ADDIS ABABA UNIVERSITY

SCHOOL OF COMMERCE

Safety management practices and challenges of road construction projects in the Central Region of the Ethiopian Roads Administration

By: Abinet Desalegn

A project submitted as partial fulfillment of the requirement for the award of a Master of Arts Degree (MA) in Project Management

Advisor: Solomon Markos (Ph.D.)

June, 2022

Addis Ababa, Ethiopia

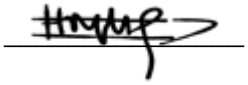
ADDIS ABABA UNIVERSITY

SCHOOL OF COMMERCE

Safety management practices and challenges of road construction projects in the Central Region of the Ethiopian roads administration

By: Abinet Desalegn

Approval Board Committee:

Solomon Markos (Ph.D.)	_____	_____
Research Advisor	Signature	Date
Teklegiorgis Assefa (Ph. D)	_____	_____
Internal Examiner	Signature	Date
Hailemichael M. (Ph. D.)		26/06/2022
External Examiner	Signature	Date

Declaration

I, the undersigned, declare that this study titled “Safety management practices and challenges of road construction projects in the Central Region of the Ethiopian roads administration” is the result of my own struggle and study that all sources of materials used for the study have been acknowledged. I have conducted this study independently with the guidance and comments of the research advisor.

This study has not been submitted for any degree in any university. It is conducted for the partial fulfillment of the Master of Arts Degree in Project Management.

_____ _____

Abinet Desalegn **Date**

Letter of Certification

This is to certify that Abinet Desalegn has conducted this project work entitled “Safety management practices and challenges of road construction projects in the Central Region of the Ethiopian roads administration” under my supervision.

This project work is original and suitable for the submission in partial fulfillment of the requirement for the award of Master of Arts Degree in Project Management.

Solomon Markos (Ph. D.) _____ _____

Advisor Signature Date

Acknowledgements

I thank the almighty GOD for his mercy and unceasing protection from the evil that I'm not aware of and brought me to this end and let me chase my dreams with full peace and health. I like to thank my Bez for the moral support and my kids Nuhamin, Amen and Aron for their patience and like to request your forgiveness for stealing your time. I hope you will understand when you grow up.

I would like to forward my sincere acknowledgment and gratitude to my advisor Dr. Solomon Markos for his extraordinary advice and leadership in this study. In addition, I would like to express my appreciation to all participants and individuals who directly or indirectly provided the necessary materials and support for the realization of this thesis.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

CCCC	China communication and construction corporation
ERA	Ethiopian roads authority (Administration)
HSE	Health and safety executive
HS	Health and safety
ILO	International Labor organization
OSHA	Occupational Safety and Health Administration
MOLSA	Ministry of Labor and Social Affairs
OHS	Occupational Health and Safety
PPE	Personal Protective Equipment
WHO	World Health Organization
ETB	Ethiopian Birr
USD	United States Dollar
ICB	International Competitive Bidding
NCB	National Competitive Bidding
CSFs	Critical Success Factors

ABSTRACT

Road construction is a major development and economic activity known for inherent casualty on men on work due to numerous reasons. These causalities if not managed properly will hamper the target of developmental goal as well as delay the realization of profit from the road development. It is difficult and challenging task to foresee incidents related to a road construction activity before happening as well as its erratic nature does not allow to plan what could be needed if something serious happened; let alone the panic at the moment of happening. Thus, establishing safety management plan is a must in such case. This study is to assess safety management practices and challenges of road construction projects under the Central region of the Ethiopian Roads Administration through two representative highway projects. A descriptive research design method is used in this research and the data collection is made through a structured questionnaire. Both primary and secondary data types were used for this study. The researcher has used quantitative and descriptive research method through a questionnaire. The data was collected from the respondent to be analyzed using quantitative data analysis techniques using SPSS. Stratified sampling technique was used to identify sample size out of total population. Accordingly, data was collected and from the data collected the major findings and conclusions are (a) safety practices is believed to be most important aspect by almost all of the respondents, during road construction; but the culture of the safety management practice during road construction is found to be poor and related trainings are very rarely given and (b) much difference was not seen in practicing safety during road construction in both local and international road construction companies. (c)Only personal protectives equipment (PPE) are sought to be a practice of managing safety in road construction projects. It is recommended that the safety practice is very important and should be implemented thoroughly. Attention must be given to the safety management at the preliminary stage of the road project and should be inspected in regular basis by both client and other governmental bodies.

Key words: Construction, Road construction safety management practice, personal protective equipment (PPE)

CHAPTER ONE

1. INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Road construction is a major development and economic activity known for inherent casualty on men on work due to numerous reasons. These causalities if not managed properly will hamper the target of developmental goal as well as delay the realization of profit from the road development. It is difficult and challenging task to foresee incidents related to a road construction activity before happening as well as its erratic nature does not allow to plan what could be needed if something serious happened; let alone the panic at the moment of happening. Hence, it is apparent to establish a mitigation plan for exhaustive possible happenings and setup a way to continuous follow up to make sure the plan is turned in to an action from time to time.

Shehab, Tariq. (2021) reported while so many researchers have been exploring the safety environments in many types of construction activities, but only limited research has addressed the highway construction sector (Kim et al. 2013 and Arditi et al. 2007), and it is observed the same is a major research gap in Ethiopia. As the road construction involve different stake holders with various interest it is a must to place a controlling mechanism to minimize damage on the road construction workers. Therefore, in this study we will try to see the status of the systematic management of work zone safety placed by road contractor and we will check its practicality during execution visa vis the common incidents in the road construction.

Ethiopia has now entered into the modern era via activities of construction in wide spectrum. Dams, bridges, and residential and office buildings are rising in almost all the parts of the country in pursuit of establishing a better environment for the well-being of the citizens by different parties like regional and federal governmental bodies, etc. It is reported road construction projects in Ethiopia has been holding 2nd place next to the military to claim the country's capital budget spending in the last two to three decades. It is evident road construction is an industry that attracts

small to large companies with ample job offer for low, medium and high-skilled workers and can accommodate a significant share of the country's employment capacity (ILO, 2020).

Ethiopian roads administration formerly (famously) known as the Ethiopian roads authority (ERA) was established in 1953Gc and re-established as per the proclamation no 80/1997 with the objectives to develop and administer highways and to ensure the standard of road construction and to create a proper condition on which the road network is coordinately promoted. Among many sections of the office, one is the central region directorates which handles construction contract management and implementation of road projects.

Bilalo- Kersa Arusi Negele road construction project is located in the Oromia region one of the upgrading road projects currently undergoing and it is around 92 km. Ethiopian roads administration employed an international construction company named china communication and construction corporation (CCCC) to execute the project and employed Sheladia Associates Inc. as the engineers' representative. It is an ICB project fully funded by the Ethiopian government with an estimated amount of 52 bln. USD.

Kossie- Mito- Worabe road construction project is located in the SNNP region. It is also an upgrading project around 91 km long. Ethiopian roads administration employed a local construction company named Yencomad Construction Company to execute the project and employed Sheladia Associates Inc. as the engineers' representative. It is an NCB project fully funded by the Ethiopian government with an estimated amount of 1.8 bln. ETB.

Both these projects are administered by the central region of the Ethiopian Road Administration I have selected these road projects to show the similarity or difference in practices about work zone safety and in a belief, that it would expand the subject matter in terms of local versus international companies. The general objective of a program of work zone safety is to protect workers, pedestrians, transit passengers and facilities, bicyclists, and motorists during construction and operations. This general objective may be achieved by A comprehensive plan for work zone safety is required.

1.2 STATEMENT OF THE PROBLEM

The construction industry is well known for hazardous accidents worldwide and highway construction is one of the major constructions/economic activity where passenger vehicles, construction vehicles, and construction equipment all pose a threat to workers. The nature of the construction process coupled with the required physical demand and use of rigorous labor with lower analytical skills, and laborious work process makes the industry to encounter higher risk of fatality and injury.

According to (NsaHTSA, 2013) in USA 87,606 crashes occurred in work zones that led to over 37,000 injuries and 576 fatalities in 2010. The USA bureau of labor and statistics reported construction industry represented 4.5% of statewide employment while it accounted for 11.48% of the statewide fatalities. (Bureau of Statistics. 2005)

Although there were few organized records found to show the incidents during the construction of the highway projects, accidents happening during commissioning activities are imminent. This fact should have been backed with proper implementation of safety precaution practices to minimize incidents, but it is seen otherwise in the construction industry due to many explanations.

On the other hand, the contractor office is only interested in officially recording and reporting incidents related to traffic accidents on the project premises where legal accountability is higher, ignoring individual happenings to its employees. This practice poses a challenge in determining the extent of causalities during construction has impacted the life of workers in the road construction sector.

To mention some of policies related to work zone safety, FDRE Ministry of labor and social affairs introduced some conditions to enhance occupational safety and health of workers in its directive of May 2008 and the Ethiopian Constitution (1995) in its Article 42/2: Rights of Labor decree on workers right for healthy and safe work environment. The government also decree proclamation no. 4/1995 to vest powers and duties of MOLSA. MOLSA is a government body

which is responsible to determine standards and measures for the safety and health of workers and follow up their implementation.

Work zone health and safety-related management procedures are implemented to a slighter degree amidst the contractual requirements to save cost. On the contrary, accidents related to failure to implement a precautious daily check on the status of adherence to the safety rules by employees are common and such problems are tried to be contained and handled within the contractor's office.

It is confirmed that risk policies and response plans in local road construction companies are given little attention with the excuse that they are in the process of capacity building. For this reason, the follow-up is loose by the client who employs them. On the other hand, international companies that are involved in highway construction in Ethiopia have vast experience in their originating countries and are believed to have risk mitigation and response plans. Yet, little attention is given by the client to inspecting their practice and implementation of their health and safety plans due to a knowledge gap.

As a result, it is found to be difficult to implement health and safety management practices at full capacity during the construction of highways in Ethiopia, and this has led to an increasing number of incidents/injuries and hospitalizations of staff during the construction.

The construction of highways is carried out in an active environment with the movement of pedestrians, livestock, and public and private transportation, and the prevention of accidents related to movements around the construction site requires bulky activities like putting up traffic signs, precaution notices, and indications to detour against the challenge of damage and theft of these instruments.

Research question

In this study, we will try to observe the state of the safety regulation and its implementation during the process of construction on two highway projects that are currently under construction

under the administration of the Central region office of the Ethiopian Roads Administration. We will try to understand the nature of safety regulations we have and procedures and practices followed during the construction, and the effectiveness and efficiency of the procedures in avoiding accidents while the construction is underway.

We will also try to observe the status of operational activities, techniques, rules, and signs on construction sites, such as the placement of safety barriers and warning tapes around the excavated area vis-à-vis frequently occurring accidents and their major causes during road construction.

To broadly show the case in point, we have selected two road projects undertaken by one international (Bilalo-Kersa-Arusi Negele Road Project) and one local contractor (Kosie-Mito-Worabe Road Projects). We will try to analyze the similarities and differences as well as the extent of the contractors' effort towards applying the principles and practices of work zone safety.

We will also try to forward some possible solutions for the collective problems related to work zone health and safety management as well as for problems related to the safety of traffic management on the construction site.

1.3 THE OBJECTIVES OF THE STUDY

1.3.1 General Objective

The overall objective of this research will be to assess the safety management practices and challenges of road construction projects in the Central region of the Ethiopian Roads Administration through two representative highway projects.

1.3.2 Specific objectives

1. To assess the current safety management practices related to work zone safety and traffic management.
2. To evaluate the effectiveness of these safety management practices applied and what are the challenges during the implementation in the construction process.

3. To determine the major types of incidents, their causes, and their intensity in the construction process of the two highway projects.

1.4 SIGNIFICANCE OF THE STUDY

The findings from this research will help to increase informed decision-making during the contract administration by the Central Region of the Ethiopian Road Administration. It reveals the covered reality of incidents that are not boldly written in the reports as well as given enough attention to prevent future accidents due to failure to implement proper safety measures. It also adds to the knowledge area and calls for other detailed studies on other projects that are beyond the reach of this research.

1.5 SCOPE OF THE STUDY

The scope of this research will be limited to exploring safety management practices and challenges of the two road projects, Bilalo-Kersa-Arusi Negele and Kosie-Mito-Worabe Road Projects. Practice and challenges meaning the state of the managerial aspects of the safety management in regard to the internationally accepted practices and trends.

It is also limited to studying work zone safety and traffic management-related safety issues during only the construction stage of highways. Road safety and black spot identification are other vast topics that are not covered in this study. The health-related issues are also not covered in this research, and it is because the effects on the health of people who are involved in road construction are to be measured over a longer period and covered by related project topics like HIV/AIDS alleviation measures.

1.6 ORGANIZATION OF THE PAPER

This research was organized into five chapters: The first chapter provides a general introduction to the study, including background of the study, statement of the problem, objectives of the study, significance of the study, and scope of the study. Chapter two covers the literature review part of the study, which is relevant to the study. It includes empirical concepts and theoretical frameworks. Chapter three elaborates on the type and design of the research. It also includes research methods, sampling techniques, data collection methods, and methods of data analysis that are used in the study. Chapter four contains the results of the study. Chapter five includes a discussion, a conclusion, and a recommendation.

CHAPTER TWO

2. LITERATURE REVIEW

Reviewing and citing relevant literature are absolutely essential in academic writing, such as in essays, theses, research reports, dissertations and research articles (Arsyad & Adila 2017). Information was collected from various literature related to work zone safety and traffic management during construction in an attempt to maximize information on the subject matter. The literature review has two parts: a theoretical literature review and an empirical literature review. The study begins with a detailed literature review on concepts of health and safety issues and their importance in the construction industry, focusing on the relationship between the nature of the construction industry and the occurrence of accidents in most activities that involve perilous operations. Following, it is attempted to show an overview of safety management processes with the identification of the most frequent incidents and their causes versus their association with the nature of mobility in the construction site, vis a vis their frequency and fatality.

2.1. Theoretical literature Review

2.1.1. Introduction to Safety and Health in Construction Projects

Safety programs contain many elements such as safety policies, safety committees, safety training, accident investigations, in-house safety rules, safety incentives programs, control of subcontractors, personal attitude and perception, personal protection equipment, emergency planning, safety promotions, safety record keeping, and job hazard analysis (Anton 1989; Rawlinson 2004).

2.1.2. Safety and Health Definition of Basic Terms

Basic definitions of the terms to be frequently used in this research are presented below to create a clear understanding of the subject matter as well as to be able to understand the nature of

incidents to be presented in the following chapters of this research. The legal frameworks related to safety and the nature of the construction area (work zone) are to be briefly discussed here.

Health

Health according to Merriam Webster's dictionary, refers to the general condition of a person being free of illness, injury or pain and being safe in terms of one's system of energy, i.e., mind, body and spirit. The medical dictionary defines health as the relative state in which one can function well physically, mentally, socially and spiritually to express the full range of one's unique potential within the environment he or she is living in.

René Dubos, "health is primarily a measure of a person's ability to do and become what he or she wants to become." High-level wellness is described as a dynamic process in which the individual is actively engaged in moving toward the fulfillment of his or her potential.

The World Health Organization (WHO) defined health in its broader sense in 1946 as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity" (WHO, 2006).

Safety

Safety is the condition of being secured or protected or being safe from being unlikely to cause danger, risk, or injury to a person, according to Merriam Webster. It is also the quality or condition of being safe; freedom from injury, danger, or damage; i.e., Security. It can also mean any method or device for preventing an accident or undesirable effect. It is related to external threats and the perception of being sheltered from threats. According to the business dictionary, safety is defined as relative freedom from danger, risk, or threat of harm, injury, or loss of personnel and/or property, whether caused deliberately or by accident.

Safety is defined as the fact of being free from danger or risk or taking safety precautions or safety measures to make sure something is safe (Dictionary of human resource and personnel management 2003). According to Mwombeki (2005) safety is defined as the condition of being

protected against any type of event (accidents) that could be considered non-desirable by controlling hazards to achieve an acceptable level of risk.

Due to the thin line separating the definitions of the two terms, it is usually being used altogether to indicate the inseparable condition of the physical and mental well-being of an individual and also to indicate the need for appropriate plans, tools, procedures, manuals, and rules and regulations to be followed in the works zone so that the impact of incidents can be kept to a minimum through welfare.

Welfare

It is the provision of facilities to maintain the health and well-being of individuals at the workplace. Again, Merriam Webster defines it as a statutory procedure or social effort designed to promote the basic physical and material well-being of people in need.

Hazards

The chance of suffering harm; danger, peril, and risk of loss. An obstacle or other feature that poses a risk or danger; originally used in sports but now used more broadly. These hazards could lead to problems manifesting within a short time; acute and/or lead to long-term problems; chronic.

Accidents

It is an unexpected event with negative consequences that occurs without the intention of the one suffering the consequences. It is an unfortunate incident that happens unexpectedly and unintentionally, typically resulting in damage or injury. An event that happens by chance or that is without apparent or deliberate cause.

An accident is defined by the Health and safety executive (HSE, 2003) as any unplanned event that results in injury or illness to people, damage or loss to property, plant, materials, or the environment, and or the loss of a business opportunity. To summarize, an accident is defined as some sudden and unexpected event taking place without the expectation of causing injury, damage, or death. (Mwombeki, 2005)

Incident

An incident is an instance of something happening; an event of occurrence. Well, we can encounter various kinds of incidents in the presence of high mobility and commission of activities, movement of construction machinery from small to large types and through these processes; accidents are hazardous incidents in the construction work zone, which deserve proper management.

An incident is a temporary encounter with something or happening that is less likely to happen within a short interval of time. Both hazards and accidents are accommodated within incidents as both are less likely to happen frequently if proper management is implemented.

2.1.3. Occupational Health and Safety (OHS)

Occupational 'safety and health' is an area concerned with the development, promotion, and maintenance of the workplace environment, policies, and programs that ensure the mental, physical, and emotional well-being of employees, as well as keeping the workplace environment relatively free from actual or potential hazards that could injure employees. Nyirenda V, Chinniah Y, and Agard B (2015).

Occupational ''safety and health'' (OHS) is a discipline dealing with the prevention of work-related injuries and diseases and the protection and promotion of the health of workers. It aims at the improvement of working conditions and the environment. Occupational safety and health (OSH) in construction is generally defined as the science of the anticipation, recognition, evaluation, and control of hazards arising in or from the workplace that could impair the health and well-being of workers, considering the possible impact on the surrounding communities and the general environment.

2.1.4. Construction sites and Accidents

Most commercial construction projects are big projects, and since such construction site is a potentially dangerous environment, health and safety standards have to be observed strictly and maintained at all times. Each project should have a safety management system in place that outlines the policies, processes, instructions, and documentation that will serve to establish a culture of safety and understanding for everyone on the construction project.

The construction Industry is labor-intensive and involves a large number of unskilled workers as compared to other industrial sectors. Some sectors of the construction industry, such as road construction, are also highly mechanized and equipment intensive. Due to these factors, the construction industry has a reputation for being among the most dangerous occupations, with a high number of job-related accidents compared to other working environments.

Workers engaged in construction activities are thus exposed to a variety of hazards, including falls, being caught in between, excavation-related hazards, dust, noise, chemical exposure, electrocution, and so on.

2.1.5. Road construction Site Hazards

The environment of the working area in road construction is more or less comprised of the following attributes to which workers in construction sites are exposed:

- To working at “height”
- Working near earthmoving machinery and equipment
- Working in confined places (excavation and mining areas),
- In areas being painted, hence exposed to gases and other chemicals
- Working near electrical equipment

These works are also carried out in a constantly changing (dynamic) environment, with working surfaces, equipment, machinery, trenching, and scaffolding being moved, assembled and

disassembled, or modified on a regular basis. Small contractors (subcontractors) perform different types of work close to each other.

Some of the hazards in construction sites are attributed to such incidents as falling from high positions, falling objects, excavation hazards, manual tasks (leading to sprains and strains, back injuries, etc.); Hazardous substance exposure; electrical hazards; traffic hazards; plant rollovers (e.g., cranes, excavators, trucks, rollers, graders); noise, dust, and sun exposure; working in confined spaces.

The major causes of safety and health problems in construction sites can be categorized into one of the four major groups

Falls: falls from a height or from scaffolding

Struck by: caused by heavy construction equipment such as trucks, graders, cranes, or scrapers, and also from materials poorly rigged or improperly stored

Caught in-between: such as the collapse of excavations or trenches, Caught between a moving piece of equipment and another surface

Electrocution: involves contact with live electrical parts. Most frequently, through contact with high voltage lines, usually contacted by a piece of construction equipment such as a crane or an aerial lift

Hazard Assessment

To minimize the work zone hazards of OSHA, the USA suggested a series of activities within a procedure called hazard mapping. The importance of this procedure is to gather knowledge about hazards from in working environment to eliminate or reduce the risk of accidents and injuries.

A Hazard Map is a visual representation of the workplace that identifies where there are hazards that could cause injuries. For example, a hazard map might look like this: Physical hazard, Exposure frequency, Level of exposure, Specific items like tools, machinery, Specific workers or job classifications are most likely to be exposed, etc.

This helps to identify areas of risk and prepare an advanced mitigation plan for accidents if they happened. These steps include examining and labeling risks according to their risk of occurrence from experience. (OSHA Field Operations Manual (FOM), CPL 02-00-148, November 2009.)

Hazard Identification

Hazard identification is the first activity to be performed by a competent team by thoroughly analyzing all the tasks and considering previous accident records. The team identifying the hazard must include engineers, safety supervisors, and workers. At this stage, worksite analysis of work activities is carried out. This includes making a list of people to be involved; responsibility to be assigned; detailed work procedures in chronological order; materials required; loading and unloading location; equipment to be used, etc. For this, various information are required, such as organizational charts, interviews, records, and a 'walk-through' survey of the worksite.

A walk-through survey is considered to be the most effective way of listing out all the activities and possible failures at a site. After analyzing and listing out everything necessary for the completion of the activity, hazard identification is carried out. The goal of hazard identification is to identify potential risks associated with a hazard. The hazards identified during this stage are to be categorized based on their nature, likelihood, severity, and risk level. The list of identified hazards needs to be updated and reviewed at regular intervals. (Devvart et al., 2021)

2.1.6. Importance of safety

The European Agency for Health and Safety at Work (1999) has seemingly highlighted and identified some of the possible benefits in this regard, while White et al. (2003) have emphasized how implementing the standards would contribute to greater prosperity within the organization and increase worker productivity since there would be a lower rate of absences due to injuries and illness. This would enhance the stature of the organization and contribute to greater profit and turnover. Because of the lower expenses connected with work environment accidents, a superior relationship with builders and contractors has an additional minimized probability of prosecution and ensuing penalties.

2.1.7. Scope of the construction industry and general problem description

The construction industry plays a vital role in the social and economic development of all countries. Its scope is very wide, from larger civil engineering projects such as dams, roads, building, water supply, sewerage schemes, river and canal work, etc. Construction work is also needed in agriculture, industry, education, health, and other service industries.

It is classified into various segments: industrial, housing, commercial, utilities, and infrastructure work. Thus, the construction industry is a mixture of different organizations, which directly and indirectly influence the construction process. These organizations include multiple professions such as property developers, architects, engineers, quantity surveyors, accountants, lawyers, civil engineering contractors, engineering contractors, management contractors, laborers, subcontractors, and specialist trades. The construction industry ‘s importance has been confirmed by several studies (Coble et al.,1999).

Productivity in the construction sector is aggressive for workers in major construction projects that employ the highest number of laborers, skilled and contract workers. This is the group that suffers the highest accident and accident rate with serious human, social, and family impact (Duran López et al., 2007).

2.2 Empirical literature review

2.2.1 Safety management

A health and safety management framework can be seen as a coordinated arrangement of work practices, beliefs, and techniques for observing and enhancing the health and safety of all parts of the operations of an organization (Civil Aviation Safety Authority, 2002). According to the European Union (1997), “The safety management system should include the part of the general management system which includes the organizational structure, responsibilities, practices, procedures, processes, and resources for determining and implementing the major-accident prevention policy.”

Safety management exhibits the systematic application of management policies, procedures, and practices to the tasks of analyzing, evaluating, and controlling safety risks (Papadakis et al., 1997). This also includes safety policies, initiatives, programs, training, campaigns, future research, etc.

Occupational accidents are never intentional and can occur through the risk of being unidentified, incorrectly analyzed, and/or the response being ineffective. Work zone safety management is the result of planning, design, and preparation of contract documents for modification of the normal traffic and pedestrian patterns during construction. In the work zone, safety management is concerned with safety for the personnel on the worksite, pedestrians, and anything in movement within the premises of the construction area.

During construction, maintaining the carrying capacity and accommodation for all users is usually not possible. Existing roads are narrowed, closed, or rerouted. Work zone safety management guidelines outline a structured approach to the development of a safety management strategy and requirements for a traffic management plan, which will minimize delay and inconvenience for road users (ICED, 2018).

A specific project of road construction shall be categorized based on the impact level that will be created in the work zone to determine the extent of information required in the management plan. It requires categorizing a project-based impact level (High, Medium, or Low) category depending on the significant of the project that is anticipated to cause sustained work zone impacts and not significant. A suitable management plan will be derived based on the category of impact of the road construction activities.

The principles of work zone safety and traffic management plans in a specific project are primarily protection of work crews from hazards associated with moving traffic and the safety of pedestrians, animals, and vehicles traveling through the work zone; and secondarily, capacity of facilities and delays to users, maintenance of access to adjoining properties, and other issues that may result in project delay.

Safety management is the procedure used to recognize-safety related risks and implement actions to decrease the possibility of a risk materializing and to diminish or eliminate the potential consequences of identified project health and safety risks. (Saeed et al., 2017)

2.2.2. Factors affecting safety management performance in construction

Literature has pointed out different factors that affect the performance of safety and health in construction. There are historical, economic, psychological, technical, procedural, organizational, and environmental factors that affect the level of construction site safety. The historical factor is assessed by the background and characteristics of the individual, such as age and experience. The economic factor is determined by the monetary values that are associated with safety, such as hazard pay. The psychological factor is assessed by the safety behavior of fellow workers on site, including supervisors. The technical and procedural factors are assessed by the provision of training and the handling of safety equipment on site. The organizational and environmental factors are assessed by the type of policy that the management adopts for site safety. (Edwin et al., 1999).

Factors like extreme weather conditions have a direct effect on safety and health performance. There are signs of heat stress like nausea, headache, fatigue, excessive thirst, profuse sweating, confusion, painful large muscle cramps, and loss of consciousness as road construction is carried out in an open environment. Those signs of heat stress can lead to heat cramps, heat exhaustion, or heatstroke, which, if untreated or sufficiently severe, may lead to death (Brake et. al., 2003).

The complexity of planning safety and health performance was found to be positively influenced when designers improve awareness of the safety and significance of their design decisions on reduction in injuries, which will decrease in redesign costs and operating costs of special procedures and economical use of personal protective equipment (Hinze et al., 1992; Kartam et al., 2000).

Type of clients

Clients can play a vital role in accomplishing better safety and health performance, such as: providing safety and health guidelines that the contractor must follow; implementing control of work permits for potentially harmful activities; obligating the contractor to elect a responsible supervisor to coordinate safety in the workplace; discussing safety at client-contractor meetings; conducting safety audits during construction; enforcing prompt reporting and full investigation of accidents (Hinze et al., 2003).

Project Duration

Safety plays a key role in keeping a construction project on schedule and on budget, although a tight project schedule had a high rank on the safety performance of the project (Zou et al., 2007).

Safety Policy

The reduction of accidents would be accomplished when top management pays dynamic attention and is dedicated to safety and health improvement as well as maintaining good safety and health policy (Sawacha, et al., 1999). Safety Signals, Signs, and Barricades Warnings in the form of signs and symbols have been stated as standard and effective tools to influence behavior and develop the risk awareness of road users during construction.

Safety Training

A successful safety program can be achieved if all employees are given periodic educational and training programs to improve their knowledge and skills related to safety at work. These training sessions can be conducted through various techniques like worker orientation, safety induction, toolbox talks, or communication programs. It may include topics such as worker rights and responsibilities, personal protective equipment, first aid and emergency procedures, confined space entry, equipment training on knowing how to maneuver around equipment and take all precautions for their safety and that of others; improving visibility in moving around the vehicle; and a wide assortment of other topics, whether to be presented as updated information or just to be provided as a refresher on a subject, (Hinze et al., 2003).

Personal Protective Equipment (PPE)

There are two categories of PPE. The first three categories are safety helmets; safety shoes; and appropriate clothing. The second category depends on the type of work, like eye protection, protective gloves, ear protectors, and the safety harness. (Jannadi et al., 2002).

The common understanding in the construction industry is that PPE is a means of protection for workers, though safety is about creating a conducive working environment in which PPE will only serve as an extra protection or be a last resort when considering all accident control measures. Other methods should be considered and used that will reduce or eliminate the risk of injury.

However, where PPE is the only effective means of controlling the risks of injury, then contractors must ensure that PPE is available. PPE should be worn at all construction sites. A typical construction site may require workers to wear a hard hat, coveralls, safety footwear, gloves, eye protection, and a high visibility vest. This equipment must be provided to all employees at the beginning of an activity and must be supervised at certain period of intervals.

Some of the personal protective equipment pertinent to road construction with their level of importance are:

Foot Protection (Safety Shoe): Steel-toed boots will prevent toes from being crushed due to falling objects. Construction workers should also wear slip-resistant or puncture-resistant soles at all times.

High-Visibility Clothing (Reflective Jacket): When visibility may be impaired, reflective clothing will be necessary, especially while working at night and near moving machinery.

Head Protection (Helmet): Hard hats protect against impacts from fixed and falling objects. Some hard hats may come equipped with face shields or earmuffs. Helmets should fit properly and never be altered. They should also be replaced after any heavy blows. Be sure to inspect them periodically for cracks or deterioration.

Hand Protection (Gloves): Workers will need heavy-duty rubber gloves for concrete work and at asphalt plants.

Eye and Face Protection (Safety Glass): Hard hats don't protect the face, which makes safety goggles or face shields very important. When it comes to cutting, grinding, welding, or nailing, eye protection is essential. They should also be worn when working with concrete or harmful chemicals, or when exposed to electrical hazards. Goggles might be tinted, and some offer side shields.

Respiratory Protection: When employees work in quarry and crusher sites, asphalt plant respiratory protection is vital. Respiratory protection can protect against chemicals and even dust. Respirators must also be cleaned to remain effective.

First aid is a provision of primary care for an injury as it is regularly carried out by a trained first aider on an injured person until definitive medical treatment can be reached if required. Each construction site needs to have the appropriate first-aid arrangements. However, these arrangements would not eliminate the hazards but only reduce the potential for injury to the injured person who might be exposed.

2.2.3. Causes of Construction Accidents

Due to the high number of accidents that occur in construction and the consequences of those on the lives of workers, organizations, society, and countries, occupational safety has become a very important issue for stakeholders as a part of human resources. The causes of accidents can be attributed to factors such as human error, unsafe behavior, and the interaction of humans with materials, tools, and environmental factors (Lehto et al., 1991).

Most accidents are caused by unintentional human errors. Human error is an unwanted human decision or action that reduces the effectiveness of safety measures and increases the risk of an accident happening. Examples are misuse of equipment and tools due to a lack of knowledge or misconduct of workers.

Accidents are naturally directly related to factors such as the project's nature, method of construction, site restriction, project duration, level of construction, and subcontracting. At work, there are three basic causes of workplace accidents; chance of occurrence, unsafe conditions, and unsafe acts. Both unsafe conditions and unsafe acts can be managed through proper planning and execution of safety precautions, but the chance of occurrence is more or less beyond management's control.

Unsafe Condition

Unsafe conditions are the mechanical and physical conditions that cause accidents. These are the main causes of accidents, and they include inappropriate personal protective equipment, procedures that are dangerous in, on, or near machines or equipment, improperly guarded areas, improper illumination, glare, and insufficient light in working night shifts

We can reduce unsafe conditions through engineering controls, administrative or organizational controls, and personal protective equipment.

Unsafe Acts

Unsafe acts contribute significantly to the occurrence of accidents; however, if managed properly, there is a significant reduction in the unsafe condition of the workplace. Here we will be forced to enquire why people act in such a reckless manner, draw an appropriate management plan, execute and control the result to overcome the problem.

We can reduce unsafe acts by emphasizing top management commitment, emphasizing safety, establishing a safety policy, reducing unsafe acts through selection, providing safety training, using posters and other propaganda, using positive reinforcement, using behavior-based safety programs, encouraging worker participation, and by conducting safety inspections regularly.

2.2.4. Role of Government and Engineering Societies

The engineering societies should help to extend engineering knowledge by developing an awareness of safety and health issues among engineers. In developing countries, there are no strong labor unions like industrial countries have, which own the power to defend their laborers and to enforce contractors to provide safe working conditions and safety tools to their laborers (Fang, et al., 2004; Teo, et al., 2005).

Construction work is also considered high-risk in the European context. As a result, the European Communities Council, in its Resolution of December 21st, 1987, named the construction sector as one of the three highest risk sectors and instructed the Commission to prepare a directive which culminated in the directive identified as 92/57 CEE, of June 24th, 1992, on construction work, which was incorporated into their legal system through RD 1627/97 of October 24th, 1997. Some interesting analyses of regulatory tools in some European countries have been published, as well as a review of the rules and regulations on safety in the countries of the European Union. (Zwetsloot et al., 2011a, b).

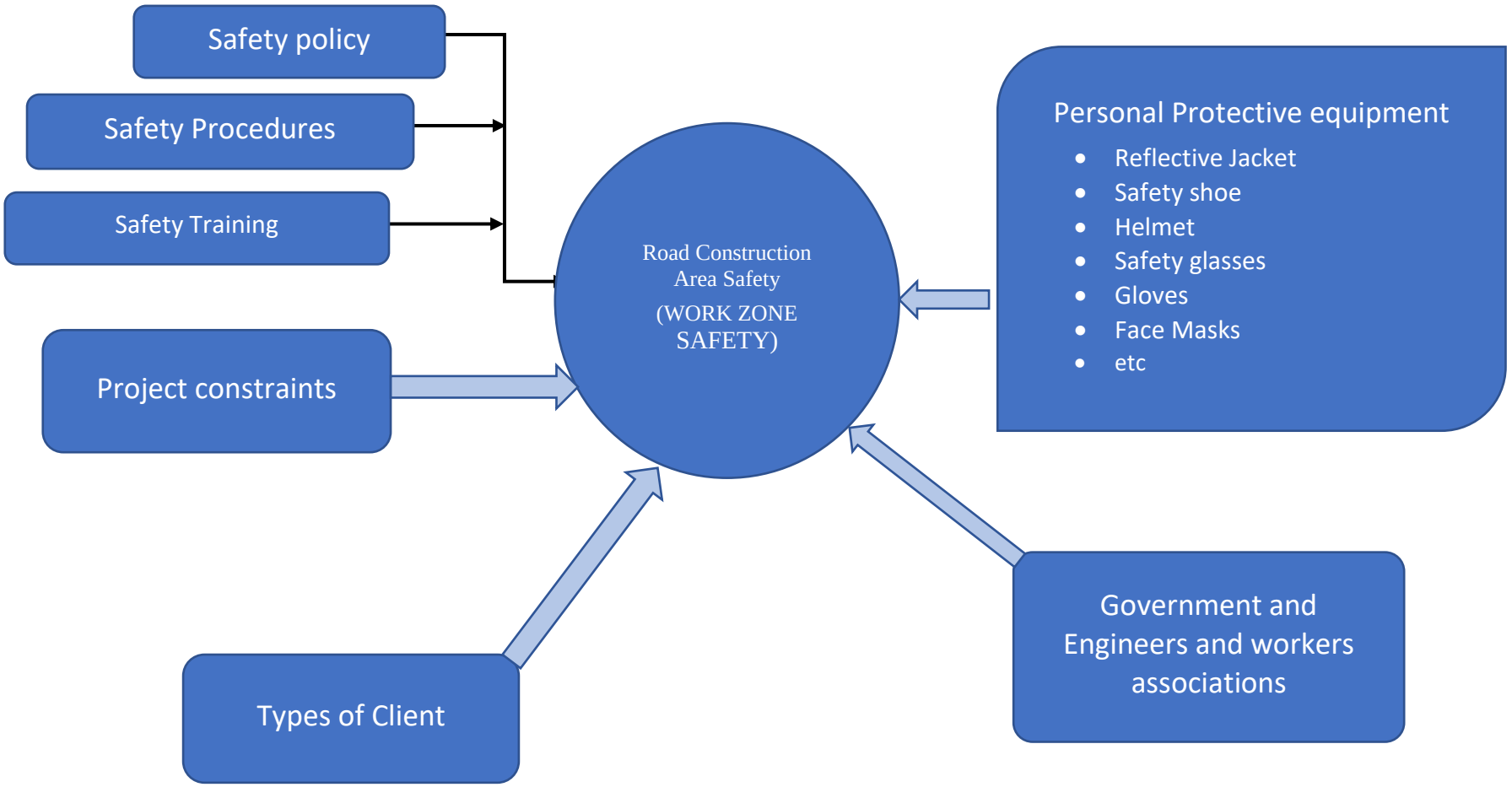
Ethiopia has had a regulation on Occupational Safety and Health (OSH) since the 1940's. The Ministry of Labor and Social Affairs (MOLSA) is the state organ that regulates workers' safety and health in workplaces, both private and state-owned. MOLSA and its regional networks have an organizational structure lining the periphery. Ethiopia is one of the many countries around the world that adopted ILO Convention No. 155 of 1981 in 1991, which resulted in two major regulations: Labor Proclamation No. 377/2003 and Labor Proclamation No. 515/2007 on public civil servants. The national-level policy on Occupational Safety and Health (OSH) has recently been developed and approved (July 2014) by the Central government. (Kumie et al. 2017).

The Ethiopian national Occupational Safety and Health (OSH) policy was lacking at the time this review was conducted on how occupational safety and health should be handled nationally or at lower governing levels as required by the International Occupation Safety and Health and Working Environment Convention No. 155/1981. (Kassie et al. 2016).

2.3. Conceptual framework

A conceptual framework for visual representation of a variable's expected relationship. The variables are the safety policies, procedures, training, and their effect on the creation of a safe working environment. It also helps to demonstrate the impact of having personal protective equipment (PPE) on reducing the impact of accidents and thus creating a safe work environment. Finally, the conceptual framework attempts to represent the effect of various external bodies, such as clients, project constraints, and various organizations (governmental and associations). The conceptual framework is generally developed based on a literature review of existing studies and theories about the topic. The conceptual framework is designed by the researcher in an attempt to convince the reader that all aspects of safety management practice and challenges are summarized.

Figure 2. 1 Conceptual framework



CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1. Introduction

This chapter attempted to present the research approach, research design and population of the study, sample size and sampling technique, data source, data collection instruments, data analysis and presentation, and also the ethical considerations.

Research methodology refers to the process of gathering information and data to achieve the objective of the study. The main objective of this study is to assess the safety management practices and challenges of road construction projects in the Central Region of the Ethiopian Roads Administration. Furthermore, it helps answer the research questions. The subtopic part will be a summary of background information about the study area, research approach, research design, data type, data collection tools and procedures, and method of data analysis.

3.2.Research Design

Designing a study helps the researcher to plan and implement the study in a way that helps the researcher to obtain the intended results, thus increasing the chances of obtaining information that could be associated with the real situation. (Buns & Grove, 2001).

Descriptive research design methods are used in this research for the data collected through a structured questionnaire. (Kothari, 2004). This explains descriptive research as a situation or condition at hand, it is one in which information will be collected without changing the operating environment. From different methods of research design, descriptive research designs were assumed to best fit based on the purpose of the study. In this research to examine safety management practices and challenges of road construction projects in the central region of the Ethiopian Roads Administration, descriptive statistics such as frequencies and percentages will be used for descriptive analysis.

3.3.Research Approach

This study used quantitative approaches. A quantitative approach is one that is primarily used by the investigator to develop knowledge on the cause and effect relationship between variables of safety management practices and their effects on creating a safe working environment during road construction.

The study of this research is piloted on ongoing road construction projects that are under construction, and currently, their contract is administered by the central region of the Ethiopian Roads Administration. As a method of data collection, only a questionnaire will be used and all questioners will also be standardized. The respondents from the research area who are going to participate in filling out the questionnaires are a sampled number of the consultants, contractors, and client staff who are involved in carrying out different tasks on these road projects.

3.4.Data Type and sources

Both primary and secondary data types were used for this study. According to Biggam (2008), primary data is the information that the researcher finds out by him/herself regarding a specific topic. The main advantage of this type of data is that it was collected with the research's purpose in mind. It implies that its information is more consistent with the research questions and objectives. The primary data was gathered through a structured questionnaire from:

contractors' staff: which are working on different positions; site engineers, builders, sub-contractors, semi-skilled laborers, and so on.

Consultants staff: key staff who take responsibility for confirmation of the contractor's adherence to the terms of the contract agreement, inspectors who carry out a routine check on site and office engineers who produce reports from the site office.

The counterpart engineers: those engineers who visit the site at random intervals for control and work-in-progress status checks

The respondent's response will be collected through questionnaires to be used as a primary source of data from the road construction projects which are still ongoing.

3.5. Method of Data Collection

To achieve the objectives of this study, the researcher used a quantitative research method through a questionnaire. The questionnaire was prepared using close-ended method questions. On the 5-point Likert scale, the respondents will be asked to indicate their level of agreement with the ratings of Very Likely (1), Fairly Likely (2), Likely (3), Un Likely (4), Very Un Likely (5), and for informative questions, the respondents will also be asked Yes/No questions. The respondents will be requested to rate their priority on the usage and availability of the PPE.

3.6. Sampling Techniques

A stratified sampling technique was used to identify an adequate number of responders since the number of contractor and consultant staff who are eligible to fill out the questionnaire is intended to be 10% of the total population size, and the intended questionnaire to be distributed was 100 for both construction projects to allow room for non-responsive questionnaires. The projects will be grouped into two groups: those which are being constructed by international construction companies and those constructed by local companies. It was decided that the Bilalo-Kersa-Arusi Negele road project would represent international companies, while the Kossie-Mito-Worabe road project would represent local construction companies.

To demonstrate the population size of this study, the populations of the two projects were stratified into four groups of engineers, inspectors, technicians, and builders. The sample was taken from each stratified group to represent the population according to their ratio of size.

Table 3. 1. Sample size

Project	Employer	Engineers	Inspectors	Technicians	Builders	Total
Billalo Kersa Road Project	Contractor	12	42	35	448	537
	Consultant	13	11	5	0	29
	ERA	3	0	0	0	3
Kossie Mito Road Projects	Contractor	9	20	26	141	196
	Consultant	14	16	5	0	35
	ERA	3	0	0	0	3
TOTAL		54	99	81	589	823
Sample size		6	10	9	60	85
Percentage of proportion		11%	10%	11%	10%	10%

Data will be collected from the contractor engineers who design, plan, and execute each activity to get a complete picture of the practices of both local and international contractors, and this will help to understand the level of care given to safety during the design and planning stages of the project activities. The site engineers (foreman) who supervise and direct other workers who will be engaged in a daily physical activity with a technical skill and their willingness to use PPE during commissioning will help to understand the behavioral pattern of workers towards using PPE. The consultant staff who will be involved in approving the work of the contractors from the design stage up to the actual work being realized is a potent source of information regarding safety management practice and its challenges in the work environment. The client counterpart engineers were to help us understand the policies, strategies, and principles of safety practice and those measures to be taken if the contractor did not adhere to the terms and evaluate the result from the practices and casualties.

3.7. Method of Data Analysis

The data was collected from the respondent to be analyzed using quantitative data analysis techniques and SPSS.

The different descriptive statistics such as frequencies, percentages, and chart tables were used to achieve the research objectives presented in chapter one, and the research question was used to assess different kinds of opinions, practical experience, and knowledge of the respondents on the safety management rules, regulations, and practices in their respective road construction projects.

3.8. Ethical Consideration

The study was conducted using some ethical considerations. Each respondent to the study was first informed about the purpose and objective of the study and the questionnaires to be administered. After explaining the objective of the study, I will assure of the secrecy of respondents and confidentiality before starting the management of the questionnaire.

CHAPTER FOUR

4. RESULTS

4.1 Respondents' background information

The total number of participants was 74, and the response rate was 88%. Most of the respondents (66, or 89.2%) were male, half of whom 37 (50%) were found between the ages of 25 and 30, and most of them 52 (70.3%) were degree holders. In terms of work experience and current position, the respondent's majority of 29 (39.2%) and 58 (78.4%) has 1–5 years' work experience and employed as foreman, respectively.

Table 4. 1 Respondents' background information in the road projects and Central Region of the Ethiopian roads administration (N=74)

VARIABLE	FREQUENCY	PERCENT
Gender		
Male	66	89.2
Female	8	10.8
Age		
25-30	37	50.0
31-35	21	28.4
36-40	14	18.9
42 and above	2	2.7
Education level		
Masters	22	29.7
Degree	52	70.3
Work experience		
1-5 years	29	39.2
6-10 years	14	18.9
11-15 years	23	31.1
Above 15 years	8	10.8
Current Position		
Engineers	58	78.4
Inspectors	13	17.6
Technicians	1	1.4
Builders	2	2.7

4.2. Questions to overview safety practices

Questions to overview safety practices

Regarding the safety practices, almost all of them (67, or 90.5%) think safety during road construction is very important; most of the participants (26, or 35.1%) said very few of them have taken training on construction safety; the majority of the respondents (31, or 41.9%) were rated 7-8 on a scale of the safety culture of the road contractors they worked for; and more than half of them (43, or 58.1%) have ever worked for a local or international road contractor that considers construction safety important.

Table 4. 2 Questions to overview safety practices in the Central Region of the Ethiopian roads authority (N=74)

Variable	Frequency	Percent
How important do you think the safety during road construction?		
Very Important	67	90.5
Important	7	9.5
How much training have you taken concerning construction safety?		
None	19	25.7
Very Few	26	35.1
Few	22	29.7
Many	7	9.5
On a scale of 0 to 10 how do you rate the safety culture of road contractors you work with?		
0-2	29	39.2
3-4	2	2.7
5-6	11	14.9
7-8	31	41.9
9-10	1	1.4
Have you ever worked in a local or international road contractor that consider construction safety important?		
Yes	43	58.1
No	31	41.9

The figure below shows that the frequency of on job training carried out concerning road construction safety and among the respondents, most of them (45.9%) confirmed training carried out very rarely.

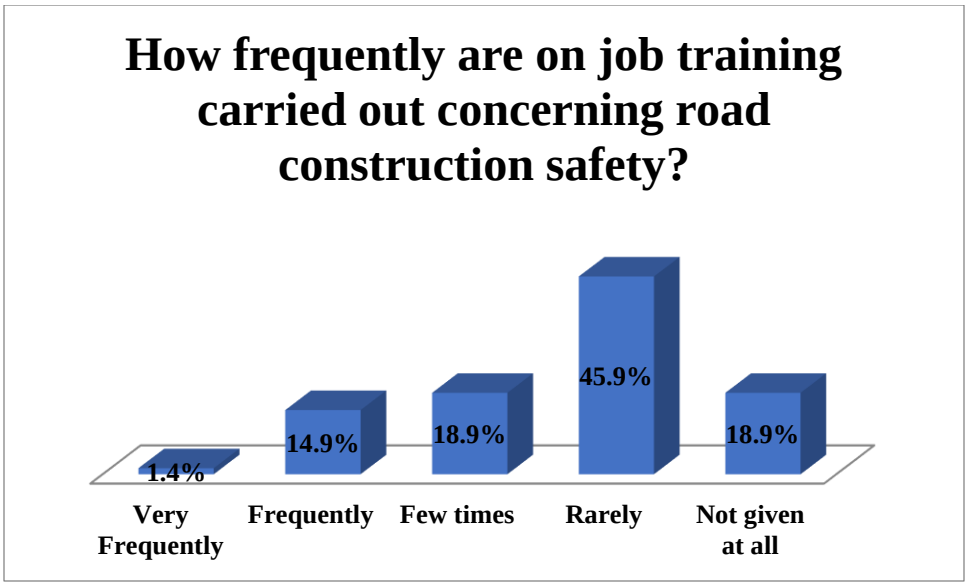


Figure 4. 1 Shows frequency of on job training carried out concerning road construction safety

Questions to overview safety practices during road constructions cont'd

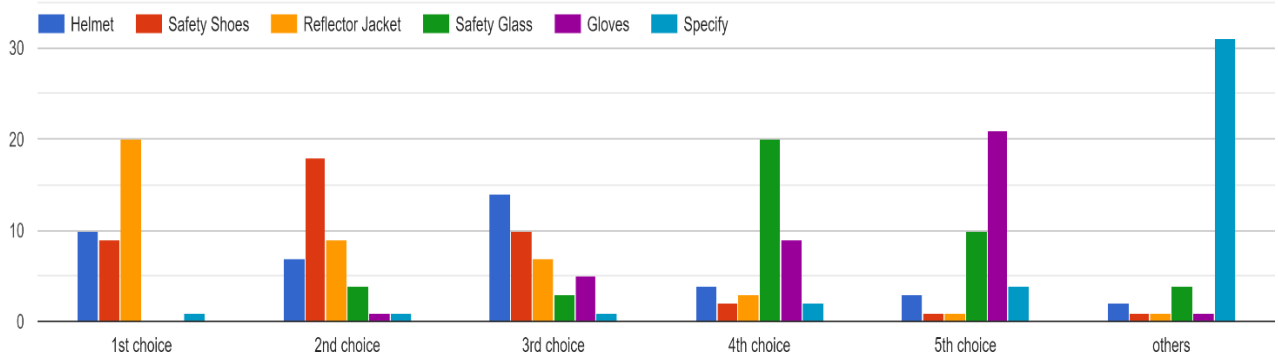
The respondents were asked to give rank to the types of personal protective equipment and their level of relevance during road construction activity, and the majority of the respondents ranked reflector jacket as their 1st choice with a weight of 34 (45.9%), safety shoes as their 2nd choice with a weight of 29 (39.2%), helmet as their 3rd choice with a weight of 27 (36.5%), safety shoes as their 4th choice with a weight of 28 (37.8%), safety glass was selected as their 5th choice with a weight of 39 (52.37%) and other types of safety equipment as their 6th choice with a weight of 51 (68.9%).

Table 4. 3 What type of safety equipment is more relevant to you in a road construction project? (what will be your response, if you were asked to rank them in order? (N=74)

Variable	Frequency	Percent
1st choice		
Safety Shoes	21	28.4
Helmet	15	20.3
Reflector	34	45.9
Safety Glass	1	1.4
Others	3	4.1
2nd choice		
Safety Shoes	29	39.2
Helmet	11	14.9

Reflector	19	25.7
Safety Glass	13	17.6
Gloves	1	1.4
Others	1	1.4
3rd choice		
Safety Shoes	17	23.0
Helmet	27	36.5
Reflector	14	18.9
Safety Glass	5	6.8
Gloves	10	13.5
Others	1	1.4
4th choice		
Safety Shoes	2	2.7
Helmet	13	17.6
Reflector	12	16.2
Safety Glass	28	37.8
Gloves	17	23.0
Others	2	2.7
5th choice		
Safety Shoes	1	1.4
Helmet	5	6.8
Reflector	4	5.4
Safety Glass	19	25.7
Gloves	39	52.7
Others	6	8.1
Others		
Safety Shoes	3	4.1
Helmet	9	12.2
Reflector	2	2.7
Safety Glass	6	8.1
Gloves	3	4.1
Others	51	68.9

What type of safety equipment is more relevant to you in a road construction project?(what will be your response, if you were asked to rank them in order?



Questions to overview safety practices cont'd

Above half of the participants, (54, or73.0%) did not think there was adequate personal protective equipment (PPE) in their project, yet the majority 50 (67.6%) replied that their company provides personal protective equipment (PPE) in their project. Most of them 33(44.6%) believed their construction company had a safety policy; more than half of their 40(54.1%) companies have written safety rules and regulations, which reflect management's concern for safety during the construction of roads. Once more, 57(77%) of them did not see any written information distributed on their construction site to create awareness about safety procedures and majorities 56(75.7%) of their construction site management did not prepare a written circular/brochure that alerts workers about the risk identified which is associated with their work.

Table 4. 4 Questions to overview safety practices in the Central Region of the Ethiopian roads authority (N=74)

Variable	Frequency	Percent
Is there adequate personal protective Equipment (PPE) in your project?		
Yes	20	27.0
No	54	73.0
Does your company provide personal protective Equipment (PPE) in your project?		
Yes	50	67.6
No	24	32.4
Does your construction company have a Safety policy?		
Yes	33	44.6
No	21	28.4
don't have the information	20	27.0
Does your Company has written Safety rules & regulations, which reflect management's concern for safety during the construction of roads?		
Yes	40	54.1
No	23	31.1
don't have the information	11	14.9
Is written information distributed on your construction site to create awareness about Safety procedures?		
Yes	17	23.0
No	57	77.0

Does your Construction site prepare a written circular/brochure that alerts workers about the risk identified which is associated with their work?		
Yes	18	24.3
No	56	75.7

The figure below shows the response to the question of what type of safety equipment do you usually see in road construction projects, and a reflector jacket is the major one used on the site, which was 69%.

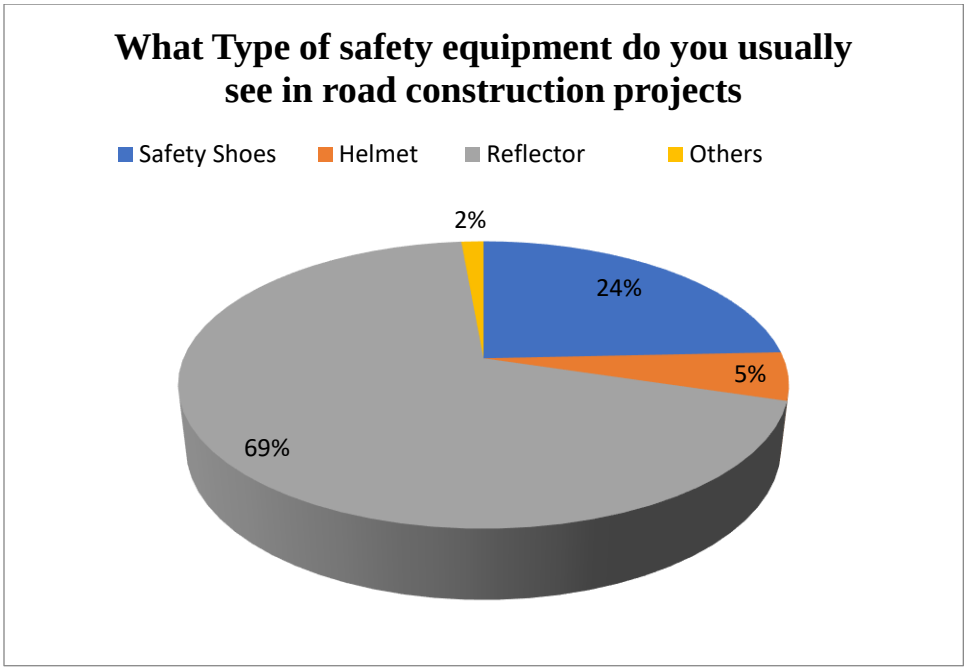


Figure 4. 2 Shows what types of safety equipment do you usually see in road construction projects

The figure below shows the safety equipment usage and the majority (36.5%) of them confirm they use PPE very likely.

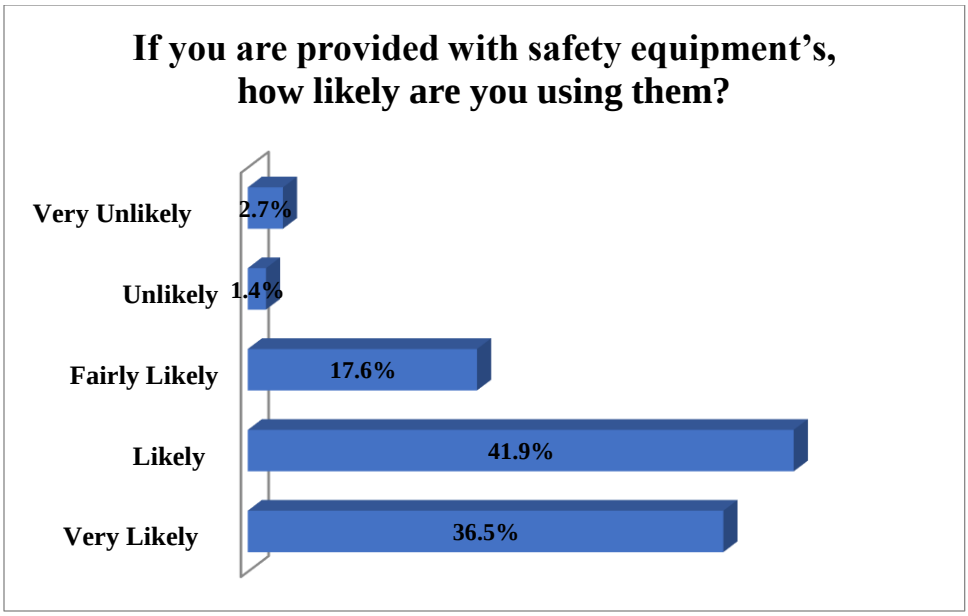


Figure 4. 3 Shows that safety equipment usage

The figure below shows that a reason not to use personal protective equipment continuously and among the reasons they gave, 15% of them because of lack of awareness, 7% of them because of discomfort to wear or use, 19% said the climate is too warm and most (59%) of those reasons were not provided.

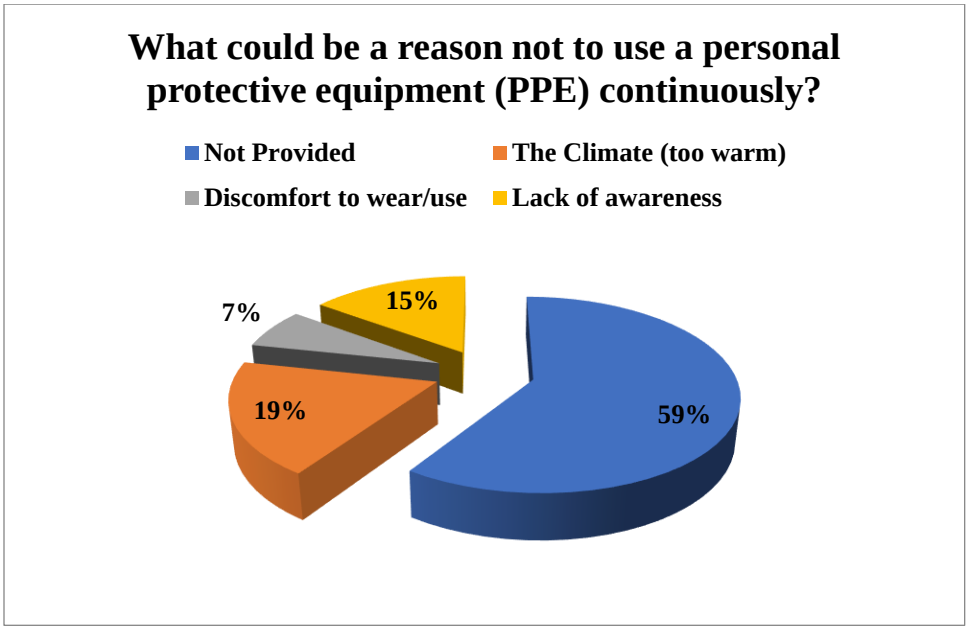


Figure 4. 4 Shows that reason not to use personal protective equipment continuously

Questions to overview safety practices cont'd

Among the respondents, more than half 38(51.4%) confirmed their project manager did not encourage and support work zone safety programs; the majority (46.2%) did not believe their project manager encouraged and supported introductory training on safety for new employees; most of the respondents (47.5%) workers could not get training on how to properly use and care for personal protective equipment; the majority of participants (45.9%) replied that their projects had a safety supervisor on-site and most of them (45.9%) had a safety inspection on the project.

Table 4. 5 Questions to overview safety practices in the Central Region of the Ethiopian roads authority (N=74)

Variable	Frequency	Percent
Does the project manager encourage and support work zone safety programs?		
Yes	36	48.6
No	38	51.4
Do project managers encourage and support introductory training on safety for new employees?		
Yes	46	62.2
No	28	37.8
Do workers get training on how properly use & care for personal protective equipment?		
Yes	16	21.6
No	47	63.5
don't have the information	11	14.9
Does the project have a safety supervisor on-site?		
Yes	34	45.9
No	28	37.8
don't have the information	12	16.2
Is there a safety inspection on the project?		
Yes	34	45.9
No	29	39.2
don't have the information	11	14.9

The figure below shows that training is not given on safety before commencing a specific work and that half of them (55.4%) confirm they didn't get any training before commencing a specific work.

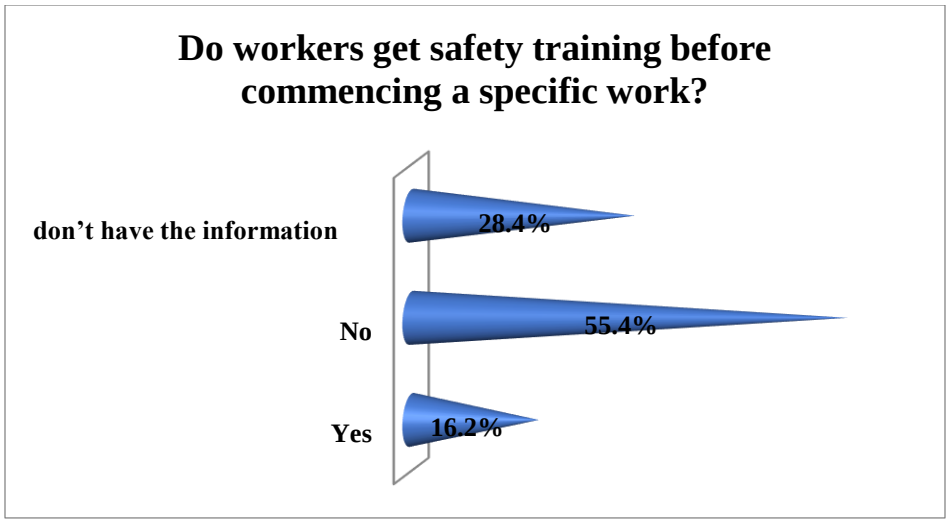


Figure 4. 5 Shows that training given on workers safety before commencing a specific work

The figure below shows that frequency of safety inspection done and among the responders most of them (36%) confirm that only few times inspection was done during site activity.

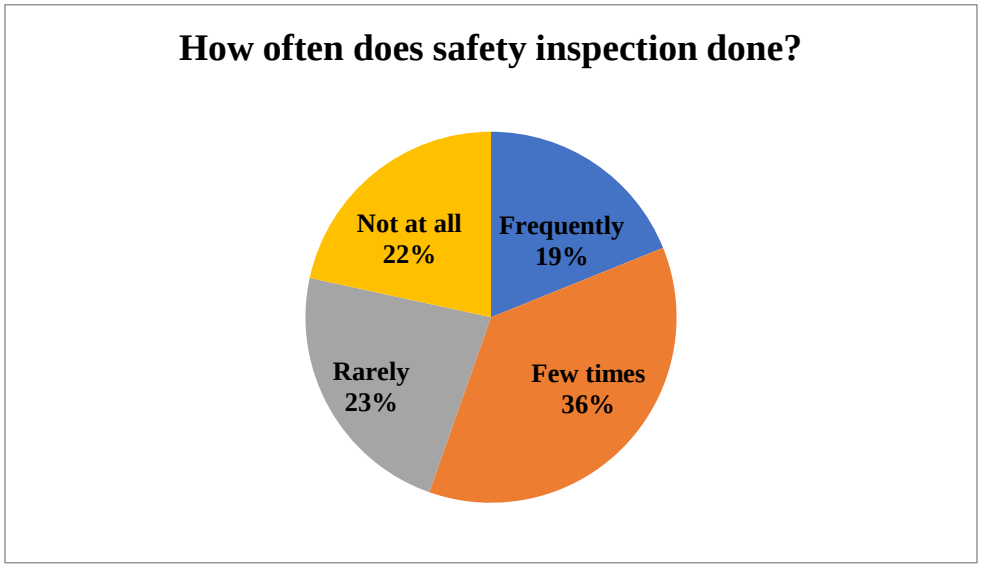


Figure 4. 6 Shows that frequency of safety inspection done

Questions to overview safety practices cont'd

Among all the participants, the majority of them (53, or 71.6%) a person will be taken to the site clinic if a minor injury occurs during the commissioning project activity, whereas most of them

replied a person will be taken to the nearby clinic if a major injury occurs during the commissioning project activity, and more than half of them (50, or 67.6%) said injuries and fatalities will be reported to the safety supervisor.

Table 4. 6 Questions to overview safety practices in the Central Region of the Ethiopian roads authority (N=74)

Variable	Frequency	Percent
What action will be taken if a minor injury occurs during the commissioning project activity?		
Will be treated by traditional means	5	6.8
Will be taken to the site clinic	53	71.6
Will be taken to the nearby clinic	16	21.6
What action will be taken if a major injury occurs during the commissioning project activity?		
Will be treated by traditional means	3	4.1
Will be taken to the site clinic	18	24.3
Will be taken to the nearby clinic	53	71.6
Are injuries &/or fatalities reported to the safety supervisor?		
Yes	50	67.6
No	24	32.4

The figure below shows that whether managers ensure that the safety budget is adequate or not and 51% of them said yes and the rest 49% said no.

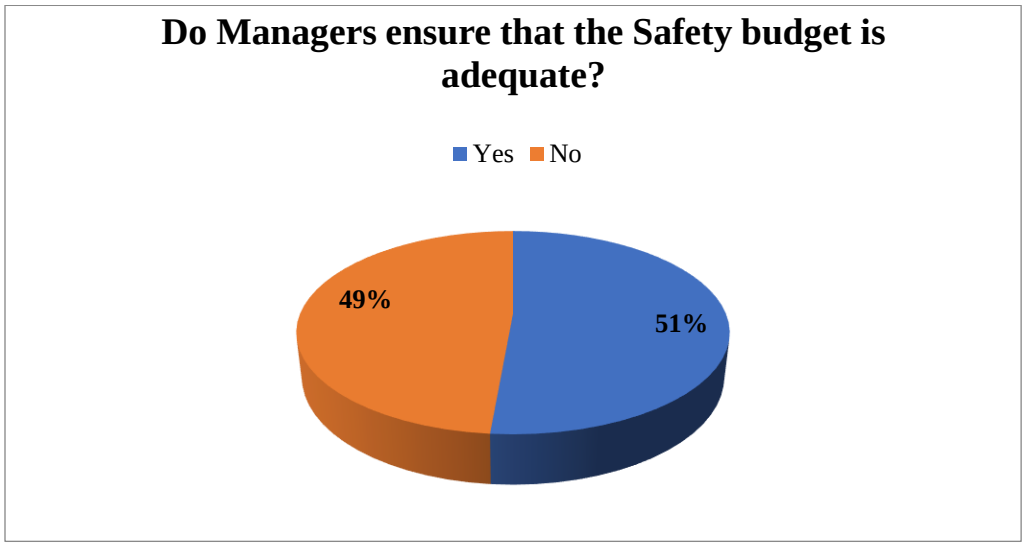


Figure 4. 7 Shows that managers ensure that the safety budget is adequate

4.3. Restraints in implementation of safety procedures

Please rate each factor based on its capacity of affecting or impending performance of the safety procedures? How likely do you think these factors affect safety performance in implementing on-road construction sites?

The participants rated the performance of safety procedures in different ways and:

For the ineffectiveness of current safety policies and Procedures most of them said very likely 36 (48.6%); for lack of inspection procedures onsite majorities said very likely 25(33.8%); for lack of skilled labor or workers most of them said fairly likely 24(32.4%); for poor legislation, codes, and standards majorities ranked fairly likely 24(32.4%); for lack of monitoring on compliance with safety measures most voted both Very likely 23(31.1%) and Fairly likely 23(31.1%) equally; for physical fatigue most said Likely 29(39.2); for excessive overtime work majorities the participants ranked likely 32(43.2%); for lack of training most of them ranked 35(47.3%) and for reckless operations most ranked Fairly likely 28(37.8).

Table 4. 7 Restraints in implementation of safety procedures in the Central Region of the Ethiopian roads authority (N=74)

Variable	Frequency	Percent
Ineffectiveness of current safety policies & Procedures		
Very likely	36	48.6
Fairly likely	11	14.9
Likely	18	24.3
Unlikely	6	8.1
Very unlikely	3	4.1
Lack of inspection procedures onsite		
Very likely	25	33.8
Fairly likely	23	31.1
Likely	18	24.3
Unlikely	6	8.1
Very unlikely	1	1.4
Lack of skilled labor or workers		
Very likely	20	27.0
Fairly likely	24	32.4
Likely	28	37.8
Unlikely	1	1.4
Very unlikely	1	1.4
Poor legislation, codes, and standards		
Very likely	21	28.4
Fairly likely	24	32.4

Likely	21	28.4
Unlikely	8	10.8
Very unlikely		
Lack of monitoring on compliance with safety measures		
Very likely	23	31.1
Fairly likely	23	31.1
Likely	20	27.0
Unlikely	4	5.4
Very unlikely	4	5.4
Physical fatigue		
Very likely	10	13.5
Fairly likely	15	20.3
Likely	29	39.2
Unlikely	20	27.0
Excessive overtime work		
Very likely	5	6.8
Fairly likely	22	29.7
Likely	32	43.2
Unlikely	13	17.6
Very unlikely	2	2.7
Lack of training		
Very likely	35	47.3
Fairly likely	34	45.9
Likely	1	1.4
Unlikely	3	4.1
Very unlikely	1	1.4
Reckless operations		
Very likely	27	36.5
Fairly likely	28	37.8
Likely	17	23.0
Unlikely	2	2.7

Restraints in implementation of safety procedures cont'd

For low academic knowledge among workers majorities said 23(31.1%) fairly likely; for poor accident record keeping and reporting system majorities answered 24(32.4%) very likely; according to insufficient safety budget most ranked 28(37.8%) very likely; for lack of personal protective equipment majorities 35(47.3%) of them said very likely; for lack of safety supervisor on site most answered 34(45.9%) very likely; for lack of top management commitment to safety programs majorities of the participants ranked 32(42.2%) very likely; for poor safety awareness among top management most of them answered 26(35.1%) very likely; according to reluctance to input resources for safety most of them28(37.8%) ranked very likely; for lack of emergency plan

and procedures majorities 31(41.9%) ranked fairly likely and for insufficient promotion of safety awareness most of them 29(39.2%) ranked very likely.

Table 4. 8.2. Restraints in implementation of safety procedures in the Central Region of the Ethiopian roads authority (N=74)

Variable	Frequency	Percent
Low academic knowledge among workers		
Very likely	18	24.3
Fairly likely	23	31.1
Likely	20	27.0
Unlikely	9	12.2
Very unlikely	4	5.4
Poor accident record keeping and reporting system		
Very likely	24	32.4
Fairly likely	23	31.1
Likely	17	23.0
Unlikely	10	13.5
Insufficient safety budget		
Very likely	28	37.8
Fairly likely	20	27.0
Likely	18	24.3
Unlikely	7	9.5
Very unlikely	1	1.4
Lack of personal protective equipment		
Very likely	35	47.3
Fairly likely	24	32.4
Likely	5	6.8
Unlikely	7	9.5
Very unlikely	3	4.1
Lack of safety supervisor on site		
Very likely	34	45.9
Fairly likely	16	21.6
Likely	12	16.2
Unlikely	9	12.2
Very unlikely	2	2.7
Lack of top management commitment to safety programs		
Very likely	32	43.2
Fairly likely	18	24.3
Likely	16	21.6
Unlikely	5	6.8
Very unlikely	3	4.1

Poor safety awareness among top management		
Very likely	26	35.1
Fairly likely	23	31.1
Likely	15	20.3
Unlikely	2	2.7
Very unlikely	8	10.8
Reluctance to input resources for safety		
Very likely	28	37.8
Fairly likely	26	35.1
Likely	11	14.9
Unlikely	5	6.8
Very unlikely	4	5.4
Lack of emergency plan and procedures		
Very likely	22	29.7
Fairly likely	31	41.9
Likely	18	24.3
Unlikely	3	4.1
Insufficient promotion of safety awareness		
Very likely	29	39.2
Fairly likely	21	28.4
Likely	23	31.1
Unlikely	1	1.4

4.4. Frequently Occurring Accidents

What are frequently occurring accidents on road construction sites

In terms of frequently occurring accidents during road construction falls ranked 1st by most of the respondents with very likely 23(31.1%); for caught in between most of them answered fairly likely 30(40.5%); for struck by moving machineries majorities 26(35.1%) of them answered likely; most 30(40.5%) of the participants chose unlikely for suffocations by chemicals and for electrocutions most of them 24(32.4%) said unlikely.

Table 4. 9 What are frequently occurring accidents on road construction sites in the Central Region of the Ethiopian roads authority (N=74)

Variable	Frequency	Percent
Falls		
Very likely	23	31.1
Fairly likely	22	29.7

Likely	17	23.0
Unlikely	9	12.2
Very unlikely	3	4.1
Caught in between		
Very likely	4	5.4
Fairly likely	30	40.5
Likely	26	35.1
Unlikely	13	17.6
Very unlikely	1	1.4
Struck by moving machineries		
Fairly likely	19	25.7
Likely	26	35.1
Unlikely	20	27.0
Very unlikely	9	12.2
Suffocations by chemicals		
Fairly likely	28	37.8
Likely	6	8.1
Unlikely	30	40.5
Very unlikely	10	13.5
Electrocutions		
Fairly likely	24	32.4
Likely	6	8.1
Unlikely	35	47.3
Very unlikely	9	12.2

Are most frequently occurring accidents in road construction sites preventable

All of the participants 38.85(52.5%) said that most frequently occurring accidents in road construction sites are preventable.

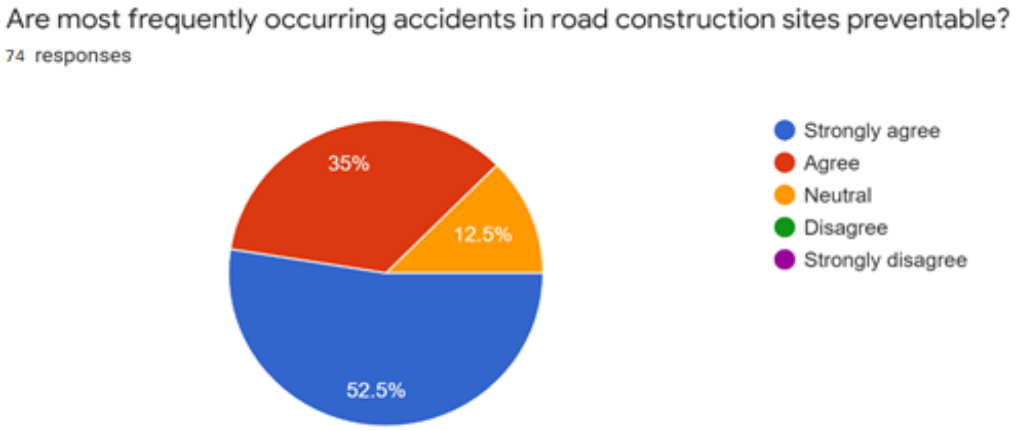


Figure 4. 8 Shows most frequently occurring accidents were preventable

For road construction projects, what are the most critical safety precautions for you in road construction sites

For the question what are the most critical safety precaution as it is presented in the table below: Most respondents 48(64.9%) said implement Proper Training was fairly likely; Ensure a Competent Person is on Site most of them said 44(59.5%) fairly likely; for set up a proper perimeter most 28(37.8%) said unlikely; for increase Worker and Work Site Visibility majorities of them 42(56.8%) said fairly likely; for wear the Proper Safety Equipment above half of them 51(68.9%) said fairly likely; Implement roper traffic control is most respondents said 51(68.9%) fairly likely; above half of the participants 46(62.2%) said Use Caution When Operating Heavy Machinery is fairly likely ;Watch for Moving Vehicles and Equipment above half of them said 54(72.0%) fairly likely ; again avoid Blind Spots also most respondents said 45(60.8%) fairly likely ; Be Constantly Aware of Your Surroundings is fairly likely safety precautions above half of them 41(55.4%) said and majorities of the participants said 39(52.7%) stay Hydrated is unlikely one.

Table 4. 10 For road construction projects, what are the most critical safety precautions for you in the Central Region of the Ethiopian roads authority (N=74)

Variable	Frequency	Percent
Implement Proper Training		
Fairly likely	48	64.9
Likely	8	10.8
Unlikely	13	17.6
Very unlikely	5	6.8
Ensure a Competent Person is On Site		
Fairly likely	44	59.5
Likely	6	8.1
Unlikely	23	31.1
Very unlikely	1	1.4
Set Up a Proper Perimeter		
Fairly likely	28	37.8
Likely	14	18.9
Unlikely	29	39.2
Very unlikely	3	4.1
Increase Worker and Work Site Visibility		
Fairly likely	42	56.8

Likely	12	16.2
Unlikely	19	25.7
Very unlikely	1	1.4
Wear the Proper Safety Equipment]		
Fairly likely	51	68.9
Likely	9	12.2
Unlikely	10	13.5
Very unlikely	4	5.4
Implement roper traffic Control		
Fairly likely	51	68.9
Likely	13	17.6
Unlikely	10	13.5
Use Caution When Operating Heavy Machinery		
Fairly likely	46	62.2
Likely	6	8.1
Unlikely	21	28.4
Very unlikely	1	1.4
Watch for Moving Vehicles and Equipment		
Fairly likely	54	73.0
Likely	8	10.8
Unlikely	12	16.2
Avoid Blind Spots		
Fairly likely	45	60.8
Likely	6	8.1
Unlikely	19	25.7
Very unlikely	4	5.4
Be Constantly Aware of Your Surroundings]		
Fairly likely	41	55.4
Likely	16	21.6
Unlikely	17	23.0
Stay Hydrated		
Fairly likely	19	25.7
Likely	9	12.2
Unlikely	39	52.7
Very unlikely	7	9.5

4.5. Causes of Accidents

Factors do you think majorly contribute to accidents occurring on road construction

Among the factors for accident occurring improperly guarded areas were moderately important said majorities of the respondents 29(39.2%); Lack of safety training was very important factor

as most respondents said 34(45.9%); again lack of safety plan/ risk identification was very important factor as most respondents answered 35(47.3%); Ineffectiveness of current safety policy was very important factor reported by most respondents 33(44.6%); above half of them40(54.1%) said Unavailability of PPE and inappropriate PPE design was very important factor; again above half of them 40(54.1%) answered Hazardous procedures, on or around were very important factor; machines or equipment's Guarding dangerous areas were very important factor said by majorities of the respondents 46(62.2%); most of them answered Improved and frequent safety training was the very important factor 52(70.3%); above half of them were said Implementation safety / risk identification plan was very important factor 51(68.9%); Effective safety policy also very important factor as most respondents answered 52(70.3%); most respondents said availability of PPE and appropriate PPE design Strict procedures and on or around machines or equipment's were the very important factors, 59(79.7%), 59(79.7%) respectively.

Table 4. 11 Which factors do you think majorly contribute to accidents occurring on road construction in the Central Region of the Ethiopian roads authority (N=74)

Variable	**Frequency**	**Percent**
Improperly guarded areas		
Very important	27	36.5
Important	10	13.5
Moderately important	29	39.2
Slightly important	1	1.4
Not important	7	9.5
Lack of safety training		
Very important	34	45.9
Important	18	24.3
Moderately important	17	23.0
Slightly important	5	6.8
Lack of safety plan/ risk identification]		
Very important	35	47.3
Important	10	13.5

Moderately important	22	29.7
Slightly important	7	9.5
Ineffectiveness of current safety policy		
Very important	33	44.6
Important	16	21.6
Moderately important	14	18.9
Slightly important	10	13.5
Not important	1	1.4
Unavailability of PPE and inappropriate PPE design		
Very important	40	54.1
Important	10	13.5
Moderately important	20	27.0
Slightly important	1	1.4
Not important	3	4.1
Hazardous procedures, on or around machines or equipment's		
Very important	40	54.1
Important	7	9.5
Moderately important	18	24.3
Slightly important	7	9.5
Not important	2	2.7
Guarding dangerous areas		
Very important	46	62.2
Important	6	8.1
Moderately important	18	24.3
Slightly important	3	4.1
Not important	1	1.4
Improved and frequent safety training		
Very important	52	70.3
Important	5	6.8
Moderately important	15	20.3

Slightly important	2	2.7
Implementation safety / risk identification plan		
Very important	51	68.9
Important	3	4.1
Moderately important	20	27.0
Effective safety policy		
Very important	52	70.3
Important	4	5.4
Moderately important	16	21.6
Slightly important	2	2.7
Availability of PPE and appropriate PPE design		
Very important	59	79.7
Important	3	4.1
Moderately important	10	13.5
Slightly important	2	2.7
Strict procedures, on or around machines or equipment's		
Very important	59	79.7
Important	5	6.8
Moderately important	8	10.8
Slightly important	1	1.4
Not important	1	1.4

Table 4. 12 Mean and Standard deviation for the query used to assess safety management practices for the road construction projects under central region of Ethiopian roads administration.

Variable	**Mean**	**Std deviation**
How important do you think the safety during road construction?	1.09	0.295

How much training have you taken concerning construction safety?	2.23	0.944
How frequently are on job training carried out concerning construction safety?	3.66	0.997
On a scale of 0 to 10 how do you rate the safety culture of road contractors you work with?	3.45	2.417
Have you ever worked in a local or international road contractor that consider construction safety important?	1.42	0.497
Is there adequate personal protective Equipment (PPE) in your project?	1.73	0.447
Does your company provide personal protective Equipment (PPE) in your project?	1.32	0.471
Does your construction company have a Safety policy?	1.82	0.834
Does your Company has written Safety rules & regulations, which reflect management's concern for safety during the construction of roads?	1.61	0.737
Is written information distributed on your construction site to create awareness about Safety procedures?	1.77	0.424
Does your Construction site prepare a written circular/brochure that alerts workers about the risk identified which is associated with their work?	1.76	0.432
Does the project manager encourage and support work zone safety programs?	1.51	0.503
Do project managers encourage and support introductory training on safety for new employees?	1.38	0.488
Do workers get safety training before commencing a specific work?	2.12	0.661
Do workers get training on how properly use & care for personal protective equipment?	1.93	0.608
Does the project have a safety supervisor on-site?	1.70	0.735
Is there a safety inspection on the project?	1.69	0.720
How often does safety inspection done?	3.47	1.037
What action will be taken if a minor injury occurs during the commissioning project activity?	2.15	0.515
What action will be taken if a major injury occurs during the commissioning project activity?	2.68	0.552

CHAPTER FIVE

5. DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1. Discussion

Another study done by Jannadiet.al. (2002) shows that the common understanding in the construction industry is that PPE is thought as a means of protection for workers, though safety is about creating a conducive working environment in which PPE should only serve as an extra protection or be used as a last resort while considering all accident control measures. Other methods or management practices should be considered and used to reduce or eliminate the risk of injury.

However, where PPE is considered the only effective means of controlling the risks of injury, then contractors must ensure that PPE is available. Effective control and inspection measures should be implemented to ensure that PPE is worn at all times on construction sites. A typical construction site may require workers to wear a hard hat, safety footwear, gloves, eye protection, and a high-visibility vest. This equipment must be provided to all employees at the beginning of an activity and must be supervised at certain periods of intervals. The current study results show that more than half of the participants (54, or 73.0%) did not have adequate personal protective equipment (PPE) in their project; and the majority confirmed that 50 (67.6%) of their companies provide personal protective equipment (PPE) in their projects; most of them (33, or 44.6%) of their construction companies had a safety policy; and more than half of their 40 (54.1%) companies have written safety rules and/or regulations, which reflect management does have a concern for safety during the construction of roads.

Research done by Edwin et al. (1999) shows that literature has pointed out different factors that affect the performance of safety and health during construction. There are historical, economic, psychological, technical, procedural, organizational, and environmental factors that affect the level of construction site safety. The historical factor is assessed by the background and characteristics of the individual, such as age and experience. The economic factor is determined by the monetary values that are associated with safety, such as hazard pay. The psychological

factor is assessed by the safety behavior of fellow workers on site, including supervisors. The technical and procedural factors are assessed by the provision of training and the handling of safety equipment on site. The organizational and environmental factors are assessed by the type of policy that the management adopts for site safety.

The current study findings show that among the factors for accidents occurring in the construction area were found to be the following:

- Improperly guarded dangerous working areas, such as mines and cutting sections,
- Lack of safety training,
- Lack of a proper safety and risk identification plan,
- ineffectiveness of current safety policies
- insufficient PPE availability and inappropriate PPE design,
- Hazardous procedures on or around machinery or equipment
- Lack of advancements in and frequency of safety training and
- Implementation of safety/risk identification plan

Another study done by Lehto et al., 1991 shows that first aid is a provision of primary care for an injury as it is regularly carried out by a trained first aider on an injured person until definitive medical treatment can be reached if required. Each construction site needs to have the appropriate first-aid arrangements.

However, these arrangements would not eliminate the hazards but only reduce the potential risk to the injured person who might be exposed to accidents. This study also revealed similar results, such as admission to a nearby clinic is a common practice, if a minor as well as major injury occurs during the commissioning project activity. It is also found that there is a practice of reporting to the safety supervisor in the case of injuries and fatalities.

5.2. Conclusion

The findings presented correspond to the current situation. Even though they do not conceal possible future problems of injuries and fatalities during road construction, there is a safety policy, procedure, and practices for both international and local road contractors. These policies, procedures, and practices tend to rely on the provision of personal protective equipment (PPE) as an ultimate mitigation mechanism for accident prevention at construction sites during construction activity. While procedures to prevent accidents like falls, being struck by moving machinery and being caught in between were given little attention, there are problems in detecting roadworks where different signs have not been sufficiently applied to clearly indicate the layout during the work zone.

The topic of best practices for work zone safety in road construction is to be covered in organizational/management issues; establishment/de-establishment of a safe work zone; informing/warning/training safety procedures to users of the road and guiding road users through work zone areas; speed information/feedback/enforcement; protection devices for road workers' and road users' safety; and incursion warning systems; as well as best practices in work zone road safety audit inspection requirements. (Varhelyi, et al., 2020).

The culture of poor utilization of personal protective equipment, training and regular inspection is the most critical issues observed in both local and international companies. These deficiencies were also observed in the management of the contractors, the client and the government bodies which are the stakeholders of resolving such problems.

5.3. Recommendation

Based on the findings from the activities in this project work, the following recommendations can be sought:

- The work zone safety issue should be given greater attention during a premature stage like during a call on tendering road construction projects and requiring a proposal on procedure towards maintaining work zone safety.

- Shift from the ‘cheapest offer’ to the ‘best offer’ practice when it comes to the implementation of health and safety practices and consider the offer as an essential part of the tender.

- Procedures for regular checks should be expected. The contract should also specify the duties and responsibilities of each party, most notably

    - Tasks to be carried out according to the safety management plan
    - To appoint a work zone safety inspector on the site
    - It is to regularly inspect if workers follow safety rules in the course of their work
    - To check if the environment is restored "back to normal" after work is done

- Reduce schedule stress by ensuring that safety procedures are not broken in order to meet a deadline or by reducing overtime work to ensure a worker is in good enough condition to perform a road construction activity.

- Improve skills and knowledge of workers through a regular training especially concerning safety and health, special skills for working on roads should be backed with caution awareness, application of barriers, safety awareness, appropriate personnel protective equipment and proper line of reporting of an incident.

- Inspections should be made regularly throughout the project duration since, experience shows that safety arrangements practice may get weaker over time.

- If deviations from the road work design are detected, notifications, instructions and/or warnings should be issued and targets to eliminate deviations can be set. It is very important to maintain the integrity and independence of the Inspectors. To create harmonious

environment in the construction site the client should assign safety inspector so that avoid manipulation in the safety procedure to reduce costs.

- Besides on-site controls according to formal work zone procedures, the contractor's documentation of its performance concerning the arranged daily checks of the work zone safety should be audited.
- Collect data on incidents and accidents in work zones in organized manner and without elimination of every little detail in a regular report and periodically in separate report.

- Speed control implementation, average speed control, appropriate speed levels at different times and activity sites to enhance the acceptance of the workers, providing information on current driving speed.
- Use symbols, pictures, signs – to make it clear and understandable for everyone throughout the project site.
- All government bodies should clearly state a regulatory and administrative framework and procedures for work zone safety and work zone safety inspections. Initiate work zone process reviews, periodic evaluation of work zone policy, procedures, processes, and impacts that systematically monitors the process of managing the safety and mobility impacts of work zones in a way such reviews can contribute to long-term improvements in road safety work management procedures.

5.4. Limitation and recommendations for future studies

This study is limited to the road construction works of two road projects. Hence, it is an open area of study to conjecture the point of study to country-level road projects. This project work is only limited to work zone safety with respect to the construction workers, inspectors, and engineers, but there is a major aspect which cannot be neglected as a point of study (i.e., traffic management during road construction). Health-related issues are also not covered in this research and it is because the effects on the health of people who are involved in road construction are to be measured over a longer period and covered by related project topics like HIV/AIDS alleviation

measures. The author of this project work believes these two aspects are the limitations of this project work and recommends them for future studies.

References:

Abera Kumie, Tadesse Amera, Kiros Berhane, Jonathan Samet, Nuvjote Hundal, Fitsum G/Michael, and Frank Gilliland School of Public Health, College of Health Sciences, Addis Ababa University, Ethiopia Pesticide Action Network (PAN) Nexus, Ethiopia Department of Preventive Medicine, Keck School of Medicine, University of Southern California, USA Ministry of Labour and Social Affairs, Ethiopia, page 2)

Anton TJ (1989). Occupational Safety and Health Management, New York, McGraw-Hill, Second Edition.

Arditi, D., Lee, D. and Polat, G., 2007. Fatal Accidents in Nighttime vs. Daytime Highway Construction Zones, Journal of Safety Research 36, 399-405

Arsyad, S. and Adila, D. (2017) 'Using local style when writing in English: The citing behaviour of Indonesian authors in English research article introductions.' Asian Englishes 20(2), 170-185

Brake, D.J. and Bates, G.P. (2003) Fluid Losses and Hydration Status of Industrial Workers under Thermal Stress Working Extended Shifts. Occupational and Environmental Medicine, 60, 90-96. http://dx.doi.org/10.1136/oem.60.2.90

Devvrat Ramteke, T. Rama Rao and Manish Kumar Mishra, International Research Journal of Engineering and Technology (IRJET), Volume: 08 Issue: 08 | Aug 2021

Edwin Sawacha, Shamil Naoum, Daniel Fong, Factors affecting safety performance on construction sites, International Journal of Project Management, Volume 17, Issue 5, 1999, Pages 309-315

F.K.Mwombeki, occupational health & safety challenges in construction sites in Tanzania, 2005, 4th triennial International conference May 2005

Health | definition of health by Medical dictionary (thefreedictionary.com)

Hinze, J. and Gambatese, J. (2003) Factors Influencing Safety Performance of Specialty Contractors. Journal of Construction Engineering and Management, 129, 159-164.

Hinze, J. and Wiegand, F. (1992) Role of Designers in Construction Worker Safety. Journal of Construction Engineering and Management, 118, 677-684.
https://www.who.int/data/gho/data/major-themes/health-and-well-being

Infrastructure and Cities for economic developments (ICED), construction capacity framework, October 2018

Jannadi, O. and Bu-Khamsin, M. (2002) Safety Factors Considered by Industrial contractors in Saudi Arabia. Building and Environment, 37, 539-547.

https://doi.org/10.1016/S0360-1323(01)00056-7

Kartam, N.A & Flood, Ian & Koushki, P. (2000). Construction safety in Kuwait: Issues, procedures, problems, and recommendations. Safety Science. 36. 163-184. 10.1016/S0925-7535(00)00041-2.

Kassie,Getnet & Motbainor, Achenef & Kumie, Abera & Samet, Jonathan & Wipfli, Heather. (2016). Review of Policy, Regulatory, and Organizational Frameworks of Environment and Health in Ethiopia. Ethiopian Journal of Health Development. 30. 42-49.)

Kim, Y., Ryoo, B., Kim, Y. and Huh, C. 2013. Major Accident Factors for Effective Safety Management of Highway Construction, Journal of Construction Engineering and Management 129(6), 628-640.

Labor market assessment – Market trends and opportunities in Ethiopia and the Gulf, ILO, 2020, page no 21

Mark Lehto, Gavriel Salvendy, Models of accident causation and their application: Review and reappraisal, Journal of Engineering and Technology Management, Volume 8, Issue 2, 1991, Pages 173-205, ISSN 0923-4748

NHTSA, 2013. Traffic safety fact 2010, http://www-nrd.nhtsa.dot.gov/Pubs/811659.pdf, Access June 3

Nyirenda, V., Chinniah,Y. & Agard,B.(2015). Identifying key factors for an occupational health and safety risk estimation tool in small and medium-size enterprises. Paper presented at 15th IFAC Symposium on information control problems in Manufacturing (INCOM 2015), Ottawa, Ontario. (Published in IFAC- Papers OnLine,48(3),541-546).

Papadakis, G.A. and Amendola,A .,1997,GuidanceonthePreparationofa Safety Report to Meet the Requirements of Council Directive 96/82/EC (Joint Research Centre European Commission, Italy). No. 353/1999 Col., Czech Law 'On the Control of Major Accident Hazards Involving Dangerous Substances and on the Changes in District Offices', Vol. 111, 7609.

R. Coble and T. C. Haupt, Safety and Health Legislation in Europe and United States: A comparison, Safety coordination and equality in construction, Proc. Int. Confi. CIB WorkingCommission 99 Task Group 36, eds. A. Gottfried, L. Trani and L. A. Dias(1999) pp.159-164

Rowlinson S (2004). Construction Safety Management Systems, London, Spon Press.

Sawacha, E., Naoum, S., & Fong, D. (1999). Factors affecting safety performance on construction sites. International Journal of Project Management, 17(5), 309–315

Shehab, Tariq. (2021). Accident Patterns in Road Construction Work Zones.

The printers guide to Health and safety, Health and safety executive (2003), page 19

United states department of labor, Bureau of Labor statistics, "Fatal occupational Injuries in Kentucky, 2005.

Varhelyi, Andras & Strnad, Bernd & Temmerman, Philip & Kluppels, Ludo & Daniels, Stijn. (2020). Safety management at road work zones - Best-practice recommendations.

Zou**,** P.X., Zhang, G.M. and Wang, J.Y. (2007) Understanding the Key Risks in construction Projects in China. International Journal of Project Management, 25, 601-614.

Zwetsloot G.I.J.M., A. Hale & S. Zwanikken (2011), Regulatory risk control through mandatory occupational safety and health (OSH) certification and testing regimes (CTRs), special issue on OSH Management Systems, Safety Science, 49, 7 pp. 995 – 1006.

Zwetsloot G.I.J.M., S. Zwanikken and A. Hale (2011), Policy expectations and the use of market mechanisms for regulatory OSH certification and testing regimes, special issue on OSH Management Systems. Safety Science, 49, 7 pp. 1007 – 1013.

Annexes

Addis Ababa University School of Commerce
MA Project Questionnaire
A Survey on safety management practices and challenges of road construction projects in the central region of the Ethiopian Roads Administration

Dear Sir/Madam,

This survey is intended only to acquire data for the specific study being conducted as partial fulfillment of the master's degree in Project Management at Addis Ababa University College of Commerce. The questionnaire is designed to obtain a professional opinion on issues related to safety management practices during road construction. The study is assumed to assess the safety practices, and factors that affect the implementation of the safety program, to identify the causes of accidents and what are frequently occurring accidents in road construction projects. It intends to critically assess practices of safety and health management; bring to the attention of different stakeholders of the road projects, identify areas of safety deficiencies in road construction projects, and recommend possible remedial action.

This survey questionnaire is to be used only for academic research and all respondents' anonymity will be kept confidential.

If there should be any clarification required of me, please do not hesitate to contact me at the mentioned address.

Thank you for your cooperation and your invaluable time in advance.

Kind regards,

Abinet Desalegn

Tel. +251(0) 911403965

E-mail: *abi2nets@yahoo.com/abi2nets@gmail.com*

PART ONE: Responders' background information

Direction: Dear participant, questions under this section are related to your background. Therefore, please circle your suitable response.

1. Gender

A Male B Female

2. Age

A 25-30 B 31-35 C 36-40 D 41 and above

3. Education Level

A Ph.D. B Masters C Degree D Diploma E Other

4. Your work experience in road construction projects

A 1-5 years B 6-10 years C 11-15 years D >15 years

5. Your Position ……..……

PART TWO: Questions to overview safety practices

Direction: Dear respondent questions in this section are related to the safety practices in your work experience please put the "X" sign for your appropriate response.

1. How important do you think the safety during road construction?
   Very Important ☐
   Important ☐
   Slightly Important ☐
   Not Important ☐
2. How much training have you taken concerning construction safety?
   None ☐ Very Few ☐ Few ☐ Many ☐
3. How frequently are on job training carried out concerning road construction safety?
   Very Frequently ☐
   Frequently ☐
   Few times ☐
   Rarely ☐
   Not given at all ☐
4. On a scale of 0 to 10 how do you rate the safety culture of road contractors you work with?
   0-2 ☐ 2-4 ☐ 4-6 ☐ 6-8 ☐ 8-10 ☐
5. Have you ever worked in a local or international road contractor that considers construction safety important?
   (Yes/No) _____
6. What type of safety equipment is more relevant to you in a road construction project? (what will be your response, if you are asked to rank them in order?)
   Safety Shoes ☐
   Helmet ☐
   Reflector ☐
   Safety Glass ☐
   Gloves ☐
   Others (can you please specify) ☐ _____

7. What type of safety equipment do you usually see in road construction projects?

   Safety Shoes ☐

   Helmet ☐

   Reflector Jacket ☐

   Safety Glass ☐

   Gloves ☐

   Others (can you please specify) ☐ _____

8. Are there adequate Personal Protective Equipment (PPE) on your construction projects?
   (Yes/No) _____
9. Do your firm Provide Personal Protective Equipment (PPE)?
   (Yes/No) _____
10. If you are provided with safety equipment's, how likely are you using them?

    Very Likely ☐ Likely☐ Fairly Likely ☐ Unlikely ☐ Very Unlikely ☐

11. What could be a reason not to use PPE continuously?

    Not Provided ☐

    The Climate (too warm) ☐

    Discomfort to wear/use ☐

    Lack of awareness ☐

    Other (Specify) ☐

12. Does your construction company have a Safety policy? (for officers only)

    Yes ☐ No ☐ Don't have the information ☐

13. Does your Company has written Safety rules & regulations, which reflect management's concern for safety during the construction of roads?

    Yes ☐ No ☐ Don't have the information ☐

14. Is written information distributed on your construction site to create awareness about Safety procedures?

    Yes ☐ No ☐

15. Does your Construction site prepare a written circular/brochure that alerts workers about the risk identified which is associated with their work?

    Yes ☐ No ☐

16. Do the project manager encourage and support work zone safety programs?

Yes ☐ No ☐

17. Do project managers encourage and support introductory training on safety for new employees?

Strongly Agree ☐ Agree☐ Neutral ☐ Disagree ☐ Strongly Disagree☐

18. Do workers get safety training before commencing a specific work?

Yes ☐ No ☐ Don't have the information ☐

19. Do workers get training on how properly use & care for personal protective equipment?

Yes ☐ No ☐ Don't have the information ☐

20. Does the project have a safety supervisor on-site?

Yes ☐ No ☐ Don't have the information ☐

21. Is there a safety inspection on the project?

Yes ☐ No ☐ Don't have the information ☐

22. How often does safety inspection done?

Very Frequently ☐

Frequently ☐

Few times ☐

Rarely ☐

Not at all ☐

23. What action will be taken if a minor injury occurs during the commissioning project activity?

Will be treated by traditional means ☐

Will be taken to the site clinic ☐

Will be taken to the nearby clinic ☐

24. What action will be taken if a major injury occurs during the commissioning project activity?

Will be treated by traditional means ☐

Will be taken to the site clinic ☐

Will be taken to the nearby clinic ☐

25. Are injuries & fatalities reported to the safety supervisor? (for officers only)

Yes ☐ No ☐

26. Do Managers ensure that the Safety budget is adequate? (Answer by managements only)

Yes ☐ No ☐

PART THREE: Restraints in implementation of safety procedures

Direction: Dear respondents' questions raised in this section are associated with the constraints in

implementation of safety procedures please put the "X" sign for your appropriate response.

27. Please rate each factor based on its capacity of affecting or impending performance of the safety procedures? How likely do you think these factors affect safety performance in implementing on-road construction sites?

	Factors	Very Likely	Fairly Likely	Likely	Un-likely	Very Un-likely
1	Ineffectiveness of current safety policies & Procedures					
2	Lack of inspection procedures onsite					
3	Lack of skilled labor or workers					
4	Poor legislation, codes, and standards					
5	Lack of monitoring on compliance with safety measures					
6	Physical fatigue					
7	Excessive overtime work					
8	Lack of training					
9	Reckless operations					
10	Low academic knowledge among workers					

11	Poor accident record keeping and reporting system					
12	Insufficient safety budget					
13	Lack of personal protective equipment					
14	Lack of safety supervisor on site					
15	Lack of top management commitment to safety programs					
16	Poor safety awareness among top management					
17	Reluctance to input resources for safety					
18	Lack of emergency plan and procedures					
19	Insufficient promotion of safety awareness					

PART FOUR: Frequently Occurring Accidents

Direction: Dear respondents' questions raised in this section are related to the frequently occurring accidents; please write your appropriate answers in the space provided.

- ***Frequently occurring accidents (FOA)***

28. What are frequently occurring accidents on road construction sites?

Accidents F	Very Likely	Fairly Likely	Likely	Un-likely	Very Un-likely
Falls					
Caught inbetween					
Struck by moving machineries					
Suffocations by chemicals					
Electrocutions					

29. Are most frequently occurring accidents in road construction sites preventable?

Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree ☐

- ***Critical safety precautions mean. (CSP)***

30. For road construction projects, what are the most critical safety precautions for you?

Factors	Very Likely	Fairly Likely	Likely	Un-likely	Very Un-likely
Implement Proper Training					
Ensure a Competent Person is On Site					
Set Up a Proper Perimeter					
Increase Worker and Work Site Visibility					
Wear the Proper Safety Equipment					
Implement roper traffic Control					
Use Caution When Operating Heavy Machinery					
Watch for Moving Vehicles and Equipment					
Avoid Blind Spots					
Be Constantly Aware of Your Surroundings					
Stay Hydrated					

PART FIVE: Causes of Accidents

Direction: Dear respondents questions raised in this section are related to the Causes of accidents;

please encircle your appropriate response.

31. Which factors do you think majorly contribute to accidents occurring on road construction projects? (CTA)

Factors	Very Likely	Fairly Likely	Likely	Un-likely	Very Un-likely
Improperly guarded areas					
Lack of safety training					
Lack of safety plan/ risk identification					
Ineffectiveness of current safety policy					
Unavailability of PPE and inappropriate PPE design					
Hazardous procedures, on or around machines or equipment's					

32. What do you want to see improved in relation to road construction safety, which, in your opinion, has a significant impact in changing the vulnerability of staffs to accidents? '(SE)

Factors	Very Likely	Fairly Likely	Likely	Un-likely	Very Un-likely
Guarding dangerous areas					
Improved and frequent safety training					
Implementation safety / risk identification plan					
Effective safety policy					
Availability of PPE and appropriate PPE design					
Strict procedures, on or around machines or equipment's					