Totally agree

Quality system not in place

Do you know why there isn't a system in place; check as many items as apply!

- We don't see the benefits We don't have time to implement it

We don't believe that the system is useful to us I don't know

We are currently in the implementing process Too expensive

Other Please specify [Your Comment please.](#)

Question about quality in general

Please rank the following items from 1-5 based on how well they indicate good quality performance

	1 poor indicator	2	3	4	5 Good indicator
End user/public/Customer satisfaction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Management commitment to quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Client satisfaction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Skilled work force	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Training and education	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The amount of rework due to error/defect	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Regular inspections	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The length of warranty the companies can give on their work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
General construction standards	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quality awards	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Certified quality programs such as the ISO 9000...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

What do you assume to be the most accurate definition of quality in construction?

- We don't use the definition of quality
- Non applicable to our work
- Looks good, works good or proud to put the company's name on the finished product
- Meets all end users expectations or demands for the finished product
- Meets design or code requirements, minimal call-backs or rework
- Able to guarantee that the finished product will not fail or have
- Other Please specify: [your comment please](#).

Does your organization or company collect quality cost from project to project?

- Yes
- No
- I don't know

What is your definition of quality cost? Please mark as many items as apply!

- Cost incurred due to material testing***
- Prevention costs
- Appraisal costs
- Cost of repairing defects/error after hand over
- Cost of redesign/ construction defect(error)
- Cost of deviation
- Cost of quality assurance in the bidding or tender process
- I don't know
- Other Please specify: [your comment please](#).

What do you consider to be the status of safety in unpaved roads construction activity?

	1	2	3	4	5	
Very bad-Serious problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Very good – No problem

What do you consider to be the status of quality in unpaved roads construction activity?

	1	2	3	4	5	
Very bad-Serious problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Very good – No problem

Organizational or company characteristics

How do you think the following company characteristics are important for quality work performance? Please fill on the scale 1-5!

	1. Less important	2	3 Medium	4	5 Very important
Training and education	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clearly defined guidelines for end user satisfaction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Means and methods for ensuring continuous improvement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clearly defined goals related to quality of work performance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Systems for collecting and tracking data for ensuring quality objectives are achieved	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A review and analysis for identifying errors/defects in the system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Improving quality

Please rank the importance of the following aspects for improving quality on a scale from 1-5 taking 1 as less important and 5 as most important!

	1. Less important	2	3 Medium	4	5 Very important
Employee involvement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Management commitment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Skilled work force	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Communication between managers and employees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Training and education	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Subcontractors involvement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Organizational work habit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Well defined roles and responsibilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clearly defined quality goals and objectives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Review/analysis used to improve performance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Regular inspection and audits	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Incentives for good quality performances	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Regular discussion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Criteria used in pre-qualification in bidding process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Written program or policy					

	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Certified program	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Increased use of special soft wares	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Increased use of strategic methods	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If you would like to express anything about this research or its topic, please comment!!!!

your comment please.