

**“EFFECTIVE HEALTH AND SAFETY PRACTICES ON HIGHWAY PROJECT
SITES”**

A THESIS

Submitted by
SIBOMANA Mathias (REG.NO: PG20135058)

Under the Guidance of

PROF. EGBU CHARLES

Submitted in partial fulfilment of the requirements for the award of

**MASTER OF SCIENCE DEGREE
IN
TRANSPORTATION ENGINEERING & ECONOMICS**



**DEPARTMENT OF CIVIL ENGINEERING AND ENVIRONMENTAL TECHNOLOGY
SCHOOL OF ENGINEERING
(Nyarugenge Campus)
COLLEGE OF SCIENCES AND TECHNOLOGY
P.O. Box: 3900 Kigali, Rwanda.
SEPTEMBER, 2014**



**DEPARTMENT OF CIVIL ENGINEERING AND ENVIRONMENTAL
TECHNOLOGY
SCHOOL OF ENGINEERING
(Nyarugenge Campus)
COLLEGE OF SCIENCES AND TECHNOLOGY
P.O. Box: 3900 Kigali, Rwanda.**

C E R T I F I C A T E

This is to certify that the Thesis Work entitled **“EFFECTIVE HEALTH AND SAFETY PRACTICES ON HIGHWAY PROJECT SITES”** is a record of the original bonafide work done by **SIBOMANA MATHIAS (REG.No: PG20135058)** in partial fulfillment of the requirement for the award of Master of Science Degree in Transportation Engineering and Economics of College of Science and Technology during the Academic Year 2012-2013.

A handwritten signature in black ink, appearing to read 'Emmanuel Charles Nduh'.

PROF. EGBU CHARLES

SUPERVISOR

Dr. KUMARAN SENTHIL

HEAD

Dept. of CE & ET

Submitted for the final defense of thesis held at CST on

DECLARATION

I hereby declare that the thesis entitled “**EFFECTIVE HEALTH AND SAFETY PRACTICES ON HIGHWAY PROJECT SITES** ” submitted for the Degree of Master of Science is my original work and the thesis has not formed the basis for the award of any Degree, Diploma, Associateship, Fellowship of similar other titles. It has not been submitted to any other University or Institution for the award of any Degree or Diploma.

Place: KIGALI
Date: 20/09/ 2014

SIBOMANA Mathias



**DEPARTMENT OF CIVIL ENGINEERING AND ENVIRONMENTAL
TECHNOLOGY
SCHOOL OF ENGINEERING
(Nyarugenge Campus)
COLLEGE OF SCIENCES AND TECHNOLOGY
P.O. Box: 3900 Kigali, Rwanda.**

BONAFIDE CERTIFICATE

Certified that this thesis entitled “**EFFECTIVE HEALTH AND SAFETY PRACTICES ON HIGHWAY PROJECT SITES**” is the bonafide work of **SIBOMANA MATHIAS (Reg.No:PG20135058)** who carried out the research under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion for this or any other candidate.

A handwritten signature in black ink that reads 'Emmanuel Charles Egbu'.

Professor Charles Egbu

SUPERVISOR

Professor

University of Salford,UK

Salford, England, UK
M5 4WT

ACKNOWLEDGEMENT

All praises are due to Almighty who has blessed me with the strength to complete this research project.

My sincere thanks go to the Management of the Rwanda Education Board for its financial support to make this project a success.

My special thanks go to my Supervisor **Professor Charles Egbu** for his invaluable advices, guidance and enormous patience throughout the development of the research project.

Besides, I would like to express thanks and gratitude to the College of Science and Technology of the University of Rwanda for support and providing this course which made my dreams become a reality. I also wish to extend my thanks to highway project professionals for their relevant contribution to the study .

In addition, I would also like to express my gratitude to all my friends and classmates who had helped and given me encouragement as well as provided their knowledge to make this project a success.

Last, but not least, I would like to extend my heartfelt gratitude to my loving wife M. Goretti for her patience, constant support and good humour. She always supports me with love and spiritual strength to strive harder in everything I do.

Thank you all.

SIBOMANA MATHIAS

ABSTRACT

The highway projects have been recognised as ones of the most hazardous projects in which to work in Rwanda because they represent, not only human tragedies, but also substantial economic costs. They have poor accidents records when compared to other construction projects.

Besides causing human tragedies and economic losses, highway construction incidents also affect the productivity and reputation of the construction industry.

The aim of this research is to develop an appropriate framework and set guidance for improved awareness and understanding of effective health and safety management for highway projects.

The specific objectives of this research are: to ascertain the nature of health and safety incidence in highway projects and to document the areas in highway projects that are prone to highest safety incidence, to investigate the factors that impacts on health and safety incidence on highways projects, to document the critical success factors to effective health & safety in highway projects, to develop and present a framework and set of guidance (including recommendations) for improved management of health and safety in highway projects.

In order to achieve the above mentioned aim, the researcher used both a qualitative and quantitative approach for data collection through the following methods: analysis of literature pertaining to health and safety, evaluation of survey questionnaires completed by ten respondents from active highway construction companies in Kigali City Districts and assessment of five structured interviews. The population comprised all highway construction companies which were in operations at the time of sampling and therefore the sample size was equal to the population. The sampling method used is convenience sampling.

Based on the results of this research, it was revealed that the level of consideration of health and safety practices was generally high, but some of them have been found to be less considered by contractors such as effective communication, conducting health and safety audits,

and regular health and safety education (training) on health and safety procedure and area of controlling noise and therefore need more attention for consideration as these component features have great impact on health and safety performance in highway projects.

Furthermore, results showed factors impacting on health and safety incidence on highway project sites. These factors were summarised as: Institutional factors, Management factors, Job/work environment factors, and Personal /individual factors.

However, critical success factors to effective health and safety in highway projects were found to be : Management activities on site, consideration of health and safety during tendering process by allocating effective resources, formulation of health and safety policies, personnel attitudes towards health and safety, process of identifying hazards and assessing risks, risk response and risk management system.

Therefore, health and safety has been proved to be a fundamental consideration for all highway projects clients, designers and contractors. Effective health and safety practices should base on both legal and professional responsibilities to ensure understanding and application of health and safety principles at all times on highway project sites.

It is anticipated that the findings of this research will enable a significant contribution to be made towards the achievements of an organisation's health and safety culture and its contributory effective health and safety management systems.

TABLE OF CONTENTS

ABSTRACT.....	vi
LIST OF TABLES.....	x
LIST OF FIGURES.....	xii
LIST OF ABBREVIATIONS.....	xiii
1 INTRODUCTION.....	1
1.1 Background.....	1
1.2 Statement of the problem.....	4
1.3 Research question.....	5
1.4 Aim of the research.....	5
1.5 Scope of the research.....	5
1.6 Significance of the research.....	5
1.7 Research objectives.....	6
1.8 Limitations.....	7
1.9 Key terms and definitions.....	7
1.10 Research structure with chapter outline.....	10
2 LITERATURE REVIEW.....	13
2.1 Introduction.....	13
2.2 Health and safety legislation.....	13
2.3 Principles of health and safety in highway projects.....	16
2.3.1 Introduction.....	16
2.3.2 Main principles in occupational highway project health and safety.....	17
2.4 Safety culture and safety climate in highway construction sites environments.....	20
2.5 Health and safety incidence in highway projects.....	21
2.5.1 Global status on highway safety.....	22
2.5.2 Health and safety practices on highway projects sites for incidents prevention.....	23
2.5.2.1 Traffic management on highway project sites.....	26
2.5.2.2 Management system for safe highway construction projects.....	31
2.6 Effective health and safety management system in highway projects.....	47
2.6.1 Essential elements of an effective health and safety management system.....	51
2.6.2 Status of occupational health and safety management system in Rwanda.....	53
3 RESEARCH METHODOLOGY AND METHODS.....	54
3.1 Introduction.....	54

3.1.1	Research approach and process.....	55
3.2	Methodology	57
3.3	Methods	57
3.3.1	Data collection methods.....	58
3.3.1.1	Questionnaire design.....	58
3.3.1.2	Sampling strategies	59
3.3.1.3	Population and sample size	60
3.3.1.4	Participants	60
3.3.1.5	Procedure.....	60
3.3.2	Data analysis methods	61
4	DATA ANALYSIS, RESULTS AND DISCUSSION.....	62
4.1	Introduction.....	62
4.2	Response rate	62
4.2.1	Survey questionnaire	62
4.2.2	Structured interview	62
4.3	Data analysis and results.....	63
4.3.1	Analysis of survey questionnaire responses	63
4.3.1.1	Physiological information for respondents.....	63
4.3.1.2	Questions for technical research information.....	64
4.3.2	Analysis of interview responses	100
4.4	Summary of main findings	102
4.5	Answer to the research question	104
4.6	Health and Safety management framework in highway projects	105
5	CONCLUSION AND RECOMMENDATIONS.....	109
5.1	Conclusion	109
5.2	Recommendations	110
5.3	Recommendations for further research	111
	REFERENCES.....	113
	APPENDIX.....	118

LIST OF TABLES

- Table 1.1– Key terms and definitions
- Table 4.1 – Level of the contracting company
- Table 4.2 – Position in the company
- Table 4.3 – Experience at work
- Table 4.4.1– Identification and analysis of health and safety hazards at the work site
- Table 4.4.2 – Control measures to eliminate or reduce the risks to workers from hazards
- Table 4.4.3– Clearly demonstrated management commitment, and written company policy
- Table 4.4.4 – Work competency and training
- Table 4.4.5 – Inspection programme
- Table 4.4.6 – Emergency response planning
- Table 4.4.7 – Incidents reporting and investigation
- Table 4.4.8 – Management system administration
- Table 4.5.1 – Excavation
- Table 4.5.2– Protection of power line and electrical equipments on sites
- Table 4.5.3– Driving plant on work site
- Table 4.5.4 –Use of explosives
- Table 4.5.5 –Earth moving
- Table 4.5.6– Working in confined space
- Table 4.5.7 – Working in, over ,or adjacent to water
- Table 4.5.8 – Controlling noise
- Table 4.5.9 – Controlling dust
- Table 4.5.10 – Work site signage
- Table 4.6.1 – Working methods and methodologies in project work
- Table 4.6.2 – Materials and equipment used in projects
- Table 4.6.3 – Lack or inadequate training and inductions on health and safety
- Table 4.6.4 – Inadequate skills and competencies of project staff/workers
- Table 4.6.5 – Absence of formal Health and Safety Management Processes and Systems

Table 4.6.6 – Government’s limited capacity in providing appropriate legal framework and inspectorate personnel to enforce compliance

Table 4.6.7 – High cost involved in providing and maintaining health and safety risk control measures

Table 4.6.8 – Lack of management commitment to health and safety

Table 4.6.9 – Lack of top management commitment to health and safety

Table 4.7 – Qualified personnel of the company to deal with health and safety issues on work site

Table 4.8 – Availability of documented procedure at the company level

Table 4.9 – Current practices for the company to eliminate or reduce the health and safety incidence on work site

Table 4.10.1 – Management activities on site

Table 4.10.2– Consideration of health and safety during tendering process by allocating effective resources

Table 4.10.3– Incentive either monetary, non monetary or disciplinary action

Table 4.10.4 – Formulation of health and safety policies

Table 4.10.5 – Personnel attitudes towards health and safety

Table 4.10.6 – Process of identifying hazards and assessing risks

Table 4.10.7 – Risk response and risk management system

Table 4.10.8 – Adequate personal protective equipment aligned with the nature of work

Table 4.11– Major elements of effective health and safety in highway projects

Table 4.12 – Company health and safety performance indicators in place in the execution of current highway projects

LIST OF FIGURES

- Figure 2.1– Occupational Health and Safety Management System
- Figure 2.2 – Risk management basics
- Figure 2.3 – Relationship between components of the framework for managing risk
- Figure 2.4 – Risk management process
- Figure 2.5 – Elements of occupational health and safety management in highway projects
- Figure 3.1 – Research process
- Figure 4.4.1– Identification and analysis of health and safety hazards at the work site
- Figure 4.4.2 – Control measures to eliminate or reduce the risks to workers from hazards
- Figure 4.4.3 – Inspection programme
- Figure 4.4.4– Incidents reporting and investigation
- Figure 4.5.1 – Excavation
- Figure 4.5.2 – Driving plant on work site
- Figure 4.5.3 – Earth moving
- Figure 4.6– Relationship between components of the framework for managing risk

LIST OF ABBREVIATIONS

OHS – Occupational Health and Safety

GDP – Gross Domestic Products

RTS – Road Traffic Safety

OHSAS – Occupational Health and Safety Assessment Series

CHAPTER 1

INTRODUCTION

This chapter introduces the work done throughout this research. It comprises of the background to the research, problem statement, research question, research aim, scope of the research, significance of the research, research objectives, as well as the study limitations. This chapter concludes with the structure of the research outline.

1.1 Background

Occupational Health and Safety (OHS) is a discipline dealing with the prevention of work related injuries and diseases, and the protection and promotion of the health of workers [1]. On the other hand, [2] defines the occupational health and safety 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, taking into account the possible impact on the surrounding communities and the general environment. He further states that a wide range of skills, knowledge and analytical capacities are needed to coordinate and implement all of the “building blocks” that make up occupational health and safety management systems so that protection is extended to both workers and the environment.

Similarly, [3] defines occupational health and safety as conditions and factors that affect, or could affect, the health and safety of employees or other workers (including temporary workers and contractor personnel), visitors, or any other person in the workplace.

Therefore, for the purpose of this study, occupational health and safety can be defined as discipline dealing with the prevention of work related injuries and diseases, and the protection and promotion of the health of workers, visitors, or any other person in the work place.

Globally, construction was found to be one of the most hazardous industry with many thousands of workers being killed and seriously injured each year [4].

The Global Status Report on road safety conducted by the World Health Organisation [5] shows that approximately 1.24 million people die every year on the world's roads, and another 20 to 50 million sustain nonfatal injuries as a result of road traffic crashes. The report also shows that road traffic injuries are the eighth leading cause of death globally, and the leading cause of death for young people. According to this report, the highest road traffic fatality rates are in middle-income countries, particularly the African Region.

Similarly, the Magazine of Rwanda National Police [6] argues the occurrence of traffic accidents based on Traffic Police Unit statistics which show that about 1135 people have died in road accidents since 2009 and 6943 others injured in the same period, whereas between January and August 2012, 1246 traffic accidents were registered in which 257 people died.

Additionally, a study was conducted [7] on Road Traffic Injuries at Kigali University Central Teaching Hospital in Rwanda found that, of the 1101 road traffic accident victims, 558 (50.7%) were in the 16 to 30 age group. Only 7.2% of the cases were aged 46 years and above with only 21 (1.9%) being above 60 years.

Moreover, [8] presented some obstacles to road safety in Rwanda including new road construction sites. It was stated that impediments to promoting road safety measures in Rwanda include lack of complete documentation on road traffic "accidents" and the resulting injuries, imprecise surveillance methods, limited research on causes and risk factors, as well as lack of awareness of existing interventions by the public and many policy makers, and lack of data collection system. In some cases, policy makers have been reluctant to introduce legislation on interventions proven to be effective in reducing injury severity.

Therefore, it is obvious that these injuries and deaths have an immeasurable impact on the families affected, whose lives are often changed irrevocably by these tragedies, and on the communities in which these people lived and worked.

Despite studies conducted on health and safety practices in construction industry in general, incidents at highway construction sites are continuing problem in Rwanda because there is no record showing fatalities, injuries and health illness that have occurred to workers, visitors,

or traffic passing on or near the highway project sites. As historical records on occupational highway injuries has been analysed, it was found that, in Rwanda, only traffic injuries are recorded by the Rwanda National Police. There is no official record on construction accidents, specifically in highway projects execution.

Additionally, statistics on highway construction accidents highlight indispensable measures which have been overlooked by the appointed highway contractors. Ignorance of the highway safety regulation has resulted in various fatal accidents for both domestic users and construction workers [2].

Health and Safety is therefore a fundamental consideration for all highway projects clients, designers and contractors. It should be part of everyday working with activities on every project. Both a legal and professional responsibility should ensure understanding and application of health and safety principles at all times. Also, successful health and safety practices should be based on collaboration and good will, as well as taking on board the opinions of people concerned.

This research attempts to evaluate a comprehensively planned approach to the implementation of health and safety improvements. It is specifically concerned with establishing how far they are currently being undertaken to a detailed planning scheme, how effective that may be, and what elements might be missing from such programmes. It reviews the health and safety literature to establish how far it currently addresses this issue and what other specialist sources of learning may be available, and of assistance.

The need for the research is due to incident rates on highway project sites that are currently encountered as they represent, not only terrible human tragedies, but also substantial economic costs. This is because incidents result in damage to plant equipments, loss of human lives, health diseases, the loss of productive work time and reduce the work rate. Therefore highway projects owners , contractors , consultants and stakeholders need to be fully prepared to deal with health and safety incidence on highway project sites, and therefore undertaking safe practices in the management system [9].

The other reason for conducting this research is to raise awareness to all parties involved in the highway projects about their influence on improving health and safety performance through the establishment and implementation of improved Health and Safety Management System as there is lack of previous studies about the health and safety issues of highway project sites in Rwanda, health and safety matters are not taken seriously by all parties involved in highway projects as they may have not been budgeted for at the tendering stage.

1.2 Statement of the problem

Highway construction is a potentially hazardous occupation involving different phases and parties, the incidence of workplaces sickness, diseases, fatalities and injuries vary enormously between companies although the construction regulations of the Health and Safety Act are in place for the protection of all participants involved in the construction process [10]. This is largely due to the negligence of the workforce, contracting parties and site supervisors [11].

Similarly, [12] argues that the construction industry which includes highway construction is experiencing a significant number of fatalities and serious injuries from work involving the movement of powered mobile plant and other vehicles within site. It has been recognized as one of the most hazardous industries in which to work and has a poor health and safety records when compared to other industries. Illness, injuries, fatalities and equipment damage, financial loss and environmental degradation vary enormously between companies and workers still continue to face serious risks arising from highway hazards.

Furthermore, a research conducted in Rwanda by [13] on health and safety practices in construction industry found that Rwanda does not record construction accidents, including highway projects, when the major organizations and construction companies most likely to possess accidents data were approached; it was found that there was no official construction accident statistics available in Rwanda.

As dangers are ever present on construction sites, it is therefore important to find better means of maintaining health and safety in transport related projects.

It is in this context that a management system is needed to ensure effective health and safety

coordination on site during highway construction while at the same time covering project planning and construction work. Specifically, the system provides a common safety framework for all parties involved in a highway construction project; systematically establish the health and safety obligations and responsibilities of each party; require contractors to have health and safety systems in place that comply with the company own management system and incorporate an effective monitoring system.

1.3 Research question

For the purpose of this research, the research question is formulated as follows:
“What factors impacting on health and safety incidence on highway project sites in Rwanda”?

1.4 Aim of the research

The aim of this research is” To develop an appropriate framework and set guidance for improved awareness and understanding of effective health and safety management for highway projects”.

1.5 Scope of the research

This research entitled” Effective Health and Safety practices on Highway Project Sites” is conducted on sites of highway construction companies operating in Kigali City where health and safety issues are of high concern due to high volume of traffic passing on or near sites of works, including site equipments and workers and visitors and it considers any work at high risk that workers may be exposed to including any process, operation or transport on a construction site, from the preparation of the site to the completion of the project.

1.6 Significance of the research

Highway projects have been causing incidents to workers due to lack of appropriate health and safety practices on site [14].

The main reason for conducting this research is the need for improving health and safety performance in highway projects by setting effective health and safety management system

requirements, guidelines for successful implementation of health and safety through establishing a management system framework.

Therefore, the research is innovative as it intends to investigate the causal factors of poor management of health and safety practices in highway projects. It also intends to raise awareness to highway projects owners, contractors, consultants and stakeholders about the need of getting fully prepared to deal with health and safety incidence by undertaking safe practices in the management system to prevent recurrence.

It involves the measurement of company health and safety culture, measurement of driver and workers attitudes at work and the collection of company accident data and finally, contractors will be provided with guidance to improve health and safety performance on highway project sites.

The final report of this research will be used by public and private institutions to establish and implement improved health and safety practices on highway projects, especially the National Highway Authorities, local authorities who are clients of projects will understand their responsibilities to plan and budget for health and safety before tendering process is done. Designers /consultants, on their side, will understand their responsibilities to set standards in health and safety area, whereas contractors will have to comply effectively with health and safety regulations and procedures on the project site.

1.7 Research objectives

The following are objectives set for this research:

- 1) To ascertain the nature of health and safety incidence in highway projects, and to document the areas in highway projects that are prone to highest safety incidence;
- 2) To investigate the factors that impacts on health and safety incidence on highways projects;
- 3) To document the critical success factors to effective health & safety in highway projects;
- 4) To develop and present a framework, and set of guidance (including recommendations) for improved management of health and safety in highway projects.

1.8 Limitations

This research has been limited due to the following factors:

- Only Kigali City contracting companies were analysed, therefore the factors impacting on health and safety incidence on highway project sites were not explored in their entirety for Rwanda.

1.9 Key terms and definitions

For the purpose of this research, the key terms and definitions indicated in table 1.1 apply.

Table 1.1– Key terms and definitions

Terms	Definitions according to[56]
Accident	An unplanned event that results in harm to people, damage to property or loss to process
Confined space	A space in which a hazardous gas, vapour, dust or fume may collect or in which oxygen may be used up because of the construction of the space, its location, contents, or the work activity carried out in it. It is an area which is not designed for continuous human occupancy and has limited opening for entry, exits or ventilation
Fatality	Death resulting from an accident
Hazard	The potential of any machine, equipment, process, material (including biological and chemical) or physical factor that may cause harm to people, or damage to property or the environment
Health	It is a state of complete physical, mental and social well-being
Safety	The prevention of physical injury to workers and the prevention of physical injury to other persons arising out of or in connection with activities in the workplace
Incident	An unwanted event which, in different circumstances, could have resulted in harm to people, damage to property or loss to a process. It is an inclusive term for injuries/illnesses, accidents and near misses

Table 1.1– Key terms and definitions (Continued)

Near miss	Any occurrence that might have led to injury or illness to a person
Legal Requirement	Anything that is demanded of a person or organization by statute, regulation, common law, or by-law
Occupational health	The development, promotion, and maintenance of workplace policies and programs that ensure the physical, mental, and emotional well-being of employees
Occupational safety	The maintenance of a work environment that is relatively free from actual or potential hazards that can injure employees
Procedure	A step-by-step description of how to do a task, job, or activity properly
Risk	The probability of a worker suffering an injury or health problem, or of damage occurring to property or the environment as a result of exposure to or contact with a hazard
Risk management terms according to[55]	
Risk Identification	Process of finding, recognizing, and describing risks
Risk management	Coordinated activities to direct and control an organization with regard to risk
Risk Assessment	Overall process of risk identification, risk analysis, and risk evaluation
Risk Analysis	Process to comprehend the nature of risk and determine the level of risk
Risk Evaluation	Process of comparing the results of risk analysis with risk criteria to determine whether the risk and/ or its magnitude is acceptable or tolerable
Likelihood	Chance of something happening
Level of Risk	Magnitude of a risk or combination of risks, expressed in terms of the combination of consequences and their likelihood

Table 1.1– Key terms and definitions (Continued)

Risk Treatment	Process to modify risk
Risk control	Measure that is modifying risk
Risk monitoring	Continual checking, supervising, critically observing, or determining the status to identify change from the performance level required or expected
Risk management process	Systematic application of management policies, procedures and practices to the activities of communicating, consulting, establishing the context, and identifying, analyzing, evaluating, treating, monitoring and reviewing risk
Establishing the context	Defining the external and internal parameters to be taken into account when managing risk, and setting the scope and risk criteria for the risk management policy
External context	External environment in which the organization seeks to achieve its objectives
Internal context	Internal environment in which the organization seeks to achieve its objectives
Risk criteria	Terms of reference against which the significance of a risk is evaluated

1.10 Research structure with chapter outline

CHAPTER 1 INTRODUCTION

This chapter Introduces the research question and outlines the path the dissertation takes to reach its conclusion. It is structured as follows:

- Background to the research;
- Problem statement;
- Research question;
- Research aim;
- Scope of the research;
- Significance of the research;
- Research objectives;
- Study limitations;
- Key terms and definition; and
- Research structure with chapter outlines

CHAPTER 2 LITERATURE REVIEW

This chapter reviews the body of knowledge developed by previous researchers. It comprises of:

- 2.1 Introduction;
- 2.2 Health and safety legislation;
- 2.3 Principles of health and safety in highway projects;
- 2.4 Safety climate and safety culture in highway construction sites environments;
- 2.5 Health and safety incidence in highway projects; and
- 2.6 Health and safety practices in highway projects.

CHAPTER 3 RESEARCH METHODOLOGY

This chapter explains the methodology and methods used in this research to collect and analyse data to achieve the aim and objectives of this study. The following are discussed:

- Introduction
- Research approach and process
- Research methodology
- Data Collection methods
- Data Analysis methods

CHAPTER 4 DATA ANALYSIS, RESULTS AND DISCUSSION

This chapter comprises of the results of applying the research methods adopted in this research.

The following are included:

- Response rate
- Analysis of survey questionnaire
- Analysis of interviews
- Summary of Findings
- Answer to the research question
- Possible solutions for improvement

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS

In this chapter, the conclusion is drawn from developed chapters with main focus on research findings and on the recommendations to be made for further improvement and further research.

It consists of:

- Contribution to the Original Body of Knowledge;
- Findings of the Research;

- Research Recommendations; and
- Areas for further research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter provides a background of the various facets of the current body of knowledge in relation to health and safety practices in highway projects and highlights the lack of a comprehensive integral model of effective health and safety practices on highway project sites. This chapter also discusses the nature of incidents in highway projects, health and safety performance scenarios, and methods used to improve health and safety performance in highway projects.

2.2 Health and safety legislation

It was stated by [15] that the health and safety legislation is designed to protect people by establishing safe systems of work to eliminate or minimise the risks to health, safety and welfare. Employers, employees and others, all have an important role to play.

According to [15], the health and safety legislation should be made up of three components which are the subsections 2.2.1 to 2.2.3.

2.2.1 Occupational Health and Safety (OHS) Act

OHS Act describes how to provide health and safety and therefore everything in it is a law and must be followed. It sets out the general requirements for protecting health and safety in the workplace and clarifies that everyone who may affect health or safety at work has a part to play in protecting it. This includes employers, employees and their representatives, designers manufacturers and suppliers of machinery, equipment or substances used at work.

As the Act aims to bring employers, employees and their representatives together to resolve health and safety issues at work, it is therefore important that every organisation has a copy.

Furthermore, giving workers the right to elect Health and Safety Representatives (HSRs) and to participate in health and safety committees in the workplace encourages employee involvement [16]. For effective compliance with the Act, the work place should be inspected to investigate health and safety issues [9].

However, employees must cooperate with their employer in ensuring health and safety in the workplace. In particular, they must use equipment provided to protect health and safety; follow reasonable instructions the employer gives on health and safety; ensure they are not so affected by alcohol or drugs to endanger their own or any other persons' health and safety[15].

In order to make sure that these duties are met, employers should establish an effective system for managing health and safety by preparing policies that set down the arrangements for protecting the health and safety of employees while they are at work. Employers must also consult employees and their representatives about health and safety issues at workplace, whereas employees must take reasonable care to protect their own health and safety, and the health and safety of others that may be affected by their actions or omissions at work [15].

Therefore, active participation in health and safety by employees is one way of taking positive steps to have health and safety problems resolved. If employees believe work is unsafe, health and safety instructions are unreasonable or arrangements intended to protect health and safety are not effective, they should report these problems and take appropriate action to protect themselves.

2.2.2 OHS Regulations

OHS Regulations are made under the Act and set out general principles and practical steps that should be followed in order to prevent incidence at work and therefore everything in them is law and must be followed. They set out general principles that provide practical steps for employers in preventing injuries and illness at work. These practical steps such as consultation with employees and their representatives; identification of hazards (potential causes of injury or illness); assessment of the risks, i.e. how likely it is that hazards will cause injury or illness, and

how serious this might be; control and minimisation of the risks to ensure that injury or illness is prevented; provision of information, instruction, training and supervision to ensure employees are aware of any risks and what must be done to control them; reporting hazardous situations, fatalities, injuries and illness so action can be taken to prevent them from happening again ensure that safe systems of work are developed and implemented.

In addition, employers and employees, designers, owners and occupiers and providers of plant, equipment or substances used at work have a role to play in ensuring health and safety. Self employed people must also take steps to protect their own health and safety and avoid adversely affecting the health and safety of others [15].

2.2.3 Approved Codes of Practice

Approved Codes of Practice are made under the OHS Act and give practical guidance on how to comply with legal requirements of specific regulations and should be used in addition to the Act and Regulations.

In addition, Approved Codes of Practice describe the preferred methods or actions to achieve the standard of health and safety. This means other standards can be used if they achieve an equal or better standard of health and safety. A code of practice is therefore different from a Regulation, as the responsible person must meet the specific requirement of the Regulation [9]. For this reason, preferred methods or courses of action in an Approved Code of Practice are preceded by the word “**should**” because they are recommendation while obligations are preceded by the word “**shall**” because they are mandatory. Failure to meet these obligations is an offence against the Act or Regulation [15].

With regard to the difference between a code of practice and a regulation, the word “should” is commonly used to express the recommendation by giving guidelines on how to perform a particular activity whereas the word “shall” is commonly used to express a requirement in technical regulations the compliance with which is mandatory and provides sanctions to non compliant in any country.

By considering what is stated in the above health and safety legislation components, it is obvious that they are also components of legal framework on health and safety practices in highway projects.

2.3 Principles of health and safety in highway projects

2.3.1 Introduction

The human, social and economic costs of occupational accidents, injuries and diseases and major industrial disasters have long been cause for concern at all levels from the individual workplace to the national and international [16].

Measures and strategies designed to prevent, control, reduce or eliminate occupational hazards and risks have been developed and applied continuously over the years to keep pace with technological and economic changes [17].

[18] made the global health report and estimated that 2 million occupational fatalities occur across the world every year, the highest proportions of these deaths being caused by work-related cancers, circulatory and cerebrovascular diseases, and some communicable diseases. In sub-Saharan Africa including Rwanda, the fatality rate per 100,000 workers is 21 and the accident rate 16,000. This means that each year 54,000 workers die and 42 million work-related accidents take place that cause at least three days' absence from work [13].

Transport projects accidents are all caused by preventable factors which could be eliminated by implementing already known and available measures and methods. This is demonstrated by continuously reduced accident rates in industrialized countries. The application of preventive strategies therefore offers significant human and economic benefits [19].

Drivers are particularly at risk. International estimates suggest that between 15 and 20 per cent of fatalities caused by road accidents are suffered by people in the course of their work, but these deaths are treated as road traffic accidents rather than work-related fatalities [19].

Despite this worrying situation, international awareness of the magnitude of the problem remains surprisingly modest. The inadequate dissemination of knowledge and information hampers action, especially in developing countries. It also limits the capacity to design and implement effective policies and programmes.

Therefore, many work-related deaths that occur every day go virtually unrecorded. Workers continue to face serious risks. To reduce the human suffering, financial loss and environmental degradation associated with these risks, there is a need for increased and sustained action to protect occupational safety and health.

2.3.2 Main principles in occupational highway project health and safety

[2] states certain basic principles in occupational health and safety in construction industry that can be identified and those include the following:

- **All workers have rights**

This principle states that workers, as well as employers and governments, must ensure that these rights are protected and must strive to establish and maintain health and safety working conditions and environment which should be consistent with workers' well-being and human dignity; work should offer real possibilities for personal achievement, self fulfilment and service to society [2].

- **Occupational health and safety policies must be established**

Such policies must be implemented at both the national (governmental) and company levels. They must be effectively communicated to all parties concerned [2].

- **A national system for occupational health and safety must be established.**

Such a system must include all the mechanisms and elements necessary to build and maintain a preventive safety and health culture. The national system must be maintained, progressively developed and periodically reviewed [2].

- **A national programme on occupational health and safety must be formulated**

Once formulated, it must be implemented, monitored, evaluated and periodically reviewed.

- **Social partners (employers and workers) and other stakeholders must be consulted**

This should be done during formulation, implementation and review of all policies, systems and programmes [2].

- **Occupational health and safety programmes and policies must aim at both prevention and protection**

In this principle, efforts must be focused above all on primary prevention at the workplace level. Workplaces and working environments should be planned and designed to be safe and healthy [2].

- **Continuous improvement of occupational health and safety must be promoted**

This is necessary to ensure that national laws, regulations and technical standards to prevent occupational injuries, diseases and deaths are adapted periodically to social, technical and scientific progress and other changes in the world of work. It is best done by the development and implementation of a national policy, national system and national programme [2].

- **Information is vital for the development and implementation of effective programmes and policies**

This principle is concerned with the collection and dissemination of accurate information on hazards and hazardous materials, surveillance of workplaces, monitoring of compliance with policies and good practice, and other related activities are central to the establishment and enforcement of effective policies [2].

- **Health promotion is a central element of occupational health practice**

This principle can be understood as efforts that must be made to enhance workers' physical, mental and social well-being [2].

- **Compensation, rehabilitation and curative services must be made available to workers who suffer occupational injuries, accidents and work-related diseases**

To this principle, action must be taken to minimize the consequences of occupational hazards.

- **Education and training are vital components of safe, healthy working environments**

This principle states that workers and employers must be made aware of the importance of establishing safe working procedures and of how to do so. Trainers must be trained in areas of special relevance to particular industries, so that they can address the specific occupational safety and health concerns [2].

Therefore, the consultation between workers and employers is a key health and safety performance tool.

- **Workers, employers and competent authorities have certain responsibilities, duties and obligations**

This principle addresses the obligations to workers and employers as well as responsibilities of both sides in order to complement each other.

For example, workers must follow established safety procedures; employers must provide safe workplaces and ensure access to first aid; and the competent authorities must devise, communicate and periodically review and update occupational safety and health policies [2].

- **Policies must be enforced**

In this principle, a system of inspection must be in place to secure compliance with occupational safety and health measures and other labour legislation.

Nevertheless, some overlap exists among these general principles. For example, the gathering and dissemination of information on various facets of occupational safety and health underlies all the activities described. Information is needed for the prevention as well as the treatment of occupational injuries and diseases. It is also needed for the creation of effective policies and to ensure that they are enforced. Education and training demand information.

While these key principles structure occupational safety and health programmes and policies, the above list is by no means exhaustive. More specialized areas such Highway projects, have corresponding principles of their own. Moreover, ethical considerations regarding such matters as individuals' rights to privacy must be taken into consideration when devising policies [2].

Although few researchers wrote on health and safety principles, the consideration of their relevance once established, as recommended by [60], in construction industry where highway projects execution is a part thereof, contributes to the performance requirements for effective health and safety practices in this area.

2.4 Safety culture and safety climate in highway construction sites environments

According to [20], safety climate is defined as a collection of attitudes and behaviors as expressed at a point in time and can be measured using surveys.

The idea of safety climate has risen out on the underlying belief that the majority of accidents are not caused by careless workers, but by failure in control, which ultimately is the responsibility of management [21].

According to [22], the American Society of Safety Engineers states that safety climate incorporates the predominant attitudes and employee behaviours associated with the state of safety in a highway construction company at a particular moment. Safety climate is relatively unstable and subject to change depending on current conditions.

From the statements of [22], safety climate is regarded as a manifestation of safety culture in the behaviour and expressed attitude of employees and its elements emerge as predictors of unsafe behaviour or accidents in numerous structural models and non-linear models and it is therefore becoming accepted that a favourable safety climate is essential for safe operation.

Furthermore, safety climate is considered as temporal state of safety culture which can indirectly be evaluated from instruments that assess safety climate.

Safety climate instruments can be used as a predictive tool to assess hazardous exposures before they develop into injuries or fatalities on highway project sites [23].

A valid safety climate survey can help eliminate the deficiencies found in more traditional methods because it incorporates near-miss cases and an evaluation of risk exposure [24].

Professional organizations supporting best practices promote the use of measuring safety climate as one of the leading indicators of effective safety management [24].

Safety climate assessments have been used by organizations to benchmark the effectiveness of an overall safety process or to assess the progress of specific safety initiatives [25].

Safety culture is therefore the assembly of characteristics and attitudes in organisations and individuals which establishes that, as an overriding priority, plant safety issues receive the attention warranted by their significance. It is important because it forms the context within which individual safety attitudes develop and persist and safety behaviours are promoted.

2.5 Health and safety incidence in highway projects

Worldwide occupational injury rates in construction industry including highway projects are highest for all major industries. Construction is always risky because of outdoor operations, work-at height, complicated on-site plant machinery and equipment operation coupled with worker's attitudes and behaviours towards safety.

According to [26], an analysis of fatal occupational injuries at road construction sites from the year 2003 to 2010 revealed that, of 962 occupational injuries occurred on road construction sites, 13 % were incurred by workers passing through the site rather than working at it and truck drivers accounted for the vast majority of these incidents.

Almost 70 % of passing-through incidents were collisions involving either vehicles or mobile equipment going in the same direction or a vehicle or mobile equipment striking a stopped vehicle or mobile equipment. While 35 % of all highway collisions involving vehicles or mobile equipment were attributable to these events from 2003 to 2010, they accounted for 89 % of highway collisions between vehicles or mobile equipment at road construction sites.

From a practical point of view, health and safety in highway construction is about using appropriate means to ensure workers are both safe and healthy. However, in a construction environment the situation is all the more challenging, where projects differ considerably in terms of size, location and complexity. Moreover, safety can impact all stages of a project from planning, operationalization to review.

2.5.1 Global status on highway safety

Road safety is a major societal issue. [27] has reported that over 1.2 million people die each year on the world's roads, and between 20 and 50 million suffer non-fatal injuries. In this report, over 90% of the world's fatalities on the roads occur in low-income and middle-income countries, which have only 48% of the world's vehicles of the world's registered vehicles. Rwanda is a low-income country as reported by [27] and, according to the Rwanda police data, road traffic fatalities were 308 defined as died within 30 days of the crash and 2158 non-fatal road traffic injuries by the year 2007. Costing study data was not available by that time.

In contrast, [28] says that, in low-income countries, the cost of road crashes is estimated to amount to 1 per cent of gross domestic product (GDP), not including the added burden of human suffering, which is not quantifiable. One per cent of GDP is the equivalent of the public development aid received by low-income countries each year.

This situation is particularly unacceptable considering that funding invested in road safety is very quickly recovered, often with added profit.

[28] continues saying that road safety is without doubt an area where action by the public authorities can be profitable. Investing in road safety leads to economic savings while protecting both a country's current population and its future generations.

The fact of making road safety a priority should not be equated with creating added burdens for road users, as is sometimes associated with the implementation of new or more stringent traffic laws such as speed limits or seat-belt laws.

As per advice from [28], for any country to be able to manage to reverse sustainably the rising trend of road casualties arising from a series of root causes such as the vehicle (a factor in 5 to 10 per cent of crashes), road infrastructure (to which 10 to 20 per cent of crashes may be attributed) and road user behaviour (which is responsible at least in part for some 80 to 90 per cent of road crashes), political awareness must be done.

It is therefore important to consider the vehicle / the road / the user as a system. The interactions between users and the physical elements are critical.

Nevertheless, records of fatalities and injuries occurred on the new road construction site are less considered all over the world and result in poor health and safety management in highway projects.

2.5.2 Health and safety practices on highway projects sites for incidents prevention

A road construction site [28] was defined as a workplace where workers are present to carry out construction, maintenance and utility works on a road, street or highway.

Road construction works involve the use of large items of plant and equipment. As a consequence, these types of construction work face particular problems that are peculiar to the Civil Engineering sectors. However, some of the problems faced are much more generic in nature and apply to road construction. Maintenance works form a significant part of the construction industry workload and contribute significantly to accident rates.

Few work environments present, as do road construction sites, the multitude of risks. For example, vehicles may pass by at high speeds, and the work conditions are constantly changing. Highway traffic is a major concern for workers at a highway construction site, but workers also face a similar danger from vehicles and mobile equipment being used at such sites [29].

Moreover, the construction industry has been recognized as one of the most hazardous industries having a poor safety record when compared to many other industries. The injury rate is still one of the highest across all sectors. Besides causing human tragedy and economic losses, construction accidents also affect the productivity and reputation of the construction industry [30].

As a recommendation, everyone needs to take responsibility for enforcing and carrying out safe practices. Employees should be aware of their company's health and safety policies and know the ramifications of not abiding by them.

Similarly, the safety performance of the construction industry has been improving and health and safety has been recognized as an important business performance subject [31].

The factors causing construction site accidents have been addressed by several researchers. [32] listed the main causes of construction accidents. These are lack of proper training, deficient enforcement of safety, lack of safety equipment, unsafe methods or sequencing, unsafe site conditions, not using provided safety equipment, poor attitude toward safety, and isolated, sudden deviation from prescribed behaviour.

Researches also show that the main causes of the fatalities in construction are due to falls, struck-by incidents, caught in/between incidents and electrocutions. It has been also indicated that the most significant factor in construction site accidents is the unsafe behaviour [33]. Construction accidents result in great economic losses. In their study, [34] found that the total costs of accidents lies between 7.9% and 15% of the total costs of non-residential, new construction. Furthermore, [35] showed that the average workers' compensation insurance costs could be estimated approximately 3.5% of the total project costs. Besides causing human tragedy

and economic losses, construction accidents also affect the productivity and reputation of the construction industry [36].

[37] examined 136,000 construction worker injuries. They examined the potential impact of minor injuries in terms of numbers of workers affected and average cost per injury. They found that over half of the injuries were associated with lacerations and injuries sustained by the lumbar spine, upper extremities, or eyes.

The importance of safety training to improve the safety performance in the construction industry has been addressed by many researchers [38]. Effective training of construction workers can be one of the best ways in improving site safety performance [39]. In the study of [40], it has been pointed out that some accidents such as falling from height and hit by falling materials in construction could easily be prevented from implementing training programs to employees. Similarly, in the study of [41], construction workers identified training as a necessary element of safety performance.

As [42] stated, workers with good safety knowledge have a more positive safety climate than those with poor safety knowledge.

[43] identified the critical factors that influence the attitudes of construction workers towards safe behaviour on construction sites. According to the results of their study, training of operatives and safety supervisors is important to safety awareness and improved performance. Moreover, it has also been found that knowledge and competence influence personal safety performance. They also stated that companies must maintain and update their workers' skills and knowledge by training, skill updates and effective on site communication [44].

Besides minimizing construction accidents, successful training can also minimize project delays and damage to company image [45]. On the other hand, lack of safety training of construction workers has been considered as one of the important causes of construction accidents [46].

As a result, safety training and knowledge of construction workers about safety and health practices are critical issues for improving safety performance in the construction industry. Although there is an increase in safety awareness, there have been few studies in Rwanda construction industry about safety and health management practices and workers' safety knowledge which is highly essential for successful safety and health practices.

2.5.2.1 Traffic management on highway project sites

The international standard [47] specifies requirements for a road traffic safety (RTS) management system to enable an organization that interacts with the road traffic system to reduce death and serious injuries related to road traffic crashes which it can influence. The requirements in this International Standard include development and implementation of an appropriate RTS policy, development of RTS objectives and action plans, which take into account legal and other requirements to which the organization subscribes, and information about elements and criteria related to RTS that the organization identifies as those which it can control and those which it can influence.

In addition, the requirements of this standard are applicable to any organization, regardless of type, size and product or service provided, that wishes to improve RTS performance, establish, implement, maintain and improve an RTS management system, assure itself of conformity with its stated RTS policy, and demonstrate conformity with this International Standard.

Although the National Police of Rwanda is in charge of the road traffic safety control through road safety awareness, road vehicle inspection, road accidents reporting and records keeping, poor records of accidents occurring in construction industry, specifically in highway projects execution has been observed, no clear data are officially available in Rwanda. Only some data on accidents occurring on existing roads are officially available.

Similarly, Australian standard [48] specifies the traffic control devices to be used to warn, instruct and guide road users to safely negotiate work sites on roads. It provides a set of uniform practices for signing and delineation of construction and maintenance works to promote safety. [48] also specifies that the traffic control devices include all signs, signals, markings, and other devices used to regulate, warn, or guide road users, but only standardized devices and signs may be used to direct traffic through temporary work zones.

Although the types of signs for the control of traffic on highway project sites are in place, the flagging is also a popular way of controlling traffic on sites in Rwanda. Flagger ahead considered as a hand warning sign in an emergency situation. For stopping and directing traffic in work zones the stop/slow paddle is used.

The STOP/SLOW paddle should be the primary and preferred hand-signalling device because the STOP/SLOW paddle gives road users more positive guidance than red flags [48].

As the purpose of traffic management is to provide safety on site for workers and road users at all times, effective traffic management depends on works planning and method, adequate and appropriate signage and traffic control, driver capability, awareness, behaviour and attitude.

In addition, the aim of worksite traffic management is to provide effective communication between road workers and road user (pedestrians). This is achieved by providing warning signs, warning of changes to road and driving conditions, warning of personnel, plant, equipment in use and Providing safe, efficient passage for road users.

Aspects of setting up and maintaining road construction sites, including signage, channelling devices, flaggers, and worker safety are outlined in [49]. It also describes the parameters for improving workers safety as follows:

- ✓ **Training:** all workers should be trained on how to work next to motor vehicle traffic in a way that minimizes their vulnerability;
- ✓ **Temporary Traffic Barriers:** temporary traffic barriers should be placed along the work space depending on factors such as lateral clearance of workers from adjacent traffic, speed of traffic, duration and type of operations, time of day, and volume of traffic;

- ✓ **Speed Reduction:** reducing the speed of vehicular traffic, mainly through regulatory speed zoning, funneling, lane reduction, or the use of uniformed law enforcement officer or flagger should be considered;
- ✓ **Activity Area:** planning the internal work activity area to minimize backing-up maneuvers of construction vehicles should be considered to minimize the exposure to risk;
- ✓ **Worker Safety Planning:** a trained person designated by the employer should conduct a basic hazard assessment for the worksite and job classifications required in the activity area.

These practices outlined above are therefore acknowledged by the researcher.

According to [50] states that road traffic signs, including those used at road works, may be divided into three broad types:

Regulatory: signs which give instructions or apply prohibitions or restrictions which road users must obey;

Warning: signs which warn of hazards/danger on the road ahead or advise persons of the precautions to be taken against such danger, or both;

Information: signs which give directions and distances to destinations on the road ahead or on intersecting roads, or which provide other information.

The above signs once effectively used by the project management and respected by road users can reduce accident rates on highway projects sites.

It is stated in [51] that where works are in progress on a highway, or on any road to which the public have access, there is a need for responsible persons for the works to establish and maintain, so far as is reasonably practicable, safe systems of work, including:

- the provision and maintenance of plant and systems of work that are safe and without risks to health;
- arrangements for ensuring the safety and absence of risks to health in connection with the use, handling, storage and transport of articles and substances;

- the provision of such information, instruction, training and supervision as is necessary to ensure the health and safety at work of their employees;
- the maintenance of any place of work under the employer's control in a condition that is safe and without risks to health including the provision and maintenance of means of access to and egress from it that are safe and without such risks; and
- the provision and maintenance of a working environment that is safe, without risks to health, and adequate as regards facilities and arrangements for their welfare at work.

Similarly, persons or organisation responsible for the works is under an obligation to any persons using the highway, i.e. vehicle users, cyclists, pedestrians and other users, to take such steps as are reasonably practicable to protect them from personal injury and their property from damage. Therefore sufficient warning signs, barriers and other measures needed to highlight any danger should be placed at or near the site of the works to the extent necessary to discharge that obligation. These measures must be removed when no longer required. The National Highway Authority has the ultimate responsibility for the administration of all work that affects its roads.

For a traffic management to be effective, a suitable and sufficient risk assessment, specific to the task being performed, must be carried out to provide input to the method statement as it is being drafted. Consideration must be given to ways of firstly eliminating, or if this is not possible, then minimising the risk to operatives and the public.

[51] also emphasizes on the fact that the organisation responsible for the temporary traffic management operation should address the following points prior to commencing operations:

- ✓ Operatives should work facing oncoming traffic as far as practicable and inside the safety of the traffic management delineators; any available footway or verge should be used when collecting or transporting equipment on foot;
- ✓ Care shall be taken when erecting signs to ensure that they are secure, upright and positioned where they are not hidden from view by other temporary signs, any existing features or

vegetation. The temporary signs should not interfere with the visibility of permanent signs, junctions etc.

- ✓ Carrying of signs on foot across the live carriageway shall be done only when there is a suitable gap in the traffic;
- ✓ The handling of large signs may be facilitated if the signs are hinged. The hinging arrangement should not compromise the appearance of the sign.
- ✓ When coning from a moving vehicle, operatives should avoid unnecessary exposure of any part of their bodies e.g. by leaning out.
- ✓ The method of placing signs on dual carriageways with no hard shoulder or driveable verge should be the subject of a risk assessment and a method statement to avoid directing traffic into lanes temporarily occupied by the traffic management vehicles.

Although general requirements for traffic management on highway project sites are specified, particular attention should be paid to the needs of vulnerable group of people such as persons with disability, elderly people, children and those with push chairs.

Furthermore, the project owner should be responsible to:

- ✓ ensure that the correct procedures have been followed for works that involve the need for prior consultation, consent or agreement (e.g. highway closures, working in the vicinity of other infrastructure such as railways);
- ✓ ensure that, before starting, a site specific risk assessment has been carried out;
- ✓ ensure that, before starting, the works site layout has been planned, necessary equipment has been identified and that you know how you will set the site out;
- ✓ understand and implement pre-planned site safety requirements before starting the works;
- ✓ sign, light, guard and maintain works safely at all times;
- ✓ ensure that works remain compliant and safe as works progress or following any alteration;
- ✓ ensure that the safety of those who pass near or through the works is maintained; and
- ✓ ensure that the work team understands all key safety issues and the local site risk assessment related to the activity.

According to [52], the following generic hierarchy of controls can be applied:

a. Elimination of traffic hazards by closing roads

Full or partial road closure is the highest level control used. Typically this involves the erection or removal of structures over or close to the road or carriageway where the works present significant potential risks to the public. Road closures are well communicated in advance to the public to reduce inconvenience, with sign posted traffic diversions in place.

This control also eliminates the traffic hazard for roadwork personnel, so the opportunity is often taken to facilitate other works concurrently reducing future road closures and further public inconvenience.

Therefore the researcher agrees with this hierarchy of controls which is a common practice in Rwanda to divert traffic, but working at night is not common in the highway projects in the country.

b. Substitution by temporary safety barriers

Isolation of traffic from the work place through the use of temporary safety barriers can also prove to be an effective control, particularly for longer term works, but is also deployed where the risk is very high such as work adjacent to high speed high volume traffic.

As this type of traffic control proved success in some countries, it is also a common practice on highway project sites to use temporary safety barriers in Rwanda.

Therefore, all Traffic should be controlled to ensure the reasonably safe and efficient movement of road users through or around work site while protecting workers.

An internal traffic control plan should be used as a tool that an employer or supervisor can use to coordinate the flow of construction vehicles, equipment, and workers on foot moving in close proximity to each other on the site.

2.5.2.2 Management system for safe highway construction projects

Safety management is an important issue in all safety critical sectors including highway industry and regarded as an important means for improving safety culture.

[47] defines management system as set of interrelated or interacting elements of an organization to establish policies and objectives , and processes to achieve those objectives.

[53] argues that safety management system is an organization's formal arrangement, through the provision of policies, resources and processes, to ensure the safety of its work activity. An effective safety management system helps the organization to identify and manage risks effectively. It allows an organization to demonstrate its capability in achieving its safety objectives and in meeting regulatory requirements.

The researchers argue with [48, 53] as these definitions are complementary.

Managing health and safety [54] is an integral part of managing the business and that doing a risk assessment to find out about the risks in the workplace is needed as well as putting sensible measures in place to control them, and make sure they stay controlled.

This section provides information on what is needed to consider when managing health and safety and assessing the risks in the workplace. It shows how a 'Plan, Do, Check, Act' approach can be followed.

Plan

Describe how you manage health and safety in your business (your legally required policy) and plan to make it happen in practice.

Planning is the key to ensuring that health and safety arrangements really works. It helps you think through the actions you have set out in your policy and work out how they will happen in practice.

Do

Prioritise and control your risks by consulting your employees and provide training and information.

Check

Measure how you are doing.

Act

Learn from your experience.

Therefore, this approach is cyclic for continual improvement in managing health and safety in highway projects as shown in the figure 2.1 below.

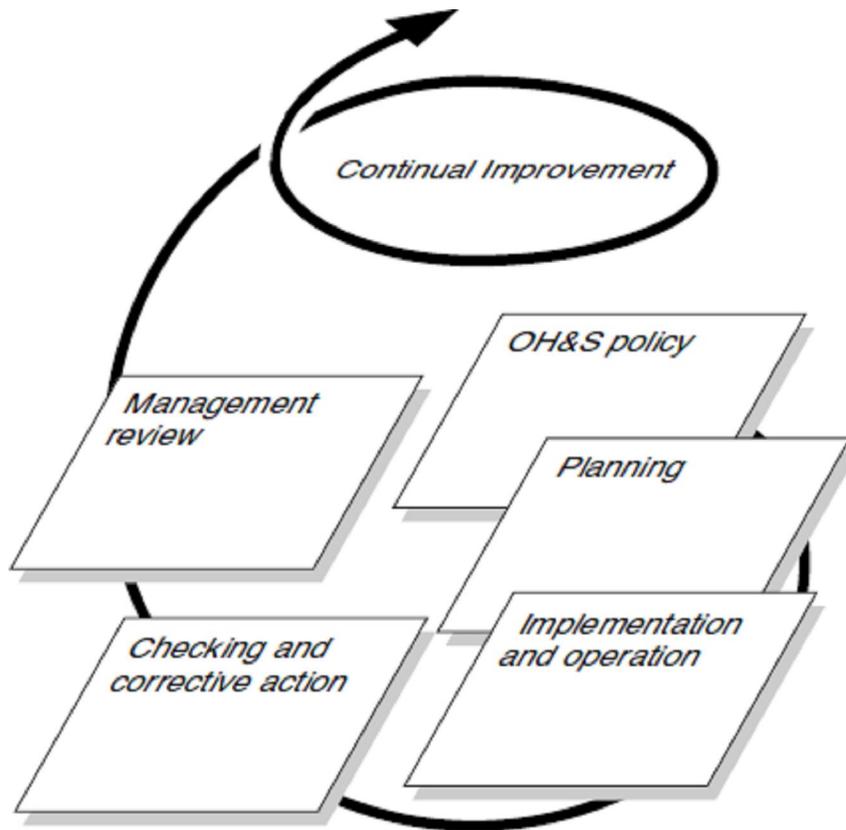


Figure 2.1 Occupational health and safety management system
Adopted from [59]

The health and safety management system shown on the figure 2.1 is cyclic for continual improvement in the organization.

2.5.2.2.1 Risk Management in highway projects

This clause provides an insight into current practices used to manage technical control in construction industry such as risk assessment and risk management processes in highway projects.

Hazards within transportation based projects may cause serious harm, not only to company employees, but also to the general public. These hazards, their associated risks and mitigations must be managed in order to reduce the possibility of accidents and lighten harm severity.

By definition, hazards are circumstantial events or physical substances that can potentially cause harm to people, property or processes, whilst risks are classed as the combination of the likelihood and severity of these given hazards occurring.

Legislation delegates the technical control of hazards to those who create them [48].

2.5.2.2.1.1 Risk management principles

[55] states principles with which an organization including highway project company should comply to ensure that risk management is effective at all levels.

These principles stated by [55] are as follows:

a) Risk management creates and protects value

This principle states that risk management contributes to the demonstrable achievement of objectives and improvement of performance in, for example, human health and safety in highway project, security, legal and regulatory compliance, public acceptance, environmental protection, product quality, project management, efficiency in operations, governance and reputation.

This principle is really important while effectively complied with and consequently the highway project contractor can benefit in winning many tenders due to good reputation.

b) Risk management is an integral part of all organizational processes

This principle states that risk management is not a stand-alone activity that is separate from the main activities and processes of the organization, rather it is part of the responsibilities of management and an integral part of all organizational processes, including strategic planning for health and safety in highway projects and all project and change management processes.

c) Risk management is part of decision making

This principle helps decision makers make informed choices, prioritize actions and distinguish among alternative courses of action.

In highway projects, this principle can help in conducting management review to take decision on which improvement to be adopted for effective health and safety practices on site.

d) Risk management explicitly addresses uncertainty

This is to mean that risk management explicitly takes account of uncertainty, the nature of that uncertainty, and how it can be addressed.

e) Risk management is systematic, structured and timely

This principle states that a systematic, timely and structured approach to risk management contributes to efficiency and to consistent, comparable and reliable results.

f) Risk management is based on the best available information.

The inputs to the process of managing risk are based on information sources such as historical data, experience, stakeholder feedback, observation, forecasts and expert judgement. However, decision makers should inform themselves of, and should take into account, any limitations of the data or modelling used or the possibility of divergence among experts.

g) Risk management is tailored

Risk management is aligned with the organization's external and internal context and risk profile.

h) Risk management takes human and cultural factors into account

Risk management recognizes the capabilities, perceptions and intentions of external and internal people that can facilitate or hinder achievement of the organization's objectives.

i) Risk management is transparent and inclusive

In this principle, it can be understood that appropriate and timely involvement of stakeholders and, in particular, decision makers at all levels of the organization, ensures that risk management remains relevant and up-to-date. Involvement also allows stakeholders to be properly represented and to have their views taken into account in determining risk criteria.

j) Risk management is dynamic, iterative and responsive to change

Risk management continually senses and responds to change. As external and internal events occur, context and knowledge change, monitoring and review of risks take place, new risks emerge, some change, and others disappear.

k) Risk management facilitates continual improvement of the organization

Organizations should develop and implement strategies to improve their risk management maturity alongside all other aspects of their organization.

2.5.2.2.1.2 Risk management basics

[49] states risk management basics which all form a set of risk responses as follows:

Risk Responses:

Risk responses include the following:

- **Mitigation:** Is a corrective action to eliminate or reduce impact or likelihood
- **Avoidance:** It requires to cease activity to eliminate risk;
- **Transfer:** It requires to shift impact to another entity; and
- **Acceptance:** Is adopted in case there is no corrective action. This basic requires documenting acceptance decision and monitoring.

Figure 2.2 illustrates risk and its corresponding risk responses.

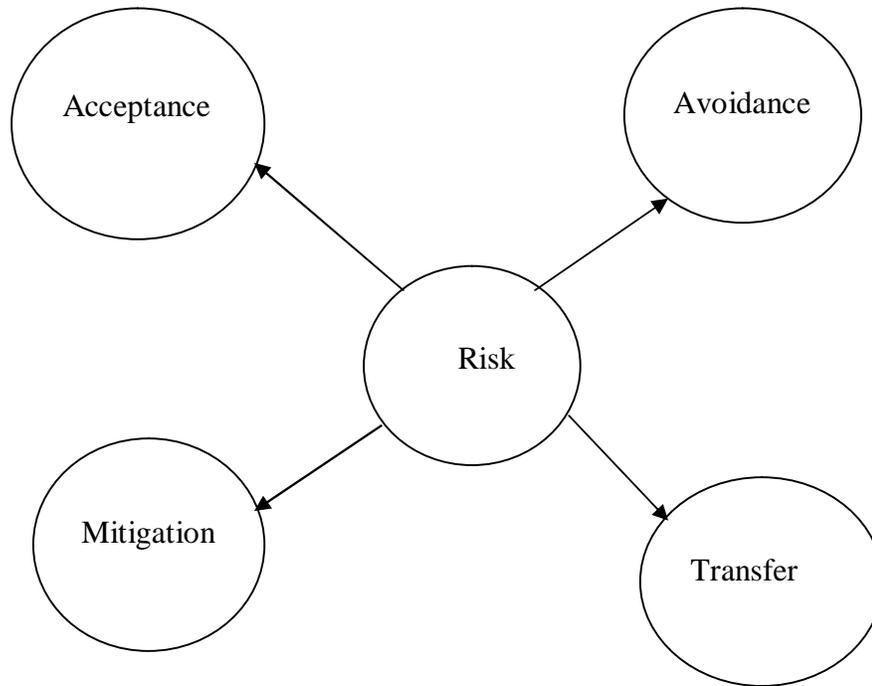


Figure 2.2 Risk management basics
Adapted from [59]

These risk management basics cannot be implemented simultaneously. The risk can either be avoided, accepted, mitigated or transferred.

2.5.2.2.1.3 Risk management framework

Risk management framework is defined as a set of components that provide the foundations and organizational arrangements for designing, implementing, monitoring, reviewing and continually improving risk management throughout the organization [55].

This clause describes the necessary components of the framework for managing risk and the way in which they interrelate in an iterative manner.

The success of risk management depends on the effectiveness of the management framework providing the foundations and arrangements that embed it throughout the organization at all levels [55].

The framework, therefore, assists in managing risks effectively through the application of the risk management process at varying levels and within specific contexts of the organization and it ensures that information about risk derived from the risk management process is adequately reported and used as a basis for decision making and accountability at all relevant organizational levels.

2.5.2.2.1.3.1 Components of risk management framework

Many authors wrote on risk management, but it was revealed that they all make reference to one internationally recognised source.

According to [55], risk management framework components are described as follows:

A. Mandate and commitment

This component of risk management framework, companies require a strong and sustained commitment by management to ensure the ongoing effectiveness of risk management in their organisation.

This commitment should, therefore, focus on a risk management culture, where management of risk is embedded in employee behaviour throughout the organization.

B. Design of framework for managing risk

In this component, companies require a systematic approach in designing a risk management framework that is relevant, effective, efficient and adequate.

For the framework to be effective, it should be supported by an organisation-wide risk management policy and plan, effective leadership arrangements and risk management accountabilities for all employees.

C. Establishing risk management policy

The risk management policy should clearly state the objectives of organization for, and commitment to, risk management by addressing the , the rationale of organization for managing risk; links between the objectives and policies and the risk management policy of the organization; accountabilities and responsibilities for managing risk; the way in which conflicting interests are dealt with; commitment to make the necessary resources available to assist those accountable and responsible for managing risk; the way in which risk management performance will be measured and reported.

The risk management policy should be communicated effectively.

D. Accountability

The company should ensure that there is accountability, authority and appropriate competence for managing risk, including implementing and maintaining the risk management process and ensuring the adequacy, effectiveness and efficiency of any controls.

This can be facilitated by identifying risk owners that have the accountability and authority to manage risks; identifying who is accountable for the development, implementation and maintenance of the framework for managing risk; identifying other responsibilities of people at all levels in the organization for the risk management process; establishing performance measurement and external and/or internal reporting and escalation processes; and ensuring appropriate levels of recognition.

E. Integration into organizational processes

Risk management should be embedded in all the practices of the company and processes in a way that it is effective. The risk management process should become part of, and not separate from, those company processes. In particular, risk management should be embedded into the policy development, business and strategic planning and review, and change management processes.

F. Resources

The company should allocate appropriate resources for risk management by considering should people, skills, experience and competence; resources needed for each step of the risk management process; the company's processes, methods and tools to be used for managing risk; documented processes and procedures; information and knowledge management systems; and training programmes.

G. Establishing internal communication and reporting mechanisms

The organization should establish internal communication and reporting mechanisms in order to support and encourage accountability and ownership of risk. These mechanisms should ensure that key components of the risk management framework, and any subsequent modifications, are communicated appropriately; there is adequate internal reporting on the framework, its effectiveness and the outcomes; relevant information derived from the application of risk management is available at appropriate levels and times; and there are processes for consultation with internal stakeholders.

H. Establishing external communication and reporting mechanisms

The organization should develop and implement a plan as to how it will communicate with external stakeholders. This should involve engaging appropriate external stakeholders and ensuring an effective exchange of information; external reporting to comply with legal, regulatory, and governance requirements; providing feedback and reporting on communication and consultation; using communication to build confidence in the organization; and communicating with stakeholders in the event of a crisis or contingency.

I. Implementing risk management

Implementation of risk management consists of implementing risk management framework and risk management process[55].

In implementing the organization's framework for managing risk, the organization should define the appropriate timing and strategy for implementing the framework; apply the risk management policy and process to the organizational processes; comply with legal and regulatory

requirements; ensure that decision making, including the development and setting of objectives, is aligned with the outcomes of risk management processes; hold information and training sessions; and communicate and consult with stakeholders to ensure that its risk management framework remains appropriate. This also applies in highway projects.

As for implementing risk management process, the activity is carried out through a risk management plan at all relevant levels and functions of the organisation as part of its practices and processes. Investment in resources and capabilities should enable a company to effectively and efficiently implement its risk management activities.

J. Monitoring and review of the framework

In order to ensure that risk management is effective and continues to support company performance, the company should measure risk management performance against indicators, which are periodically reviewed for appropriateness; periodically measure progress against, and deviation from, the risk management plan; periodically review whether the risk management framework, policy and plan are still appropriate, given companies external and internal context; report on risk, progress with the risk management plan and how well the risk management policy is being followed; and review the effectiveness of the risk management framework.

K. Continual improvement of the framework

Based on results of monitoring and reviews, decisions should be made on how the risk management framework, policy and plan can be improved. These decisions should lead to improvements in the company's management of risk and its risk management culture.

The figure 2.3 illustrates the relationship between components of the framework for managing risk.

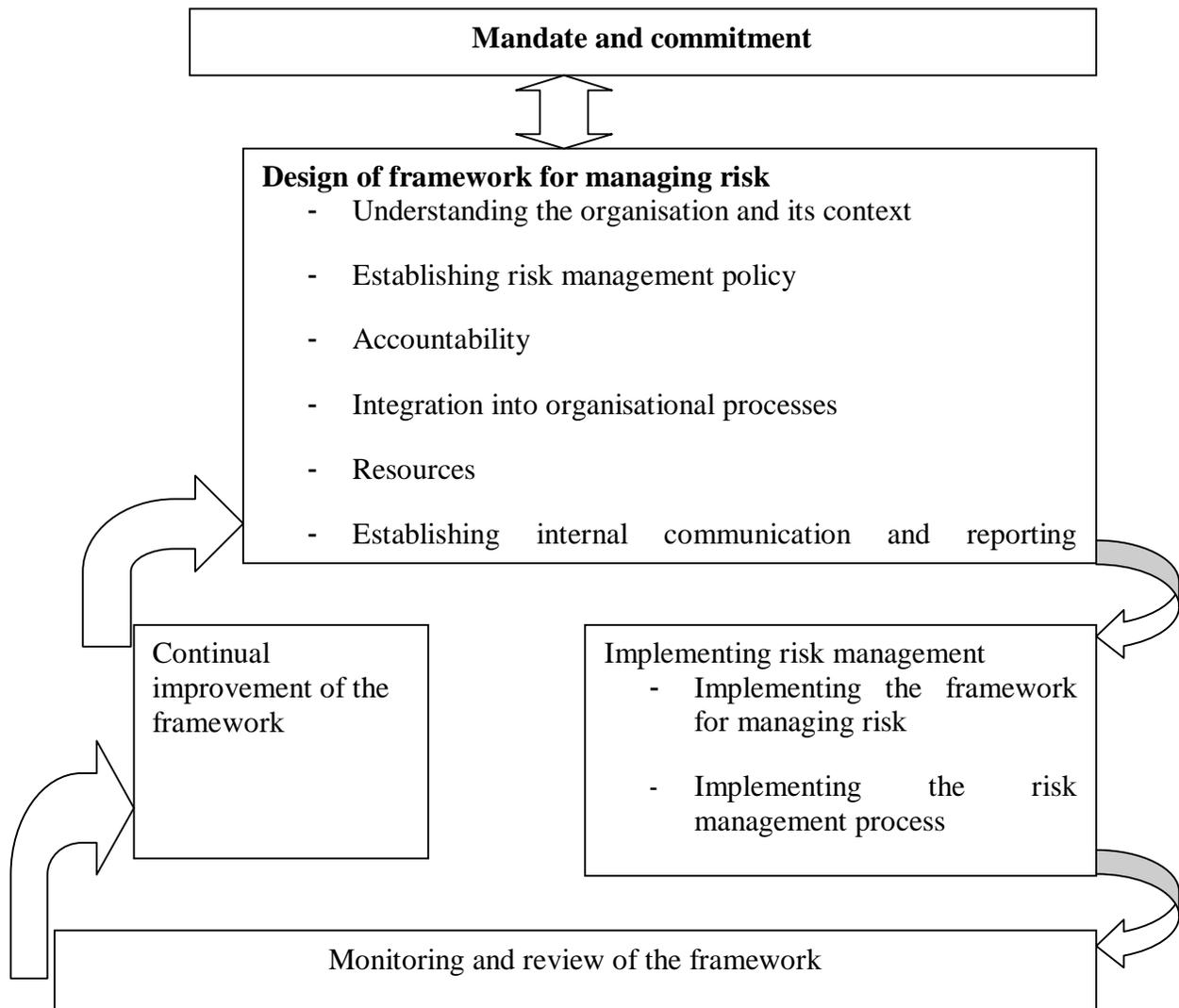


Figure 2.3 Relationship between the components of the framework for managing risk
 Source: Adapted from [55]

2.5.2.2.1.3.2 Risk management process

From discussion made in section 2.5.2.2.1, risk management process should also be an integral part of management; embedded in the culture and practices; and tailored to the business processes of the company.

The risk management process is shown in Figure 2.3 and it comprises seven steps where risk assessment is the overall process of risk identification, risk analysis and risk evaluation.

Step 1: Communication and consultation;

Step 2: Establishing the context;

Step 3: Risk identification;

Step 4: Risk analysis ;

Step 5: Risk evaluation ;

Step 6: Risk treatment; and

Step 7: Monitoring and review

These steps are shown on figure 2.4.

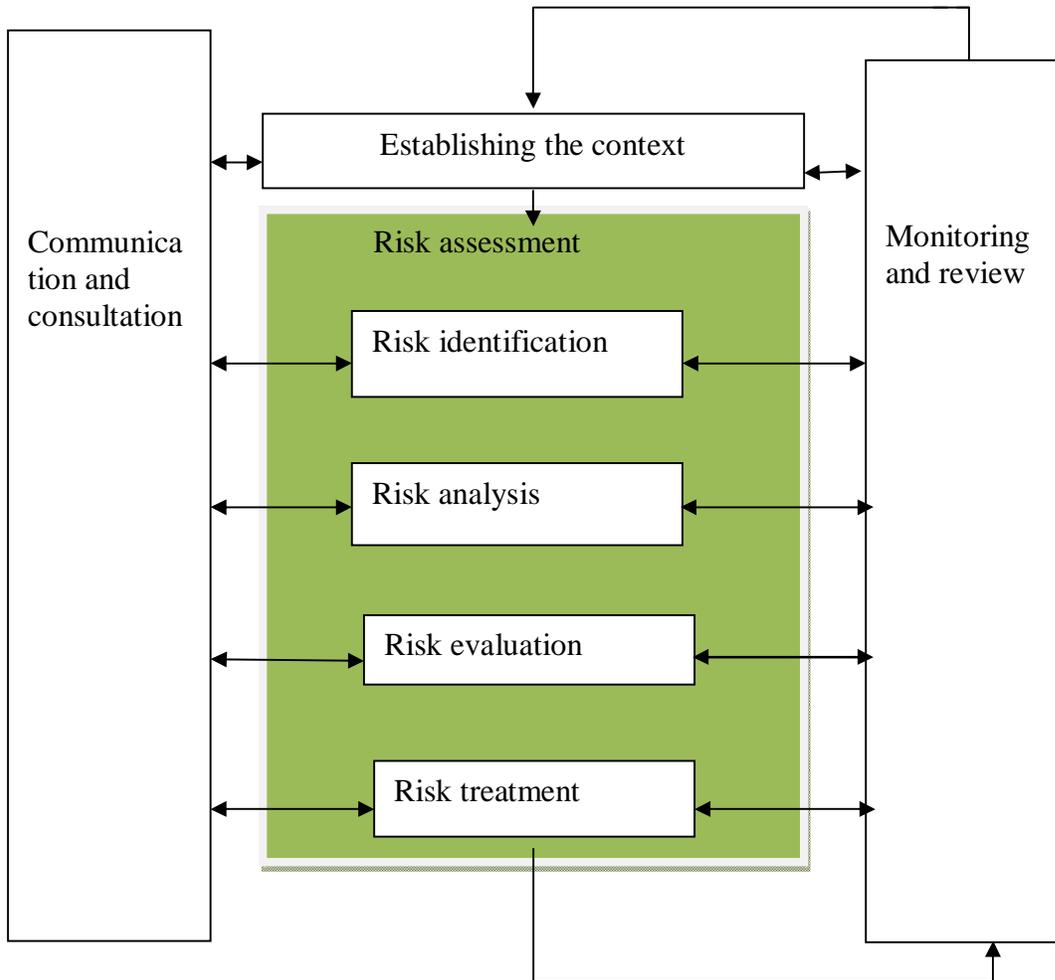


Figure 2.4 Risk management process

Adapted from [55]

Step 1 Communication and consultation

Communication and consultation with external and internal stakeholders in highway projects should take place during all stages of the risk management process[55].

Therefore, plans for communication and consultation should be developed at an early stage. These should address issues relating to the risk itself, its causes, its consequences (if known), and the measures being taken to treat it. Effective external and internal communication and consultation should take place to ensure that those accountable for implementing the risk

management process and stakeholders understand the basis on which decisions are made, and the reasons why particular actions are required.

A consultative team approach may be used for further inputs on this matter.

Step 2 Establishing the context

By establishing the context [55], the company articulates its objectives, defines the external and internal parameters to be taken into account when managing risk, and sets the scope and risk criteria for the remaining process.

Step 3 Risk identification

The aim of this step is to generate a comprehensive list of risks based on those events that might create, enhance, prevent, degrade, accelerate or delay the achievement of objectives [55].

The organization should, therefore, apply risk identification tools and techniques that are suited to its objectives and capabilities, and to the risks faced. Relevant and up-to-date information is important in identifying risks.

Step 4 Risk analysis

Risk analysis [55] involves developing an understanding of the risk. It provides an input to risk evaluation and to decisions on whether risks need to be treated, and on the most appropriate risk treatment strategies and methods. Risk analysis can also provide an input into making decisions where choices must be made and the options involve different types and levels of risk.

In addition, risk analysis should consider the causes and sources of risk, their positive and negative consequences, and the likelihood that those consequences can occur.

Step 5 Risk evaluation

The purpose of risk evaluation is to assist in making decisions, based on the outcomes of risk analysis, about which risks need treatment and the priority for treatment implementation. Risk evaluation involves comparing the level of risk found during the analysis process with risk criteria established when the context was considered. Based on this comparison, the need for treatment can be considered.

Decisions should take account of the wider context of the risk and include consideration of the tolerance of the risks borne by parties other than the organization that benefits from the risk [55]. Therefore, decisions should be made in accordance with legal, regulatory and other requirements

Step 6 Risk treatment

Risk treatment involves selecting one or more options for modifying risks, and implementing those options.

Once implemented, treatments provide or modify the controls.

Risk treatment involves a cyclical process of assessing a risk treatment; deciding whether residual risk levels are tolerable; if not tolerable, generating a new risk treatment; and assessing the effectiveness of that treatment.

Step 7 Monitoring and review

Both monitoring and review should be a planned part of the risk management process and involve regular checking or surveillance. It should be periodic. Responsibilities for monitoring and review should be clearly defined. The highway project company's monitoring and review processes should encompass all aspects of the risk management process for the purposes of ensuring that controls are effective and efficient in both design and operation; obtaining further information to improve risk assessment; analyzing and learning lessons from events (including near-misses), changes, trends, successes and failures; detecting changes in the external and internal context, including changes to risk criteria and the risk itself which can require revision of risk treatments and priorities; and identifying emerging risks.

In order to ensure effectiveness in risk management process, the results of monitoring and review should be recorded and externally and internally reported as appropriate, and should also be used as an input to the review of the risk management framework.

2.6 Effective health and safety management system in highway projects

The Occupational Health and Safety Assessment Series (OHSAS) specification [56], have been developed as recognizable occupational health and safety management system standard against which management systems can be assessed and certified. [56] is compatible with the [57] (Quality) and [58] (Environmental) management systems standards, which facilitates the integration of quality, environmental and occupational health and safety management systems by organizations.

There are numbers of occupational health and safety management systems which can be applied, including guide to achieving effective occupational health and safety performance in accordance with [59] , Occupational Health and Safety Assessment Series in accordance with [56] and the Guidelines on occupational safety and health management systems in accordance with [60]. Each of these management systems is based on the “plan-do-check-act” management model and embodies the principle of continual improvement.

This section contains the standards requirements for effective health and safety practices in workplaces where highway projects execution is a part thereof.

[56] specifies requirements for an Occupational Health and Safety (OHS) management system to enable an organization to develop and implement a policy and objectives which take into account legal requirements and information about OHS risks.

The OHS requirements are:

A. OHS policy

In this requirement [50], top management must define and authorize the organization’s OHS policy and ensure that within the defined scope of its OHS management system it is appropriate to the nature and scale of the organization’s OHS risks; includes a commitment to prevention of injury and ill health and continual improvement in OHS management and OHS

performance; includes a commitment to at least comply with applicable legal requirements and with other requirements to which the organization subscribes that relate to its OHS hazards; provides the framework for setting and reviewing OHS objectives; documented, implemented and maintained; communicated to all persons working under the control of the organization with the intent that they are made aware of their individual OHS obligations; available to interested parties; and reviewed periodically to ensure that it remains relevant and appropriate to the organization.

Besides having a policy in place, an effective OHS policy should demonstrate the company commitment to OHS. It should establish an overall sense of direction and should guide the setting of objectives against which all subsequent actions will be evaluated [59].

B. Planning

In this requirement [56], the organization must establish, implement and maintain a procedure(s) for the ongoing hazard identification, risk assessment, and determination of necessary controls.

The procedure(s) for hazard identification and risk assessment must take into account routine and non-routine activities; activities of all persons having access to the workplace (including contractors and visitors); human behaviour, capabilities and other human factors; identified hazards originating outside the workplace capable of adversely affecting the health and safety of persons under the control of the organization within the workplace; hazards created in the vicinity of the workplace by work-related activities under the control of the organization; infrastructure, equipment and materials at the workplace, whether provided by the organization or others; changes or proposed changes in the organization, its activities, or materials; modifications to the OHS management system, including temporary changes, and their impacts on operations, processes, and activities; any applicable legal obligations relating to risk assessment and implementation of necessary controls; the design of work areas, processes, installations, machinery/equipment, operating procedures and work; and organization, including their adaptation to human capabilities.

Therefore, the company's methodology for hazard identification and risk assessment should be defined with respect to its scope, nature and timing to ensure it is proactive rather than

reactive; and provide for the identification, prioritization and documentation of risks, and the application of controls, as appropriate.

C. Implementation and operation

In this requirement, according to [56], top management must demonstrate its commitment by ensuring the availability of resources essential to establish, implement, maintain and improve the OHS management system; defining roles, allocating responsibilities and accountabilities, and delegating authorities, to facilitate effective OHS management; roles, responsibilities, accountabilities, and authorities must be documented and communicated.

Additionally, the organization must appoint a member(s) of top management with specific responsibility for OHS, irrespective of other responsibilities, and with defined roles and authority for ensuring that the OHS management system is established, implemented and maintained in accordance with this OHSAS Standard; ensuring that reports on the performance of the OHS management system are presented to top management for review and used as a basis for improvement of the OHS management system [56].

For the purpose of effectiveness, the company must ensure that any person(s) under its control performing tasks that can impact on OHS is (are) competent on the basis of appropriate education, training or experience, and must retain associated records. The organization must also identify training needs associated with its OHS risks and its OHS management system. It must provide training or take other action to meet these needs, evaluate the effectiveness of the training or action taken, and retain associated records and finally, the organization must establish, implement and maintain a procedure(s) to make persons working under its control aware of the OHS consequences, actual or potential, of their work activities, their behaviour, and the OHS benefits of improved personal performance; their roles and responsibilities and importance in achieving conformity to the OHS policy and procedures and to the requirements of the OHS management system, including emergency preparedness and response requirements; and the potential consequences of departure from specified procedures[56].

D. Checking

The organization must establish, implement and maintain a procedure(s) to monitor and measure OHS performance on a regular basis [56]. This is recognizable in highway projects as a tool to ensure effectiveness.

Arrangements to conduct periodic audits are to be established in order to determine whether the OHS management system and its elements are in place, adequate, and effective in protecting the safety and health of workers and preventing incidents [62].

An audit policy and programme should be developed, which includes a designation of auditor competency, the audit scope, the frequency of audits, audit methodology and reporting. Procedures to monitor, measure and record OHS performance on a regular basis should be developed, established and periodically reviewed. Responsibility, accountability and authority for monitoring at different levels in the management structure should be allocated [63].

The selection of performance indicators should be according to the size and nature of activity of the organization and the OHS objectives. Both qualitative and quantitative measures appropriate to the needs of the organization should be considered. The audit includes an evaluation of the organization's OHS management system elements or a subset of these, as appropriate [64].

Preventive and corrective action of the organization, including the safety and health committee, where it exists, changes in national laws and regulations, voluntary programmes and collective agreements should be made [63].

E. Management review

Top management must review the organization's OHS management system, at planned intervals, to ensure its continuing suitability, adequacy and effectiveness. Reviews must include assessing opportunities for improvement and the need for changes to the OHS management system, including the OHS policy and OHS objectives. Records of the management reviews must be retained [56].

However, [61] states that management approach to health and safety in construction industry can be seen in three important ways:

- firstly, from legal point of view, the need to abide the rules and regulations of the place;
- secondly, the socio-humanitarian aspects which is to consider human lives involved; and
- thirdly, the financial-economic aspects of the accidents which have high direct and indirect costs.

[61] also says that construction safety management deals with actions that managers at all levels can take to create an organizational setting in which workers will be trained and motivated to perform safe and productive construction work.

Therefore, the system should delineate responsibilities and accountabilities. It should also outline procedures for eliminating hazards and identifying potential hazards before they become the contributing factors to unfortunate accidents.

Review must provide the feedback direction, including the determination of priorities, for meaningful planning and continual improvement. It should also evaluate progress towards the organization's OHS objectives and corrective action, activities and evaluate the effectiveness of follow-up actions from earlier management reviews [63].

In conclusion, the company should document and keep up-to-date the results of identification of hazards, risk assessments and determined controls. The organization should ensure that the OHS risks and determined controls are taken into account when establishing, implementing and maintaining its OHS management system. Risk controls and risk control systems are more effective when they are properly designed to take into account the strengths and weaknesses of human behaviour, attitudes to risk and existing business practice [63].

2.6.1 Essential elements of an effective health and safety management system

Main elements of the occupational health and safety management system in the organization which also apply in highway projects are specified [62]. The effective system

should contain elements of policy, organizing, planning and implementation, evaluation and action for improvement based on the Plan-Do-Check-Act management approach, as shown in figure 2.5[62].

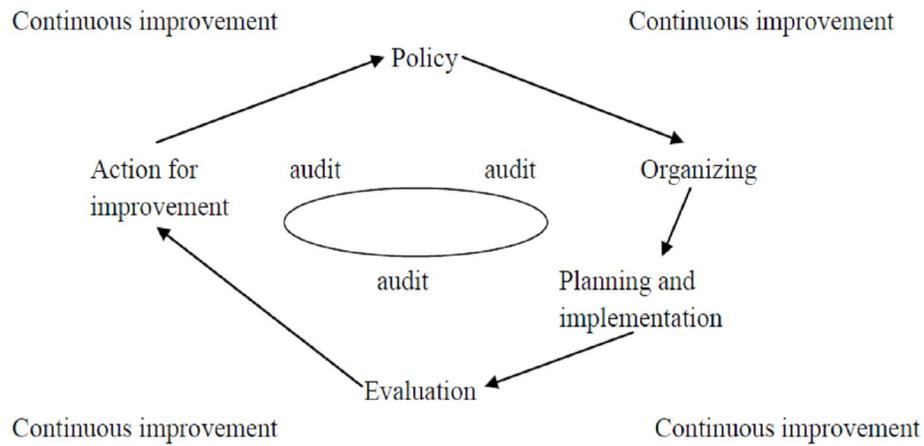


Figure 2.5– Elements of Occupational health and safety management system in highway projects
Adopted from [62]

2.6.2 Status of occupational health and safety management system in Rwanda

The Rwanda Ministry of Public Service and Labour is the public organization in charge of the overall occupational health and safety management in compliance with related national laws and regulations.

In the Official Gazette n° Special [65], appears a ministerial order n°01 of 17/05/2012 determining modalities of establishing and functioning of occupational health and safety committees at workplaces.

Despite the law is in place, health and safety committees at some work places are still pending. In addition, health and safety regulations in construction industry are not officially documented for ease of reference by researchers.

Therefore, the occupational health and safety management system in Rwanda needs improvement from top policy makers, specifically in construction industry in general, and in highway projects in particular.

CHAPTER 3

RESEARCH METHODOLOGY AND METHODS

3.1 Introduction

This chapter describes the means by which the research data was obtained and analysed. Based on the information gathered from the literature review, a specific research methodology was adopted for developing an appropriate framework and setting a guidance for improved awareness and understanding effective health and safety management for highway projects including the data collection procedures, survey instruments development, and data analysis techniques.

The data for this research was collected through the use of surveys targeting highway project contractors and subcontractors who were actively in operation in order to achieve the specified aim and objectives of the research.

A literature review, with critical thinking, of published materials to safety performance in the construction industry provided a basis for the researcher's investigation. A mixed use of both qualitative and quantitative research methodologies was adopted to achieve the study aim and objectives.

A survey was conducted to determine factors impacting on health and safety incidence in highway project in Rwanda.

Survey questionnaires comprising of two sections on close-ended and open question respectively were issued out to contractors, site Engineers and Health and Safety Officers for completion. The participants involved in the survey were from Kigali City Districts.

Structured interviews were conducted with two H&S officers and three H&S representatives to gain a more practical insight into their understanding and application of safety management systems in the execution of their duties.

3.1.1 Research approach and process

According to [66], Mixed research methods is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches for the purposes of breadth and depth of understanding and corroboration.

[67] argues that using mixed approaches strengthens the overall research design, as the strengths of one approach offset the weaknesses of the other, and can provide more comprehensive and convincing evidence than mono-method studies. Another more practical benefit is that mixed method research can encourage interdisciplinary collaboration and the use of multiple paradigms.

[68] says that the emphasis of quantitative research is concerned with objective assessment and is on collecting and analysing numerical data; it concentrates on measuring the scale, range, frequency etc. of phenomena. This method uses questionnaire survey to collect primary data by asking questions to respondents.

The author continues saying that qualitative approach to research is concerned with subjective assessment of attitudes, opinions and behaviour. Research in such a situation is a function of researcher's insights and impressions.

In order to provide enhanced understanding of the concept of safety and health practices and get detailed information from the workers, the interview technique is also thought as appropriate and complementary method for this study.

In this research, it has to note that, the combination of both quantitative and qualitative approach has been adopted as the most appropriate method of collecting data to address research objectives.

Data was collected from participants involved in the practices of Health and Safety on Highway Project Sites through postal questionnaire survey, face- to- face interview for the purpose of breadth and depth of understanding and corroboration and was then analysed using descriptive statistics through Statistical Package for Social Sciences software to show how many responses

were distributed in each category and then use frequencies to show the count and proportion (frequencies in percentages) of cases in each category of variable [69].

The quantitative approach was used to address broadly the health and safety management in terms of knowledge of legislation (its existence); perceptions relative to health and safety; aspects of health and safety culture, and management practices/interventions. Additionally, qualitative approach was also used to deeply understand the people's opinions about health and safety issues in highway projects and therefore the mixed approach was used to gather relevant information during the whole period of the study.

The following figure 3.1 shows the summary of stages through which research was processed to meet research objectives.

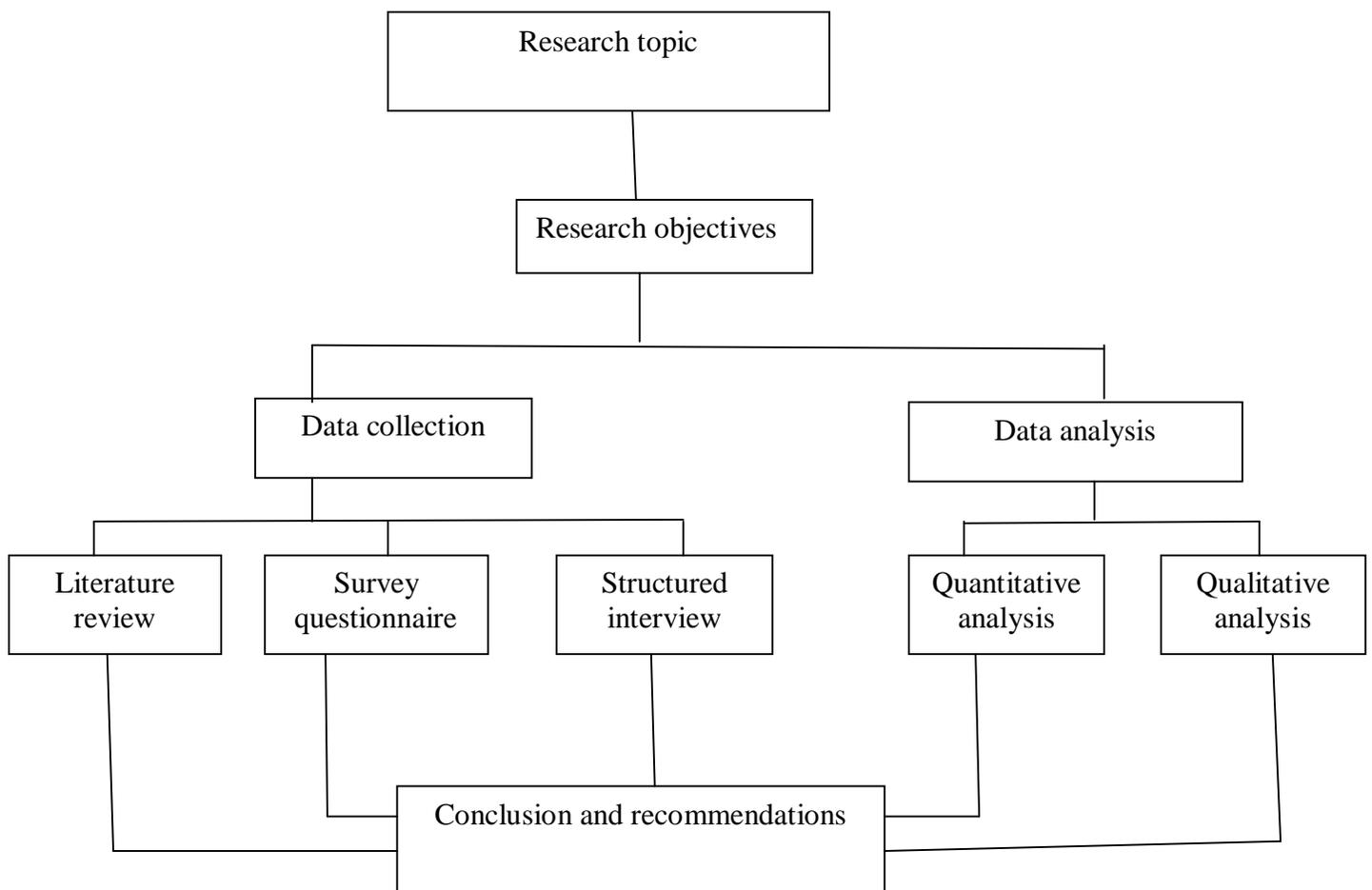


Figure 3.1– Research process

3.2 Methodology

According to [68], methodology refers to the research approach and is concerned with why data will be collected, what data will be collected, where it will be collected, how it will be collected and how it will be analysed.

According to [70], methodology is defined as the way to systematically solve the research problem.

[71] defines research methodology as the philosophy, system of methods and principles used in a particular discipline to achieve and satisfy the research aim.

Therefore, research methodology can be defined as the path to finding answers to the research questions through useful methods adopted to apply.

In this research which is quantitative oriented, the methodology adopted consists of a questionnaire and interviews. A relevant literature review was conducted in the initial stage in order to develop survey instruments to be used in the study. Published literature on current health and safety scenarios in highway projects sites was carefully studied with particular emphasis on current health and safety statistics, prevalent health and safety practices of highway projects contactors such as health and safety legislation, policies, procedures, programs, systems, health and safety performance measurement and improvement, safety culture & climate measurement and improvement, role, success and criticism on Occupational Health and Safety Administration and the move towards the development and the presentation of the framework of improved management of health and safety in highway projects.

3.3 Methods

[71] refers to research methods as the established form of procedure to be followed for accomplishing or approaching an objective in a systematic way. These methods are linked with the objectives of the research and thus satisfy the aim of the research.

3.3.1 Data collection methods

In this research, literature review, survey questionnaire and structured interview were used as data collection methods.

3.3.1.1 Questionnaire design

Questionnaire survey was designed in such a way to gather information from respondents to meet research objectives.

[68] states that survey is a method of gathering information from a sample of population under study. He adds on that survey involves selecting a representative and unbiased sample of subjects drawn from the group that the researcher wishes to study.

In this research, the structured postal questionnaire survey and structured interview were conducted for data collection. Same questions with same wording were asked to all respondents. The purpose of using the structured postal questionnaire survey is to avoid any kind of bias in gathering information while structured interview is used to complement postal survey questionnaire to seek detailed information about research participants' perception on health and safety issues [71].

The research was carried out among 3 highway construction companies and questionnaire surveys have been widely used to describe safety climate and safety culture [42].

Moreover, in order to provide enhanced understanding of the concept of safety and health practices and get detailed information from the workers, the interview technique has also been thought as the most appropriate method for this study.

Therefore, this method was selected as the mode of data collection in this study.

Postal questionnaire contained ten questions (nine close-ended questions in multiple choice format and one open question in quantitative nature).It was composed of two sections: section 1 is concerned with personal information for respondents, section 2 is concerned with research questions with two sub sections:

2.1 Open ended questions

2.2 Open questions

Section 2 dealt with safety and health practices in construction projects; the factors impacting on health and safety on transport projects; health and safety responsibility, and health and safety performance indicators.

The interviews took place over a 3 months period between February and April 2014 and each lasted approximately 30 minutes and it consisted of the status of safety culture and safety climate in the company. Particularly, the first part included information about company profile such as business activity of the company and also respondent particulars such as field of specialisation and numbers of years of experience. The second part of the interview form dealt with the risk assessment of health and safety applied on highway construction sites, causes of accidents on sites, accidents reporting and health and safety awareness by the company itself.

Based on the aim and objectives of the study to be conducted, all variables to be investigated using the questionnaire survey have equal strength in terms of importance because they are complementary in ensuring effectiveness of health and safety practices. Questionnaires were distributed to respondents by the researcher in person and by email where possible and were self-administered. Respondents were given at most two weeks to complete the questionnaires but the deadline was not respected because it took two months to return questionnaires to the researcher for analysis. Face to face interview was interviewer-administered and addressed the contribution of individual factors to health and safety performance on highway project sites.

The target group was active contractors whose highway projects were in operation in Kigali City during the study period.

3.3.1.2 Sampling strategies

According to [72], the purpose of sampling is to obtain a group of subjects who will be representative of the larger population or will provide specific information needed. The degree of representativeness is based on the sampling technique employed.

Convenience sampling involves drawing samples that are both easily accessible and willing to participate in a study [69].

There were no other criteria established for selecting highway projects contractors.

The sampling method for collecting data for this research is by non-random sampling. A convenience sample was taken from contractors and subcontractors who were actively in operation in Kigali City with a view to getting field data which is easily accessible due to limited time.

There were no criteria established for the selection of highway construction companies other than being actively in operations in the Kigali City Districts.

3.3.1.3 Population and sample size

All contractors who were actively in operation in Kigali City were taken to form simultaneously the population under study and sample size because the number of contractors to the research in the study area was limited (less than ten) and it was easy to approach them all in order to elicit useful information. The sample size was equal to the population (three companies with five sites in operation in total).

3.3.1.4 Participants

Responsible persons whose duties were in relation with Health and Safety issues in the company responded to questions. These included project managers, site supervisors, engineers and safety officers and safety representatives.

3.3.1.5 Procedure

Five persons from each site with work experience of not less than five years were allowed to respond to questions. Respondents included project managers, site supervisors, engineers, safety officers and safety representatives.

In stage one, postal questionnaires were designed in such a way that the responses are in logical order from the first to the last question to answer the research question and meet research

objectives. Thereafter, questionnaires were distributed to respondents in person and by email where possible.

Completed questionnaires were collected and returned to the researcher. Responses from all respondents were compiled for analysis.

In stage two, face to face interview was conducted and explanation from respondents were recorded for analysis.

3.3.2 Data analysis methods

Data were analysed using statistical techniques (descriptive statistics using distribution method to see how many responses were there in each category of a variable. Frequencies are used to show the count and proportion (percentage) of cases in each category of a variable [69].

Statistical Package for Social Sciences (SPSS) is the software which is designed to carry out the data analysis with comprehensive statistical tests. The collected data from the survey questionnaire were analyzed by using SPSS in order to carry out the data entry, data view and data analysis in this research.

CHAPTER 4

DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

The purpose of this chapter is to analyze data obtained from survey questionnaires and interviews, summarize the results of research and interpret results obtained to answer the research question, aim and objectives and therefore to form the conclusion and recommendations to the research.

4.2 Response rate

4.2.1 Survey questionnaire

A total of 10 out of 15 questionnaires were returned for this research. In other words, there is 66.67% of the highway construction companies replied. The main objective of the survey questionnaire was to obtain the highway construction players' views and opinions regarding the factors impacting on health and safety incidence on highway projects sites in Rwanda. The analysis is carried out based on the 10 returned questionnaires to the researcher. The collected data from the survey questionnaire were analyzed by using SPSS software.

A total of 3 active highway projects contractors participated in this study.

4.2.2 Structured interview

Structured interviews were conducted with three Health and Safety Engineers and two Health and Safety Representatives. Health and safety legislation, health and safety culture and health and safety climate were approached. A 100% response rate was achieved.

Recommendations made by interviewees were further included in the interview responses to help improve the work conditions and therefore ensure the decrease of incidents on work site.

4.3 Data analysis and results

4.3.1 Analysis of survey questionnaire responses

4.3.1.1 Physiological information for respondents

This section aimed to bring information to the researcher about the company name of the respondent, the level of contracting company, either Main Contractor or Sub Contractor, the position of the respondents in the company and their experience in the company.

Responses obtained are indicated in table 4.1, 4. 2, 4.3, and 4.4 respectively.

Table 4.1– Level of the contracting company

Level	Frequency	Percentage	Cumulative percentage
Main contractor	10	100	100
Sub contractor	0	0	
Total	10	100	

Source: Field survey data

Of 10 respondents, 10 (100%) were found to work for Main Contractors. It is clear that, at the time of gathering data, there was no active subcontractor who participated in this research.

Table 4.2 – Position in the company

Position	Frequency	Percentage	Cumulative percentage
Project Manager	4	40	40
Site Engineer	4	40	80
Senior Engineer	1	10	90
Health and Safety Representative/ Officer	1	10	100
Total	10	100	

Source: Field survey data

From table 4.2 above, it has been realized that Project Managers (40%) and Site Engineers (40%) are main respondents in this research, whereas the position of Health and Safety Officer/Representative is less considered in companies under study and therefore some important information may be missing because they are the ones to report health and safety issues on daily basis.

Table 4. 3 – Experience at work

Years of experience	Frequency	Percentage	Cumulative percentage
Less than 5 years	0	0	0
5-9	3	30	30
10-19	5	50	80
20 and above	2	20	100
Total	10	100	

Source: Field survey data

From table 4.3, there was no case of respondents with less than five years working experience. Technical Personnel who responded to questions had enough experience to perform work (More than five years).

4.3.1.2 Questions for technical research information

These questions aimed to set guidance for improved awareness and understanding of effective health and safety management for highway projects.

Question 1

Consideration and implementation of health and safety in transport projects in Rwanda.

The aim of this question was to ascertain the nature of health and safety incidence in highway projects in Rwanda and to identify the areas of highway projects that are prone to highest safety incidence.

Response

The results obtained from respondents are indicated in table 4.4.1 to 4.4.8 (See appendix, question 1, A to H).

Number of respondents remains ten (10) in this research.

Table 4.4.1– Identification and analysis of health and safety hazards at the work site

Level of consideration	Frequency	Percentage	Cumulative percentage
Very highly considered	3	30	30
Level of consideration is high	6	60	90
Low level of consideration	1	10	100
Very low level of consideration	0	0	100
Total	10	100	

Source: Field survey data

From table 4.4.1 and figure 4.4.1 , it can be observed that 6 respondents which represent 60% indicated that the level of consideration of health and safety in the evaluation of all equipments, machinery, work areas and work processes to identify and analyze all potential sources of harm to workers is high.

Three respondents rated the identification and analysis of health and safety hazards at the work site as very highly considered, whereas one respondent rated it as lowly considered.

It can therefore be observed that , in Rwanda, the level of consideration of health and safety in the evaluation of all equipments, machinery, work areas and work processes to identify and analyze all potential sources of harm to workers is high.

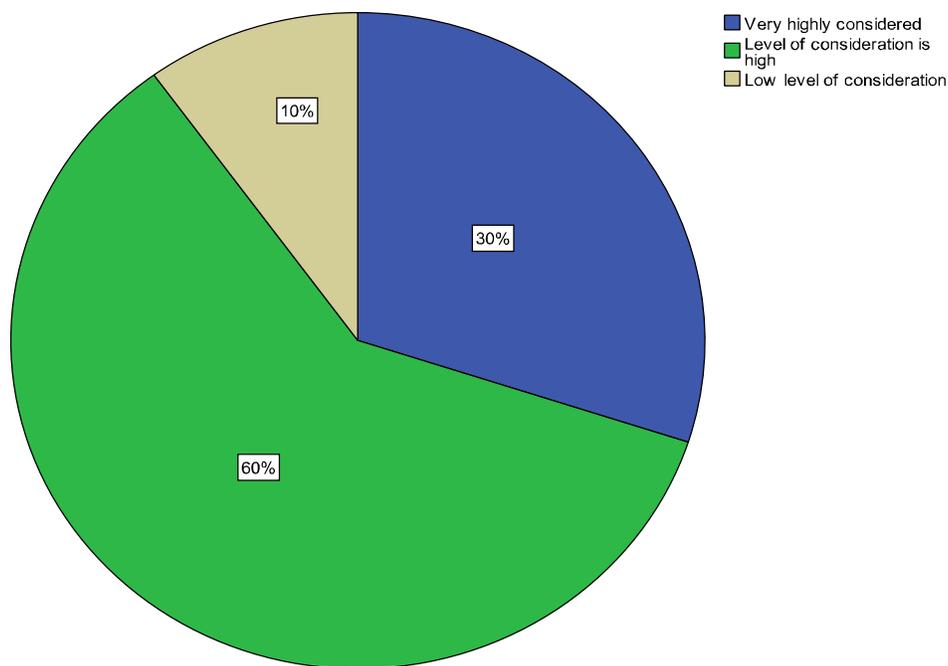


Figure 4.4.1– Identification and analysis of health and safety hazards at the work site

Source: Field survey data

Table 4.4.2 – Control measures to eliminate or reduce the risks to workers from hazards

Level of consideration	Frequency	Percentage	Cumulative percentage
Very highly considered	5	50	50
Level of consideration is high	2	20	70
Low level of consideration	2	20	90
Very low level of consideration	1	10	100
Total	10	100	

Source: Field survey data

From table 4.4.2 above and figure 4.4.2, five respondents (50%) rated control measures to eliminate or reduce the risks to workers from hazards as “very highly considered” to mean that they understand the significance of effective health and safety practices in highway projects. Two respondents (20%) understand this significance moderately. For the rest of

respondents, their level of consideration of risk control measures is questionable, which may mean that they do not understand the values of effective health and safety practices in highway projects.

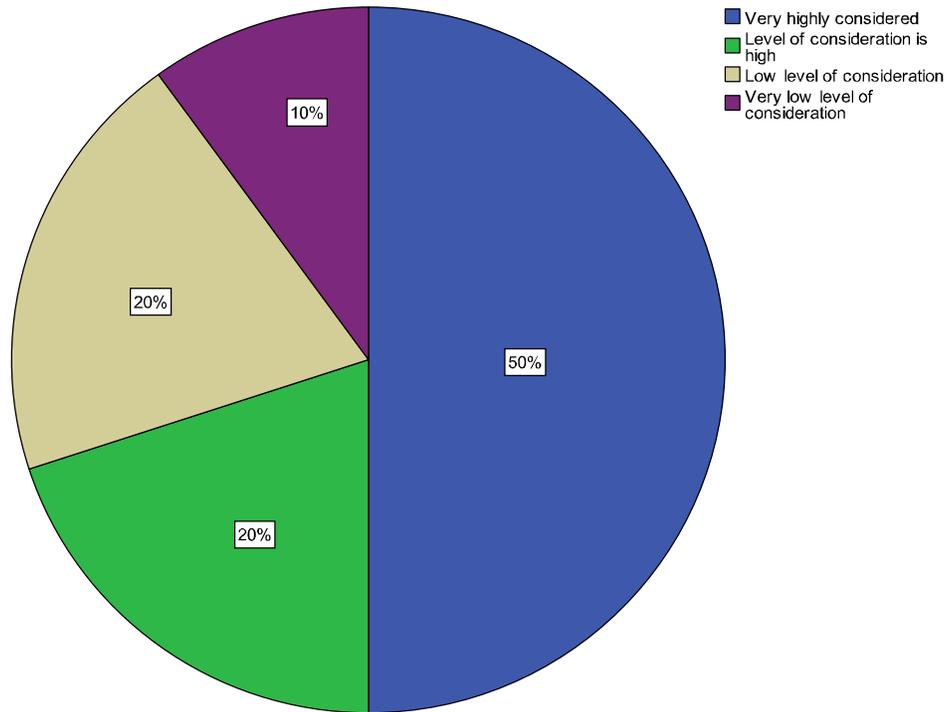


Figure 4.4.2– Control measures to eliminate or reduce the risks to workers from hazards

Source: Field survey data

Table 4.4.3– Clearly demonstrated management commitment and written company policy

Level of consideration	Frequency	Percentage	Cumulative percentage
Very highly considered	5	50	50
Level of consideration is high	5	50	100
Low level of consideration	0	0	100
Very low level of consideration	0	0	100
Total	10	100	

Source: Field survey data

From table 4.4.3, it was revealed that management commitment and written company policy was Very highly considered at the rate of 50% of all respondents and the other half of respondents stated that management commitment and written company policy are highly considered.

It seems that management commitment and written company policy are really considered and implemented.

However, documented company policy which is effectively communicated and understood by all categories of workers should be undoubtedly a major tool for practicing health and safety principles in compliance with applicable laws and regulations.

Table 4.4.4 – Work competency and training

Level of consideration	Frequency	Percentage	Cumulative percentage
Very highly considered	6	60	60
Level of consideration is high	2	20	80
Low level of consideration	2	20	100
Very low level of consideration	0	0	100
Total	10	100	

Source: Field survey data

From table 4.4.4, more respondents (60%) stated that work competency and training is very highly considered and implemented in transport projects in Rwanda, while other respondents (20%) stated that this component feature on health and safety is highly considered. The other part of respondents (20%) observed that the level of consideration is low.

By considering these results, it is can be obvious that work competency and training feature is very highly considered and implemented in transport projects in Rwanda.

Of course, for workers to effectively perform their work, the need basic competence and training on internal guidelines, safety instructions, operating procedures, interpretation of national legislation. Therefore, regular trainings as per the training plan at company level is needed for better performing work.

Table 4.4.5 – Inspection programme

Level of consideration	Frequency	Percentage	Cumulative percentage
Very highly considered	5	50	50
Level of consideration is high	3	30	80
Low level of consideration	2	20	100
Very low level of consideration	0	0	100
Total	10	100	

Source: Field survey data

Responses indicated in table 4.4.5 and figure 4.4.3 showed that a half of respondents (50%) confirm that the inspection programme in the execution of highway projects is very highly considered and implemented, 30% stated that this component feature on health and safety is highly considered and implemented, while only two respondents (20%) stated that the level of consideration is low.

Analysing these responses, there is a hope that inspection programme in transport projects is considered and implemented and consequently, non conformities can be identified, corrective actions can be set, management review conducted and therefore compliance with the management model: plan-do-check-act is achieved for continual improvement.

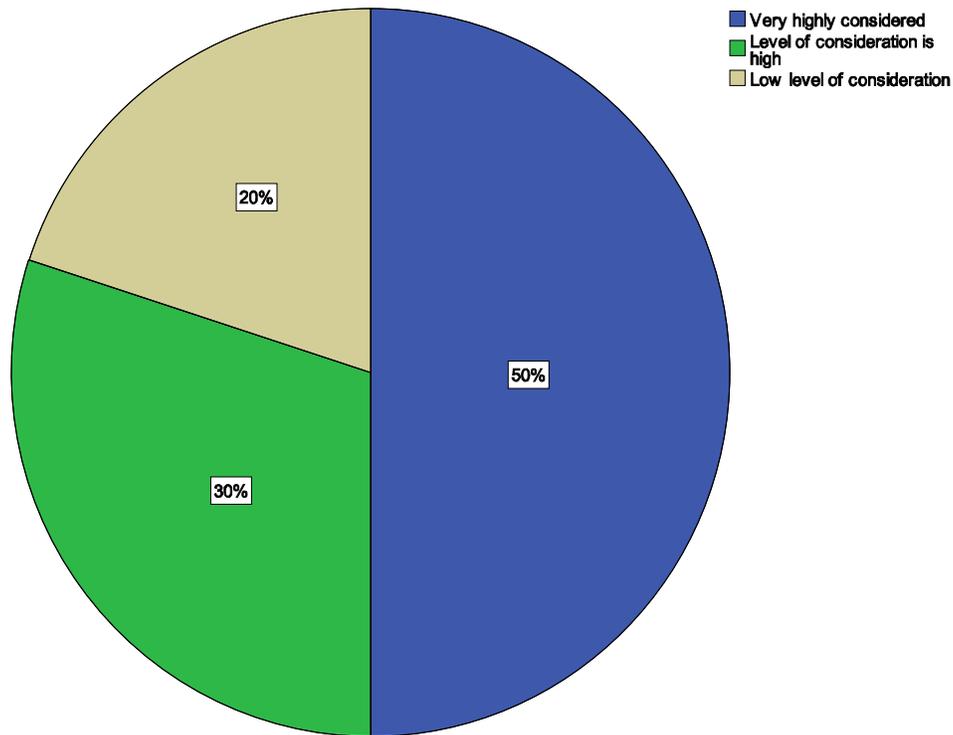


Figure 4.4.3– Inspection programme
Source: Field survey data

Table 4.4.6– Emergency response planning

Level of consideration	Frequency	Percentage	Cumulative percentage
Very highly considered	5	50	50
Level of consideration is high	3	30	80
Low level of consideration	2	20	100
Very low level of consideration	0	0	100
Total	10	100	

Source: Field survey data

As indicated in table 4.4.6, emergency response planning in highway projects has been very highly rated by respondents (50%) , 30% rated it highly and 20% stated that it is at less low level of consideration.

From these responses, it was realized that companies understand well the importance of planning for emergency response in highway project execution as workers may get injured on site and immediately need first aid treatment. This issue has to be budgeted for in the design stage.

Table 4.4.7– Incidents reporting and investigation

Level of consideration	Frequency	Percentage	Cumulative percentage
Very highly considered	3	30	30
Level of consideration is high	6	60	90
Low level of consideration	1	10	100
Very low level of consideration	0	0	100
Total	10	100	

Source: Field survey data

Responses from table 4.4.7 and figure 4.4.4 showed that 30% respondents very highly rated the importance of incidents reporting and investigation in the execution of highway projects. Further 60% of respondents stated that incident reporting and investigation is high, whereas other 10% stated that it is at low level of consideration.

In this regard, it can be observed that incidents reporting and investigation is highly considered and implemented in transport projects. However, most of the time incidents occurring on highway projects are not recorded and it is the reason why accidents data in this sector is still poor.

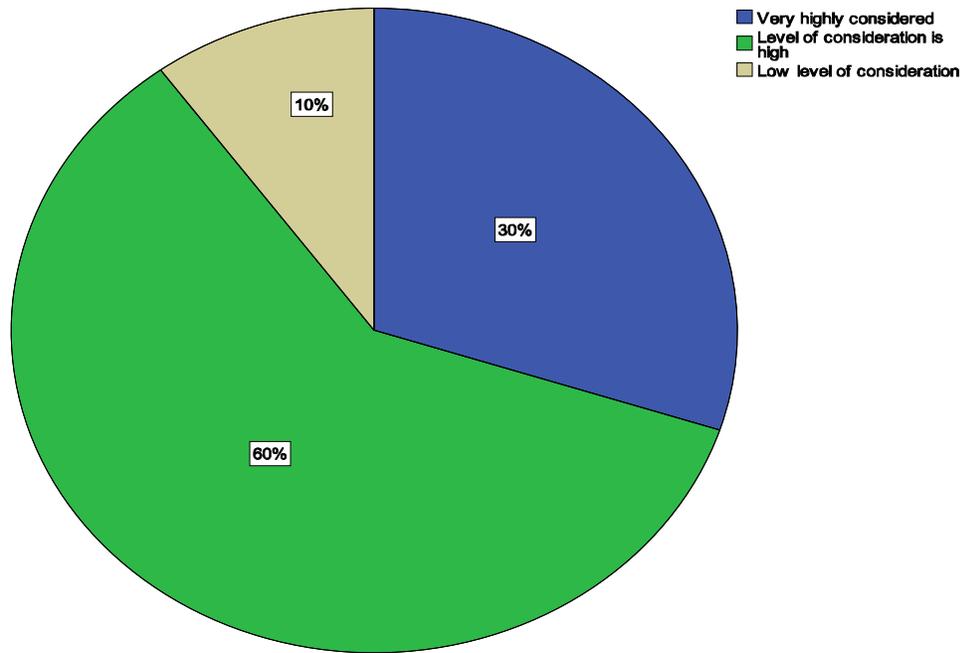


Figure 4.4.4– Incidents reporting and investigation

Source: Field survey data

Table 4.4.8 – Management System Administration

Level of consideration	Frequency	Percentage	Cumulative percentage
Very highly considered	2	20	20
Level of consideration is high	5	50	70
Low level of consideration	3	30	100
Very low level of consideration	0	10	100
Total	10	100	

Source: Field survey data

From the point of view of respondents, management system administration, as indicated in table 4.4.8 is at high level of consideration (50%), very high level of consideration is at 20% and 30% for low level of consideration. It means that, in some companies, the management system administration is not effective.

Question 2

Indication of areas of highway projects believed to be prone to high safety incidence

Based on the role and the nature of the employees' work, this question aimed to indicate the areas of highway projects where there are potentials to high safety incidence and indicate the extent to which they are prone to safety incidence.

Responses

Table 4.5.1 to 4.5.10 and the figures deriving from them indicate the results obtained from respondents in this research on areas of highway projects that are believed to be prone to high safety incidence(See appendix, question 2, A to J).

Table 4 .5.1– Excavation

Areas	Level of consideration	Frequency	Percentage	Cumulative percentage
Excavation	Very highly considered	5	50	52
	Level of consideration is high	2	20	70
	Low level of consideration	3	30	100
	Very low level of consideration	0	0	
Total		10	100	

Source: Field survey data

From table 4. 5.1 and figure 4.5.1 , it was observed that 50% of respondents rated excavation as an area in highway projects which is very highly considered to be prone to high safety incidence 20% of respondents rated excavation as an area in highway project which is highly considered, while 30% of respondents stand on low level of consideration.

By analyzing these results, excavation in highway projects has very high frequency of safety incidence and therefore needs more attention for risk control by providing personal protective equipments and non defective collective equipments and hand tools.

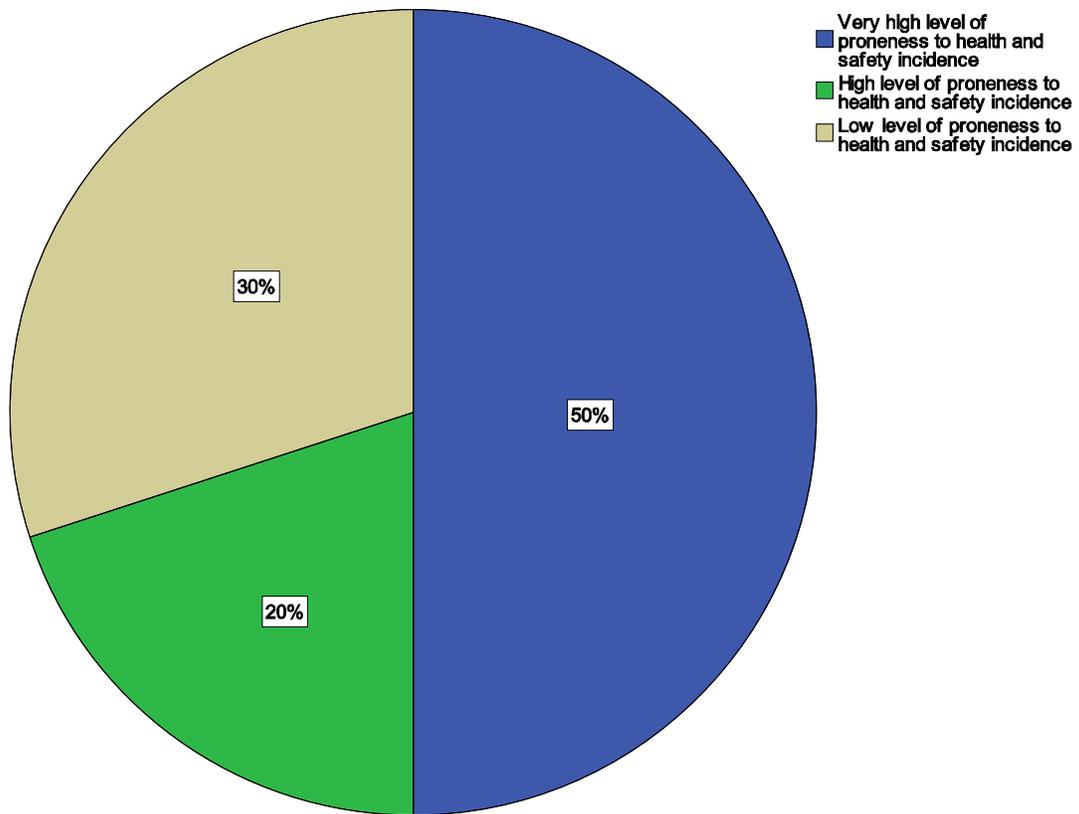


Figure 4.5.1– Excavation

Source: Field survey data

Table 4. 5.2 – Protection of power line and electrical equipments on sites

Areas	Level of consideration	Frequency	Percentage	Cumulative percentage
Protection of power line and electrical equipments on sites	Very highly considered	4	40	40
	Level of consideration is high	6	60	100
	Low level of consideration	0	0	
	Very low level of consideration	0	0	
Total		10	100	

Source: Field survey data

From table 4.5.2, 40% of respondents indicated that the area of protection of power line and electrical equipments on sites was very highly rated to be prone to safety incidence, whereas 60% of respondents rated this area at high level to be prone to high safety incidence. Considering these observations from respondents, it was found that area of protection of power line and electrical equipments on sites has high potential of occurrence of safety incidence and therefore the safety management system has to consider it at high level to ensure risks are properly managed by preventing workers from electrocution.

Table 4.5.3– Driving plant on work site

Areas	Level of consideration	Frequency	Percentage	Cumulative percentage
Driving plant on work site	Very highly considered	5	50	50
	Level of consideration is high	2	20	70
	Low level of consideration	1	10	80
	Very low level of consideration	2	20	100
Total		10	100	

Source: Field survey data

Table 4.5.3 and figure 4. 5.2, the area of driving plant on work site is the major source of safety incidence as 50% of respondents rated it at a very high level of consideration. 20% of respondents rated this area at a high level of consideration,10% rated it at a low level of consideration and 20% respondents rated it at a very low level of consideration. Considering all the above levels of consideration from respondents, it can be seen that driving plant on work site is obviously an area of high safety incidence and therefore needs effective traffic management for safety incidence prevention by providing effective site signage, training drivers on safe manoeuvring of mobile plant,etc.

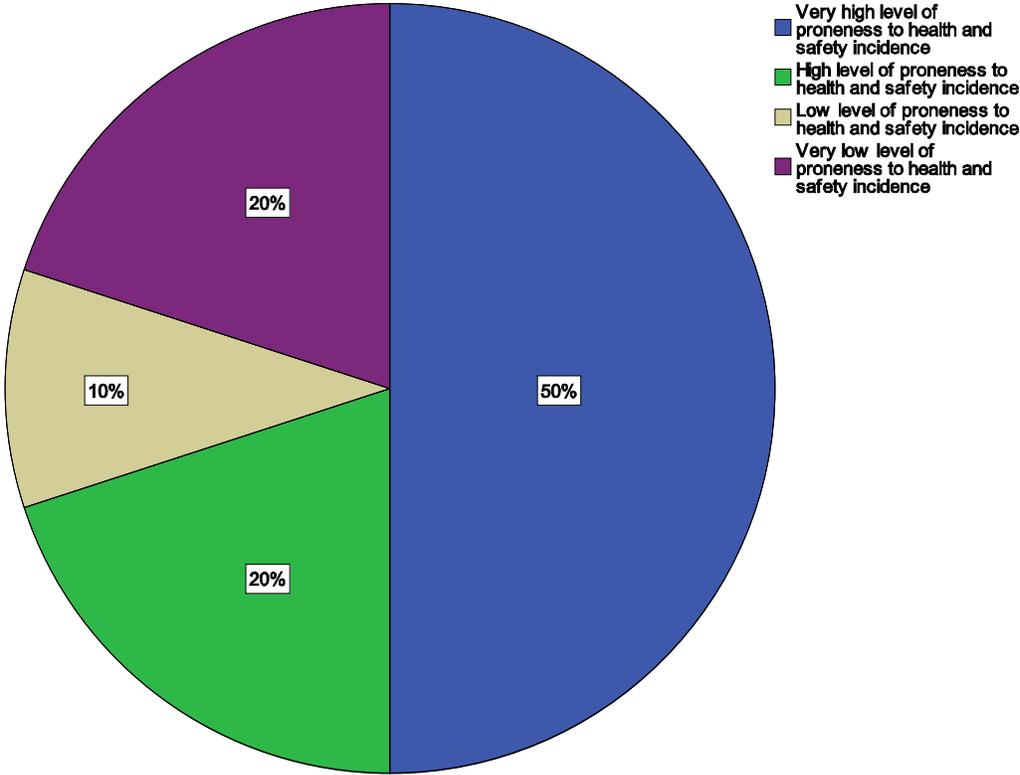


Figure 4.5.2– Driving plant on work site

Source: Field survey data

Table 4.5.4– Use of explosives

Areas	Level of consideration	Frequency	Percentage	Cumulative percentage
Use of explosives	Very highly considered	9	90	90
	Level of consideration is high	0	0	90
	Low level of consideration	1	10	100
	Very low level of consideration	0	0	
Total		10	100	

Source: Field survey data

From table 4.5.4, the majority of respondents (90%) understand how use of explosives is very dangerous to human lives (source of quick fatalities and injuries). Only 10% of respondents stated that this area can be considered at low level. From these data, use of explosives is very risky area in transport projects. Therefore effective safety management is needed to prevent workers from noise pollution, injuries and health ill from dust and fumes emission.

Table 4.5.5 – Earth moving

Areas	Level of consideration	Frequency	Percentage	Cumulative percentage
Earth moving	Very highly considered	3	30	30
	Level of consideration is high	6	60	90
	Low level of consideration	1	10	100
	Very low level of consideration	0	0	100
Total		10	100	

Source: Field survey data

From Table 4.5.5 and figure 4.5.3, 30% of respondents indicated that the area of earth moving in highway projects is very highly considered to be prone to high safety incidence, 60% of

respondents stated that this area is highly considered and only 10% stated that the area is considered at low level.

By analysing these data, the majority of respondents (60%) have experienced that earth moving is prone to high safety incidence and consequently has to be effectively managed to prevent accidents to workers, by-passing pedestrians, visitors and environment.

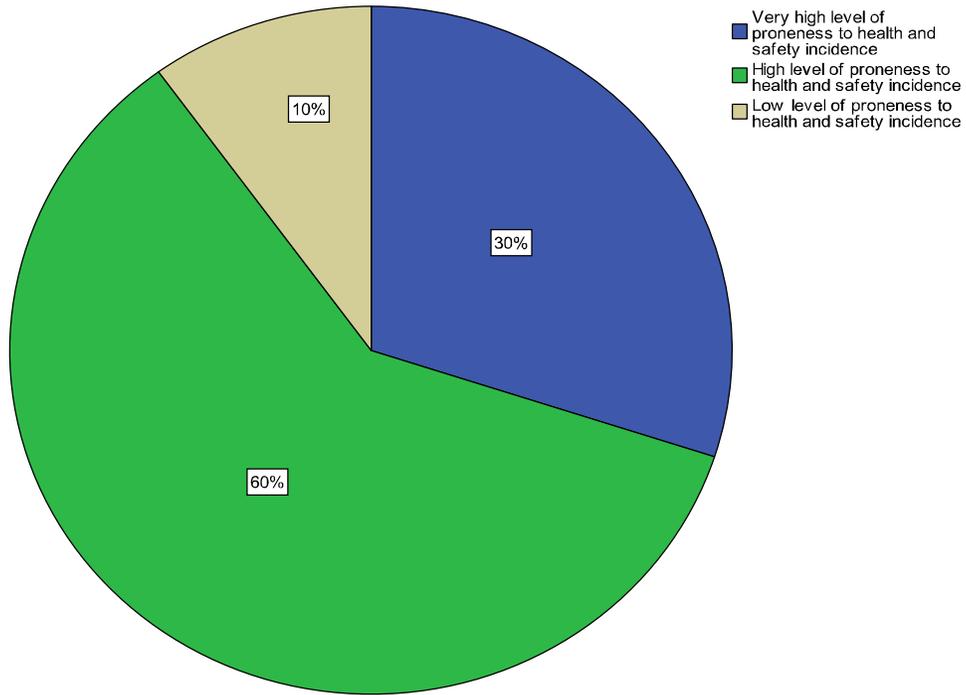


Figure 4.5.3– Earth moving

Source: Field survey data

Table 4.5.6– Working in confined space

Areas	Level of consideration	Frequen cy	Percentage	Cumulative percentage
Working in confined space	Very highly considered	5	50	50
	Level of consideration is high	5	50	100
	Low level of consideration	0	0	100
	Very low level of consideration	0	0	100
Total		10	100	

Source: Field survey data

From table 4.5.6, respondents are equally distributed on only two levels of consideration. 50% of respondents experienced that the area of working in confined space is at a very high consideration, while the other 50% of respondents stated that the area is at a high consideration. Therefore, as working in confined space has potential to cause breathing problems to workers due to toxic substances and other chemicals which may be present, preventive measures and first aid treatment are needed in case this safety incidence occurs.

Table 4.5.7– Working in, over, or adjacent to water

Areas	Level of consideration	Frequency	Percentage	Cumulative percentage
Working in, over, or adjacent to water	Very highly considered	6	60	60
	Level of consideration is high	3	30	90
	Low level of consideration	1	10	100
	Very low level of consideration	0	0	100
Total		10	100	

Source: Field survey data

From table 4.5.7, 60% of respondents indicated that the area of working in, over, or adjacent to water is very highly considered to be prone to high safety incidence in highway projects, 30% of respondents indicated that the area is at high level of consideration, while 10% of respondents indicated that this area is at low level of consideration. Therefore, serious preventive measures and risk control measures are needed by providing training to workers, appropriate protective cloths to prevent a worker from sinking in water in case of the occurrence of incidence.

Table 4.5.8 – Controlling noise

Areas	Level of consideration	Frequency	Percentage	Cumulative percentage
Controlling noise	Very highly considered	4	40	40
	Level of consideration is high	0	0	40
	Low level of consideration	6	60	100
	Very low level of consideration	0	0	100
Total		10	100	

Source: Field survey data

The data in table 5.8 showed that 40% of respondents considered the area of controlling noise at a very high level to be prone to high safety incidence; the other part of respondents (60%) considered this area to be at high level of proneness to safety incidence. By critically analyzing these data, the majority of respondents do not understand the effects of noise to health; it is because these effects cannot directly be observed physically. However, noise pollution must be prevented by providing equipments producing noise which is in acceptable limits or providing ear protection where high noise cannot be prevented.

Table 4.5.9– Controlling dust

Areas	Level of consideration	Frequenc y	Percentage	Cumulative percentage
Controlling dust	Very highly considered	2	20	20
	Level of consideration is high	5	50	70
	Low level of consideration	2	20	90
	Very low level of consideration	1	10	100
Total		10	100	

Source: Field survey data

The data in table 4.5.9 showed that 20% of respondents considered the area of controlling dust at a very high level to be prone to high safety incidence, the 50%) considered this area to be at high level of proneness to safety incidence, 20% stated that the area is at low level of consideration, and the remaining part of respondents (10%) stated that the area is at a very low level of consideration.

Contrarily to the level of consideration of noise nuisance, dust effects are quickly observed to workers and other nearby population by sneezing and coughing. This is why this area has been rated at high level of consideration by the half of respondents to be prone to high safety incidence. Therefore dust control measures should be taken into consideration by providing masks to workers for filtering air and by watering dusty highway where works are still in progress or other means of protection.

Table 4.5.10– Work site signage

Areas	Level of consideration	Frequency	Percentage	Cumulative percentage
Work site signage	Very highly considered	5	50	50
	Level of consideration is high	4	40	90
	Low level of consideration	0	0	90
	Very low level of consideration	1	10	100
Total		10	100	

Source: Field survey data

Table 4.5.10 indicate that the area of work site signage was rated at very high level of consideration by 50% of respondents, 40% of respondents rated it at high level of consideration. Only 10% of respondents rated this area at very low level of consideration. From these data, work site signage is very important for site workers and other traffic passing near or using the work site.

Therefore, effective signage is to be adopted.

Question 3

Indication of the factors impacting on health and safety and their levels of impact drawn on respondents' experience of transport projects.

The aim of this question was to indicate the factors that impact on health and safety incidence on highway projects.

Response

Table 4. 6.1 to 4.6.9 below indicate the results obtained from respondents in this research. (See appendix, question 3,A to I).

Table 4. 6.1 – Working methods and methodologies in project work

Factor	Level of impact	Frequency	Percentage	Cumulative percentage
Working methods and methodologies in project work	Very high level of impact	7	70	70
	High level of impact	3	30	100
	Low level of impact	0	0	100
	Very low level of impact	0	0	100
Total		10	100	

Source: Field survey data

From table 4. 6.1, 70% of respondents indicated that the level of impact for working methods and methodologies in project work factor has a very high level of impact, whereas 30% of respondents indicated that this factor has a high level of impact. From the respondents statements, it can be revealed that operating procedures at company level is very important to perform work continually and therefore should be availed and understood by all categories of workers.

Table 4.6.2– Materials and equipment used in projects

Factors	Level of impact	Frequency	Percentage	Cumulative percentage
Materials and equipment used in projects	Very high level of impact	3	30	30
	High level of impact	7	70	100
	Low level of impact	0	0	100
	Very low level of impact	0	0	100
Total		10	100	

Source: Field survey data

From table 4.6.2, 30% of respondents indicated that materials and equipment used in a project is a factor impacting on health and safety incidence in highway projects at a very high level, 70% of respondents indicated that it has high level of impact.

Therefore, quality of materials and equipments is of great importance, as well as effective use of those materials and equipments.

Table 4. 6.3– Lack or inadequate training and inductions on health and safety

Factors	Level of impact	Frequency	Percentage	Cumulative percentage
Lack or inadequate training and inductions on health and safety	Very high level of impact	8	80	80
	High level of impact	0	0	80
	Low level of impact	2	20	100
	Very low level of impact	0	0	100
Total		10	100	

Source: Field survey data

From table 4. 6.3, 80% of respondents indicated that lack of inadequate training and inductions on health and safety impacts very highly on health and safety in transport projects. 20% of respondents observed that the impact of this factor to health and safety is at low level. Therefore, training to all workers and inductions to new workers are more important to prevent health and safety incidence from workers, and for this reason, training programme should be made available in the company.

Table 4.6.4– Inadequate skills and competencies of project staff/workers

Factors	Level of impact	Frequency	Percentage	Cumulative percentage
Inadequate skills and competencies of project staff/workers	Very high level of impact	10	100	100
	High level of impact	0	0	100
	Low level of impact	0	0	100
	Very low level of impact	0	0	100
Total		10	100	

Source: Field survey data

From table 4.6.4, all respondents (100%) have the same views that inadequate skills and competencies of project staff/workers is a major factor to impact on health and safety incidence. Therefore, the company management must employ skilled and competent staff and provide regular training for capacity building for the purpose of effective performance of work.

Table 4. 6.5– Absence of formal Health and Safety Management Processes and Systems

Factors	Level of impact	Frequency	Percentage	Cumulative percentage
Absence of formal Health and Safety Management Processes and Systems	Very high level of impact	7	70	70
	High level of impact	3	30	100
	Low level of impact	0	0	100
	Very low level of impact	0	0	100

Source: Field survey data

From table 4.6.5, 70% of respondents indicated absence of formal Health and Safety Management Process and Systems is a factor impacting on health and safety incidence in highway projects at a very high level, 30% of respondents indicated that it has high level of impact.

Therefore, absence of formal Health and Safety Management Processes and Systems in highway projects can impact strongly on health and safety incidence, the reason being that, without management processes, means that there is no policy in which the management commitment is made, no work programme to indicate priorities, no plan of actions to be implemented based on priorities, no inspection programme to identify gaps and other non conformities, no corrective actions to non conformities, no management review to manage changes for continual improvement.

Table 4.6.6– Government’s limited capacity in providing appropriate legal framework and inspectorate personnel to enforce compliance

Factors	Level of impact	Frequency	Percentage	Cumulative percentage
Government’s limited capacity in providing appropriate legal framework and inspectorate personnel to enforce compliance	Very high level of impact	4	40	40
	High level of impact	5	50	90
	Low level of impact	1	10	100
	Very low level of impact	0	0	100
Total		10	100	

Source: Field survey data

From table 4.6.6, 40% of respondents stated that Government’s limited capacity in providing appropriate legal framework and inspectorate personnel to enforce compliance can impact very highly on health and safety incidence, 50% of respondents stated that this factor can impact on health and safety at high level, 10% stated that this factor has an impact to health and safety incidence at low level. However, health and safety incidence cannot be effectively managed without legal framework to provide rights and responsibilities of workers, how to enforce health and safety principles at work, and how to penalize those who do not comply with the legislation. Therefore legal framework should be made priority by the government.

Table 4.6.7– High cost involved in providing and maintaining health and safety risk control measures

Factors	Level of impact	Frequency	Percentage	Cumulative percentage
High cost involved in providing and maintaining health and safety risk control measures	Very high level of impact	3	30	30
	High level of impact	3	30	60
	Low level of impact	3	30	90
	Very low level of impact	1	10	100
Total		10	100	

Source: Field survey data

From table 4.6.7, 30% of respondents stated that high cost involved in providing and maintaining health and safety risk control measures is a factor at very high level of impact,30% stated that this factor is at high level of impact,30% stated that the factor is at low level of impact, 10% stated that the factor is at very low level of impact. Analysing these levels of impact, it can be seen that high cost involved in providing and maintaining health and safety risk control measures does not matter because life is more expensive than other things and therefore must be made priority.

Table 4.6.8– Lack of concern towards health and safety issues in project by the clients

Factors	Level of impact	Frequency	Percentage	Cumulative percentage
Lack of concern towards health and safety issues in project by the clients	Very high level of impact	2	20	20
	High level of impact	8	80	100
	Low level of impact	0	0	100
	Very low level of impact	0	0	100
Total		10	100	

Source: Field survey data

From table 4.6.8, 20% of respondents stated that lack of concern towards health and safety issues in project by the clients is a factor impacting on health and safety at a very high level,80% of respondents estimated that it is at a high level.

Looking at these responses, it was observed that this factor is very challenging as the majority stated that it has high impact to health and safety incidence. The biggest mistake that is usually made by highway project clients is not to providing resources for health and safety issues in tendering process. It is therefore the responsibility of clients to budget for health and safety and the contractor has to comply with the specifications in tender document in conformity to applicable legislation.

Table 4.6.9– Lack of top management commitment to health and safety

Factors	Level of impact	Frequency	Percentage	Cumulative percentage
Lack of top management commitment to health and safety	Very high level of impact	10	100	100
	High level of impact	0	0	100
	Low level of impact	0	0	100
	Very low level of impact	0	0	100
Total		10	100	

Source: Field survey data

From table 4.6.9, all respondents (100%) have the same view that lack of top management commitment to health and safety is a major factor impacting on health and safety incidence. Therefore, the company Top management commitment is very important for driving the whole management process. Top management commitment with clear/auditable objectives should be effectively communicated and understood by all categories of workers.

Question 4

Identification of qualified personnel employed by the company s to deal with health and safety issues on highway project sites

The aim of this question was to identify technical personnel to deal with health and safety issues in highway projects at company level.

Response

Table 4.7 below indicates results obtained from respondents in this research.(See appendix, question 4).

Table 4.7– Qualified personnel of the company to deal with health and safety issues on work site

Key personnel to be recruited	Recruitment priority	Frequency	Percentage	Cumulative percentage
Project Manager	Recruited	8	80	80
	Not recruited	2	20	100
Health and safety Engineer	Recruited	5	50	50
	Not recruited	5	50	100
Health and Safety Officer	Recruited	1	10	10
	Not recruited	9	90	100
Health and Safety Representative	Recruited	7	70	70
	Not recruited	3	30	100

Source: Field survey data

From table 4.7, respondents indicated technical personnel currently employed by the company to deal with health and safety issues in highway projects.80% of respondents indicated that Project Managers are available, 20% indicated that this position is still vacant. Similarly, 50% of respondents indicated that Health and Safety Engineer is employed in the company, whereas the other 50% indicated that this position is still vacant.

Furthermore, 10% of respondents indicated that Health and Safety Officer was recruited, other 90% of respondents indicated that this position is not actually filled.

For the position of Health and Safety Representative which is a very important position to deal with effective implementation of health and safety principles in highway projects, 70% of respondents indicated that this position is filled, whereas 30% indicated that this position is still vacant.

By analyzing these data, it was realized that most highway projects have Project Managers, Health and Safety Engineers and Health and Safety Representatives. In this regard, the recruitment of this staff should be the performance indicator of the company and therefore, in case this particular staff is not recruited, health and safety committee must be established and work in compliance with the provisions of the national law on occupational health and safety.

Question 5

Identification of training materials that are in possession of the company

The aim of this question was to identify whether the company has a written document in which steps of doing work and health and safety awareness tools to prevent the occurrence of incidents on work site is in place.

Response

Table 4.8 below indicates results obtained from respondents in this research. (See appendix, question 5).

Table 4.8– Availability of documented procedure at the company level

	Frequency	Percentage	Cumulative percentage
Documented procedure is available	2	20	20
Documented procedure is not available	8	80	100
Total	10	100	

Source: Field survey data

From table 4.8, 20% of respondents agreed that they have documented procedure in the company on one hand, and 80% disagreed to be in the possession of a documented procedure in the company on the other hand.

Based on these responses, most companies in highway projects do not have documented procedures which are normally main tools for better performing the work as they contain steps of doing works and this can lead to ineffective quality managed in highway projects and therefore results in high incident rates.

Question 6

Identification of company’s current practices to reduce or eliminate the health and safety incidence on work site

The aim of this question was ascertain the nature and type of practices currently in place to eliminate or minimize health and safety incidence in highway projects.

Response

Table 4.9 below indicates results obtained from respondents in this research.(See appendix, question 6).

Table 4.9 – Current practices for the company to eliminate or reduce the health and safety incidence on work site

Type of practices	Current status	Frequency	Percentage	Cumulative percentage
Regular health and safety education (training) on health and safety procedure	Practised	3	30	30
	Not practised	7	70	100
Setting clear responsibilities to workers about health and safety	Practised	9	90	90
	Not practised	1	10	100
Accountability	Practised	5	50	50
	Not practised	5	50	100
Consultation between workers about health and safety issues	Practised	8	80	80
	Not practised	2	20	100
Effective communication	Practised	2	20	20
	Not practised	8	80	100
Conducting health and safety audits	Practised	2	20	20
	Not practised	8	80	100

Source: Field survey data

From table 4. 9, respondents indicated rates of current practices for the company to eliminate or reduce the health and safety incidence on work site.

It was observed that 30% of respondents stated that regular health and safety education on health and safety procedure is practiced, whereas 70% stated that this practice does not exist. For the practice on setting clear responsibilities to workers about health and safety,90% of respondents stated that the practice exists in the company, whereas 10% stated disagreed. For accountability, observations from respondents for those who practice and those who do not, responses showed that there was uniform distribution (50% for each option). For practicing effective communication and conducting health and safety audits, 20% of respondents stated that companies have these practices, whereas 80% responded negatively. Similarly, consultation between workers about health and safety issues was found to be 80% positive, whereas 20% were found to be negative.

By looking at these data, it was revealed that setting clear responsibilities to workers about health and safety, accountability and consultation between workers about health and safety issues are effectively practiced, whereas effective communication and conducting health and safety audits are poorly practiced in these transport projects. Nevertheless, these last two practices are more important performance tool used to share information between workers and managers and identify gaps for further improvement. Therefore the whole system can be affected if no improvement is done.

Question 7

Indication of the level of criticality of the health and safety issues addressed to respondents

The aim of this question was to indicate the level of criticality of success factor to effective health and safety in highway projects in the company.

Response

Table 4.10.1 to 4.10.8 below contain results obtained from respondents in this research (See appendix, question 7, A to H).

Table 4.10.1– Management activities on site

Critical success factors to effective health and safety in highway projects in your company	Level of criticality	Frequency	Percentage	Cumulative percentage
Management activities on site comprising: - health and safety inspection, - health and safety meeting, - complying with health and safety regulation, - enforcement, - safety training and education, health and safety communication	Very critical	6	60	60
	Critical	4	40	100
	Fairly Critical	0	0	
	Low level of criticality	0	0	
Total		10	100	

Source: Field survey data

From table 4.10.1, 60% of respondents stated that management activities on site is very critical success factors to effective health and safety in highway projects , whereas 40% stated that it is critical.

Analysing these data, it is fortunate that companies are aware of success factors in transport projects and therefore, there is a hope for improvement in conducting regular health and safety inspection, health and safety meeting, complying with health and safety regulation, enforcement, safety training and education, and health and safety communication.

Table 4.10.2 – Consideration of health and safety during tendering process by allocating effective resources

Critical success factors to effective health and safety in highway projects in your company	Level of criticality	Frequenc y	Percentage	Cumulative percentage
Consideration of health and safety during tendering process by allocating effective resources	Very critical	7	70	70
	Critical	3	30	100
	Fairly Critical	0	0	
	Low level of criticality	0	0	
Total		10	100	

Source Field survey data

With regard to data contained in table 4.10.2, 70% of respondents indicated that Consideration of health and safety during tendering process by allocating effective resources is a very critical success factor to effective health and safety in highway projects.

As it was realized that health and safety has not been considered in tendering process for many highway projects by clients, now there is a chance for changing the mind to allocate effective resources to this issue, because contractors also do not consider it due to lack of resources allocated to it in tendering process.

Table 4.10.3– Incentives either monetary, non monetary or disciplinary action

Critical success factors to effective health and safety in highway projects in your company	Level of criticality	Frequency	Percentage	Cumulative percentage
Incentives either monetary, non monetary or disciplinary action	Very critical	1	10	10
	Critical	2	20	30
	Fairly Critical	7	70	100
	Low level of criticality	0	0	
Total		10	100	

Source: Field survey data

From data contained in table 4.10.3, 10% of respondents considered incentives either monetary and disciplinary action as a very critical success factor to effective health and safety in highway projects, 20% considered it as critical while 70% considered it as fairly critical.

Based on these data, incentives either monetary, non monetary or disciplinary action has been considered not to be a major success factor to effective health and safety in highway projects.

Table 4.10.4 – Formulation of health and safety policies

Critical success factors to effective health and safety in highway projects in your company	Level of criticality	Frequency	Percentage	Cumulative percentage
Formulation of health and safety policies	Very critical	2	20	20
	Critical	5	50	70
	Fairly Critical	3	30	100
	Low level of criticality	0	0	
Total		10	100	

Source: Field survey data

From data contained in table 4.10.4, 20% of respondents considered formulation of health and safety policies as a very critical success factor to effective health and safety in highway projects, 50% considered it as critical while 30% considered it as fairly critical.

Based on these data, formulation of health and safety policies has been considered to be an important factor element to effective health and safety in highway projects as policies come first in establishing effective health and safety management system and the effectiveness is largely dependent on the quality policy and quality objectives.

Table 4.10.5– Personnel attitudes towards health and safety

Critical success factors to effective health and safety in highway projects in your company	Level of criticality	Frequency	Percentage	Cumulative percentage
Personnel attitudes towards health and safety	Very critical	6	60	60
	Critical	4	40	100
	Fairly Critical	0	0	
	Low level of criticality	0	0	
Total		10	100	

Source: Field survey data

With regard to data indicated in table 4.10.5, 60% of respondents stated that personal attitudes towards health and safety is a very critical success factor to effective health and safety in highway projects, and it was also found that 40% of respondents stated that this success factor is critical.

Criticizing these data, many respondents observed that personal attitudes can lead to success towards health and safety depending on their level of goodness.

Table 4.10.6– Process of identifying hazards and assessing risks

Critical success factors to effective health and safety in highway projects in your company	Level of criticality	Frequency	Percentage	Cumulative percentage
Process of identifying hazards and assessing risks	Very critical	6	60	60
	Critical	3	30	90
	Fairly Critical	1	10	100
	Low level of criticality	0	0	
Total		10	100	

Source: Field survey data

With regard to data indicated in table 4.10.6, 60% of respondents stated that process of identifying hazards and assessing risks is a very critical success factor to effective health and safety in highway projects, and it was also found that 30% of respondents stated that this success factor is critical, whereas 10% stated that it is fairly critical.

Criticizing these data, many respondents observed that process of identifying hazards and assessing risks impacts on health and safety, that means that, for health and safety to be effective in transport projects, process of identifying hazards and assessing risks impacts on health and safety should be as effective as possible.

Table 4.10.7 –Risk response and risk management system

Critical success factors to effective health and safety in highway projects in your company	Level of criticality	Frequency	Percentage	Cumulative percentage
Risk response and risk management system	Very critical	6	60	60
	Critical	4	40	100
	Fairly Critical	0	0	
	Low level of criticality	0	0	
Total		10	100	

Source: Field survey data

With regard to data indicated in table 4.10.7, 60% of respondents stated that risk response and risk management system is a very critical success factor to effective health and safety in highway projects, and it was also found that 40% of respondents stated that this success factor is critical.

Criticizing these data, many respondents observed that risk response and risk management system, meaning that risk control measures should be in place as well as management system can lead to success towards health and safety depending on their level of effectiveness.

Table 4.10.8 – Adequate personal protective equipment aligned with the nature of work

Critical success factors to effective health and safety in highway projects in your company	Level of criticality	Frequency	Percentage	Cumulative percentage
Adequate personal protective equipment aligned with the nature of work	Very critical	9	90	90
	Critical	1	10	100
	Fairly Critical	0	0	
	Low level of criticality	0	0	
Total		10	100	

Source: Field survey data

With regard to data contained in table 4.10.8, 90% of respondents indicated that adequate personal protective equipment aligned with the nature of work is a very critical success factor to effective health and safety in highway projects. Also 10% of respondents stated that this factor is critical.

Analysing the data, it can be seen that adequate personal protective equipment aligned with the nature of work is undoubtedly a very useful success factor as adequate personal protective equipment must comply with safety requirement/standards to prevent health and safety incidences.

Question 8

Identification of major elements of effective health and safety in highway projects

The aim of this question was to confirm major elements of effective health and safety practices in highway projects.

Response

Table 4.11 below contains results obtained from respondents in this research.

Table 4.11– Major elements of effective health and safety in highway projects

Major elements	Option of the company	Frequency	Percentage	Cumulative percentage
Management leadership and organizational commitment	Agree	9	90	90
	Disagree	1	10	100
Hazard identification and assessment	Agree	9	90	90
	Disagree	1	10	100
Hazard control	Agree	8	80	80
	Disagree	2	20	100
Highway work site inspections	Agree	9	90	90
	Disagree	1	10	100
Worker competency and training	Agree	8	80	80
	Disagree	2	20	100
Incident investigation and reporting	Agree	7	70	70
	Disagree	3	30	100
Emergency response planning	Agree	9	90	90
	Disagree	1	10	100

Source: Field survey data

From table 4.11, respondents agreed that, Management leadership and organizational commitment, hazard identification and assessment, hazard control, highway work site inspections, worker competency and training, incident investigation and reporting, and emergency response planning are major elements of effective health and safety in highway projects.

Therefore, these major elements of health and safety in highway projects should be audited to evaluate their level of implementation at company level to ensure that the management system is effectively implemented and if some nonconformities are identified, corrective actions are immediately recommended.

Question 9

Identification of performance indicators in the respondents' company for Health and Safety Management System in highway projects

The aim of this question was to investigate the performance indicators of the company in health and safety management system for highway project currently in execution progress.

Response

Table 4. 12 below contains results obtained from respondents in this research.

Table 4.12– Company health and safety performance indicators in place in the execution of current highway projects

Indicators	Current status in the company	Frequency	Percentage	Cumulative percentage
Written management commitment about health and safety practices	Available	3	30	30
	Not available	7	70	100
Active health and safety committee	Available	7	70	70
	Not available	3	30	100
Health and safety internal and external audit reports	Available	5	50	50
	Not available	5	50	100
Health and safety evaluation report	Available	9	90	90
	Not available	1	10	100
Accountability process	Available	8	80	80
	Not available	2	20	100
Site accidents records and reports	Available	10	100	100
	Not available	0	0	
Health and safety procedure	Available	3	30	30
	Not available	7	70	100
Training records	Available	4	40	40
	Not available	6	60	100
Review program of health and safety guidelines	Available	2	20	20
	Not available	8	80	100
Risk assessment report	Available	4	40	40
	Not available	6	60	100

Source: Field survey data

From table 4.12, respondents showed that written management commitment about health and safety practices, active health and safety committee, health and safety internal and external audit reports, health and safety evaluation report, accountability process, site accidents records and reports, site accidents records and reports, health and safety and risk assessment report are performance indicators at a rate of around 70%.

Analysing these data obtained from the field, the performance indicators are available and should therefore conform to project objectives which should be specific, measurable, achievable, realistic and time bound in order to be auditable.

Question 10

Identification of performance indicators that a company would set to ensure that traffic is effectively managed on the respondents' highway project site

The aim of this question was to identify performance indicators in the company to ensure effective traffic management on highway project sites.

Response

It was revealed that site signage covers a rate of 60%, driver training program (40%), traffic management plan (30%), training report (1%), site accident records (1%), mobile equipments insurance (1%) and traffic control procedure (1%).

Therefore, effective site signage and planned trainings for drivers are more recommended to ensure effective traffic management on highway project sites.

4.3.2 Analysis of interview responses

Respondents stated that the role of the Safety Officer on highway project sites was to identify hazards that can lead to the loss of human lives and production; to compile risk assessments; to advise Senior Management with regards to legal requirements in the execution of each and every task required by law; to ensure that everyone is executing their task in their scope of management; and to execute incident investigation as well as safety training, whereas the role of the Health and Safety Representative was to advise, consult and train the various sectors of

manufacturing, industry, commerce, building and government, to conduct Health, Safety and Environmental legal compliance audits, training and risk assessments.

Concerning cause of accidents on highway projects sites, respondents stated that most accidents are caused by inadequate capability of workers; lack of health and safety knowledge; negligence and carelessness; inadequate quality of equipments and materials inadequate management of personnel about health and safety issues and environmental conditions of the work site.

Therefore, respondents informed the interviewer that common accidents occurring on sites are deaths, injuries (cuts, abrasions and lacerations); being struck by vehicles; and falls from heights in case of bridge's walls and decks construction.

Concerning respondents' views with regard to the compliance of the Construction Regulations on sites, it was stated that the level of compliance is not satisfactory due to the lack of support by Senior Management as they are more focused on the operations side and disregard safety aspects.

For most common non-compliance with H&S regulations on sites and the parties responsible for such, respondents stated that mobile equipments are not tested, before anyone use, by the relevant Health and Safety authority to ensure that they comply with the applicable health and safety regulations, failure of supervisors to train and inform employees of risk assessments, failure to enforce the health and safety procedures by employers and failure to comply with guidelines for putting on Personal Protective Equipment by employees. This was attributed to their lack of understanding of the measures present and why such measures are important.

Respondents also stated they should be involved in the preparation of the health and safety plan to improve pre-accident prevention methods that already exist; improve the accident reporting structure as this brings confidence to the employees to report incidents; contribute to the closing out of accidents; be involved in reviewing of risk assessments; adjust the H&S plan as the works progresses and assist employers to become legally compliant and illustrate measures to prevent any loss.

Major issues faced by respondents in executing health and safety procedures at all times on site were found to be the following:

- Insufficient training to understand what is stated in operating procedures;
- The lack of regular supervision to identify health; and
- Safety issues on sites.

4.4 Summary of main findings

This research which aims to develop an appropriate framework and set guidance for improved awareness and understanding of effective health and safety management for highway projects was conducted to meet research objectives which were set at the design stage to provide the answer to the research question.

Ten Participants were registered to be part of this research during field data collection.

From analysis of data, a number of observations have been made. These are helpful in broadly setting the scene for the detailed interpretation of the results that are to follow. They also serve to provide some indication of the value of the findings against the original research objectives.

All survey questionnaire data and interviews were critically and analytically evaluated and it was found that health and safety practices on highway project sites are at high level of consideration, but some improvements are still needed to work effectively in this area.

Mainly the following research elements were approached **objectively** and were found to be generally at **high level of consideration** by highway project contractors:

- a) The nature of health and safety incidence in highway projects were ascertained: deaths, injuries (cuts, abrasions and lacerations), being struck by vehicles, and falls from heights in case of bridge's walls and decks construction. In this context, the important component features on health and safety in transport projects such as evaluation of all equipments, machinery, work areas and work processes to identify and analyze all potential sources of harm to workers, engineering controls, administrative controls and personal protective equipment, essential commitment from senior management for effective health and safety

management, work competency and training, inspection programme, emergency response planning, incidents reporting and investigation, and management system administration were found to be at a high level of consideration by contractors.

Areas of highway projects that are prone to high safety incidence were investigated.

These are: Excavation, protection of power line and electrical equipments on sites, driving plant on work site, use of explosives, earth moving, working in confined space, Working in, over ,or adjacent to water , controlling dust, and work site signage;

- b) Factors impacting on health and safety in transport projects were identified. These are: working methods and methodology, materials and equipment used in projects, lack or inadequate training and induction on health and safety, inadequate skills and competencies of project staff/workers, absence of formal health and safety management processes and systems, government's limited capacity in providing appropriate legal framework and inspectorate personnel to enforce compliance, lack of concern towards health and safety in projects by clients and lack of top management commitment to health and safety;
- c) Critical success factors to effective health and safety in highway projects were identified. These include: Management activities on site, consideration of health and safety during tendering process by allocating effective resources, formulation of health and safety policies, personnel attitudes towards health and safety, process of identifying hazards and assessing risks, risk response and risk management system;
- d) Types of practices currently in place to minimize or eliminate health and safety incidence in highway projects were ascertained. These include: Setting clear responsibilities to workers about health and safety, accountability, consultation between workers about health and safety issues.

Therefore, health and safety incidence in highway projects was found to be at high level of consideration by highway projects Contractors, but continual improvements in the above four important component features on health and safety in transport projects are encouraged.

Despite the above practices were found to be highly considered, some others were found to be less considered by contractors such as effective communication, conducting health and safety audits, and regular health and safety education (training) on health and safety procedure and area of controlling noise was found to be at a low level of consideration and therefore need more attention for consideration as these component features have great impact on health and safety performance.

4.5 Answer to the research question

In this research, the research question was: **What factors impacting on health and safety incidence on highway projects sites in Rwanda?**

Many factors were identified to act together for incidents occurrence. These are summarised as: Institutional factors, Management factors, Job factors, and Personal factors.

a) Institutional factors

It was found that institutional factors have great impact on health and safety incidence in highway projects in case there is a Government's limited capacity in providing appropriate legal framework and inspectorate personnel to enforce compliance where laws and regulations are lacking to impose restrictions by defining the legal, moral, and cultural boundaries that separate legitimate from illegitimate activities. Institutions shape behaviour by constituting the set of acceptable interpretations and actions available to social actors. Thus they comprise the laws, regulations and control mechanism.

b) Management factors

It was found that management factors impacting on health and safety on highway projects sites include: lack of policies on Health and Safety Management processes and system, allocation of less resources to deal with Health and Safety issues, inadequate or regular training on health and safety to workers, lack of concern towards health and safety issues in project by the clients, lack of top management commitment to health and safety ,inadequate leadership, lack of induction for new workers, inadequate communication, inadequate health and safety awareness, and inadequate hazards control.

c) Job/ work environment factors

It was found that job factors impacting on health and safety on highway projects sites include: Working methods and methodologies in project work, materials and equipment used in projects, inadequate quality of equipments and materials, inadequate maintenance of equipments, lack of health and safety operating procedures, work team and physical space conditions.

d) Personal/ individual factors

It was found that Personal /individual factors impacting on health and safety on highway projects sites include: inadequate capability of workers, lack of health and safety knowledge, negligence and carelessness, inadequate quality of equipments and materials, inadequate management of personnel about health and safety issues and environmental conditions of the work site.

Additionally, the above answer to the research question which specified various insights to be collected in order to achieve research objectives is the evidence that the latter were met because all particular issues stated to meet research aim were addressed (see 4.4(a) to 4.4(d), 4.6 and 5.2).

4.6 Health and Safety management framework in highway projects

The purpose of the framework is to describe the rationale for risk management and arrangements for ensuring that effective risk management is implemented at all levels throughout the organization [55].

The framework ensures that information about risk derived from the risk management process is adequately reported and used as a basis for decision making and accountability at all relevant organizational levels [55].

In order to ensure effective health and safety practices on highway project sites, a safety management framework is required to show how risk management principles, risk management framework and risk management processes are interrelated.

The figure 4.6 shows the cyclic risk management framework which can be used in health and safety management systems in highway projects for continual improvement.

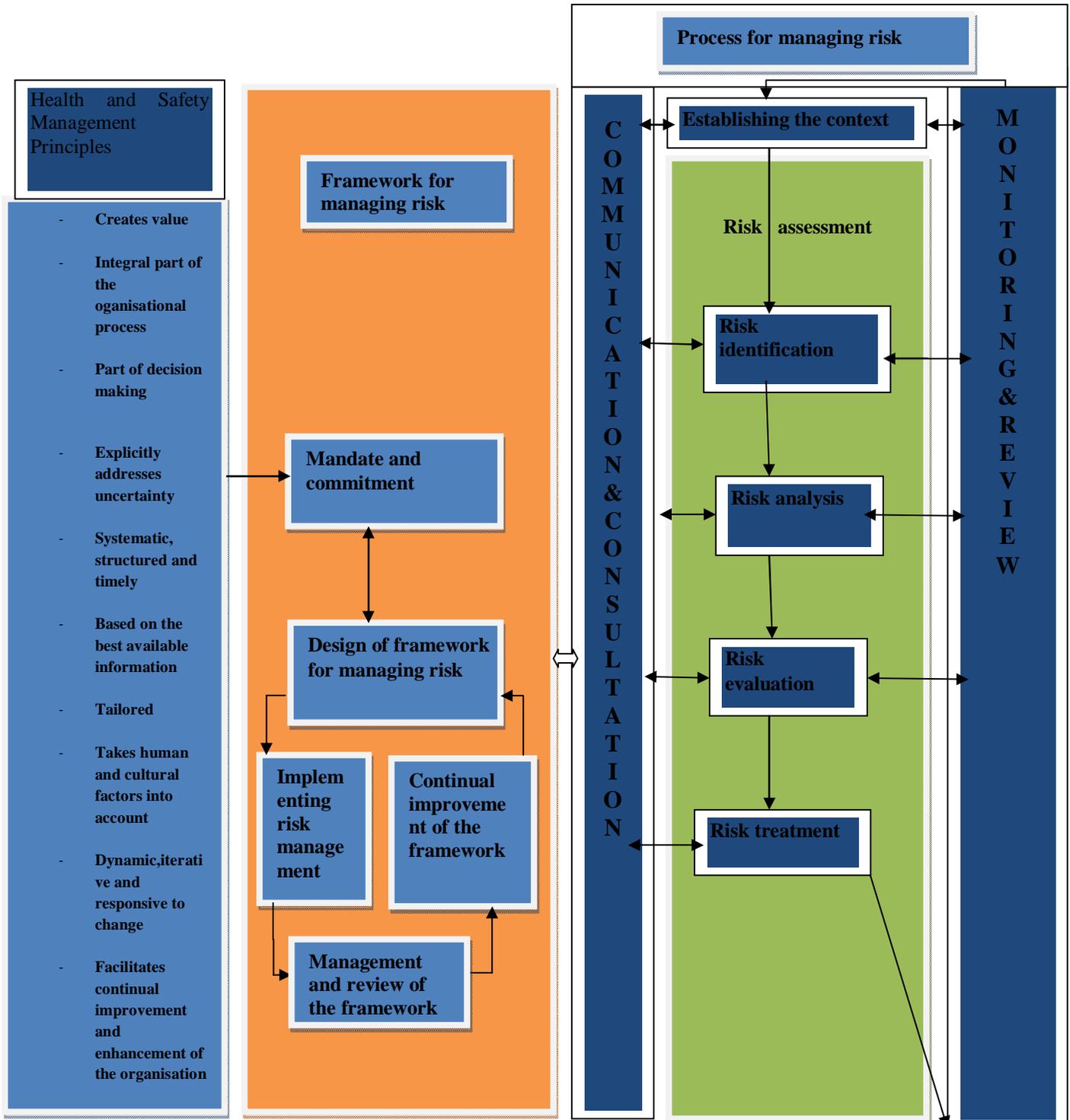


Figure 4.6 – Relationship between the components of the framework for managing risk

Adapted from [55]

Figure 4.6 shows the relationship between the components of a framework for managing risk.

This framework can be appropriate in managing risk in highway projects.

By analysing figure 4.6, risk management framework is cyclic and its components are interrelated: risk management principles form a basis for a highway project company to define its mandate and commitment from which the framework for risk management is designed, communicated to all involved for further inputs, then implemented for effective risk management, monitored to assess its level of performance, and finally reviewed for managing changes identified with the purpose of continual improvement.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The highway projects have been recognised as ones of the most hazardous projects in which to work in Rwanda because they represent, not only human tragedies, but also substantial economic costs. They have poor accidents records when compared to other construction projects.

This research revealed that generally health and safety practices on highway project sites are at high level of consideration by Contractors, but some of them have been found to be less considered by contractors such as effective communication, conducting health and safety audits, and regular health and safety education (training) on health and safety procedure and area of controlling noise and therefore need more attention for consideration as these component features have great impact on health and safety performance in highway projects.

Moreover, different factors were identified to act together for incidents occurrence. These are summarised as: Institutional factors, Management factors, Job factors, and Personal/Individual factors.

However, critical success factors to effective health and safety in highway projects were identified. These include: Management activities on site (health and safety inspection, health and safety meeting, health and safety regulation enforcement, health and safety training and education, and health and safety communication), consideration of health and safety during tendering process by allocating effective resources, formulation of health and safety policies, personnel attitudes towards health and safety, process of identifying hazards and assessing risks, risk response and risk management system.

Similarly, the relationship between the components of the framework for managing risks has been established to ensure that information about risks derived from the risk

management process is adequately reported and used as a basis for decision making and accountability at all relevant organizational levels (Fig 4.6).

Therefore, health and safety has been proved to be a fundamental consideration for all highway projects clients, designers and contractors. Effective health and safety practices should base on both legal and professional responsibilities to ensure understanding and application of health and safety principles at all times on highway project sites.

It is anticipated that the findings of this research will enable a significant contribution to be made towards the achievements of an organisation's health and safety culture and its contributory Effective Health and Safety Management Systems.

5.2 Recommendations

Based on identified factors against the Effective Health and Safety Practices on Highway Project Sites in Rwanda for the provision of welfare facilities and safe working conditions, the following recommendations were made for further improvement.

- Health, safety and accessibility for highway users and workers should be an integral and high priority element of every project from planning through design and construction;
- Highway users should be guided in a clear and positive manner by providing adequate signage system on the work site;
- In order to provide acceptable levels of operations, regular inspections of the work site should be performed to identify non conformities and therefore adopt relevant corrective actions;
- Companies and other stakeholders should consider aspects of health and safety culture when addressing work-related highway health and safety issues;
- Companies should be aware that, by improving safety culture, they can improve the safety attitudes of drivers on work site;

- Companies should consider improving incident reporting and feedback as a way to learn from driving incidents, and these systems should be tailored specifically for use with on road incidents;
- Drivers should be consulted on problem areas and solutions to ensure that driving risk management is likely to be effective;
- All contractors should provide health and safety leadership, be committed to health and safety, and view health and safety as a strategic issue, as opposed to an operational issue;
- All new workers should receive health and safety induction and training;
- All clients, designers, consultants and contractors should determine what are the legal requirements on health and safety issue and thereafter decide how to go about resolving the issue;
- Every contractor should have a qualified Health and Safety Officer and/or Health and Safety Representative to ensure that all incidents occurred are effectively recorded, reported and controlled through effective risk management framework;
- Every employer in highway projects should have health and safety incidents records to serve as a basis for decision making to counteract accidents causal factors and therefore improve health and safety management system in this area.

5.3 Recommendations for further research

This research was limited with only ten respondents working in highway projects in Kigali City Districts. However, it is believed that findings of this research give a general idea about Effective Health and Safety Practices in Highway Project sites in Rwanda. Further research is needed among a greater number of highway projects contractors across the country which can provide a comparison of results.

It was revealed that the reason why highway contractors do not pay high attention to the health and safety issues in highway projects is that project clients do not consider them

during tendering process and therefore result in poor consideration on work sites. It is therefore recommended that further research should be conducted on **”impacts of Procurement Processes to improve Health and Safety practices in Transport Related Projects”**.

REFERENCES

- [1] Macrothink Institute (2012), OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEMS: INSTITUTIONAL AND REGULATORY FRAMEWORKS IN ZIMBABWE . *International Journal of Human Resource Studies* , 2012, Volume. 2, Number 4,pp 100
- [2] Alli Benjamin.O. (2008) *Fundamental Principles of Occupational Health and Safety*, ISBN 978-92-2-120454-1 [Online]. Available from:www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/@publ/documents/publication/wcms_093550.pdf.(Accessed: 10 October 2013).
- [3] British Standards Institute (2008), BS OHSAS 18002, *Occupational health and safety management systems — Guidelines for the implementation of OHSAS 18001:2007*
- [4] Aoife Finneran, Alistair Gibb (2013:2) W099 - Safety and Health in Construction, Research Roadmap Report for Consultation, Loughborough University, UK: CIB General Secretariat
- [5] World Health Organisation (2013) Global status report on road safety—*Supporting a decade of action,Geneva,Switzerland: World Health Organisation*
- [6] Rwanda National Police (2012)“SAFER ROADS FOR SUSTAINABLE DEVELOPMENT OF AFRICA”,*Police Magazine*, no 005,November 2012[Online].Available from:www.rnp.gov.rw (Accessed: 25 November 2013),pp 7
- [7] Twagirayezu .E, Teteli .R, A. Bonane,Rugwizangoga. E (2008:73) “ROAD TRAFFIC INJURIES AT KIGALI UNIVERSITY CENTRAL TEACHING HOSPITAL, RWANDA” , *East and Central African Journal of Surgery*, 13(1), March/April 2008[Online].Available from: <http://www.bioline.org.br/js> (Accessed:25 November 2013),pp 73.
- [8] The New Times (2012)“Safer Roads for Sustainable Development of Africa”,*The New Times*,28 December 2012.Available from <http://www.newtimes.co.rw/news/index.php?i=15221&v=254&t=Safer%20Roads%20for%20Sustainable%20Development%20of%20Africa> ,[Accessed:03 December 2013].
- [9] Enshassi, A. (1997) Construction safety issues in Gaza Strip. *Building Research and information*, 25, (6) 370
- [10] Smallwood J,and Musonda ,I(2008) HEALTH AND SAFETY AWARENESS AND IMPLEMENTATION IN BOTSWANA’S CONSTRUCTION INDUSTRY.*Journal of Engineering Design and Technology*,6(1),pp 81-90
- [11] Holt ,AS.J (2001) *Principles of construction safety*

- [12] Michael Rose ,CFSIA RSP Aust, Manager Project Safety, VicRoads Major Projects(2012)” Evolution and innovation of safety controls at vicroads “,*ROADWORK SAFETY – INNOVATION AND FUTURE DIRECTIONS* , Melbourne 2012 [Online]. Available from : <http://www.aapaq.org/15hs2012/PDF PPT/24 AAPA2012HS doc Michael Rose Roadwork Safety-Innovation and future directions.pdf> (Accessed:5 December 2013),pp 4
- [13] Matthew Cokeham and Apollo Tutesigensi (2012)” An investigation of construction accidents in Rwanda: perspectives from Kigali”, *Management, Procurement and Law*, 166(MP4), August 2013[Online]. Available from: <http://dx.doi.org/10.1680.mpal.11.00046> (Accessed:21 October 2013) pp179-187.
- [14] Wellington Didibhuku Thwala(2013)”HUMAN CAPITAL THEORY: IMPLICATIONS FOR THE GHANAIAN CONSTRUCTION INDUSTRY DEVELOPMENT”, *Journal of Construction Project management and Innovation*, 3(1), Available from: <http://reference.sabinet.co.za/webx/access/electronicjournals/jcpmiv1.n1.a6.pdf>. [Accessed 10th October 2013]. pp 475
- [15] SafeWork SA(2012) ,*Workplce health and safety handbook*, South Australia
- [16] Health and Safety Executive (2013) *Managing for health and safety*
- [17] Hämäläinen, P.; Takala, J.; Saarela, K. L.(2006). “*Global estimates of occupational accidents*”, in *Safety Science*, Vol. 44, pp. 137–156.
- [18] International Labour Organization (2003b) Safety in Numbers: Pointers for A Global Safety Culture at Work. ILO, Geneva, Switzerland. Available at http://www.ilo.org/wcmsp5/groups/public/—ed_protect/—protrav/—safework/documents/publication/wcms_142840.pdf (accessed 31/10/2013).
- [19] European Union (2004) *Statistical analysis of socio-economic costs of accidents at work in the European Union*, final report, July 2004. Available at: http://epp.eurostat.cec.eu.int/cache/ity_offpub/ks-cc-04-006/en/ks-cc-04-006-en.pdf
- [20] Yule, S., Flin, R. & Murdy, A. (2007). THE ROLE OF MANAGEMENT AND SAFETY CLIMATE IN PREVENTING RISK TAKING AT WORK. *International Journal of Risk Assessment and Management*, 7(2)
- [21] Kanchana Priyadarshani, Gayani karunasena and Sajani Jayasuriya(2013), CONSTRUCTION SAFETY ASSESSMENT FOR DEVELOPING COUNTRIES. *Journal of Construction in Developing Countries* 18(1).pp35
- [22] AMERICAN SOCIETY OF SAFETY ENGINEERS, ASSE (2013) *Journal of Safety, Health & Environmental Research* • VOLUME 8, NO. 3
- [23] Seo, D.C., Torabi, M.R., Blair, E. H. & Ellis, N.T. (2004). A cross validation of safety climate scale using confirmatory factor analytic approach. *Journal of Safety Research*, 35(4),

[24] Flin, R., Mearns, K., O'Connor, P. & Bryden, R. (2000). Measuring safety climate: Identifying the common features. *Safety Science*, 34(1-3), 177-192.

[25] Arboleda, A., Morrow, P.C., Crum, M.R. & Shelly II, M.C. (2003). MANAGEMENT PRACTICES AS ANTECEDENTS OF SAFETY CULTURE WITHIN THE TRUCKING INDUSTRY: SIMILARITIES AND DIFFERENCES BY HIERARCHICAL LEVEL. *Journal of Safety Research*, 34(2), 189-197

[26] UNITED STATES BUREAU OF LABOR STATISTICS (2013),An analysis of fatal occupational injuries at road construction sites, 2003–2010,ARTICLE

[27] World Health Organisation (2013) Global status report on road safety—*Supporting a decade of action*,Geneva,Switzerland: World Health Organisation

[28] International Federation of Red Cross and Red Crescent Societies (2007),Practical guide on road safety, Switzerland

[29] Stephen Pegula (2010), Fatal occupational injuries at road construction sites, *Monthly Labour Review Report*,pp 37

[30-46] Gokhan Arslan and Serkan Kivrak (2008) Safety and health practices in construction: an investigation among construction workers

[47] Rwanda Bureau of Standard (RS ISO39001:2012) *Road traffic safety management systems- Requirements with guidance for use*,Kigali,Rwanda: Rwanda Bureau of Standard

[48] Standards Australia (2009), AS 1742-3, *Manual of Uniform Traffic Control Devices, Part 3 – Traffic Control Devices for Works on Roads, and associated field guides*

[49] United States (2009) *Manual on Uniform Ttraffic Control Devices (MUTCD): MUTCD, original* Department of Transportation, 2013), http://mutcd.fhwa.dot.gov/kno_2009.htm

[50] Health and Safety Authority (2010) *Guidance for the Control and Management of Traffic at Road Works*

[51] Transport Scotland (2009) ,Chapter 8: Traffic signs manual, *Traffic Safety Measures and Signs for Road Works and Temporary Situations Part 1: Design*, London: TSO

[52] Michael Rose ,CFSIA RSP Aust, Manager Project Safety, VicRoads Major Projects(2012)” Evolution and innovation of safety controls at vicroads “,*ROADWORK SAFETY – INNOVATION AND FUTURE DIRECTIONS* , Melbourne 2012 [Online]. Available from:http://www.aapaq.org/15hs2012/PDF_PPT/24_AAPA2012HS_doc_Michael_Rose_Roadwork_Safety-Innovation_and_future_directions.pdf (Accessed:5 December 2013),pp 4

- [53] Abdelaziz Berrado, El-Miloudi El-Koursi, Abdelghani Cherkaoui and Moha Kaddour (2011), A FRAMEWORK FOR RISK MANAGEMENT IN RAILWAY SECTOR: APPLICATION TO ROAD-RAIL LEVEL CROSSINGS, *The Open Transportation Journal*, Volume 5, pp34-44
- [54] Health and Safety Executive (2007) Construction (Design and Management) Regulations-Approved Code of Practice, *Managing health and safety in construction*
- [55] International Organisation for Standardisation (2012), ISO:3100, *Risk management—Principles and guidelines*, Geneva, Switzerland:ISO
- [56] British Standards Institution (2007), BS OHSAS 18001 , *Occupational health and safety management systems - Requirements.*, London, UK: British Standards Institution
- [57] Rwanda Bureau of Standards (2008),RS ISO 9001, *Quality management systems - Requirements.* 2008, Kigali, Rwanda : Rwanda Bureau of Standards
- [58] Rwanda Bureau of Standards (2004), RS ISO 14001, *Environmental management systems — Requirements with guidance for use.* Kigali, Rwanda: Rwanda Bureau of Standards
- [59] British Standards Institution (2008), BS 18004, *Guide to achieving effective occupational health and safety performance.* London, UK: British Standards Institution
- [60] International labour Organization (ILO-2001) *Guidelines on occupational health and safety management systems ILO-OSH 2001.* Geneva: International Labour Office
- [61] International Labour Organisation, (2012). *Country Office Zimbabwe*: <http://www.ilo.org/public/english/region/afpro/harare/> Accessed 31 October 2013
- [62] ILO, (2010). *Guidelines on Occupational Safety and Health Management Systems(ILO-OSH 2001)*. SafeWork, ILO Geneva http://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/publication/wcms_1110496.pdf
- [63] International Labour Organisation, (2011). *OSH Management System; A tool for Continual Improvement.* International Labour Organisation, Turin International Organization of Employers, (2011). *Employers Confederation of Zimbabwe.* <http://www.ioe-emp.org/en/ioe-members/index.htm>. Accessed 31 October 2013
- [64] Alli, B. (2001). *Fundamental Principles of Occupational Health and Safety.* International Labour Office, Geneva
- [65] Government of Rwanda (2012) Ministry of Public Service, Labour, *Official Gazette n° Special of 25/05/2012 Kigali : Government of Rwanda.*
- [66] Johnson, R. B., Onwuegbuzie, A. J., & Turner, L. A. (2007) "TOWARD A DEFINITION OF MIXED METHODS RESEARCH" *Journal of Mixed Methods Research*, 1(2), Available

from: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.130.8292&rep=rep1&type=pdf>
[Accessed:15 December 2013] pp112–133.

[67] Creswell, J., & Plano Clark, V. (2007) "Designing and conducting mixed methods research"
Thousand Oaks, CA: Sage

[68] Colin Neville(2007)"Introduction to Research and Research Methods", *Effective learning service*, UK: BRARFORB UNIVERSITY. Available from:
<http://www.brad.ac.uk/management/media/management/els/Introduction-to-Research-and-Research-Methods.pdf> .(Accessed:15 December 2013)

[69] McKinney, K. (2011). *Quantitative analysis and reporting: Telling a story with numbers*. Assessment Institute, Chicago

[70] S. Rajasekar, P. Philominathan, V. Chinnathambi (2013),"RESEARCH METHODOLOGY", *Research methodology paper of Master of Philosophy (M.Phil.) course and Doctor of Philosophy (Ph.D.) course*. [online] .Available from:
<http://arxiv.org/pdf/physics/0601009.pdf> (Accessed:10December 2013),

[71] Leedy, P.D. (2005) *Practical research: Planning and design, 8th ed.*, Pearson Merille Prentice Hall, United States of America.

[72] Charles Teddlie and Fen Yu (2007)" Mixed Methods Sampling: A TYPOLOGY WITH EXAMPLES", *Journal of Mixed Methods Research*,1(1),January 2007[Online],Available from:
<http://sociologyofeuropa.unifi.it/upload/sub/documenti/Teddlie%20-%20Mixed%20Methods%20Sampling%20-%20A%20Typology%20With%20Examples.pdf>
(Accessed:16 December 2013),pp78.

[73] Chia-kuang Lee Yusmin Jaafar (2012) *Prioritisation of factors influencing safety performance on construction sites: A study based on grade seven(G 7) main contractors' perspective*.

Appendix

Research questionnaire for data collection

Highway construction projects continue to be one of the most dangerous professions. Accidents and diseases occur on worksite day to day and result in losing work temporarily or permanently, but there is limited information available concerning such incidents.

We are conducting an academic research on factors impacting on health and safety incidence on highway projects sites in Rwanda.

Dear respondent, my name is **SIBOMANA Mathias, a Student at University of Rwanda, College of Science and Technology (Former KIST), Master's program in Transportation Engineering and Economics.**

My research topic is:” **Effective Health and Safety Practices on Highway Project Sites**”.

This questionnaire survey has been developed for academic purpose only to assess the attitude towards health and safety issues within your company and what can be done to improve them. It has been designed as one of the tools for data collection. All results will be compiled for analysis and no individual results will be kept. It is worth noting that the researcher is not looking for right or wrong answers to these questions, rather he wants to know what your thoughts are about the health and safety culture of your company.

In this regard, the researcher is kindly requesting you to respond to the questions laid down to the best of your knowledge.

Part I: Respondents profile

Name of your company.....

Please tick one box as appropriate to indicate the level of your contracting company

Main contractor

Subcontractor

Your position in the company.....

Tick one box to indicate your experience at work :

Less than 5 years

5-9 years

10-19 Years

20 years and above

Part II. Questions for specific research information

II.1 Close-ended questions

Question1

In order to gauge the nature of health and safety incidence in highway projects, please kindly consider your experiences and rate the extent to which the following important components feature on health and safety in transport project is considered and implemented in Rwanda.

Tick:

- **Very high** to indicate that the component feature is **always** considered;
- **High** to indicate that the component feature is **usually** considered;
- **Low** to indicate that the component feature is **sometimes** considered; and
- **Very low** to indicate that the component feature is **rarely** considered.

A. Identification and analysis of health and safety hazards at the work site.

Evaluation of all equipments, machinery, work areas and work processes to identify and analyze all potential sources of harm to workers.

Please tick one box only

- Very highly considered
- Level of consideration is high
- Low level of consideration
- Very low level of consideration

B. Control measures to eliminate or reduce the risks to workers from hazards

Control measures include: engineering controls, administrative controls and personal protective equipment.

Please tick one box only

- Very highly considered
- Level of consideration is high
- Low level of consideration
- Very low level of consideration

C. Clearly demonstrated management commitment, and written company policy

Commitment from senior management is essential for the health and safety management system to be effective.

Please tick one box only

- Very highly considered
- Level of consideration is high
- Low level of consideration
- Very low level of consideration

D. Work competency and training

Workers need to know how to do their jobs safely and without risks to their health; new and/or young workers need special attention.

Please tick one box only

- Very highly considered
- Level of consideration is high
- Low level of consideration
- Very low level of consideration

E. Inspection programme

Inspections are an opportunity to identify any hazards that have not been recognized before, and to check that existing hazard controls are working.

Please tick one box only

- Very highly considered
- Level of consideration is high
- Low level of consideration
- Very low level of consideration

F. Emergency response planning

Emergencies could include natural or manmade disasters as well as health emergencies or injuries. Effective plans need to be in place to address all potential emergencies.

Please tick one box only

- Very highly considered
- Level of consideration is high
- Low level of consideration
- Very low level of consideration

G. Incidents reporting and investigation

When an incident occurs at any work place, it is important to investigate so that any inadequately controlled hazards are identified and controlled and processes can be put in place to prevent the recurrence of similar incidents.

Please tick one box only

- Very highly considered
- Level of consideration is high
- Low level of consideration
- Very low level of consideration

H. Management system administration

Program administration ensures that all parts of health and safety management system are properly looked after and communicated to employees.

Please tick one box only

- Very highly considered
- Level of consideration is high

Low level of consideration

Very low level of consideration

Question 2

By considering your role and the nature of the work you do, please kindly indicate the areas of highway projects which you believe are prone to high safety incidence.

Please tick one box in each row and indicate **Very High Level** of proneness to health and safety incidence, **High Level**, **Low level** or **Very low level** to show whether incidence:

- **always** occurs;
- **usually** occurs;
- **sometimes** occurs;
- **rarely** occurs respectively.

Area of highway project work that you believe are prone to high safety incidence	Very high level of proneness to health and safety incidence	High level of proneness to health and safety incidence	Low level of proneness to health and safety incidence	Very low level of proneness to health and safety incidence
Excavation				
Protection of power line and electrical equipments on sites				
Driving plant on work site				
Use of explosives				
Earth moving				
Working in confined space				
Working in, over ,or adjacent to water				
Controlling noise				
Controlling dust				
Work site signage				

Question 3

By drawing on your experiences of transport projects, please kindly indicate the level of impact the following factors have on health and safety on transport projects. Please kindly tick one box

in each row and indicate Very high Level of impact on health and safety, High level, Low level or Very low level to show whether each factor:

- **Always** impacts on health and safety
- **Usually** impacts on health and safety
- **Sometimes** impacts on health and safety, or
- **Rarely** impacts on health and safety respectively.

Factors that impact on health and safety on transport project	Very High level of impact	High Level of impact	Low Level of impact	Very low level of impact
Working methods and methodologies in project work				
Materials and equipment used in projects				
Lack or inadequate training and inductions on health and safety				
Inadequate skills and competencies of project staff/workers				
Absence of formal Health and Safety Management Processes and Systems				
Government's limited capacity in providing appropriate legal framework and inspectorate personnel to enforce compliance				
High cost involved in providing and maintaining health and safety risk control measures				
Lack of concern towards health and safety issues in project by the clients				
Lack of top management commitment to health and safety				

Question 4

Which qualified personnel that your company employs to deal with health and safety issues on highway project sites?

Please tick appropriate boxes

- Project Manager
- Health and Safety Engineer
- Health and Safety Officer
- Health and Safety Representatives

Other
(specify).....
.....
.....
.....

Question 5

Do you have documented procedure in your company on raising awareness to workers about the best practice of health and safety on work site?

Please tick one box only

- Yes No

If yes, list main tools stated in the procedure for use in raising awareness to workers

.....
.....
.....
.....
.....
.....
.....

Question 6

What are your current practices to eliminate or reduce the health and safety incidence at your work site?

Please tick relevant boxes

Regular health and safety education (training) on health and safety procedure

Setting clear responsibilities to workers about health and safety

Accountability

Consultation between workers about health and safety issues

Effective communication

Conducting health and safety audits

Other (Specify)

.....
.....
.....

Question 7

Please kindly indicate the level of criticality of the health and safety issues listed by ticking:

- **Very critical** to indicate that critical success factors to effective health and safety in highway projects in your company are **always** considered;
- **Critical** to indicate that critical success factors to effective health and safety in highway projects in your company are **usually** considered;
- **Fairly Critical** to indicate that critical success factors to effective health and safety in highway projects in your company are **sometimes** considered;
- **Low level of criticality** to indicate that critical success factors to effective health and safety in highway projects in your company are **rarely** considered.

Critical success factors to effective health and safety in highway projects in your company	Very critical	Critical	Fairly Critical	Low level of criticality
Management activities on site comprising: - health and safety inspection, - health and safety meeting, - complying with health and safety regulation, - enforcement, - safety training and education, - health and safety communication				
Consideration of health and safety during tendering process by allocating effective resources				
Incentives either monetary, non monetary or disciplinary action				
Formulation of health and safety policies				
Personnel attitudes towards health and safety				
Process of identifying hazards and assessing risks				
Risk response and risk management system				
Adequate personal protective equipment aligned with the nature of work				

Question 8

Please tick all boxes that are major elements of effective health and safety in highway projects

Management leadership and organizational commitment

- Hazard control
- Highway work site inspections
- Worker competency and training
- Incident investigation and reporting
- Emergency response planning

Other (specify)

.....

.....

.....

.....

.....

Question 9

Which proofs/indicators do you have in your company showing the level of performance of Health and Safety Management System for highway projects that you are executing?

Please, tick boxes corresponding to applicable indicators in your company

- Written management commitment about health and safety practices
- Active health and safety committee
- Health and safety internal and external audit reports
- Health and safety evaluation report
- Accountability process
- Site accidents records and reports
- Health and safety procedure
- Training records
- Review program of health and safety guidelines

Risk assessment report

Other (specify)

.....
.....
.....

II.2 Open question

Which performance indicators would you set to ensure that traffic is effectively managed on your highway project site?

Please, specify

.....
.....
.....
.....

Thank you for your time and cooperation

Researcher: SIBOMANA Mathias (M_{SC} Student, CST).