PROJECT ID: CE/

" *COMPLIANCE OF HIGHWAY WORKERS WITH THE OCCUPATIONAL HEALTH AND SAFETY (OHS) POLICIES OF RWANDA* "

A DISSERTATION

Submitted by

By UKWIZAGIRA Jean Paul

Reg. NO: 221028215

Under the guidance of

Ass. Prof. OLUWASEUN SUNDAY DOSUMU and

Mr. Camille NYAMIHANA

Submitted in partial fulfillment of the requirement for degree of

MASTER OF SCIENCE IN HIGHWAY ENGINEERING AND MANAGEMENT

July 2025

COLLEGE OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING

P.O. Box: 3900 Kigali, Rwanda.

DEPARTMENTOF CIVIL ENVIRONMENTAL AND GEOMATICS

ENGINEERING (CEGE)

DECLARATION

I, Jean Paul UKWIZAGIRA with Reg. No. 221028215, from University of Rwanda College of Science and Technology, School of Engineering; Department of Civil, Environmental and Geomatics Engineering, following studies of Master of Science in Highway Engineering and Management Program, hereby declare that this dissertation is my own work and has never been submitted for any academic award in the University of Rwanda or any other University or Institution or anyone else where for the same purpose.

Students Names: Jean Paul UKWIZAGIRA

Ref. Number: 221028215

Signature: 

Date. 20 July 2025

CERTIFICATION

This dissertation has been submitted with approval from the University supervisor.

Main Supervisor Names: Ass. Prof. OLUWASEUN SUNDAY DOSUMU

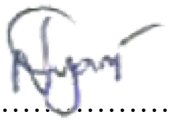
Co-Supervisor Names: Mr. Camille NYAMIHANA

Department of Civil, Environmental and Geomatics Engineering

University of Rwanda College of science and Technology

P.O. BOX 3900, KIGALI

Supervisor's Signature:  ..... Date: 28/08/2025.....

Co-Supervisor's signature:  ……. Date: 28/08/2025.....

ABSTRACT

Highway construction remains one of the most hazardous sectors globally, with nearly 2 million work-related deaths annually [1]. In Rwanda, the construction industry accounts for approximately 18% of occupational hazard exposures. This study assessed the compliance of highway workers with Occupational Health and Safety (OHS) policies on major international donor-funded projects, specifically the Rwanda Feeder Roads Development Project (RFDP), the Lake Victoria Transport Program (LVTP), and the Huye–Kibeho road project. A structured questionnaire was administered to 140 respondents, including contractors, government agencies employers, consultants and site workers among others. The findings revealed a slight level of compliance with Rwanda's OHS policies on donor-funded road projects with a wellness level of 53% (corresponding to an overall Mean of 3.51). The relatively low percentage was primarily attributed to poor first-aid and hygiene standards, insufficient trainings on OHS, and inadequate medical cost coverage. In contrast, respondents demonstrated a higher level of awareness, with 84% understanding the benefits of complying with OHS policies, 87% recognizing the benefits of complying with OHS policies, 84% acknowledging the potential consequences of non-compliance, and 89% agreeing with the proposed mechanisms and strategies aimed at improving compliance with OHS policies. The study concludes that while Rwanda's OHS policies are in place and broadly acknowledged, their implementation on donor-funded road projects remains inadequate. To improve compliance, the study recommends: (1) regular and structured OHS training programs; (2) strict government agencies supervision and application of penalties for repeated violations for non-complying contractors; (3) improved medical coverage and compensation for both permanent and casual workers; (5) enhanced worker participation in safety management; and (6) stronger collaboration among contractors, consultants, and government agencies. Improving oversight, and aligning national enforcement with international safety standards to build trust with donors and safeguard workers is very critical for advancing infrastructure development while ensuring occupational safety in Rwanda.

TABLE OF CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

C155: Convention No. 155 on Occupational Health and Safety Convention of 1981

GIIP: Good International Industry Practice

GoR: Government of Rwanda

IFC: International Finance Corporation

ILO: International Labor Organization

ISO: International Organization for Standardization

LVTP: Lake Victoria Transport Project

MIFOTRA: Ministry of Public Service and Labor, Rwanda

MSDS: Material Safety Data Sheet

NST: National Strategy for Transformation

OHS: Occupational Health and Safety

OHSMS: Occupational Health and Safety Management Systems

PPE: Personal Protective Equipment

RFDP: Rwanda Feeder Roads Development Project

RTDA: Rwanda Transport Development Agency

SDGs: Sustainable Development Goals

UN: United Nations

EXIM Bank: Export and Import Bank

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENT

First and foremost, I am profoundly grateful to Almighty God, whose blessings, guidance, and strength have been my constant source of inspiration throughout my academic journey. Without his grace, the successful completion of this dissertation would not have been possible.

I wish to extend my deepest appreciation to my supervisor and co-supervisor, Oluwaseun Sunday DOSUMU and Camille NYAMIHANA, for their invaluable guidance, encouragement, and commitment throughout this research. Your insightful feedback, patience, and mentorship have not only shaped this dissertation but have also contributed immensely to my academic growth and professional development. I remain deeply indebted to you for your unwavering support.

This work would not have been possible without the cooperation of the research participants/respondents, I wish to sincerely thank all of them for taking time out of their busy schedules to share valuable information, experiences, and perspectives that formed the backbone of this study. Your contribution is genuinely appreciated.

Special thanks also go to my colleagues and classmates for their companionship, stimulating discussions, and moral support during the course of my studies. The exchange of ideas, shared challenges, and mutual encouragement greatly enriched both my academic experience and personal life.

Lastly, I would like to express my sincere appreciation to my beloved family and friends – words cannot adequately express my gratitude. To my parents, thank you for your unconditional love, prayers, sacrifices, and constant encouragement which laid the foundation for my educational pursuits. To my siblings and relatives, your moral support and motivation have been an endless source of strength. To my friends, whose patience, understanding, and encouragement helped me to maintain balance during stressful period. This achievement is as much yours as mine.

DEDICTION

This dissertation is dedicated with deepest gratitude to my beloved parents, who laid the foundation of my academic journey through their unwavering support, sacrifice and encouragement. Your belief in me has been the source of my strength.

To my spouse and children, thank you for your patience, love and understanding during the countless hours I spent away from you in the pursuit of this goal. Your support means everything.

I also dedicate this work to my supervisors and Lecturers whose guidance and knowledge shaped the quality of this dissertation. Your insights have been of paramount interest.

Lastly, to all those who continue to strive for knowledge against all odds, may this work serves as a testament to the power of perseverance and faith.

CHAPTER 1. INTRODUCTION

1.1. Background to the study

Construction industry is globally recognized as one of the most hazardous sectors, significantly contributing to occupational accidents and fatalities. The industry accounts 30% of all occupational fatal injuries, where at least 108,000 workers die each year on site. Industrialized countries have shown that construction workers are 3 to 4 times more likely to dies at work than any other worker, where the number is 3 to 6 times greater in developing countries [2]. Highway construction workers operate in some of the most hazardous environments within the construction industry. Unlike workers on enclosed or static building sites, highway workers are constantly exposed to three primary types of hazards: physical, chemical and ergonomic hazards [3]. They include: fast-moving vehicles, heavy machinery, shifting site layouts, emissions such as Volatile Organic Compounds (VOCs), Particulate matter, and Nitrogen dioxide among others [4], etc. Their proximity to live traffic zones, limited physical barriers, and often long work hours significantly heighten the risk of accidents, injuries, and even fatalities. These factors make occupational safety not just a legal requirement but a critical aspect of daily operations in road infrastructure development. [5]. This makes highway construction a unique and particularly high-risk work environment that requires specific research focus.

A wide range of global research points to comparable challenges in Occupational Health and Safety compliance. Across the EU, there were 1506 non-fatal and 1.66 fatal accidents per 100,000 employed people in 2022 due to non-compliance of OHS guidelines. The construction sector only accounts for 22.9% (a quarter) of all fatal accidents at work, the transportation sector constitutes 15.6%., manufacturing represents (15.2%), while the remaining industries (forestry, agriculture, and fishing) amount to 11.8% [6]. Therefore, different countries have strengthened the implementation of standards and guidelines existing in the 1992 Directive 92/57/EEC which aims to establish minimum Safety and Health requirements for construction sites [7]. For instance, countries like the UK and Germany have implemented advanced cooperative intelligent transport systems (C-ITS) on highways to warn approaching vehicles of construction zones in real time, covering about 8,600 and 13,000 km of road in Germany alone to enhance worker safety [8]. Even though there was a 15% reduction in fatal injuries in the US highway sector from 2011 to 2023, the industry still contributes an unacceptably high death rate compared to other sectors – with 88 fatalities reported in 2023 alone [9]. Furthermore, in 2022, eight (8) US construction companies were heavily fined hundreds of thousands of dollars, with one surpassing $1 million, due to safety hazards, mainly fall from heights and failure to provide PPEs [10]. In Ecuador, the construction and manufacturing sectors account for 17.47% and 26.15%, respectively, of all fatal injuries in 2018 [11]. Road works accounted for 52% of accident cases in Indonesia, where collisions with construction machinery was the frequent safety hazard [12]. In 2022, South Korea introduced a law to address safety hazards and punish companies in charge of the ongoing construction activities if a worker is killed during the job. However, in 2023, the South Korea's labor ministry showed that the construction sector accounted for nearly half of 598 industrial fatalities. Furthermore, in 2025 South Korea has also experienced multiple deadly highway or bridge construction accidents, including collapses in Cheonan and Anseong, resulting in at least 7 fatalities and 12 injuries [13].

A persistent pattern of difficulties and slow advancements in Occupational Health and Safety (OHS) compliance has been widely documented in African countries. Common challenges include the lack of personal protective equipment (PPE), inadequate training, low worker awareness, and weak enforcement mechanisms. For example, an industry analysis from September 2024 emphasizes that motor vehicle accidents—specifically vehicles intruding into live work zones—are responsible for about 40% of all accidents in South Africa's highway construction sector, accounting for nearly half of work-related fatalities [14]. Moreover, studies in Kenya's construction sector found that although safety laws exist, many workers were unaware of them, and most sites failed to meet minimum safety standards due to insufficient monitoring and cost-cutting practices [15]. OHS practices have been set up to maintain workers' overall well-being during construction projects in Uganda, after the suspension of two road projects by the World Bank in 2015 – North Eastern Road Corridor Asset Management Project and the Albertine Region Sustainable Development Project – due to safety shortcomings at highway works, including unsafe interactions between workers and traffic, poor handling of materials, and inadequately maintained equipment [16].

In Rwanda, infrastructure development has become a key component of national growth strategies, as articulated in Vision 2050 and the National Strategy for Transformation (NST) [17]. Massive investments are currently underway in road infrastructure through projects, such as the Huye–Kibeho Road Project, the Rwanda Feeder Roads Development Project (FRDP), and the Lake Victoria Transport Program. These projects aim to enhance rural connectivity, regional integration, and socio-economic development. While these efforts are vital for national progress, they also heighten the risk of occupational injuries among highway workers due to increased exposure to unsafe working conditions. From numerous studies, it was found that 85.71% of workers do not conduct training in the road safety construction sites, the level of accidents tolled up to 85.71%, while the lack of PPE on site accounted for 42.86% [18].

Although Rwanda has a relatively robust legal framework, including the National Occupational Health and Safety Policy (2014) and Labor Law N°66/2018, actual implementation remains inconsistent [17]. Research by local scholars and institutions like the University of Rwanda and MIFOTRA has shown that safety practices on construction sites are unevenly enforced. Workers frequently lack basic safety training, PPE is often missing or misused, and data collection on workplace incidents remains insufficient [19]. Additionally, informal employment practices, especially in highway construction, further exacerbate the risks due to low worker bargaining power, irregular inspections, and weak accountability. Despite these challenges, limited research focuses specifically on highway construction in Rwanda, leaving a critical knowledge gap. This study addressed that gap by assessing the compliance of highway construction workers with national OHS policies. It focused on providing a well-developed questionnaire tailored to the context of highway workers. It details how the questionnaire was developed increasing the relevance of its findings on behaviors, attitudes, and challenges faced by highway workers in relation to occupational safety policies.

1.2. Problem statement

Several studies have explored Occupational Health and Safety (OHS) in construction, but very few have focused specifically on road construction workers in Rwanda. A study conducted by [18] investigated OHS practices on a project fully funded by the Government of Rwanda (GoR) road project construction sites in Kigali; where he found that while awareness of safety protocols existed, actual compliance among workers

was low due to insufficient training, lack of supervision, and limited availability of safety equipment. Similarly, [19] examined compliance with OHS regulations among construction workers in Rwanda, highlighting that despite existing policies, many workers failed to consistently adhere to safety standards because of inadequate enforcement, low risk perception, and insufficient safety culture on sites. This noncompliance contributes significantly to workplace accidents and injuries in the sector. Given the absence of a clearly defined construction sub-sector—such as building, road, or civil works—the individual's work appears to span across the construction industry in a general manner. The lack of specificity limits the ability to identify and recommend best practices grounded in the unique activities and risk profiles of a particular construction domain. Therefore, it allows for an examination of occupational health and safety (OHS) practices under international standards and donor requirements, which are often more stringent and closely aligned with global best practices such as those outlined by the World Bank, IFC, and ISO standards.

Globally, numerous international studies highlight similar OHS compliance challenges. Noncompliance to OHS in Kuwait's construction industry was accountable for 29-34% of all injuries which occurred between 2014 and 2016. In addition, it led to different fatalities, work suspensions, and penalties on some ongoing projects [20]. Al-Naser & Al-Tabtabia (2024) also noted that low safety cultures contributed heavily to workers' fatality rates in various countries: 4.3% per 100,000 workers in Poland, 16.8 in Estonia and 2.6 in Sweden. Moreover, during the year 1998, it was reported that the average cost per injury was estimated at $189 in Lebanon, where the construction industry accounts for 43% of work injuries. In Indonesia, proper OHS implementation in road construction improved productivity and reduced accidents [21]. In Malaysia, it was found that the most common noncompliance resulted from non-fulfillment of employers' duties to their employees [22]. Furthermore, poor safety culture, limited training, and weak enforcement were key factors in high accident rates [23]. While poor safety compliance led to more incidents, cost overruns, and delays in Pakistan [24]. Internationally, developing countries in Asia and Africa, including Rwanda, struggle with OHS due to weak institutions and poor monitoring [25].

While these studies provide valuable insights into OHS conditions, there remains a critical gap in research related to road and highway construction sectors in Rwanda. Despite the country's growing infrastructure development, no in-depth study has been conducted to assess how well highway construction workers comply with OHS policies, or how frequently accidents occur due to non-compliance. This absence of data not only limits effective enforcement but also blocks efforts by government agencies like the Rwanda Transport Development Agency (RTDA) and the Ministry of Labor to develop targeted interventions.

A particularly urgent concern lies in road infrastructure projects funded by Development Partners (DPs) and Multinational Banks, which strictly require compliance with Occupational Health and Safety (OHS) standards. Failure to meet these standards can result in severe consequences such as temporary suspension or even permanent closure of the projects. This situation further underscores the importance of addressing the compliance gap in these donor-funded projects, which remain under-researched.

Therefore, this study examined the level of compliance with OHS policies among road construction workers in Rwanda, specifically focusing on projects funded by international donors. It seeks to determine the causes of non-compliance, suggest actionable strategies to promote a safer and more productive working environment, and ensure continued trust and confidence from international donors.

1.3. Main Objective

To assess the compliance of highway workers with Rwanda's Occupational Health and Safety policies on donor-funded road projects: Rwanda Feeder Roads Development Project (RFDP), Lake Victoria Transport Project (LVTP), and Huye–Kibeho road project

1.4. Specific Objective

The aim of the study is to investigate the compliance of highway workers with the Occupational Health and Safety (OHS) policy of Rwanda with a view to improving the health and safety record of construction sites as well as the productivity of the construction industry.

1. To assess the level of compliance of highway workers with Rwanda's Occupational Health and Safety (OHS) policy
2. To examine the benefits of complying with the Occupational Health and Safety (OHS) policy.
3. To identify the risks and consequences associated with non-compliance with OHS policy in road construction projects.
4. To recommend effective strategies and mechanisms for improving compliance with OHS policy in Rwanda's highway construction sector.

1.5. Justification

Ensuring Occupational Health and Safety (OHS) compliance is fundamental to safeguarding the well-being of workers and promoting efficiency within the construction industry. In Rwanda, despite the existence of national OHS regulations, their practical enforcement—particularly in government-funded road infrastructure projects—remains ambiguous. This study is therefore timely and necessary, as it aims to not only evaluate the level of compliance but also explore the factors influencing safety behavior and institutional accountability.

This study is justified by several key factors:

High rate of accidents in highway construction projects

The construction sector in Rwanda, like in many developing countries, experiences frequent workplace accidents and fatalities, making it one of the most hazardous industries. Contributing factors include inadequate safety training, limited use of protective equipment, and weak enforcement of safety regulations. These risks not only threaten workers' lives but also hinder productivity and economic growth, highlighting the urgent need for improved safety measures in the industry.

To examine the benefits of complying with OHS policy

While OHS compliance is known to reduce injuries and delays, these benefits are rarely documented in the Rwandan context. Highlighting these positive outcomes will support the case for stronger enforcement, raise awareness among contractors and workers, and promote a safety-first culture that can improve overall project efficiency and workforce morale.

Research gap

Previous studies on OHS compliance in Rwanda's construction sector did not prioritize projects funded by international donors such as the World Bank, which impose strict safety standards. They also lacked engagement with key implementers like RTDA and contractor safeguard officers. This limited scope creates a gap in understanding how well OHS policies are enforced in high-stakes projects. This study addresses that gap by focusing on donor-funded projects to better assess compliance and enforcement challenges.

Assess the compliance level of highway construction workers with Rwanda's OHS policy

There is currently a lack of empirical evidence regarding safety practices on publicly projects funded by international funders that require high and international level (OHS) practice. By assessing compliance across selected initiatives such as the RFDP, LVTP, and the Huye–Kibeho road project, this study provides a data-driven basis for evaluating adherence to safety standards.

Gap Fill-Up and Recommendations

This study addresses the gap in Rwanda's highway construction sector by assessing employers' knowledge and compliance with Occupational Health and Safety (OHS) regulations. While policies exist, enforcement is weak. By examining worker behavior and contractor practices, the study proposes practical strategies to strengthen compliance. The findings aim to support better enforcement and align with the safety standards of specifically international development partners, such as the World Bank and others, to ensure safer, more effective road construction projects.

1.6. Scope of the research study

This study assessed the compliance of highway construction workers with Occupational Health and Safety (OHS) policies in Rwanda, focusing on sensitive projects funded by international donors. It examines the use of PPE, safety training, and enforcement measures on-site. The findings aim to support policymakers and project managers in promoting international best OHS practices that will help attract more diverse international donors.

1.6.1. Content Scope

This study examined the implementation and compliance of Occupational Health and Safety (OHS) policies among highway workers on key road construction projects in Rwanda, including the RFDP, Huye–Kibeho road, and LVTP. These projects, funded by the World Bank and EXIM China bank managed by the Rwanda Transport Development Agency (RTDA), serve as the focus due to RTDA's central role in enforcing national and international OHS standards. The research analyzes the behaviors and practices of RTDA staff, contractors' managers, and site workers, as they are directly responsible for ensuring OHS compliance through supervision, decision-making, and on-site execution. Additionally, the study explores the impacts of non-compliance, such as injuries, project delays, cost overruns, and reduced productivity which are significant risks to project success and worker well-being. Highlighting the importance of strict adherence to OHS policies for worker safety and project success.

1.6.2. The geographical scope

The geographical scope of this study was limited to Rwanda, focusing specifically on road construction projects funded by the World Bank Group and EXIM china bank. The study targets national roads and

district class one roads because these are among the most strategically significant and heavily used roads, often involving large-scale construction activities that pose higher occupational health and safety risks. Moreover, these roads are generally prioritized for international funding and are subject to careful environmental and social safeguard standards, making them suitable for evaluating OHS compliance. The study will involve construction companies active in Rwanda because they are the direct implementers of road works. Focusing on EXIM china bank and World Bank-funded projects is intentional, as these projects operate under strict OHS frameworks and international best practices, offering a structured environment to assess compliance. Key respondents will include contractor project managers, consultant experts in environment and social safeguards, RTDA staff overseeing project implementation, contractor foremen, and members of the Grievance Redress Committees (GRC) representing both contractors and communities. This diverse group of respondents is essential for gaining a comprehensive understanding of OHS policy compliance from planning to implementation, as well as the effectiveness of accountability mechanisms on site.

1.7. Significance of the Study

This study on the compliance of highway workers with Occupational Health and Safety (OHS) policies in Rwanda is significant for multiple stakeholders. For the researcher, community policymaker and the University of Rwanda, it contributes to academic knowledge and supports research on labor safety in infrastructure development especially in highway roads construction. For policymakers and agencies like RTDA, it offers evidence-based recommendations to strengthen OHS enforcement on donor-funded road projects and other kinds of projects require safety. Emphasizing these donor-funded projects is crucial for maintaining the trust of existing international donors and positioning Rwanda to attract additional funding in the future by demonstrating adherence to global safety practices. The findings also benefit the wider community by promoting safer work environments and reinforcing Rwanda's reputation for meeting international safety standards.

1.7.1. To the Country in general

This study is of critical national importance as it addresses a major gap in Occupational Health and Safety (OHS) research within Rwanda's infrastructure sector, particularly regarding internationally funded projects. Such projects are often subject to stringent international standards and expectations, especially in relation to worker safety, transparency, and sustainable development. However, the absence of localized, sector-specific research means that existing OHS frameworks may fall short in aligning with these global requirements.

By focusing on highway workers and examining OHS conditions within the context of donor-funded projects, this study provides evidence that can directly inform policy and operational improvements. Enhancing OHS practices not only protects workers but also helps ensure compliance with international guidelines—strengthening Rwanda's reputation as a reliable and responsible partner for development cooperation.

A recent example is the temporary suspension of works under the Rwanda Feeder Roads Development Project (FRDP) in Gakenke District following a site accident. This incident highlights the real and immediate risks associated with inadequate safety measures on high-profile infrastructure projects. It

underscores the need for research-driven interventions that help prevent future occurrences, minimize delays, and maintain continuous project implementation.

Moreover, by generating reliable data and analysis, the study contributes to the broader goal of attracting and sustaining international support. Donors are more likely to invest in environments where safety standards are taken seriously and data-driven decisions are possible. The findings may also help build a culture of accountability, drive policy reform, and encourage the allocation of resources to underserved areas, ultimately supporting Rwanda's broader development goals.

1.7.2. To the Researcher

The study was significant to the researcher as it deepens their understanding of Occupational Health and Safety (OHS) practices within Rwanda's road construction sector. By carrying out this research, the researcher gained hands-on experience in field data collection, policy analysis, and evaluation of safety compliance in infrastructure projects. This contributed to their academic development and builds expertise in workplace safety, public infrastructure governance, and international donor project standards. The study also provides a valuable foundation for future research in OHS and labor rights in Rwanda and other developing contexts.

1.7.3. To the University of Rwanda

For the University of Rwanda, this study enriched the institution's research portfolio in the areas of occupational safety, infrastructure development, and public health. As a leading academic institution committed to producing practical and policy-relevant research, the findings supported teaching, learning, and further investigations in civil engineering, safety management, and labor studies. The study also informs curriculum development, support grant proposals, and enhance partnerships with stakeholders focused on infrastructure safety and sustainable development.

1.7.4. To the Community

The community benefited from this study through increased awareness of Occupational Health and Safety (OHS) practices on major road construction sites. By highlighting the importance of compliance with OHS standards, the study promotes safer working conditions for local laborers and helps prevent work-related injuries and fatalities. Safer worksites also reduce disruptions and hazards in surrounding communities, such as accidents or pollution. Moreover, the presence of well-managed, donor-funded projects boosts local confidence and encourages responsible development practices that improve public welfare.

1.7.5. To Policymakers

For policymakers, this study offers evidence-based insights into the level of compliance with Occupational Health and Safety (OHS) policies in donor-funded road construction projects in Rwanda. The findings help identify strengths and gaps in the current enforcement mechanisms and inform the development of more effective regulatory frameworks. This supports the creation of policies that ensure safer working environments, reduce accidents, and enhance productivity on infrastructure projects. Emphasizing these donor-funded projects is also crucial for maintaining the trust of existing international donors and attracting future investments by demonstrating Rwanda's commitment to global OHS standards.

CHAPTER 2. LITERATURE REVIEW

2.1.Overview of Occupational Health and Safety (OHS)

The field of practice and legislation known as "Occupational Health and Safety" (OHS) aims to safeguard the welfare, health, and safety of those who are employed or working. It covers a wide range of fields with the goal of preventing occupational diseases, injuries, and deaths, such as engineering, medicine, law, and behavioral sciences [26]. OHS's primary objective is to establish safe and healthy working conditions for employees, which will ultimately boost output and organizational effectiveness.

Preventing occupational illnesses and accidents, enhancing employees' physical and emotional well-being, and guaranteeing adherence to national and international labor norms are among OHS's goals. These goals are especially important in high-risk industries like highway construction, where employees are frequently subjected to a variety of risks, such as moving cars, large machinery, noise, dust, and working at heights or in inclement weather.

In the past, industrialization and the growing complexity of work environments have prompted changes in OHS. Early workplace regulations and labor movements were established as a result of the industrial revolution, which signaled a shift in the understanding of the necessity of worker protection. Worldwide institutions like the International Labor Organization (ILO) have been instrumental in establishing worldwide standards over time. One such standard is ILO Convention No. 155, which offers a foundation for national OHS policies and initiatives [27].

Several essential elements are usually present in an efficient OHS system. These consist of risk assessment and hazard identification, workplace inspections, safety education and training, personal protective equipment (PPE) use, incident reporting and investigation protocols, and health monitoring. By working together, these actions seek to create a proactive safety culture where hazards are controlled before they cause harm.

In the building and highway industries, the significance of OHS is particularly apparent. These sectors frequently feature dynamic, outdoor settings where numerous teams may operate concurrently and dangers might alter quickly. The requirement for rigorous adherence to OHS standards and ongoing worker training is highlighted by the fact that improper safety precautions in such situations can result in significant injuries or even fatalities.

The necessity of strong OHS systems is further supported by international norms. Organizations can improve employee safety, lower workplace dangers, and create safer working conditions by following standards like ISO 45001 [28].To assist nations and organizations in putting into practice successful OHS initiatives, the World Health Organization (WHO) and the ILO both provide recommendations and technical assistance.

In conclusion, OHS is essential to attaining sustainable development. OHS directly supports Sustainable Development Goal (SDG) 3—which emphasizes good health and well-being—and SDG 8—which encourages decent work and economic growth—by guaranteeing safe and healthy working conditions. In this sense, workplace safety is crucial to wider social and economic advancement in addition to being a compliance issue.

2.2. Theoretical Frameworks Related to Compliance and Workplace Safety

Theoretical frameworks collectively explain why workers comply—or fail to comply—with safety policies. Cognitive-behavioral models like the Theory of Planned Behavior, Health Belief Model, Social Cognitive Theory, and Behavior-Based Safety Theory highlight how beliefs, perceptions, and learning shape safety behavior. Accident causation models such as Reason's Swiss Cheese Model, Domino Theory, and Systems Theory emphasize that unsafe acts occur within layers of organizational, technical, and human factors. Compliance Theory, along with Safety Climate and Safety Culture Theory, links safety behavior to organizational norms, leadership, and enforcement. Meanwhile, Goal-Setting Theory and High Reliability Organization Theory show how clear objectives, resilience, and reliability practices drive consistent compliance. Finally, Risk Homeostasis Theory suggests that workers adjust their behavior based on perceived risk levels, which can either enhance or undermine safety. Together, these perspectives provide a holistic understanding that compliance is influenced by individual attitudes, organizational systems, and the broader safety culture.

2.2.1. Theory of Planned Behavior (TPB)

According to Icek Ajzen's Theory of Planned conduct, three factors—attitude toward the conduct, subjective norms, and perceived behavioral control—influence an individual's intentions, which in turn determine their behavior. TPB aids in the explanation of how employees' actual safety practices are influenced by their ideas about safety, their understanding of peer and supervisor expectations, and their confidence in their capacity to follow safety regulations. It is frequently used in organizational settings to forecast and comprehend compliance behavior.

2.2.2. Health Belief Model (HBM)

By concentrating on people's beliefs of the advantages and disadvantages of taking preventive action, the Health Belief Model helps to explain health-related behaviors. According to this theory, employees are more likely to follow safety procedures if they think they could get hurt, think that an accident would have serious repercussions, think that precautions are effective, and see minimal obstacles to doing so. When researching the use of personal protective equipment (PPE) and adherence to safety procedures, this model is particularly pertinent.

2.2.3. Reason's Swiss Cheese Model of Accident Causation

According to James Reason's Swiss Cheese Model, organizational defenses are represented by layers of Swiss cheese, with holes signifying flaws or shortcomings. When the gaps in several layers line up, a hazard can get past all barriers and cause accidents. This model highlights the fact that accidents are typically the consequence of a number of latent circumstances and active failures rather than a single failure. It is helpful for enhancing organizational safety culture and identifying systemic safety flaws.

2.2.4. Domino Theory of Accident Causation

The Domino Theory, which was developed by H.W. Heinrich, likens the cause of accidents to a series of falling dominoes. The five variables are accident, injury, unsafe behavior or situation, ancestry/social environment, and personal blame. The accident chain can be stopped by removing one domino, usually the dangerous behavior or circumstance. This conventional view, which serves as the foundation for many

safety training initiatives, emphasizes the significance of unsafe conditions and human conduct in workplace accidents.

2.2.5. Systems Theory

According to systems theory, people, procedures, tools, and the environment are all interconnected components that make up the workplace relationships inside the system are thought to be the cause of safety, and these relationships frequently break down after failures. By encouraging businesses to focus on system design, communication, and coordination for efficient safety management rather than individual behavior, this approach fosters a holistic view of safety.

2.2.6. Social Cognitive Theory

Self-efficacy, reciprocal determinism (the interplay of behavioral, environmental, and personal factors), and observational learning are all important components of Albert Bandura's Social Cognitive Theory. It aids in the explanation of how employees pick up safe or hazardous behaviors by watching others, how their confidence in their capacity to carry out safe behaviors influences compliance, and how the environment either encourages or discourages safety procedures.

2.2.7. Behavior-Based Safety (BBS) Theory

Behavior-Oriented Safety is an active strategy that emphasizes recognizing, monitoring, and rewarding safe conduct while discouraging risky activity. BBS, which has its roots in behavioral psychology, stresses the use of direct observation and feedback as instruments to enhance safety performance. It is predicated on the idea that risky habits account for the majority of accidents and that altering them can greatly lower the number of events.

2.2.8. Goal-Setting Theory

According to the Goal-Setting Theory, which was put out by Edwin Locke and Gary Latham, performance improves when clear, difficult goals are combined with constructive criticism. In the context of safety, employees' involvement and compliance with safety procedures typically improve when they are provided with attainable safety goals (such zero-accident targets) and receive regular monitoring and assistance. It also emphasizes how crucial motivation is for promoting safe behavior.

2.2.9. Risk Homeostasis Theory

This idea, which was first put forth by Gerald Wilde, contends that people have a threshold for risk tolerance. People may change their behavior to retain their desired level of risk when safety precautions are implemented; in certain cases, they may even take more risks because they feel safer. This theory highlights the necessity to take into account how individuals perceive and react to risk, challenging the notion that implementing more safety measures automatically leads to safer behavior.

2.2.10. High Reliability Organization (HRO) Theory

The focus of HRO Theory is on businesses that manage to keep accident rates low while operating in high-risk sectors, such as nuclear power, aviation, or construction. These firms are focused on possible failure, uphold a culture of continual learning, and value safety. This theory's application to highway construction

highlights the necessity of robust systems, constant training, and strong leadership in order to avoid catastrophic failures in hazardous work situations.

2.2.11. Compliance Theory (Deterrence and Normative Approaches)

The study of compliance theory investigates why people abide by laws and regulations. While the normative approach contends that people are more likely to comply when they feel that the rules are reasonable, fair, and in line with their values, the deterrence approach contends that people follow the rules in order to avoid punishment. This theory aids in the explanation of the efficacy of enforcement tools like inspections and fines in OHS as well as the significance of fostering a safety culture based on common values.

2.2.12. Safety Climate and Safety Culture Theories

While safety culture reflects the more profound, long-standing beliefs, customs, and practices around safety, safety climate refers to employees' opinions on how safety is regarded in their company at a specific moment in time. According to these beliefs, there are fewer incidents and greater adherence to safety standards in companies with strong safety cultures and climates. These attitudes and actions are shaped in large part by leadership, communication, and employee involvement.

2.3.Conceptual Framework

The conceptual framework of this study illustrates the relationship between OHS compliance and occupational health and safety outcomes in donor-funded road construction projects in Rwanda. OHS compliance is the independent variable, which includes elements such as adherence to safety protocols, availability and use of personal protective equipment (PPE), safety training, emergency preparedness, regular safety audits, and the presence of site-specific OHS officers.

These practices influence intervening variables, including worker behavior, hazard identification and mitigation, and organizational safety culture. These, in turn, affect the dependent variables, which are occupational health and safety outcomes—such as the number and severity of workplace accidents, incidence of work-related illnesses, worker productivity, and compliance with project timelines.

Moderating variables such as the level of project funding, the strictness of donor OHS guidelines, enforcement by supervising agencies (e.g., RTDA), and community and stakeholder engagement may either strengthen or weaken the link between OHS compliance and safety outcomes.

This framework provides a structured lens for assessing how well the implementation of OHS standards contributes to reducing occupational hazards and promoting safe working environments in Rwanda's infrastructure development sector.

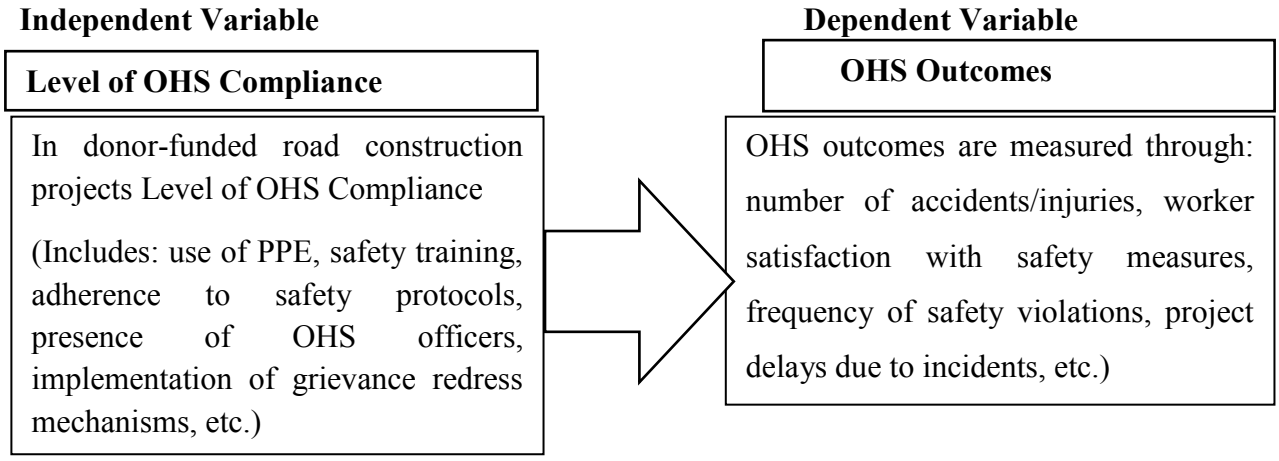


Figure 2-2 Conceptual framework

2.4.Global Perspectives on OHS in the Construction and Highway Sector

In terms of Occupational Health and Safety (OHS), the roadway and construction industries are among the most dangerous in the world. Because of the nature of the jobs—working at heights, operating heavy machinery, being near moving traffic, and functioning in unpredictable outside environments—these industries have high incidence of work-related injuries and fatalities. In order to safeguard employees, lower financial losses from accidents, and boost overall productivity, governments, international organizations, and industry stakeholders have made OHS a top priority. The figure below shows the various primary categories of OHS issues that have been found in infrastructure projects [29]

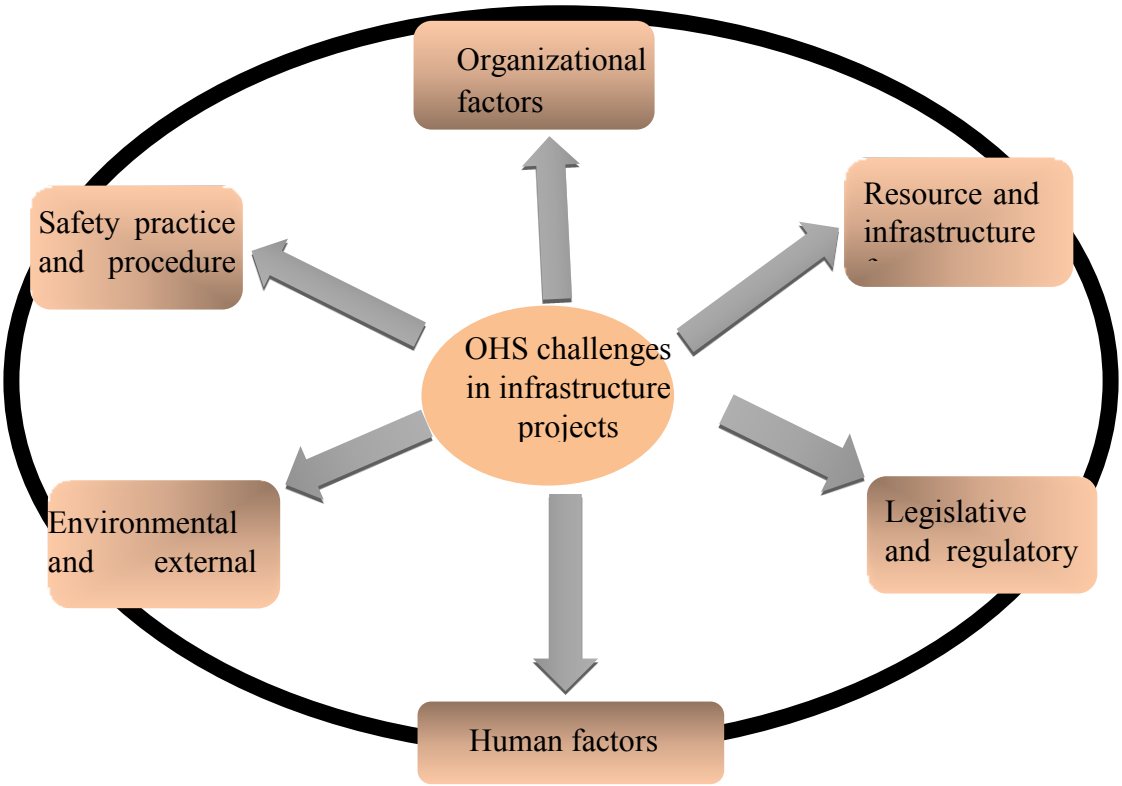


Figure 2-3 Main categories of the identified OHS challenges in infrastructure projects

On a global scale, the International Labor Organization (ILO) is instrumental in advancing OHS norms and procedures in the building sector. Convention No. 167 on Safety and Health in Construction, which specifies minimum safety standards for all construction activity, including road and highway building, is one of the conventions and recommendations created by the ILO. These recommendations have been incorporated into national laws in numerous nations, or they have served as models for enhancing their own safety laws. The International Social Security Association (ISSA) and the World Health Organization (WHO) also support worldwide initiatives by creating tools, policy briefs, and research that promote workplace safety in high-risk industries.

OHS in construction is frequently regulated in developed nations by extensive laws, robust enforcement systems, and a safety-oriented culture that permeates project design and execution. For example, nations like the United States, the United Kingdom, and Australia have put in place comprehensive safety standards, such as the Construction (Design and Management) laws in the United Kingdom and the Occupational Health and Safety Administration (OHSA) laws in the United States. Regular site inspections, incident reporting, worker training, and risk assessments are all mandated by these frameworks. Wearables, drones, and digital monitoring systems are examples of advanced safety technology that are being utilized more and more to avoid accidents and keep an eye on compliance.

On the other hand, putting in place efficient OHS systems in the building industry is frequently quite difficult for developing nations. These difficulties include a lack of safety training, inadequate enforcement of regulations, informal work practices, and few resources [30]. Many times, construction workers—particularly those engaged in highway projects—work without proper contracts or enough personal protective equipment (PPE), which makes them more susceptible to mishaps and health hazards. Furthermore, because of financial limitations and project schedules, infrastructure development is usually given precedence above safety, which compromises safety protocols.

However, the necessity of improving OHS in building is becoming more widely acknowledged, even in low- and middle-income nations. Raising awareness and enhancing safety outcomes have been made possible by donor-funded safety initiatives, capacity-building programs, and collaborations between international organizations and local governments. For instance, compliance with worldwide OHS standards is sometimes a requirement of funding for major international infrastructure projects, which leads to improvements in national practices. Furthermore, as part of the objectives of sustainable growth, regional initiatives like the African Union's Agenda 2063 place a strong emphasis on the building of safe and inclusive infrastructure.

All things considered, the global viewpoint on OHS in the transportation and construction industry emphasizes how crucial it is to align local implementation methods with worldwide norms. Even while there has been improvement, particularly in raising awareness and developing policies, many areas still struggle with the regular use of safety procedures. To ensure the safety and well-being of highway workers, nations like Rwanda must adapt solutions to local conditions while learning from international best practices.

2.5.OHS Policies and Regulations in Rwanda

The table below summarizes the key Occupational Health and Safety (OHS) policies and regulations in Rwanda, particularly relevant to workers, including those in highway construction and maintenance [31].

Table 2-1 Occupational Health and Safety policies in Rwanda

Policy/Regulation	Description	Key Provisions	Responsible Authority
Labor Law (Law N° 66/2018 of 30/08/2018 Regulating Labor in Rwanda)	The primary legal framework for employment and OSH in Rwanda.	- Employers must ensure a safe working environment. - Obligation to provide PPE (Personal Protective Equipment). - Training on health and safety. - Reporting and compensation for workplace accidents.	Ministry of Public Service and Labour (MIFOTRA)
Ministerial Order No 02/19.20 of 17/10/2012	Governs general OSH standards.	- Defines risk assessment requirements. - Describes measures for accident prevention. - Lists roles of employers and workers. - Addresses first aid and hygiene standards.	MIFOTRA
Ministerial Order No 04/MIFOTRA/2013	Focuses on workplace safety and health committees.	- Requires formation of OSH committees in companies with more than 20 workers. - Committees must monitor compliance and promote awareness.	MIFOTRA
National OSH Policy (2014)	Provides strategic guidance for improving OSH across sectors.	- Sets out national OSH goals and strategies. - Emphasizes capacity building and enforcement. - Focus on high-risk sectors including construction.	MIFOTRA and Rwanda Labour Inspectorate
Construction Code of Practice (Rwanda Standards Board)	Technical standards for safety in construction.	- Specifies safety measures for construction sites. - Guidelines on scaffolding, signage, and protective gear.	Rwanda Standards Board (RSB)

		- Site supervision and hazard control procedures.	
Rwanda Social Security Board (RSSB) Work Injury Insurance	Ensures compensation for work-related injuries.	- Mandatory enrollment by employers. - Compensation for accidents, disability, or death. - Medical cost coverage.	RSSB

2.6. World Bank Occupational Health and Safety Standards in Infrastructure Projects

In donor-funded highway projects, particularly those financed by the Multi National Bank institutions, compliance with Occupational Health and Safety (OHS) standards is not optional—it is a binding requirement outlined in the Environmental and Social Framework (ESF), especially Environmental and Social Standard: Labor and Working Conditions [32]. These standards emphasize hazard identification, risk assessment, emergency preparedness, access to grievance redress mechanisms, and continuous worker engagement. Contractors are expected to develop and implement site-specific Occupational Health and Safety Management Plans (OHSMPs), ensure the provision and use of PPE, conduct regular training, and document safety incidents. Importantly, in Rwanda's FRDP and LVTP, the World Bank OHS standards were the primary guidelines governing site safety and compliance monitoring. Non-compliance in such projects can lead to severe consequences, including funding suspension, legal penalties, or project closure. Adherence to World Bank OHS standards not only safeguards workers but also enhances project transparency, long-term sustainability, and credibility in the eyes of international stakeholders (World Bank, 2021).

2.7. ISO 45001 Occupational Health and Safety Management Systems

ISO 45001 is the first international standard for Occupational Health and Safety Management Systems. It provides a systematic framework for identifying workplace hazards, reducing risks, and ensuring continuous improvement in safety performance. Key principles include leadership involvement, worker participation, risk-based thinking, legal compliance, and proactive hazard control. Unlike other standards, ISO 45001 integrates safety into organizational strategy rather than treating it as a stand-alone concern. In Rwanda, although not legally required, ISO 45001 is increasingly adopted in donor-funded projects to demonstrate alignment with global best practices. Its relevance in highway construction lies in its structured process for managing dynamic and high-risk environments, fostering a preventive culture, and ensuring accountability across all project phases.

2.8. Compliance Factors among Highway Workers

Highway workers' adherence to Occupational Health and Safety (OHS) policies is impacted by a variety of factors that can either help or impede that adherence. Awareness and training rank among the most important variables. Employees are more likely to follow safety procedures if they receive frequent training on OHS regulations, how to use equipment properly, and how to identify hazards. However, access to such training may be restricted in many poor countries, including Rwanda, particularly for temporary or casual workers.

The use and accessibility of personal protective equipment (PPE) is another important consideration. When companies regularly supply essential personal protective equipment (PPE), such as helmets, safety boots, reflective vests, gloves, and goggles, compliance tends to be higher. PPE may be misused or disregarded by employees because to discomfort, a lack of enforcement, or a lack of awareness of its significance. Regrettably, some companies may dismiss this duty because of financial considerations.

Mechanisms for enforcement and supervision are also quite important. Accountability is increased and compliance is improved through routine monitoring by labor inspectors, safety officials, or site supervisors. When there is little supervision or no formal safety committees, compliance with safety regulations frequently decreases [33].

Peer pressure and workplace culture also have an impact on compliance. Employees are more likely to adhere to safety procedures in settings where peers and management value and support safety. On the other hand, a culture that encourages carelessness, informality, or risk-taking may deter people from adhering to protocols.

Highway workers may also disregard safety precautions in order to fulfill deadlines or save their jobs due to financial strains and employment insecurity. This is especially important in the infrastructure and construction industries, since contracts are frequently output-driven and have short durations.

2.9. Challenges in Implementing OHS Policies in Developing Countries

Rwanda and other developing nations confront a number of practical and structural obstacles when implementing Occupational Health and Safety (OHS) regulations. These barriers reduce the efficacy of safety programs and raise workplace accident rates, especially in high-risk industries like highway maintenance and construction [34]. The following are the key challenges:

2.9.1. Limited Financial Resources

Budgets are tight for many governments and businesses in emerging nations. This has an impact on their capacity to spend money on OHS infrastructure, including the right tools, training courses, safety checks, and skilled workers. Small and medium-sized businesses (SMEs), which employ a large percentage of the workforce, frequently lack the funding necessary to put in place thorough OHS procedures.

2.9.2 .Low Awareness and Education Levels

A sizable section of the workforce could not have had any formal schooling or even the most basic occupational safety training. As a result, safety procedures are not well understood or given enough priority. Employees may not be aware of potential risks or know how to properly use safety equipment. In a similar vein, compan**ies** might undervalue how crucial it is to adhere to OHS laws.

2.9.3. Inadequate Enforcement and Inspection

Understaffing, a lack of mobility, a lack of technical expertise, and inadequate logistical support are common problems for OHS enforcement organizations in underdeveloped nations. Because of this, regular inspections are rarely conducted, follow-up measures are irregular, and infractions are frequently ignored. This lessens the incentive for compliance and damages the legitimacy of OHS regulations.

2.9.4. Informal Employment Sector

In developing nations, a sizable section of the workforce works in the unregulated and unmonitored informal sector. Since informal workers typically don't have contracts, benefits, or safety safeguards, it can be very challenging to enforce OHS regulations or hold employers responsible for hazardous working conditions [35].

2.9.5. Cultural and Behavioral Factors

Particularly in physically demanding industries, there may be a cultural inclination in some areas to accept risk as an inherent aspect of the job. Employees may believe that safety procedures are superfluous, particularly if they have been performing the same activities for years without experiencing any problems. Employers may also put speed and productivity ahead of safety, which could lead to a dangerous workplace culture.

2.9.6. Lack of Data and Research

In underdeveloped nations, there is sometimes a dearth of trustworthy data on occupational illnesses and injuries, which makes it challenging to create focused treatments or track the effects of current regulations. Policymakers' capacity to efficiently allocate resources and establish suitable safety standards is further hampered by this knowledge gap.

2.9.7. Weak Institutional Coordination

Collaboration between many stakeholders, including as ministries, labor unions, private businesses, and international organizations, is frequently necessary for the implementation of OHS policy. The impact of safety rules is sometimes delayed or lessened in developing countries due to inadequate coordination and communication amongst various groups.

2.10. Role of Government and Institutions in OHS Enforcement

Using a mix of institutional, statutory, and regulatory tools, the Rwandan government is instrumental in enforcing Occupational Health and Safety (OHS) regulations. The Ministry of Public Service and Labor (MIFOTRA) is the main organization in charge of OHS; it creates national labor laws and makes sure firms follow OHS regulations. Through the Labor Inspectorate, MIFOTRA carries out workplace inspections, looks into mishaps, and ensures that OHS rules are followed. These inspectors are able to report harmful activities to higher authorities, enforce penalties, and mandate corrective actions.

The Rwanda Social Security Board (RSSB), which oversees work-related injury insurance, contributes significantly in addition to MIFOTRA. In order to guarantee compensation in the event of workplace accidents, injuries, or fatalities, employers are required to register their employees with the RSSB. In addition to offering workers financial stability, this system encourages businesses to take preventive safety precautions to lower liability.

By creating and promoting national safety standards, particularly in technical domains like building and roadworks, the Rwanda Standards Board (RSB) also aids in the enforcement of OHS. To reduce occupational dangers, RSB develops standards for safe equipment use, workplace layout, and construction methods. During audits and inspections, these criteria are frequently utilized as benchmarks.

Additionally, OHS is promoted at the grassroots level by district labor officials and local government representatives, particularly in decentralized projects like road construction. They assist in keeping an eye on adherence, resolving conflicts, and spreading knowledge of safety regulations locally [36].

In order to improve coordination, the Rwandan government collaborates with a number of parties, such as employer groups, trade unions, and foreign partners like World Bank the International Labor Organization (ILO), to foster a culture of safety and increase.

2.11. Impact of OHS Compliance on Worker Safety and Productivity

The table below shows the impact of OHS (Occupational Safety and Health) compliance on both worker safety and productivity, with a focus on how these outcomes are logically interconnected [37].

Table 2-2 Occupational Health and Safety compliance on both worker safety and productivity

Aspect	**With OSH Compliance**	**Without OSH Compliance**	**Impact Summary**
Worker Safety	Reduced workplace accidents and injuries due to use of PPE, hazard controls, and safety training.	Higher risk of injuries, illnesses, and fatalities; unsafe work environments.	OSH compliance directly improves physical safety and reduces health risks.
Absenteeism	Lower absenteeism as workers remain healthy and fit for duty.	Increased absenteeism due to injury, illness, or stress.	Safer work environments reduce downtime and maintain workforce stability.
Productivity	Higher productivity due to fewer disruptions, more focused workers, and safer task execution.	Lower productivity from interruptions, injuries, and reduced morale.	Safety enables smoother operations and more efficient labor output.
Work Quality	Improved quality due to better focus, confidence, and skill retention among workers.	Decreased quality due to stress, fatigue, or lack of proper safety tools.	Safety leads to better concentration and fewer errors.
Employee Morale	Boosted morale and job satisfaction from feeling valued and protected.	Low morale due to fear of injury and lack of employer support.	Positive work culture increases engagement and loyalty.
Turnover Rates	Lower turnover as workers are more likely to stay in a secure job.	Higher turnover due to unsafe or exploitative working conditions.	Retaining skilled workers enhances continuity and reduces training costs.

Legal and Financial Risk	Reduced risk of legal action, fines, or compensation claims.	High risk of lawsuits, fines, and increased insurance costs.	Compliance protects employers from financial and reputational damage.
Company Reputation	Enhanced public image and employer attractiveness.	Poor reputation leading to loss of contracts and difficulty hiring.	Compliance helps build trust with clients, partners, and employees.

2.12. Knowledge, Attitudes, and Practices (KAP) Related to OHS

The table below breaks down Knowledge, Attitudes, and Practices (KAP) related to Occupational Health and Safety (OHS)—specifically in the context of highway workers [38].

Table 2-3 Knowledge, attitudes and practices related to occupational safety and health

KAP Component	**Description**	**Typical Findings in Highway Work Context**	**Relevance to Rwanda**
Knowledge	Awareness and understanding of OSH laws, risks, and preventive measures.	- Workers may know basic safety rules (e.g., wearing helmets, vests). - Some may lack detailed knowledge of Rwandan OSH policies or risk assessment procedures.	Limited training opportunities and low literacy levels in some areas may hinder full comprehension of national OSH regulations.
Attitudes	Beliefs, perceptions, and feelings toward OSH policies and workplace safety.	- Some workers value safety but may prioritize productivity over safety due to deadlines or pressure. - Others may see safety compliance as time-consuming or unnecessary.	Attitudes may be influenced by management behavior, peer pressure, and cultural norms related to risk-taking and authority.
Practices	Actual behaviors and actions workers take to ensure safety on the job.	- Wearing PPE, attending safety briefings, reporting hazards. - Inconsistencies in applying safety procedures (e.g., skipping checks when supervisors are absent).	Practices often vary depending on enforcement, supervision, and availability of safety materials and equipment.

2.13. Empirical Studies on OHS Compliance in Africa and Rwanda

A persistent pattern of difficulties and slow advancements is seen in empirical research on Occupational Health and Safety (OHS) compliance in Africa, including Rwanda. Studies show that OHS standards are generally not well followed throughout the continent, particularly in high-risk industries including mining, construction, and transportation. Lack of personal protective equipment (PPE), inadequate training, low awareness, and lax enforcement are common obstacles to successful OHS adoption in nations including South Africa, Ghana, Nigeria, and Kenya. For instance, studies on the building industry in Kenya revealed that although there are safety laws, many workers were not aware of them, and most construction sites did not satisfy the bare minimum of safety standards because of poor monitoring and cost-cutting measures [39].

Even though there aren't as many empirical research on Rwanda, they nevertheless follow these general African patterns. Although there is a robust legal framework for OHS, its actual implementation is still uneven, according to research done by Rwandan academics and organizations like the University of Rwanda and MIFOTRA. For example, research on infrastructure and building projects has shown that many workers lack basic safety training and that personal protective equipment (PPE) is frequently either lacking or improperly used [40]

Companies with regular safety training and active OHS committees had much lower accident rates than those without, according to a noteworthy study on OHS compliance in Rwandan industries. According to studies, there is particularly little control, economic pressures, and little worker negotiating power in industries like highway construction, which use informal labor and short-term contracts [41].

2.14. Historical catastrophes due to noncompliance of OHS

In 2008, a crane collapsed fatally leading to seven fatalities and seven injuries. Investigations attributed the collapse to faulty crane equipment, lack of proper training, and oversight failures [20].

On February 4th, 2018, a trench collapse at I-95 occurred in Miami. The incident was due to instability of the concrete barrier wall, lack of support systems such as shoring, bracing, or underpinning to ensure the safety of employees. The collapse of the concrete barriers wall, approximately 121 ft. long, killed two employees who were inside the trench [42].

A recent noncompliance of OHS was in Qatar during construction of stadiums for Holding FIFA world cup 2022. The International Trade Union Confederation (ITUC) estimated that at least 4000 workers were to die before the start of the world cup in 2022 based only on Nepal and Indian embassies in Qatar [43]. In 2012 and 2013 alone, 169 and 191 Nepalese construction workers died, respectively, while 237 and 218 Indian workers died in those same years. This death toll is attributed to: unsafe working conditions, heat stress, poor working facilities for workers (workplaces stank of urine), and lack of PPE. For instance, a certain carpenter from Nepal reported maltreatment after an eye injury due to lack of safety glasses on site [43]. Due to appalling conditions of workers at Qatar, It was assumed that 1,200 deaths may have occurred during construction of the stadiums between 2010 and 2015 [44].

2.15. Gaps in existing research

Despite Rwanda's progress in establishing OHS frameworks, significant research gaps remain, especially in high-risk sectors like highway construction, including lack of a questionnaire, ambiguity of the reliability

and validity of questions asked, and internationally funded projects that demand higher safety standards and attention.

A review of the previous research conducted by Nkurunziza (2020) reveals a lack of standardized or well-developed questionnaire tailored to the context of highway workers. The study fails to provide details on how the questionnaire was developed, consequently undermining the precision and relevance of its findings as the instruments used may not adequately capture the specific behaviors, attitudes, and challenges faced by highway workers in relation to occupational safety policies.

Last but not least, there is a lack of sector-specific studies, reliable data on accidents, and analysis of informal employment conditions. Research on enforcement mechanisms, worker perspectives, and long-term OHS outcomes is also limited. Additionally, the roles of gender, age, and disability in OHS remain largely unexplored. These gaps offer critical opportunities for researchers to support safer, more inclusive practices in Rwanda's infrastructure development.

CHAPTER 3. RESEARCH METHODOLOGY

3.1. Research design and framework

The figure below presents the overall framework and design of this research. Data were primarily collected through questionnaires with key stakeholders, including representatives from institutions such as RTDA staffs, project managers, site engineers, safety officers, and casual workers. The qualitative data obtained were then analyzed using thematic analysis to identify patterns, levels of awareness, and gaps in OHS compliance. The analysis was guided by relevant literature to ensure validity and depth of interpretation. Ethical considerations were observed throughout the study, and findings were critically discussed in relation to global OHS standards. The research concludes with evidence-based recommendations aimed at improving compliance and implementation of OHS measures in Rwanda's highway construction projects.

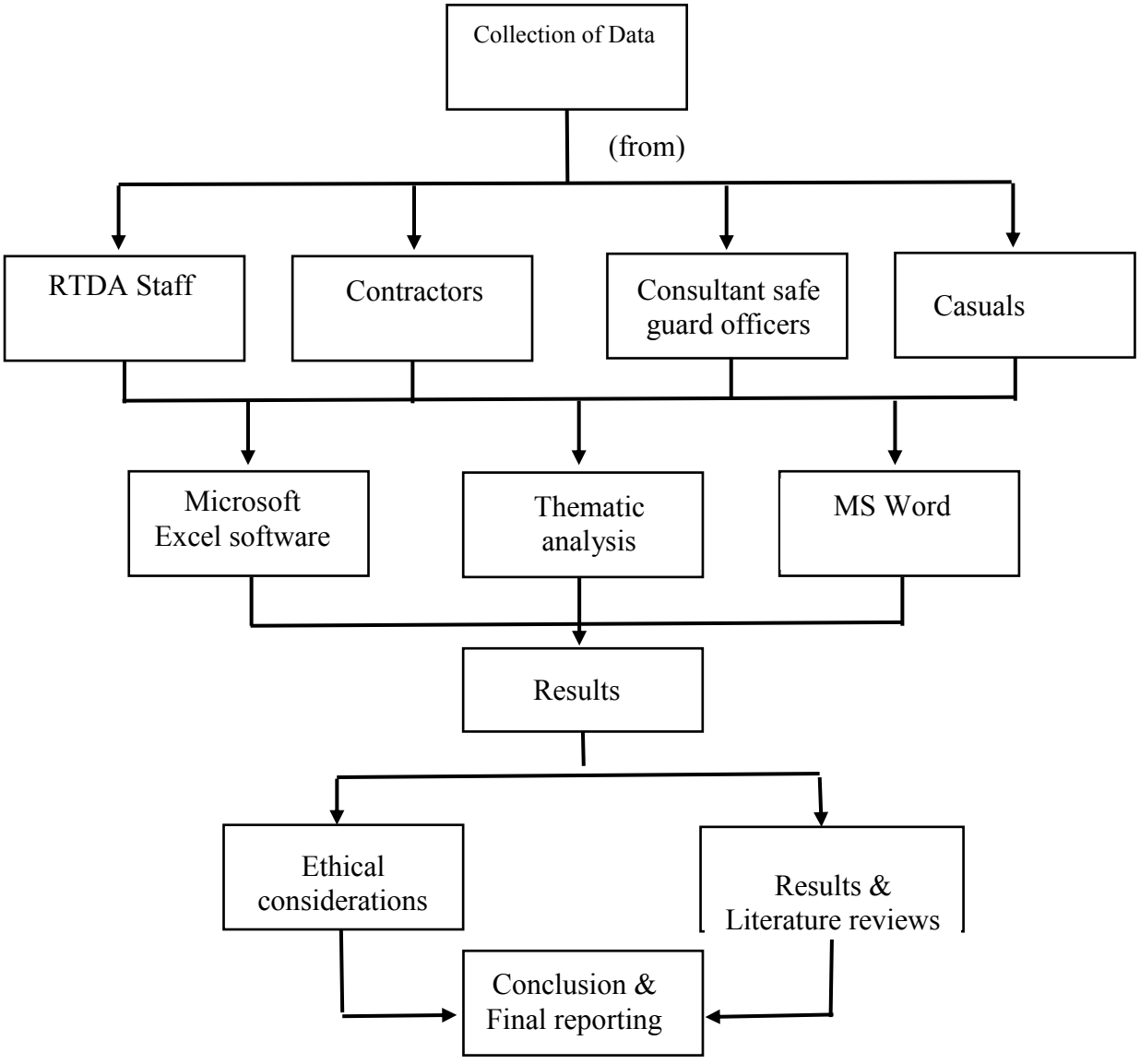


Figure 3-1 Research design and methodology

3.2. Choosing a research methodology

There are two research methods which are mostly used to choose the appropriate data collection method. There are: quantitative and qualitative methods. According to Bell, et al. (2019), quantitative methods consist of systematic empirical studies which involve measuring through the use of mathematics and statistics. Data obtained is transformed into numbers which are empirically tested to see if there is an existing pattern in order to deduce a conclusion from the results gained [45]. On the other hand, qualitative research involves the collection of non-numerical data (words, images, sounds) to explore subjective experiences and attitudes, mostly through observations and interviews. It aims to produce detailed descriptions and uncover new insights about the studied phenomenon which quantitative research cannot identify [46]. Therefore, based on the context of our research study, to determine the percentage or extent to which highway workers comply with OHS policies, quantitative research will be considered; where data is collected by means of a questionnaire which is sent out to the companies and then returned to the authors via e-mail.

A research methodology requires a theoretical framework that defines the nature of relationship between theory and research. Therefore, two different approaches, namely inductive and deductive theories, are used to question whether data is collected in order to test theories or whether to build theories [47]. Inductive theories involve the collection and analysis of data to develop theories, concepts, or hypothesis based on patterns and observations seen in the data; whereas deductive theories require the researcher to start with a theory or hypothesis and tests it through observations and data collection [48]. As a result, our thesis will adopt an inductive approach, as it begins with data collection to assess the compliance of highway workers with OHS policies.

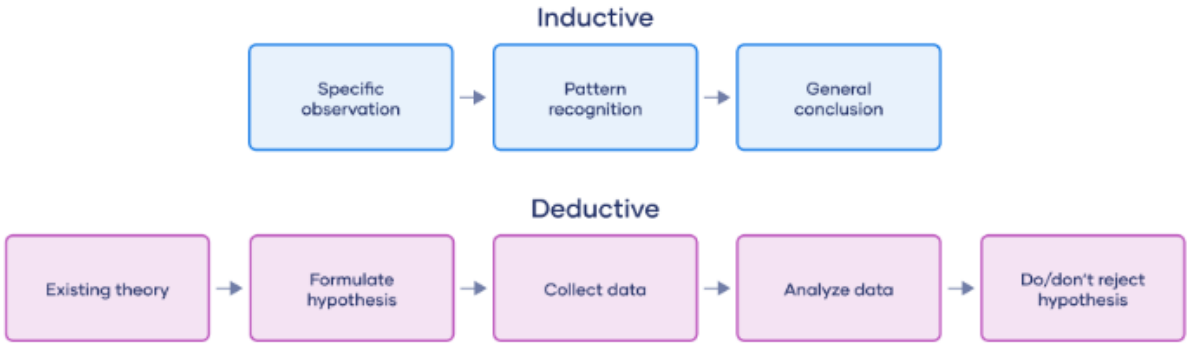


Figure 3-2 Inductive Vs deductive approach

3.3. Sample selection

Sample selection/sample design refers "to the methodical process of selecting a subset of individuals or items from a larger population for the purpose of conducting research or analysis" [49]. Sample design can be classified into two major groups: Probability sampling and non-probability sampling. Probability sampling is a statistical method used to select samples from a larger population in a way that each member of the population has a known, non-zero chance of being selected, whereas non-probability sampling is a method of selecting a sample from a population in which *not* every individual has a known chance of being selected. These can be divided into further subgroups as shown in figure 3-2.

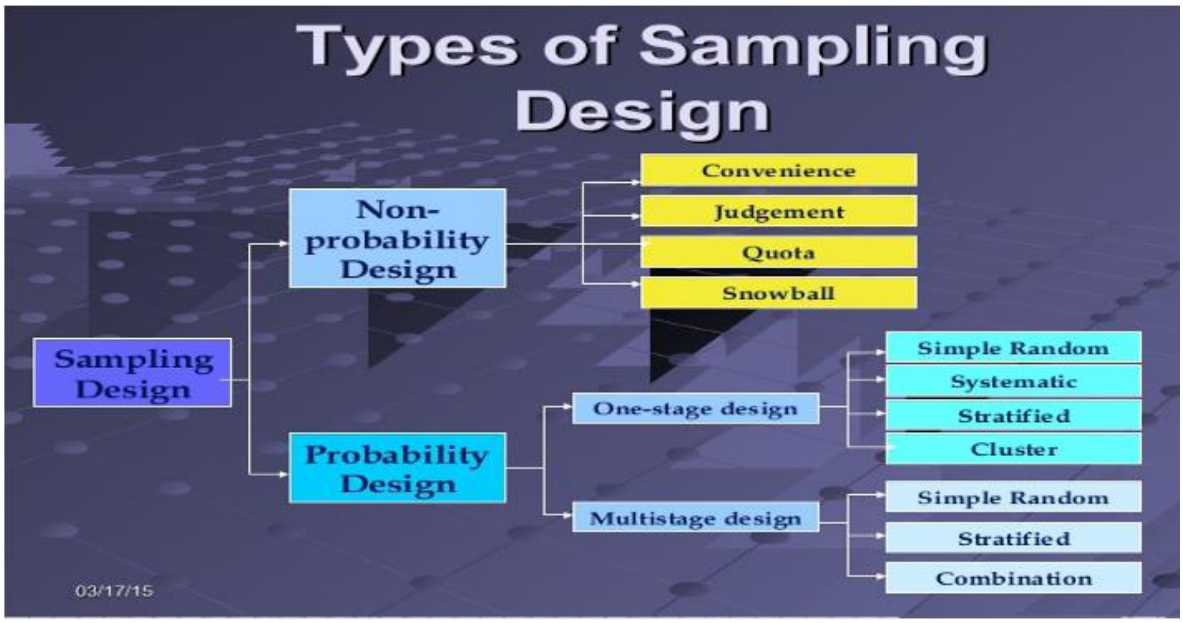


Figure 3-3 Sample design

Source: [49]

In the survey, we used probability sampling because every individual has a chance of being selected. Since probability sampling is divided into different kinds of sample methods: simple random, systematic, stratified random, cluster, and multi-stage sampling; I chose to use simple random sampling for every member has an equal chance of being selected. The sample size converged between 100 – 150 respondents, where 140 were randomly selected, according to the Yamane's formula (1967), from workers involved in the Rwanda Feeder Roads Development project (RFDP), Lake Victoria Transport program (LVTP), and Huye-Kibeho road project.

$$n = \frac{N}{1 + N(e)^2}$$

Source: [50]

Where:

- N: Number in population
- e: Confidence interval
- n: Sample size

3.4. Data collection

Data collection can be either primary or secondary. Primary data is information that the researcher gathers on his own, for instance by using questionnaires, interviews, tests. Etc. [47]. On the other hand, secondary data refers to data collected by other researchers and institutions from documents, articles, and literature. [47]. In my thesis, only primary data is used, as there is insufficient secondary data available and existing sources contain significant gaps. To collect data, I used a structured questionnaire which was prepared through 3 steps: pre-testing, pilot testing and a final documentation of the questionnaire for conducting a large-scale survey.

3.4.1. Pre-testing

Pre-testing was done by consulting three (3) contractors and RTDA staffs. It assessed the ambiguity and wording of questions consisting the questionnaire and interview [51]. After revising the ambiguous questions identified by the first three participants, retesting survey with three additional participants from contractor companies and RTDA staff was done. Furthermore, I measured the time required to complete the survey and found that each questionnaire took between 10 and 15 minutes to complete the survey.

3.4.2. Pilot testing

Pilot testing is a small-scale, preliminary trial of data collection tools and procedures before the actual full-scale study. It helps to minimize the likelihood of respondents having problem in answering the questions assuring that they truly understand them, checks the time required to complete questionnaires, evaluates the appropriateness of the surveying environment and effectiveness of data collectors, and assesses the quality of asked questions to ensure the validity and reliability of collected data [52].

The reliability of questions was assessed by using Statistical Package for Social Sciences (SPSS) after 20 gathered questionnaires from randomly selected personnel. Participants who give a high response for one of the items are most likely to give similar responses for other items due to their correlation [53].

3.4.3. Final questionnaire

After pre-testing and pilot test, the final questionnaire was designed. The questionnaire consists of five (5) main parts: personal information, compliance with Rwanda's OHS policy, Benefits of OHS compliance, Risks and consequences of non-compliance, and Recommendations of strategies and mechanisms for improving compliance. Appendix A shows questionnaire.

The questionnaire starts by collecting essential demographic and background details of the respondents to provide context for the analysis of occupational safety compliance. This section includes questions on age, gender, education level, work experience, job position, and employment status. Gathering this information helps to identify patterns and relationships between workers' characteristics and their adherence to safety policies. It also enables the segmentation of data for more targeted insights, such as understanding whether certain groups face unique challenges or exhibit different safety behaviors. Ensuring the confidentiality of this information encourages honest and accurate responses from participants.

The second section assesses the compliance with Rwanda's OHS policy by workers. This section assesses the extent to which highway construction workers and contractors adhere to the national OHS policies set by the Government of Rwanda. Questions explore whether workers are aware of these policies, if safety procedures are consistently followed, and whether inspections or enforcement mechanisms are in place. It also evaluates how well employers communicate safety protocols and whether the provided working environment aligns with legal OHS standards.

In the third section, the questionnaire gathers opinions and experiences related to the advantages of complying with OHS standards on-site. It includes benefits such as reduced workplace accidents, improved worker morale, increased productivity, legal protection, and better project outcomes. It also explores whether compliance contributes to the overall reputation and success of construction firms and government institutions involved in highway projects.

The two next parts examine respondents understanding and experiences of the dangers associated with failing to follow OHS guidelines. Questions focus on the types of injuries or incidents that have occurred due to non-compliance, the financial and legal consequences for contractors, and the impact on project timelines and quality. It also assesses whether workers and employers are sufficiently aware of these risks and how seriously they take them.

Finally, the questionnaire seeks suggestions from respondents on how to strengthen OHS compliance. This involves proposals such as increasing training frequency, enhancing government enforcement, involving workers in decision-making, ensuring regular supply of safety gear, and imposing penalties for violations. It also offered an opportunity to gather ideas on improving coordination among stakeholders, updating policy frameworks, and tailoring strategies to specific site conditions.

3.5. Ethical considerations

This research adheres to ethical standards throughout the data collection and reporting process. Prior to the commencement of the study, ethical clearance will be obtained from appropriate institutional review boards. Formal permission will also be sought from the Rwanda Transport Development Agency (RTDA) and the management of the selected construction firms. All participants will be informed about the purpose and scope of the research, and their consent will be obtained voluntarily, either orally or in writing. Participation will be entirely voluntary, with respondents free to decline or withdraw at any stage without any repercussions. The privacy and confidentiality of participants will be maintained throughout the research by anonymizing data and ensuring that no identifying information is disclosed in the final report.

CHAPTER 4. RESULTS AND DISCUSSIONS

4.1. Introduction

This chapter presents the findings of the study on compliance with Occupational Health and Safety (OHS) policies on donor-funded road projects in Rwanda. Data were collected from 140 respondents, including contractors, consultants, government agencies, and site workers, and analyzed using the Statistical Package for Social Sciences (SPSS). Descriptive statistics (means, frequencies, and percentages) and inferential tests (p-values) were used to evaluate the level of compliance, awareness, risks, consequences, and recommendations related to OHS implementation. The findings are presented in five sections covering compliance status, awareness, risks, consequences, and recommendations. Each section combines statistical evidence with interpretive discussion, providing insights into existing gaps, their implications for worker safety, and strategies to strengthen adherence to Rwanda's OHS policies on donor-funded road projects.

4.2. Descriptive statistics

4.2.1. Percentages and frequencies of Agreement Levels per Section

Table 4 and 5 illustrate the percentages and frequencies of agreement levels for each objective. Objective A has a wellness level of 53% which indicates a slight adherence to Rwanda OHS Policies. This low percentage is attributed to poor first-aid and hygiene standards, insufficient trainings on OHS, and inadequate medical cost coverage, as reflected in their overall means shown in table 17 (Appendix 2). In contrast, Objective B recorded a high wellness level of 84%, demonstrating strong awareness among road project stakeholders on the benefits of complying with OHS policies. The risks associated with non-compliance with OHS were understood at a wellness level of 87%. Similarly, Objective D which assessed road workers' understanding of the consequences of non-compliance, showed a wellness level of 84%. Finally, strategies and mechanisms for improving compliance were recommended at a level of 89%.

Table 4 Objective A agreement level percentage and frequency

Objective A	F	%
Very Well	608	19
Well	1064	34
Average	975	31
Slightly Well	338	11
Not Well	173	5

Table 5 Agreement level percentages and frequencies for other objectives

	Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree	
	F	%	f	%	f	%	f	%	f	%

Objective B	1011	34	1484	50	358	12	77	3	46	1
Objective C	456	37	606	50	131	11	15	1	12	1
Objective D	400	27	850	57	169	11	61	4	12	1
Objective E	1130	40	1394	49	206	7	87	3	24	1

Note: f=frequency of agreement level, %=percentage of agreement level

Table 6 Agreement level intervals

Agreement level code number	Agreement levels	Interval
1	Strongly Disagree	1.00 – 1.79
2	Disagree	1.80 – 2.59
3	Neutral	2.60 – 3.39
4	Agree	3.40 – 4.19
5	Strongly Agree	4.20 – 5.00

Table 7 objective Overall Mean

Objectives	Overall Mean
Objective A	3.51
Objective B	4.12
Objective C	4.21
Objective D	4.05
Objective E	4.24

4.3. Inferential statistics

Table 8 presents the demographic characteristics of the respondents. The results indicate that the majority of respondents were male (94.3%), while only 5.7% were female. With regard to academic qualifications, 74.3% of the respondents had a bachelor's degree, followed by 18.6% with a master's degree, 5% with secondary education, and 2.1% with a PhD. In terms of working experience, 40.7% of respondents had over 10 years of experience, 37.1% had between 7–10 years, 15% had 4–6 years, 5.7% had 1–3 years, and 1.4% had less than 1 year. This indicates that the majority of respondents had adequate experience to provide informed responses for the study.

Regarding profession, 41.4% of the respondents were project managers, 17.9% were site engineers, 16.4% were site inspectors, 10.7% were construction workers, 5.7% were skilled casual workers, 5% were

environmental and safeguard officers, and 2.9% were foremen/forewomen. Looking at the sector of organization, 37.1% of respondents were from government agencies, 33.6% from consultancy firms, and 29.3% from contracting firms. In terms of the type of business, 54.3% of the organizations were private, while 45.7% were public. These demographic results provide assurance that the respondents possessed the necessary diversity of roles, qualifications, and experience to give reliable information for the study.

Table 8 Profile of respondents and their organizations

Statement	Variable	Frequency	Percent
Gender	Male	132	94.3
	Female	8	5.7
	Total	**140**	**100**
Highest Academic Qualification	Secondary	7	5
	Bachelor's Degree	104	74.3
	Master's Degree	26	18.6
	Ph.D.	3	2.1
	Total	**140**	**100**
Working experience	Less than 1 year	2	1.4
	1 – 3 years	8	5.7
	c. 4 – 6 years	21	15
	7 – 10 years	52	37.1
	Over 10 years	57	40.7
	Total	**140**	**100**
Profession	Project Manager	58	41.4
	Site Engineer	25	17.9
	Construction Worker	15	10.7
	environmental and safeguard officer	7	5
	Site Inspector	23	16.4
	Skilled Casual Worker	8	5.7
	Foreman/forewoman	4	2.9
	Total	**140**	**100**
Sector of organization	Consultancy Firm	47	33.6
	Contracting Firm	41	29.3
	Government Agency	52	37.1
	Total	**140**	**100**

Type of business	Public	64	45.7
	Private	76	54.3
	Total	**140**	**100**

Table 9 presents the level of awareness and compliance with occupational safety practices across different organizations. The highest-ranked practices included wearing PPE (3.92), supervisors enforcing safety procedures (3.88), and receiving PPE training (3.80). Other areas with high awareness were accident documentation (3.75), clear safety signage (3.65), emergency response (3.65), and hazard control and employer–worker collaboration (3.63 each), all indicating that respondents were generally well aware of core safety requirements.

In contrast, lower awareness levels were recorded for items relating to medical coverage and compensation for occupational injuries. For instance, "informing workers about the availability of medical coverage" (3.24, aware), "handling the process of claiming medical reimbursement effectively" (3.23, aware), and "training workers on basic first aid response procedures" (3.21, aware) were ranked among the lowest. Similarly, "conducting regular safety briefings and toolbox meetings" (3.22, aware) and "responding promptly to reported safety concerns" (3.49, aware) were found to have relatively weaker compliance compared to PPE and hazard management.

Further analysis revealed that significant differences ($p < 0.05$) were observed in several areas, including "maintaining PPE in good condition" ($p = 0.03$), "maintaining hygiene facilities properly" ($p = 0.03$), "organizing training sessions to address actual safety risks" ($p = 0.02$), "implementing emergency response procedures" ($p = 0.00$), "reporting unsafe practices or hazards to supervisors" ($p = 0.00$), "informing workers about medical coverage" ($p = 0.03$), "handling medical cost reimbursement" ($p = 0.04$), "responding to safety concerns" ($p = 0.00$), and "documenting and investigating accidents" ($p = 0.00$). These differences suggest that organization type influences awareness and implementation of specific safety practices.

On the other hand, most practices such as "wearing PPE," "enforcing safety compliance by supervisors," "safety signage," and "collaboration on safety matters" showed no significant difference ($p > 0.05$) across organization types. This indicates a relatively uniform compliance on fundamental safety measures across consultants, contractors, and government bodies. Overall, while the data show encouraging levels of awareness in essential PPE use and supervisory enforcement, gaps remain in medical coverage, first aid, and consistent communication of safety procedures, highlighting the need for targeted interventions to strengthen occupational health and safety practices across the construction sector.

Table 9 Level of awareness of consultants, contractors and government agency of the national OHS regulation

Type of organization worked for	Cons	R	Contr	R	Gover	R	Total	R	Dec	P values	Sig
Wearing all the required PPE (helmet, gloves, boots, reflective vest) while on site.	3.68	5.00	4.02	2.00	4.06	2.00	3.92	1.00	W	0.15	NS
Receiving trainings or guidance on the correct use of PPE	3.83	1.00	3.76	5.00	3.81	7.00	3.80	3.00	W	0.95	NS

Maintain PPE in good condition (cleanliness, replacement when damaged)	3.72	2.00	3.44	18.00	3.10	22.00	3.41	12.00	A	0.03	S
Supplying PPE regularly on site	3.34	10.00	3.24	22.00	3.38	18.00	3.33	17.00	A	0.84	NS
Provide hygiene and sanitation facilities (toilets, drinking water, rest areas) at the site	3.04	16.00	3.56	12.00	3.56	13.00	3.39	14.00	A	0.05	NS
Maintain hygiene facilities properly	3.06	15.00	3.39	20.00	3.63	10.00	3.37	15.00	A	0.03	S
Make first-aid equipment available on site	3.00	18.00	3.51	14.00	3.44	15.00	3.31	18.00	A	0.07	NS
Train workers on basic first aid response procedures	2.98	19.00	3.46	17.00	3.21	20.00	3.21	22.00	A	0.14	NS
Conduct regular safety briefings and toolbox meetings on site	2.96	20.00	3.49	15.00	3.25	19.00	3.22	21.00	A	0.08	NS
Organize training sessions to address actual safety risks on site	3.02	17.00	3.37	21.00	3.67	9.00	3.35	16.00	A	0.02	S
Post and communicate safety signs and warnings clearly across the construction site	3.55	7.00	3.63	6.00	3.77	8.00	3.65	5.00	W	0.51	NS
Enforce compliance with safety procedures by supervisors	3.72	2.00	4.10	1.00	3.85	5.00	3.88	2.00	W	0.10	NS
Implement emergency response procedures on site	3.34	10.00	3.59	9.00	4.00	3.00	3.65	6.00	W	0.00	S
Identify and control safety hazards during daily operations	3.53	8.00	3.78	4.00	3.58	12.00	3.63	8.00	W	0.43	NS
Report unsafe practices or hazards to supervisors	3.09	13.00	3.85	3.00	3.92	4.00	3.61	9.00	W	0.00	S
Collaborate between employers and workers to identify and address safety issues	3.70	4.00	3.59	9.00	3.60	11.00	3.63	7.00	W	0.79	NS
Inform workers about the availability of medical coverage	2.84	22.00	3.44	18.00	3.44	17.00	3.24	19.00	A	0.03	S
Cover medical expenses for occupational injuries by the employer or project authorities	3.11	12.00	3.59	9.00	3.50	14.00	3.39	13.00	A	0.08	NS
Handle the process of claiming medical cost reimbursement effectively	2.93	21.00	3.59	8.00	3.19	21.00	3.23	20.00	A	0.04	S
Respond promptly to reported safety concerns or hazards	3.09	13.00	3.49	15.00	3.85	6.00	3.49	11.00	A	0.00	S
Document and investigate accidents and incidents at the worksite	3.42	9.00	3.56	13.00	4.17	1.00	3.75	4.00	W	0.00	S
Ensure workers understand the process of reporting accidents.	3.64	6.00	3.63	6.00	3.44	16.00	3.57	10.00	W	0.56	NS

Note: a. <1.5 = Not Aware (NA), 1.5–2.49 = Slightly Aware (SA), 2.5–3.49 = Averagely Aware (AA), 3.5–4.49 = Aware (A), 4.5 and above = Very Aware (VA). Cons = Consultants, Cont = Contractors, Gover = Government, R = Rank, Dec = Decision, Sig = Significance.

b. NS = No significant difference between consultants, contractors, and government organizations in the level of awareness of Occupational Health and Safety practices ($p > 0.05$).

c. S = There is a significant difference between consultants, contractors, and government organizations in the level of awareness of Occupational Health and Safety practices ($p < 0.05$).

Table 10 presents the level of awareness of Occupational Health and Safety (OHS) practices based on the sector of organization (public and private). Respondents were well aware of essential practices such as "wearing all required PPE while on site" (3.92, well aware), "enforcing compliance with safety procedures by supervisors" (3.88, well aware), "posting and communicating safety signs and warnings" (3.65, well aware), and "documenting and investigating accidents at the worksite" (3.75, well aware). Additionally, collaboration between employers and workers (3.63, well aware) and ensuring workers' understanding of accident reporting (3.57, well aware) were also emphasized.

Lower levels of awareness were reported in areas related to medical coverage and training. These included "training workers on first aid response" (3.21, aware), "conducting safety briefings and toolbox meetings" (3.22, aware), "handling medical cost reimbursement effectively" (3.23, aware), and "informing workers about the availability of medical coverage" (3.24, aware).

Significant differences ($p < 0.05$) were observed in maintaining hygiene facilities ($p = 0.02$), organizing training sessions on actual safety risks ($p = 0.01$), implementing emergency response procedures ($p = 0.00$), reporting unsafe practices ($p = 0.00$), and responding promptly to reported hazards ($p = 0.03$). This suggests variability between public and private organizations in these specific practices. However, for the majority of OHS practices such as PPE use, signage, supervision, and hazard control, no significant difference ($p > 0.05$) was found, indicating similar awareness levels across sectors.

Table 10 Level of awareness of sector of organization of the national OHS regulation

Sector of organization	Public	R	Private	R	Total	R	Dec	P values	Sig
Wearing all the required PPE (helmet, gloves, boots, reflective vest) while on site.	3.95	1.00	3.89	1.00	3.92	1.00	W	0.74	NS
Receiving trainings or guidance on the correct use of PPE	3.94	4.00	3.68	3.00	3.80	3.00	W	0.17	NS
Maintain PPE in good condition (cleanliness, replacement when damaged)	3.36	19.00	3.45	9.00	3.41	12.00	A	0.66	NS
Supplying PPE regularly on site	3.45	15.00	3.22	16.00	3.33	17.00	A	0.25	NS
Provide hygiene and sanitation facilities (toilets, drinking water, rest areas) at the site	3.59	11.00	3.21	17.00	3.39	14.00	A	0.06	NS

Maintain hygiene facilities properly	3.59	11.00	3.18	19.00	3.37	15.00	A	0.02	S
Make first-aid equipment available on site	3.45	15.00	3.20	18.00	3.31	18.00	A	0.19	NS
Train workers on basic first aid response procedures	3.28	20.00	3.15	20.00	3.21	22.00	A	0.51	NS
Conduct regular safety briefings and toolbox meetings on site	3.15	22.00	3.28	14.00	3.22	21.00	A	0.52	NS
Organize training sessions to address actual safety risks on site	3.65	9.00	3.12	21.00	3.35	16.00	A	0.01	S
Post and communicate safety signs and warnings clearly across the construction site	3.72	7.00	3.61	7.00	3.65	5.00	W	0.48	NS
Enforce compliance with safety procedures by supervisors	3.88	6.00	3.88	2.00	3.88	2.00	W	0.99	NS
Implement emergency response procedures on site	3.95	2.00	3.41	10.00	3.65	6.00	W	0.00	S
Identify and control safety hazards during daily operations	3.58	13.00	3.66	4.00	3.63	8.00	W	0.64	NS
Report unsafe practices or hazards to supervisors	3.90	5.00	3.38	11.00	3.61	9.00	W	0.00	S
Collaborate between employers and workers to identify and address safety issues	3.65	9.00	3.62	6.00	3.63	7.00	W	0.83	NS
Inform workers about the availability of medical coverage	3.40	17.00	3.11	22.00	3.24	19.00	A	0.17	NS
Cover medical expenses for occupational injuries by the	3.40	17.00	3.38	11.00	3.39	13.00	A	0.92	NS

employer or project authorities									
Handle the process of claiming medical cost reimbursement effectively	3.20	21.00	3.25	15.00	3.23	20.00	A	0.82	NS
Respond promptly to reported safety concerns or hazards	3.70	8.00	3.30	13.00	3.49	11.00	A	0.03	S
Document and investigate accidents and incidents at the worksite	3.95	2.00	3.57	8.00	3.75	4.00	W	0.05	NS
Ensure workers understand the process of reporting accidents.	3.48	14.00	3.63	5.00	3.57	10.00	W	0.40	NS

Note: R = Rank, Dec = Decision, Sig = Significance.

Table 11 and 12 present the perceived **benefits of OHS compliance** across different types of organizations (consultants, contractors, and government) and across sectors (public and private). Overall, respondents consistently rated the benefits of OHS compliance highly, with most mean scores falling within the "Aware" category (3.5–4.49). This indicates that stakeholders broadly recognize the importance of OHS compliance in improving safety, productivity, and organizational outcomes.

From Table 11, the highest-rated benefits include safe practices reduce stress and fear of injury (4.33), knowing safety is taken seriously makes me feel valued as a worker (4.29), and promotes a safer and more organized work environment (4.19). These suggest that OHS compliance is most strongly perceived in terms of improving workers' confidence, wellbeing, and safety culture. In contrast, relatively lower scores were recorded for fewer accidents mean I can keep earning money without interruption (3.91), good safety records help employers win more contracts (3.79), and being part of a safe site gives me more chances to be selected for future projects (3.94). These findings indicate that while direct safety benefits are well acknowledged, economic and long-term professional benefits are less emphasized by respondents.

Significant differences (**$p < 0.05$**) were observed in several benefits across consultants, contractors, and government institutions. These include increasing workers' confidence and productivity ($p = 0.01$), promoting safer work environments ($p = 0.00$), reducing work stoppages ($p = 0.00$), avoiding long-term disability ($p = 0.01$), making work easier to manage ($p = 0.01$), encouraging regular attendance ($p = 0.00$), feeling valued as a worker ($p = 0.00$), improving worker–management relations ($p = 0.03$), attracting continued project funding ($p = 0.01$), and strengthening teamwork ($p = 0.02$). These findings suggest that the type of organization significantly shapes the way certain OHS compliance benefits are perceived. Conversely, benefits such as reducing risk of injuries, minimizing legal risks, building trust with partners, reducing absenteeism, and provision of PPE showed no significant difference, indicating uniform recognition across organization types.

Similarly, Table 12 shows that both public and private sector organizations rated OHS compliance positively, with higher ratings for benefits such as safe practices reduce stress and fear of injury (4.44 public; 4.24 private; 4.33 total), knowing safety is taken seriously makes me feel valued as a worker (4.44 public; 4.16 private; 4.29 total), and reducing work stoppages and delays (4.22 public; 4.05 private; 4.13 total). Lower-rated benefits included fewer accidents mean I can keep earning money without interruption (3.91) and good safety records help employers win more contracts (3.79), again showing that immediate safety-related benefits are valued more than indirect or economic ones.

Significant differences were observed between public and private sectors in increasing workers' confidence and productivity ($p = 0.039$), making work easier to manage ($p = 0.043$), encouraging regular attendance ($p = 0.016$), and feeling valued as a worker ($p = 0.043$). This suggests that public organizations perceive stronger benefits in terms of personal motivation and productivity outcomes than private organizations. However, for the majority of the benefits—including reducing injuries, minimizing legal risks, building trust with partners, reducing absenteeism, use of PPE, and improving reputation—no significant difference was found ($p > 0.05$), reflecting general agreement across both sectors.

Table 11 Benefits of OHS compliance on sector of organization

type of organization you work for	Consult	R	Contr	R	Gover	R	Total	R	Dec	P values	Sig
It reduces the risk of injuries and accidents.	3.85	13.00	4.22	7.00	4.17	11.00	4.08	9.00	A	0.10	NS
It increases workers' confidence and productivity on site	3.89	6.00	3.90	18.00	4.33	7.00	4.06	10.00	A	0.01	S
It promotes a safer and more organized work environment for employees.	3.87	8.00	4.24	4.00	4.44	3.00	4.19	3.00	A	0.00	S
It enhances the company's reputation and credibility	4.26	1.00	3.95	16.00	4.17	11.00	4.14	4.00	A	0.21	NS
It reduces work stoppages and delays due to accidents or inspections.	4.06	4.00	3.83	19.00	4.42	4.00	4.13	6.00	A	0.00	S
It minimizes legal risks and penalties for the company.	3.89	6.00	4.32	3.00	3.88	23.00	4.01	13.00	A	0.09	NS
It builds trust between implementing agencies and funding partners.	3.85	13.00	4.17	10.00	4.02	17.00	4.01	13.00	A	0.38	NS
Complying with OSH regulations	3.83	15.00	4.34	2.00	4.25	8.00	4.14	4.00	A	0.01	S

helps me avoid long-term disability.											
Safe practices reduce the stress and fear of getting injured at work.	4.26	1.00	4.22	7.00	4.48	2.00	4.33	1.00	A	0.20	NS
OSH compliance protects me from breathing dust or toxic chemicals.	3.87	8.00	4.15	12.00	4.17	11.00	4.06	10.00	A	0.18	NS
When safety procedures are followed, my work becomes easier to manage.	3.72	19.00	3.95	16.00	4.35	6.00	4.02	12.00	A	0.01	S
OSH compliance helps reduce worker absenteeism caused by injury.	3.87	8.00	4.15	12.00	4.04	16.00	4.01	13.00	A	0.38	NS
Having access to PPE allows me to perform physically demanding tasks more safely.	3.96	5.00	4.24	4.00	4.12	14.00	4.10	8.00	A	0.24	NS
A safe workplace encourages me to come to work regularly.	3.62	21.00	4.05	14.00	4.25	8.00	3.98	17.00	A	0.00	S
Knowing safety is taken seriously makes me feel valued as a worker.	3.87	8.00	4.44	1.00	4.54	1.00	4.29	2.00	A	0.00	S
Complying with safety rules makes me feel part of a professional workforce	3.81	16.00	4.24	4.00	4.02	17.00	4.01	13.00	A	0.14	NS
Fewer accidents mean I can keep earning money without interruption.	3.62	21.00	4.20	9.00	3.94	20.00	3.91	21.00	A	0.01	S
Being part of a safe site gives me more chances to be selected for future projects.	3.77	17.00	4.05	14.00	4.02	17.00	3.94	19.00	A	0.30	NS
Safety compliance improves the relationship	3.70	20.00	4.17	10.00	4.08	15.00	3.98	17.00	A	0.03	S

between workers and management.											
A safety-compliant site is more likely to attract continued project funding.	4.09	3.00	3.80	21.00	4.38	5.00	4.11	7.00	A	0.01	S
OSH compliance strengthens teamwork between contractors and workers.	3.87	8.00	3.68	22.00	4.19	10.00	3.94	19.00	A	0.02	S
Good safety records help employers win more contracts, which means more job opportunities	3.77	17.00	3.83	19.00	3.77	25.00	3.79	22.00	A	0.95	NS

Table 12 Sector organization and benefits of OHS compliance

Sector of organization	Public	R	Private	R	Total	R	Dec	P values	Sig
It reduces the risk of injuries and accidents.	4.06	12.00	4.09	8.00	4.08	9.00	A	0.842	NS
It increases workers' confidence and productivity on site	4.2	6.00	3.93	17.00	4.06	10.00	A	0.039	S
It promotes a safer and more organized work environment for employees.	4.3	3.00	4.11	7.00	4.19	3.00	A	0.137	NS
It enhances the company's reputation and credibility	4.03	13.00	4.22	2.00	4.14	4.00	A	0.17	NS
It reduces work stoppages and delays due to accidents or inspections.	4.22	4.00	4.05	10.00	4.13	6.00	A	0.224	NS
It minimizes legal risks and penalties for the company.	3.88	21.00	4.13	5.00	4.01	13.00	A	0.151	NS
It builds trust between implementing agencies and funding partners.	3.98	16.00	4.03	12.00	4.01	13.00	A	0.818	NS

Complying with OHS regulations helps me avoid long-term disability.	4.120	9.00	4.140	4.00	4.140	4.00	A	0.895	NS
Safe practices reduce the stress and fear of getting injured at work.	4.44	1.00	4.24	1.00	4.33	1.00	A	0.126	NS
OHS compliance protects me from breathing dust or toxic chemicals.	4.11	10.00	4.03	12.00	4.06	10.00	A	0.574	NS
When safety procedures are followed, my work becomes easier to manage.	4.22	4.00	3.86	20.00	4.02	12.00	A	0.043	S
OHS compliance helps reduce worker absenteeism caused by injury.	4	15.00	4.03	12.00	4.01	13.00	A	0.869	NS
Having access to PPE allows me to perform physically demanding tasks more safely.	4.08	11.00	4.12	6.00	4.1	8.00	A	0.767	NS
A safe workplace encourages me to come to work regularly.	4.19	8.00	3.8	22.00	3.98	17.00	A	0.016	S
Knowing safety is taken seriously makes me feel valued as a worker.	4.44	1.00	4.16	3.00	4.29	2.00	A	0.043	S
Complying with safety rules makes me feel part of a professional workforce	3.95	18.00	4.07	9.00	4.01	13.00	A	0.522	NS
Fewer accidents mean I can keep earning money without interruption.	3.91	19.00	3.91	18.00	3.91	21.00	A	0.992	NS
Being part of a safe site gives me more chances to be selected for future projects.	3.91	19.00	3.97	15.00	3.94	19.00	A	0.68	NS
Safety compliance improves the relationship between workers and management.	4.02	14.00	3.95	16.00	3.98	17.00	A	0.651	NS
A safety-compliant site is more likely	4.2	6.00	4.04	11.00	4.11	7.00	A	0.293	NS

to attract continued project funding.									
OHS compliance strengthens teamwork between contractors and workers.	3.97	17.00	3.91	18.00	3.94	19.00	A	0.694	NS
Good safety records help employers win more contracts, which means more job opportunities	3.75	22.00	3.82	21.00	3.79	22.00	A	0.706	NS

Tables 13 and 14 present the perceived risks of non-compliance with OHS standards across different sectors (public vs. private) and types of organizations (consultants, contractors, government). The results indicate that respondents across all groups consistently recognized the dangers of failing to comply with OHS practices, with all mean scores falling within the "Aware" category (3.5–4.49).

In Table 13 (sector of organization), the highest-rated risk was lack of clean water or toilets increases the risk of diseases on site (M = 4.43, ranked 1st overall). This was followed by failure to use PPE exposes workers to health hazards (M = 4.14, ranked 4th), and ignoring safety rules increases the likelihood of falling, slipping, or being struck by objects (M = 4.14, ranked 4th). The lowest-rated items, though still in the "Aware" range, included inadequate supervision increases unsafe practices (M = 4.06, ranked 9th) and working in unsafe conditions causes mental stress and fear (M = 4.07, ranked 8th). Importantly, almost all risks showed no significant differences between public and private organizations ($p > 0.05$), except for failure to use PPE ($p = 0.00$), which was rated significantly higher in public organizations.

In Table 14 (type of organization), a similar trend is observed, with lack of clean water or toilets increases the risk of diseases on site again ranked as the most critical risk (M = 4.43, ranked 1st). This highlights the strong emphasis placed on basic sanitation facilities in preventing workplace health risks. Other highly rated items included non-compliance with OHS standards increases the chance of workplace injuries (M = 4.16, ranked 2nd) and workers without proper training are more likely to cause accidents (M = 4.15, ranked 3rd). Among the lower-rated risks were inadequate supervision (M = 4.06, ranked 9th) and working in unsafe conditions causes mental stress (M = 4.07, ranked 8th).

Statistical results from Table 14 revealed several significant differences ($p < 0.05$) among consultants, contractors, and government organizations. For example, failure to use PPE ($p = 0.00$), inadequate supervision ($p = 0.05$), lack of clean water or toilets ($p = 0.04$), and poor communication between workers and supervisors ($p = 0.00$) all showed significant variation. In these cases, government organizations generally rated the risks higher than consultants and contractors, suggesting a heightened sensitivity to the consequences of non-compliance in the public sector.

Overall, both tables highlight a consistent perception that non-compliance with OHS practices poses serious risks, particularly regarding sanitation, use of PPE, and accident prevention. However, differences

across organization types suggest that government institutions may prioritize certain risks more strongly, possibly due to stricter regulations and oversight.

Table 13 Sector organization with Risks of non-compliance

Sector of organization	Public	R	Private	R	Total	R	Dec	P values	Sig
Non-compliance with OHS standards increases the chance of workplace injuries	4.16	5.00	4.16	3.00	4.16	2.00	A	0.99	NS
Failure to use PPE exposes workers to health hazards.	4.38	2.00	3.95	9.00	4.14	4.00	A	0.00	S
Inadequate supervision on-site increases the chances of unsafe practices.	4.08	8.00	4.04	6.00	4.06	9.00	A	0.82	NS
Lack of regular safety training contributes to unsafe work behavior.	4.16	5.00	4.03	7.00	4.09	7.00	A	0.34	NS
Ignoring safety rules increases the likelihood of falling, slipping, or being struck by objects.	4.27	3.00	4.03	7.00	4.14	4.00	A	0.08	NS
Workers without proper training are more likely to cause accidents for themselves or others.	4.11	7.00	4.18	2.00	4.15	3.00	A	0.61	NS
Working in unsafe conditions causes mental stress and fear among workers.	4.03	9.00	4.11	4.00	4.07	8.00	A	0.62	NS
Lack of clean water or toilets increases the risk of diseases on site.	4.55	1.00	4.33	1.00	4.43	1.00	A	0.07	NS
Poor communication between workers and supervisors increases safety misunderstandings.	4.22	4.00	4.08	5.00	4.14	4.00	A	0.35	NS

Note: R = Rank, Dec = Decision, Sig = Significance

Table 14 Type of organization with Risks of Non-compliance

What type of organization did you work for?	Consult	R	Contr	R	Gover	R	Total	R	Dec	P values	Sig
Non-compliance with OHS standards increases the chance of workplace injuries	4.11	3.00	4.05	6.00	4.29	4.00	4.16	2.00	A	0.35	NS
Failure to use PPE exposes workers to health hazards.	4.19	2.00	3.73	9.00	4.42	2.00	4.14	4.00	A	0.00	S
Inadequate supervision on-site increases the	3.83	8.00	4.00	8.00	4.31	3.00	4.06	9.00	A	0.05	S

chances of unsafe practices.											
Lack of regular safety training contributes to unsafe work behavior.	3.96	7.00	4.05	6.00	4.23	7.00	4.09	7.00	A	0.22	NS
Ignoring safety rules increases the likelihood of falling, slipping, or being struck by objects.	3.98	6.00	4.15	4.00	4.27	5.00	4.14	4.00	A	0.19	NS
Workers without proper training are more likely to cause accidents for themselves or others.	4.06	4.00	4.34	3.00	4.08	8.00	4.15	3.00	A	0.23	NS
Working in unsafe conditions causes mental stress and fear among workers.	4.02	5.00	4.12	5.00	4.08	8.00	4.07	8.00	A	0.86	NS
Lack of clean water or toilets increases the risk of diseases on site.	4.23	1.00	4.44	1.00	4.60	1.00	4.43	1.00	A	0.04	S
Poor communication between workers and supervisors increases safety misunderstandings.	3.77	9.00	4.41	2.00	4.27	5.00	4.14	4.00	A	0.00	S

Table 15 presents the perceived consequences of non-compliance with OHS regulations across consultants, contractors, and government organizations. Overall, all items were rated within the "Aware" category (M = 3.5–4.49), suggesting that respondents generally recognize the wide-ranging negative impacts of failing to adhere to safety standards.

The most highly ranked consequences included non-compliance with OHS can result in legal penalties or project shutdowns (M = 4.22, ranked 1st), injuries resulting from non-compliance can lead to long-term disability or death (M = 4.21, ranked 2nd), and accidents caused by safety negligence increase project costs due to medical expenses (M = 4.19, ranked 3rd). These findings highlight that respondents are most concerned with the direct and tangible outcomes of non-compliance—namely severe harm to workers, financial burdens, and legal accountability.

Other strongly endorsed consequences were unsafe working conditions damage the reputation of the contractor or employer (M = 4.15, ranked 4th) and families of injured workers suffer financially due to lack of compensation (M = 4.02, ranked 5th). This indicates that both reputational and social impacts of workplace accidents are widely acknowledged, extending beyond the immediate workforce to affect employers and dependents alike. On the other hand, the lowest-rated consequence was projects with many accidents may face protests or strikes from workers (M = 3.62, ranked 11th), followed by casual workers often do not get compensated after accidents due to unclear policies (M = 3.66, ranked 10th). While still rated "Aware," these suggest that respondents consider industrial action and lack of compensation for casual workers as less pressing compared to injuries, financial costs, and legal issues.

The results of the statistical analysis revealed significant differences ($p < 0.05$) across organization types for several items. These include casual workers often do not get compensated after accidents ($p = 0.00$), serious accidents reduce workers' trust in their employers and the project ($p = 0.02$), and non-compliance

with OHS leads to loss of morale among workers (p = 0.00). In most of these cases, government respondents tended to report higher mean scores compared to consultants and contractors, suggesting that government officials may be more attuned to systemic and long-term workforce implications such as trust, morale, and fair compensation.

Overall, the findings indicate that respondents perceive injury, financial costs, and legal sanctions as the most immediate and severe consequences of non-compliance. However, differences across organization types suggest that while contractors and consultants prioritize tangible outcomes (costs, shutdowns, reputation), government stakeholders also emphasize social and psychological consequences such as loss of morale and trust.

Table 15 Type of organization with consequences of Non-compliance

What type of organization did you work for?	Consult	R	Contr	R	Gover	R	Total	R	Dec	P values	Sig
Injuries resulting from non-compliance can lead to long term disability or death.	4.09	3.00	4.39	1.00	4.17	6.00	4.21	2.00	A	0.09	NS
Non-compliance with OHS can result in legal penalties or project shutdowns.	4.19	2.00	4.07	4.00	4.37	1.00	4.22	1.00	A	0.17	NS
Accidents caused by safety negligence increases project costs due to medical expenses.	4.06	4.00	4.20	3.00	4.29	2.00	4.19	3.00	A	0.42	NS
Unsafe working conditions damage the reputation of the contractor or employer.	4.21	1.00	4.37	2.00	3.92	9.00	4.15	4.00	A	0.06	NS
Workers injured due to non-compliance may lose income while recovering.	3.94	5.00	4.07	4.00	4.06	8.00	4.02	5.00	A	0.69	NS

Casual workers often do not get compensated after accidents due to unclear policies.	3.30	11.00	3.93	8.00	3.79	10.00	3.66	10.00	A	0.00	S
Serious accidents reduce workers' trust in their employers and the project.	3.68	10.00	3.95	7.00	4.23	3.00	3.96	7.00	A	0.02	S
Families of injured workers suffer financially due to lack of compensation.	3.83	6.00	4.00	6.00	4.21	4.00	4.02	5.00	A	0.09	NS
Non-compliance with OHS leads to loss of morale among workers.	3.74	7.00	3.88	9.00	4.19	5.00	3.95	8.00	A	0.00	S
Worker's fear speaking up about risks when past accidents were ignored.	3.72	8.00	3.78	10.00	4.08	7.00	3.87	9.00	A	0.08	NS
Projects with many accidents may face protests or strikes from workers.	3.70	9.00	3.56	11.00	3.60	11.00	3.62	11.00	A	0.73	NS

Table 16 presents the recommendations for improving compliance with OHS practices as perceived by respondents across consultants, contractors, and government organizations. The overall results show that all items were rated in the "Aware" category (M = 3.5–4.49), indicating strong agreement that multiple strategies could enhance compliance with safety regulations.

Among the highest-ranked recommendations, more coordination between contractors, consultants, and government would improve safety received the top overall mean score (M = 4.36, ranked 1st). This highlights the importance of collaboration between stakeholders to create an integrated safety management approach. Similarly, safety information should be shared in local languages spoken by workers (M = 4.29, ranked 2nd) and workers should be given anonymous ways to report unsafe conditions (M = 4.25, ranked 3rd) were also strongly endorsed, emphasizing both effective communication and the empowerment of workers in promoting safety culture. Other recommendations that scored highly included safe resting areas and clean sanitation should be mandatory on all sites (M = 4.24, ranked 4th) and equipment used on site

should be regularly maintained to avoid accidents (M = 4.24, ranked 4th). These findings align with earlier results in Tables 6 and 7, where sanitation and equipment-related issues were also emphasized as critical risk factors.

On the other hand, the least supported recommendations, though still rated as "Aware," included workers should be rewarded or recognized for reporting hazards (M = 3.72, ranked 15th) and community members should be involved in monitoring safety near road projects (M = 4.01, ranked 14th). This suggests that while internal workplace strategies (training, PPE, audits) are seen as essential, external or incentive-based measures may be perceived as less immediately impactful. The statistical analysis revealed significant differences ($p < 0.05$) among organization types on several recommendations. These include equipment should be regularly maintained ($p = 0.00$), community members should be involved in monitoring safety ($p = 0.00$), contractors and supervisors should attend safety workshops ($p = 0.02$), and a national database should track accidents and safety issues ($p = 0.00$). In most of these cases, contractors rated the recommendations more strongly compared to consultants and government respondents. This may reflect contractors' greater direct responsibility for day-to-day safety operations, thus shaping their stronger support for practical interventions.

Overall, the findings suggest that while coordination, communication, and regular safety reinforcement are universally acknowledged as critical, certain organization types emphasize different approaches. Government agencies tend to stress systemic solutions (such as regulations and oversight), contractors prioritize operational measures (such as equipment maintenance and workshops), while consultants emphasize communication and worker empowerment.

Table 16 Comparison of sector of organization with Recommendations for improving compliance

What type of organization did you work for?	Consult	R	Contr	R	Gover	R	Total	R	Dec	P values	Sig
Safety information should be shared in local languages spoken by workers.	4.17	4.00	4.59	1.00	4.17	6.00	4.29	2.00	A	0.07	NS
Refresher training sessions should be provided regularly throughout the project.	4.11	5.00	4.29	11.00	4.10	10.00	4.16	10.00	A	0.35	NS
Workers should elect a safety representative to speak on their behalf.	4.02	11.00	4.39	7.00	4.27	2.00	4.22	7.00	A	0.09	NS

Workers should be given anonymous ways to report unsafe conditions.	4.21	3.00	4.29	11.00	4.25	3.00	4.25	3.00	A	0.92	NS
Workers should be rewarded or recognized for reporting hazards.	3.55	14.00	4.00	15.00	3.65	15.00	3.72	15.00	A	0.06	NS
PPE should be replaced quickly when damaged or worn out.	4.06	7.00	4.24	14.00	4.37	1.00	4.23	6.00	A	0.23	NS
Safe resting areas and clean sanitation should be mandatory on all sites.	4.28	2.00	4.29	11.00	4.17	6.00	4.24	4.00	A	0.76	NS
Equipment used on site should be regularly maintained to avoid accidents.	4.11	5.00	4.59	1.00	4.10	10.00	4.24	4.00	A	0.00	S
Surprise safety audits by independent inspectors should be introduced.	4.04	8.00	4.39	7.00	4.21	5.00	4.21	9.00	A	0.07	NS
Contractors should be held accountable for repeated safety violations.	4.04	8.00	4.39	7.00	4.25	3.00	4.22	7.00	A	0.20	NS
Non-compliant sites should face temporary shutdowns until corrected.	4.04	8.00	4.32	10.00	3.90	14.00	4.07	13.00	A	0.11	NS
Community members should be involved in monitoring	3.55	14.00	4.41	5.00	4.12	9.00	4.01	14.00	A	0.00	S

safety near road projects											
Contractors and supervisors should attend safety workshops before projects begin.	3.87	12.00	4.41	5.00	4.08	12.00	4.11	12.00	A	0.02	S
A national database should track accidents and safety issues on road projects.	3.83	13.00	4.59	1.00	4.06	13.00	4.14	11.00	A	0.00	S
More coordination between contractor, consultant, and government would improve safety.	4.36	1.00	4.59	1.00	4.17	6.00	4.36	1.00	A	0.05	NS

4.4. Discussion of findings

This study investigated the level of awareness and compliance of construction organizations with Rwanda's OHS policies on donor-funded road projects. The findings revealed that respondents demonstrated a relatively **high level of awareness** of occupational safety requirements. For example, the majority reported being well aware of the need to wear all required PPE (mean = 3.92), enforce compliance with safety procedures (3.88), document and investigate accidents (3.75), and provide training on PPE usage (3.80). Similarly, awareness was strong regarding safety signage, hazard identification, emergency response, and employer–worker collaboration, with mean scores above 3.6. This suggests that most organizations and workers clearly understand the benefits of OHS practices, the risks of non-compliance, and the strategies necessary to improve safety on site.

Despite this awareness, however, the overall **level of compliance** with OHS obligations was only slight to moderate. Respondents highlighted poor first-aid facilities, inadequate hygiene standards, irregular OHS training sessions, and limited medical coverage as persistent gaps. For instance, only 53% of wellness-related indicators were met, corresponding to a mean of 3.51, which reflects average compliance rather than full adherence. Inferential analysis further revealed no significant difference ($p > 0.05$) in awareness levels between consultants and contractors in most areas, except in specific obligations such as the appointment of a dedicated safety officer, where variations emerged. This indicates that, although awareness is widespread, implementation and consistent practice remain limited across organizations.

These findings partly contrast with earlier studies in other African countries. For instance, Okoye et al. (2016) and Eyiah et al. (2019) found **low safety knowledge and compliance** among construction workers in Nigeria, while Windapo and Oladapo (2012) attributed non-compliance in South Africa to a lack of awareness. In Rwanda, the situation appears different, as **awareness is not the primary challenge**—rather, the issue lies in the **translation of awareness into practice**. This aligns more closely with Mohammed (2014), who argued that compliance often remains low due to weak supervision and lack of safety experts on site, and with Geller (2000), who noted contractor non-compliance with safety regulations in China despite formal knowledge of safety standards.

Overall, the study confirms a **significant relationship between awareness and compliance** in Rwanda's donor-funded road projects, but also highlights gaps in enforcement and practice. While workers and organizations are knowledgeable about OHS policies, compliance is undermined by resource constraints, weak monitoring, and inconsistent implementation. This reflects a pattern where knowledge alone is insufficient without robust enforcement mechanisms and institutional support

CHAPTER 5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

The study assessed the level of awareness, compliance, recommendations for improving compliance, and consequences of non-compliance with Occupational Health and Safety (OHS) regulations on Rwanda's donor-funded road projects. Findings reveal that Rwanda's OHS policies are only moderately adhered to, with significant gaps in implementation across contractors, consultants, and government agencies. Overall, the level of awareness of OHS regulations was found to be within the "Aware" category (3.5–4.49). However, awareness varied across specific components. Consultants and contractors demonstrated higher awareness of immediate safety practices such as PPE use, site inspections, and hazard identification, whereas government stakeholders emphasized long-term impacts, including loss of worker trust, morale, and compensation issues. Despite this, certain areas—such as proper medical coverage, sanitation, and participation of casual workers in safety programs—remained insufficiently prioritized.

The study also highlighted that although most respondents acknowledge the importance of OHS compliance, enforcement remains weak. Non-compliance consequences such as workplace injuries, project shutdowns, and reputational damage were widely recognized. However, issues affecting vulnerable groups (e.g., casual workers without compensation) and broader social consequences (e.g., worker morale, community involvement) received relatively less emphasis. Statistical analysis further showed that while there were no significant differences across many awareness and compliance items, certain areas (such as equipment maintenance, compensation for casual workers, and morale impacts) displayed significant variation between consultants, contractors, and government representatives. This suggests differing priorities among stakeholders, with government agencies being more sensitive to systemic and long-term safety concerns.

In summary, the study concludes that although Rwanda's OHS policies are in place and broadly acknowledged, their implementation on donor-funded road projects remains inadequate. The major shortcomings include:

i. Inconsistent training and weak awareness programs, particularly for casual and vulnerable workers.
ii. Insufficient hygiene and medical coverage, with limited availability of sanitation facilities and unclear policies on compensation.
iii. Poor enforcement and accountability mechanisms, with contractors often escaping penalties for repeated violations.
iv. Limited collaboration and coordination among contractors, consultants, and government agencies, leading to fragmented safety management.

5.1.1. Limitations of the Study

This study is limited to assessing Occupational Health and Safety (OHS) compliance in road construction projects funded by the World Bank and EXIM China Bank in Rwanda. Due to time and resource constraints, the research focused only on selected national and district class road construction sites, excluding smaller or privately funded projects that may also face significant or other kind of OHS challenges. Data collection were affected by limited access to some construction sites and reluctance from certain stakeholders—such as contractor staff or community members—to provide detailed or candid information due to

confidentiality concerns or fear of reprisal. Additionally, the study relies primarily on interviews, document reviews, and field observations, which may not fully capture ongoing or undocumented OHS practices.

Another limitation is the potential bias in self-reported data from contractors and consultants, who may overstate compliance levels. Moreover, the short duration of the study might not allow for long-term observation of OHS outcomes or monitoring of safety improvements over the full project lifecycle. Socio-economic impacts of non-compliance, psychological stress on workers, and long-term health effects are beyond the study's scope, as it primarily evaluates visible and procedural compliance with OHS standards. Lastly, the absence of centralized or up-to-date OHS data from government bodies affected the comprehensiveness of the analysis.

5.2. Recommendations

These findings align with earlier research such as Nkurunziza (2020), which also identified gaps in compliance; however, this study shows that donor-funded projects perform even worse in areas such as medical coverage and worker participation.

To improve compliance with Rwanda's OHS regulations and enhance the safety culture on donor-funded road projects, the following recommendations are proposed:

Regular and structured OHS training sessions: Training should be continuous, covering hazard identification, emergency response, first aid, and worker rights. Casual workers, who are often excluded from formal training, should be actively included.

Provision and timely replacement of PPE and safety equipment: Ensure consistent supply of protective gear such as helmets, vests, gloves, and boots. PPE should be promptly replaced when damaged or worn out to maintain effectiveness.

Strict on-site supervision by government agencies. Active oversight helps to enforce safety standards, identify violations promptly, and hold contractors accountable. This continuous presence also encourages workers and site managers to prioritize safety practices, ultimately reducing the risk of accidents and promoting a safer working environment.

Improved medical coverage and compensation policies: Establish clear and transparent processes for covering medical expenses also guarantee that both permanent and casual workers receive compensation for injuries sustained on-site.

Fining repeated non-compliance cases. Penalties serve as a deterrent against negligence and encourage both workers and contractors to take safety regulations seriously. By holding individuals and companies accountable for persistent violations, this approach promotes a higher level of discipline and responsibility, ultimately leading to a safer and more compliant work environment. Encouraging worker participation in safety management: Workers should elect safety representatives to voice concerns. Anonymous reporting channels should be institutionalized to encourage reporting without fear of retaliation.

Enhancing collaboration among contractors, consultants, and government agencies. When these stakeholders work together, they can share information, align safety standards, and coordinate efforts to implement and monitor OHS programs more efficiently. Strong collaboration fosters clear communication, reduces gaps in policy enforcement, and creates a unified approach to addressing safety challenges on-site.

Establishment of a national OHS database: Develop a centralized system to track workplace accidents, near misses, and compliance records. Data should be shared among stakeholders to inform policy decisions and future safety strategies.

The implementing the above recommendations, Rwanda can significantly improve compliance with OHS regulations, reduce workplace accidents, and foster a culture of safety in road construction projects.

REFERENCES

[1] WHO/ILO., "Global Monitoring Report,Joint Estimates of the Work-related Burden of Disease and Injury," ILO, 2000-2016.

[2] ILO, "Construction: a hazardous work," 2020. [Online]. Available: https://www.ilo.org/resource/construction-hazardous-work#:~:text=At%20least%20108%20thousand%20workers,die%20from%20accidents%20at%20work.. [Accessed 2 7 2025].

[3] D. Almaskati, S. Kermanshachi and A. Pamidimukkala, "Identification of Safety Hazards in Highway Construction Projects," 2024.

[4] S. Blaauw and J. Maina, "Exposure of Construction Workers to Hazardous Emissions in Highway Rehabilitation Projects," p. 21, 2022.

[5] Spagnoletti, "Understanding the Risks Faced by Highway Construction Workers," Eric Rhine, Texas, 2024.

[6] European Commission, "Accidents at work statistics," 2024. [Online]. Available: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Accidents_at_work_statistics. [Accessed 2 7 2025].

[7] D. M.Aires, M. L.Alonso, M. Torres, A. A.Aguilera and P. Arezes, "Occupational risk prevention in the European Union construction sector: 30 Years since the publication of the Directive," *Safety Science,* vol. 177, September 2024.

[8] S. Bijelic, "German highways safer thanks to construction site warnings," 2025. [Online]. Available: https://www.kapsch.net/en/press/releases/ktc-20250520-pr-en. [Accessed 2 7 2025].

[9] ARTBA, "Fatalities and Injuries Trending Downward, New Analysis Shows," 2025. [Online]. Available: https://www.artba.org/news/fatalities-and-injuries-trending-downward-new-analysis-shows/. [Accessed 2 7 2025].

[10] M. Thibault, "The 8 largest OSHA fines of Q1 2022," 2022. [Online]. Available: https://www.constructiondive.com/news/top-8-largest-osha-fines-construction-safety-q1-2022/623664/. [Accessed 2 7 2025].

[11] M. Paguay, J. Febres and E. Valarezo, "Occupational Accidents in Ecuador: An Approach from the Construction and Manufacturing Industries," *Sustainability,* vol. 15, no. 16, 2023.

[12] T. A. Bria, W. Chen, M. Muhammad and M. Rantelembang, "Analysis of Fatal Construction Accidents in Indonesia," *MDPI,* vol. 14, no. 4, 2025.

[13] K. Hongji and S. Hyonhee , " South Korea highway construction project collapse," 2025. [Online]. Available: https://www.reuters.com/world/asia-pacific/three-people-dead-five-hurt-south-korea-highway-construction-site-yonhap-says-2025-02-25/. [Accessed 2 7 2025].

[14] M. Olebogeng, "The deadly gap in South Africa's highway construction safety," 2024. [Online]. Available: https://www.engineeringnews.co.za/article/the-deadly-gap-in-south-africas-highway-construction-safety-2024-09-10. [Accessed 2 7 2025].

[15] W. S. Elvis, M. Kiambigi and J. Okak, "A Strategy for Effective Safety Management in Construction Sites in Kenya," *East African Journal of Engineering,* 2023.

[16] A. . H. Ahanga , "Occupational Health and Safety Practices for the Construction Sector's Projects Performance in Uganda," vol. 11, no. 10, pp. 1-18, 2024.

[17] MINECOFIN, "Vision 2050," MINECOFIN, Kigali, 2019.

[18] . D. Nkurunziza, "Investigation into Road Construction Safety Management Techniques," *Open Journal of Safety Science and Technology,* 2020.

[19] D. Oluwaseun and L. Inshuti, "Awareness and Compliance of Construction Employers with the National Occupational Safety and Health (OSH) Regulation of Rwanda," *Rwanda Journal of Engineering, Science, Technology and Environment,* p. 1, 2025.

[20] N. Al-Naser and H. A.Tabtabai, "The impact of safety violations on construction project performance: A case study of the ADFA project," *Journal of Engineering Research,* pp. 1-14, 2024.

[21] F. Handoko, M. Wijayaningtyas, I. H. A. Kusuma, S. Hidayat and A. A. Z. Ismail, "The Occupational Health and Safety Effect on Road Construction Worker Performance," *Civil Engineering and Architecture,* vol. 8, no. 5, pp. 750-759, 2020.

[22] A. R. A. Hamid, A. R. A. Razak, A. M. Yusof, R. P. Jaya, R. Zakaria, . E. Aminudin, M. A. S. K. Anuar, K. Yahya, Z. Haron, R. Yunus and I. A. Rashid, "Noncompliance of the occupational safety and health legilsation in the Malaysian construciton industry," *IOP conf. series: Earth and Environmental Science,* pp. 1-8, 2019.

[23] Q. Wong, N. Sapuan and W. Khan, "THE IMPACT OF SAFETY AND HEALTH ISSUES ON THE CONSTRUCTION WORKFORCE PRODUCTIVITY IN MALAYSIA," *Journal of Governance and integrity,* vol. 6, no. 1, pp. 504-514, 2022.

[24] K. Hussain, A. Hussain, M. H. Talpur, M. Akhund and F. Hussain, "Occupational Health Problems in Construction Industry: A Case Study," *Sindh University Research Journal (Science Series),* vol. 48, no. 4, pp. 737-740, 2016.

[25] P.Hämäläinen, J.Takala and K. Boon, "Global Estimates of Occupational Accidents and Work-Related Illnesses 2017," Ministry of Manpower Services Centre,, Singapore, 2017.

[26] T. V., V. Golinko, S.Cheberiachko and O.Deryugin, "RELATIONSHIP OF THE CONCEPTS: "OCCUPATIONAL PROTECTION" AND "OCCUPATIONAL SAFETY AND EMPLOYEE HEALTH"," *Labor protection problems in Ukraine,* vol. 40, no. 3-4, 2024.

[27] L.Kakhidze, N.Razmadze, N.Ratiani, M.Qitoshvili and N.Gumberidze, "Occupational health and safety standards and issues in the construction sector," *Georgian scientists,* pp. 473-482, 2025.

[28] S. Kurniawan and A.Mawardi, "Occupational Safety Health and Work Motivation on Worker Performance Construction Projects," *ASTONJADRO,* vol. 14, no. 2, pp. 554-564, 2025.

[29] A.Baghdadi, "Navigating occupational safety and health challenges in sustainable infrastructure projects: a comprehensive review," *Frontiers in built environment,* vol. 10, 2024.

[30] A. A. Oyen, H.Ismaeel, D.Tann and O.Olatoye, "Theory of Occupational Health and Safety Costs for Construction Sector," 2025.

[31] Ministry of Public Service and Labour, "National occupational safety and health strategy," MIFOTRA, Kigali, 2019.

[32] WorldBank, "world bank environmental and social policy for investment project financing," 2018.

[33] Z.Haki, F.Achmadi and P.Vitasari, "Analysis of Safety Climate Factors to Improve Occupational Safety and Health in Construction Work at PT XYZ Bunyu Field," *Jurnal Rekayasa sistem industri,* vol. 14, no. 1, pp. 38-45, 2025.

[34] D.Almaskati, S.Kermanshachi, A.Pamidimukkala, K.Loganathan and Z.Yin, "A Review on Construction Safety: Hazards. Mitigation Strategies, and Impacted Sectors," *Buildings,* vol. 14, no. 2, p. 526, 2024.

[35] M. Alqarni and R. Shah , "An Investigation of Health and Safety Issues at Highway Construction Sites in Developing Countries," *Journal of Advanced College of Engineering and Management,* vol. 4, pp. pp. 83-93, 2018.

[36] K.Adetunji, M. Misnan, Z.Ismail, F. Rahim and Z.Abdul-Samad, "Approaches to Improving Occupational Health and Safety of the Nigerian Construction Industry," in *Risk Management in Construction - Recent Advances*, N. G. a. A. S. Hasan Tosun, Ed., 2024.

[37] X.Suiaosheng, K. Yin, G. Ho, H. Yip and Y.M.Tang, "A bibliometric study on technology usage for occupational safety and health risk assessment in construction industry," *Journal of Asian Architecture and Building Engineering,* 2025.

[38] S.Shikhar, S. Anshuman, S.Sandeep, R. A. N. Marathe, J.Chakresh and N.Priyanshi, "Awareness Of Occupational Health Hazards & Practice of Safety Measures Among Construction Workers in Rewa City," *Indian Journal of Public Health and Research Development,* vol. 16, no. 1, 2025.

[39] A.Khan, M.Shakeel, M.Khan, N.Sohail, N.Shahab and M.Wasil, "Qualitative risk evaluation of occupational health and safety measures of under-construction Indus Highway N-55: A Case Study," *IEEE,* pp. 1-8, 2023.

[40] D. Sunday, L.Inshuti, J.Neema and D. Gbeminiyi, "Awareness and compliance of construction employers with the National Occupational Safety and Health (osh) regulation of Rwanda," *Rwanda Journal of Engineering, Science, Technology and Environment,* vol. 7, no. 1, 2025.

[41] J.Gasana, A. Loulwah and E.Iden, "O-396 OCCUPATIONAL SAFETY AND HEALTH (OSH) NEEDS IN AFRICA – IDENTIFICATION OF PRIORITIES, BARRIERS, AND SOLUTIONS THROUGH MODIFIED DELPHI METHOD USING OSHAFRICA PLATFORM," *Occupational Medicine,* vol. 74, no. 1, 2024.

[42] A. Ph.D.Lu, "Investigation of the Trench Collapse at I-95 on February 4, 2018, in Miami, FL," U.S. Department of Labor, Miami, 2018.

[43] ITUC, "The case against Qatar," ITUC, 2014.

[44] W. Stephenson, "Have 1,200 World Cup workers really died in Qatar?," 2015. [Online]. Available: https://www.bbc.com/news/magazine-33019838. [Accessed 10 6 2025].

[45] E.Grimsholm and L.Poblete, *Internal and External factors hampering SME growth,* Gotland: Gotland university, 2010.

[46] S. McLead, "Qualitative Vs Quantitative Research Methods," 2025. [Online]. Available: https://www.simplypsychology.org/qualitative-quantitative.html. [Accessed 10 6 2025].

[47] E. Bell, A. Bryman and B. Harley, Business Research Methods, Fifth edition ed., Oxford: Oxford University Press, 2019.

[48] M. A. Anas, "Inductive Vs Deductive Research: Difference of Approaches," [Online]. Available: https://www.questionpro.com/blog/inductive-vs-deductive-research/. [Accessed 10 6 2025].

[49] S.Tripathi, P.LPatel, N.K.Mishra and D.B.Suryawanshi, "Sampling Designs-Probability and Non-Probability Sampling," in *Research Methodology in Extension Education*, New Delhi, Elite Publishing House, 2024, pp. 75-81.

[50] S.Ellen, "Slovin's formula sampling techniques," 2022. [Online]. Available: https://www.sciencing.com/slovins-formula-sampling-techniques-5475547/. [Accessed 22 8 2025].

[51] W.Xiaoyan, *An Empirical Investigation of Personal and Social Factors on Knowledge Sharing in China,* 2010.

[52] T.Rose, "Investigating factors which influence M-payment services adoption by Iranian customers," 2009.

[53] J.Frost, "Cronbach's Alpha: Definition, Calculations & Example," 2022. [Online]. Available: https://statisticsbyjim.com/basics/cronbachs-alpha/.

[54] . H. Jimmie and G. John , "Factors That Influence Safety Performance of Specialty Contractors," *OURNAL OF CONSTRUCTION ENGINEERING AND MANAGEMENT,* 2003.

[55] R. A. Machfudiyanto, S. Kim, Y. Latief, T. Sari, N. Rachmawati and N. B. Laksono, "Analysis of design-for-safety implementation factors in the Indonesian construction industry: A two-staged SEM-artificial neural network approach," *Heliyon,* pp. 2-15, 2023.

[56] P. Abos, K. Boateng and M. Andersson, "Validity and Reliability: The extent to which your research findings are accurate and consistent," Taipei, 2024.

[57] Statement, World Bank, "World Bank Statement on Cancellation of the Uganda Transport Sector Development Project," in *David Theis*, Washington, 2015.

[58] t. Guardian, "World Bank announces multimillion-dollar redress fund after killings and abuse claims at Tanzanian project," Guardian, 2024.

[59] D. T. Bee and D. Murdoch-Eaton, "Questionnaire design: the good, the bad and the pitfalls," 2016.

[60] D. Kuphanga, "Questionnaires in Research: Their Role, Advantages, and Main Aspects".

[61] Y. Haji-Othman and M. S. S. Yusuff , "Assessing Reliability and Validity of Attitude Construct Using Partial Least Squares Structural Equation Modeling (PLS-SEM)," *International Jouranl of Academic Research in Business & Social Sciences,* vol. 12, no. 5, pp. 378-385, 2022.

[62] A. Z. M. Khairul, I. Syuhaida and S. L. Abd, "Contractor's Performance Appraisal System in the Malaysian Construction Industry: Current Practice, Perception and Understanding," *International Journal of Engineering & Technology,* vol. 7, no. 3, pp. 46-51, 2018.

[63] S. Dr. Rashmi, "Reliability and its types," India.

[64] P. C. Price, R. S. Jhangiani, I.-C. A. Chiang, D. C. Leighton and C. Cuttler, "Reliability and validity of measurement," in *Research Methods in Psychology, 3rd ed.*, SAGE publications Ltd, 2017, p. 584.

[65] W. M. Lim, "A typology of validity: content, face, convergent, discriminant, nomological and predictive validity," *Journal of Trade Science,* vol. 12, no. 3, pp. pp. 155-179, 2024.

[66] F. Middleton, "Reliability vs. Validity in Research | Difference, Types and Examples," 2019. [Online]. Available: https://www.scribbr.com/methodology/reliability-vs-validity/. [Accessed 10 6 2025].

[67] E. Heffernan, "Types of Validity in Research | Definition & Examples," 2024. [Online]. Available: https://quillbot.com/blog/research/types-of-validity/. [Accessed 10 6 2025].

[68] A. Fashir, "Health-and-safety-policy-requirements-in-the-workplace," https://absolutehealth.co.za/author/ahs/, 2019.

[69] E. Iden, "Abstracts of the 33rd International Congress on Occupational Health 2022 (ICOH 2022) 6–10 February 2022," *Elsevier Korea LLC,* p. s9, 2022.

[70] Internation Labour Organization, "C155 - Occupational Safety and Health Convention, 1981," https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312300, 1981.

[71] ILO, "Promotional Framework for Occupational Safety and Health Convention," ILO, 2006.

[72] M. RWANDA, "National Strategy on Occupational Safety and Health 2019-2024," MIFOTRA, Kigali, 2019.

[73] U. Nations, "United Nations Sustainable Development Goals," https://unric.org/en/wp-content/uploads/sites/15/2020/01/sdgs-eng.pdf, 2015.

[74] ILO, "ILO Convention Ratification," ILO.

[75] United Natons , Global status report on road safety, New York , United States of America: World Health Organization (WHO), 2018.

[76] M. Wijayaningtyas, I. Sipan and K. Lukiyanto, "nformal worker phenomenon in a housing construction projects," in *AIP Conference Proceedings*, 2017.

[77] E. O. E. O. Bonface Maturi Nyabioge, "Construction Health and Safety Management and its Influence on ProjectSuccess in Nairobi County," *International Journal of Soft Computing and Software Engineering [JSCSE],* p. 19, 2021.

[78] J. A. K. R. Moavenzadeh, "The Construction industry in developping countries," Massachusetts Institute of Technology, Cambridge, Massachusetts, 1976.

[79] G. Ofori, "Construction in Developing Countries: A Research Agenda," 1990.

[80] M. S. Boz'ena Hola, "Analysis of the Development of Accident Situations in the construction industry," *Elsevier,* p. 429, 214.

[81] R. Irumba, "Spatial analysis of construction accidents in Kampala, Uganda," *Elsevier,* vol. 64, p. 109, 2014.

[82] U. N. G. Compact, "(A Safe and Healthy Working Environment);Nine Business Practices for Improving Safety and Health Through Supply Chains and Building a Culture of Prevention and Protection," United Nations Global Compact, 2021.

[83] WHO, "WHO mortality data base," WHO, 2023.

[84] U. O. Peter , U. E. John and O. E. Fidelis , "Building Construction Workers' Health and Safety Knowledge and Compliance on Site," *Journal of Safety Engineering ,* 2016.

[85] R. M. o. P. S. a. Labour, "Labor code,Article 91 of the Mninisterial order No 02 of 17/05/2012 Determining conditions for Occupational Health and Safety," Ministry of Justice, Rwanda, 2009.

[86] A. Kofi , S. Barbara and B. Seth , "Factors influencing the performance of safety programmes in the Ghanaian Construction Industry," *Acta Structilia ,* 2018.

[87] M. Loosemore and N. Andonakis, "Barriers to implementing OHS reforms – The experiences of small subcontractors in the Australian Construction Industry," *International Journal of Project Management,* 2007.

[88] World Bank Group, "Environmental, Health, and Safety General Guidelines," World Bank Group, Washington, D.C, 2007.

[89] P. Tukesiga, S. Diang'a and O. A. Gwaya , "Health and Safety Performance in the Construction Industry in Rwanda," *International Journal of Soft Computing and Engineering,* p. 22, 2019.

[90] MIFOTRA, "Laobor Code ,article 90-96 of the Ministerial Order No 02 of 17/05/2012 Derermining conditions for Occupational Heath and Safety ;Ministerial Order No 01/Mifotra/ 15of 15/01/2015 Establishing Modalities and functioning of Occupational Heath and Safety," Ministry of Labour and Public service, Rwanda,Kigali, 2012.

[91] S. H. Khahro, M. A. H. Talpur, T. H. Ali and M. A. Akhund, Occupational Health Problems in Construction Industry: A Case Study, Department of EM, CoE, Prince Sultan University, Kingdom of Saudi Arabia: SINDH UNIVERSITY RESEARCH JOURNAL (SCIENCE SERIES), 2016.

[92] M. W. I. H. A. K. S. H. A. I. Z. A. Fourry Handoko, "The Occupational Health and Safety Effect on Road Construction Worker Performance," Civil Engineering, National Institute of Technology Malang, Indonesia, 2020.

[93] ILO, "DG Labour Market Indicators (ILOSDG)," ILO, 2022.

[94] F. Handoko, P. Visatari, S. Hidayat and M. E. Tjahjadi, "Constructing Knowledge and Technology Transfer Model for SMEs Technology Development in Indonesia," *International Journal of Pedagogy and Teacher Education,* vol. 1, no. 2, p. pp.93, 2017.

APPENDICES

Appendix 1. Questionnaire

SECTION A: BIO-DATA

Instruction: Please tick good (√) for your correct option selected among the options provided for each question

1. **What is your gender?**
☐ a. Male
☐ b. Female

2. **What is your age group?**
☐ a. 18 – 25
☐ b. 26 – 35
☐ c. 36 – 45
☐ d. 46 – 55
☐ e. 56 and above

3. **Highest Academic Qualification**
☐ a. secondary
☐ b. Bachelor (BSc) Degree
☐ c. Master's Degree
☐ d. Ph.D.

4. **Working Experience**
☐ a. Less than 1 year
☐ b. 1- 3 years
☐ b. 4 – 6 years
☐ c. 7 – 10 years
☐ d. 10 years and above

5. **Which highway project are you involved in?**
☐ a. Rwanda Feeder Roads Development Project (RFDP)
☐ b. Lake Victoria Transport Program (LVTP)
☐ c. Huye–Kibeho road project

6. **What is your current role in the above highway construction projects?**
☐ a. Project Manager
☐ b. Site Engineer
☐ c. Construction Worker
☐ d. Consultant
☐ e. Site Inspector
☐ f. Government Agency
☐ g. Other (please specify): _____

10. **What type of organization did you work for?**

☐ Consultancy Firm
☐ Contracting Firm
☐ Government Agency

11. **Is your organization public or private?**

☐ Public
☐ Private

12. **Which professional body are you registered with? (Tick all that apply)**

☐ Institution of Engineers Rwanda (IER)
☐ Rwanda Institute of Architects (RIA)
☐ Project Management Professional (PMP)
☐ Rwanda Institute of Quantity Surveyors (RIQS)
☐ Rwanda Association of Professional Environmental Practitioners (RAPEP)
☐ Rwanda Association of Consulting Engineers (RACE)
☐ Association of Construction Managers of Rwanda (ACMR)

SECTION B: "QUESTION ITEMS ON "COMPLIANCE OF HIGHWAY WORKERS WITH THE OCCUPATIONAL HEALTH AND SAFETYPOLICIES OF RWANDA

Objective A: To assess the level of compliance of highway workers with Rwanda's OHS policy

Please rate by ticking your level of agreement with the following statements (5 = Very Well, 4 = Well, 3 = Average, 2 = Slightly Well, 1 = Not Well).

Assessing the level of compliance of highway workers with Rwanda's OHS policy	1	2	3	4	5
PPE					
1. How well do you wear all the required PPE (helmet, gloves, boots, reflective vest) while on site?					
2. How well you receive trainings or guidance on the correct use of PPE?					
3. How well is the condition of PPE maintained (cleanliness, replacement when damaged)?					
4. How well are PPEs regularly supplied on site?					
FIRST-AID AND HYGIENE STANDARDS					
5. How well are hygiene and sanitation facilities (toilets, drinking water, rest areas) provided at your site?					
6. How well are hygiene facilities maintained?					
7. How well first-aid equipment is made available on site?					
8. How well are you trained on basic first aid response procedures?					
TRAININGS on OHS					
9. How well are safety briefings and toolbox meetings conducted regularly on your site?					
10. How well are training sessions organized to address actual safety risks on site?					

SITE SUPERVISION AND HAZARD CONTROL PROCEDURES					
11. How well are safety signs and warnings posted and understood across the construction site?					
12. How well do supervisors enforce compliance with safety procedures					
13. How well are emergency response procedures implemented on site?					
14. How well are safety hazards identified and controlled during daily operations?					
15. How well do workers report unsafe practices or hazards to supervisors?					
16. How well do employers and workers collaborate to identify and address safety issues?					
MEDICAL COST COVERAGE					
17. How well are workers informed about the availability of medical coverage?					
18. How well are medical expenses for occupational injuries covered by the employer or project authorities?					
19. How well is the process for claiming medical cost reimbursement handled?					
REPORTING AND COMPENSATION FOR ACCIDENTS					
20. How well does your site respond to reported safety concerns or hazards?					
21. How well are accidents and incidents documented and investigated at your worksite?					
22. How well is the process of reporting accidents understood by workers?					
23. How well are workers encouraged to report work-related accidents or near misses?					

Objective B: To examine the benefits of complying with OHS policy

Please rate by ticking your level of agreement with the following statements (5= Strongly Agree, 4= Agree, 3 = Neutral, 2= Disagree, 1= Strongly Disagree).

Benefits of complying with OHS policy	1	2	3	4	5
1. It reduces the risk of injuries and accidents.					
2. It increases workers' confidence and productivity on site.					
3. It promotes a safer and more organized work environment for employees.					
4. It enhances the company's reputation and credibility					
5. It reduces work stoppages and delays due to accidents or inspections.					
6. It minimizes legal risks and penalties for the company.					
7. It builds trust between implementing agencies and funding partners.					
8. Complying with OHS regulations helps me avoid long-term disability.					
9. Safe practices reduce the stress and fear of getting injured at work.					

10.	OHS compliance protects me from breathing dust or toxic chemicals.					
11.	When safety procedures are followed, my work becomes easier to manage.					
12.	OHS compliance helps reduce worker absenteeism caused by injury.					
13.	Having access to PPE allows me to perform physically demanding tasks more safely.					
14.	A safe workplace encourages me to come to work regularly.					
15.	Knowing safety is taken seriously makes me feel valued as a worker.					
16.	Complying with safety rules makes me feel part of a professional workforce					
17.	Fewer accidents mean I can keep earning money without interruption.					
18.	Being part of a safe site gives me more chances to be selected for future projects.					
19.	Safety compliance improves the relationship between workers and management.					
20.	A safety-compliant site is more likely to attract continued project funding.					
21.	OHS compliance strengthens teamwork between contractors and workers.					
22.	Good safety records help employers win more contracts, which means more job opportunities.					

Objective C: To identify risks associated with non-compliance of OHS

Please rate by ticking your level of agreement with the following statements (5= Strongly Agree, 4= Agree, 3 = Neutral, 2= Disagree, 1= Strongly Disagree).

Identifying risks associated with non-compliance of OHS		1	2	3	4	5
RISKS						
1.	Non-compliance with OHS standards increases the chance of workplace injuries					
2.	Failure to use PPE exposes workers to health hazards.					
3.	Inadequate supervision on-site increases the chances of unsafe practices.					
4.	Lack of regular safety training contributes to unsafe work behavior.					
5.	Ignoring safety rules increases the likelihood of falling, slipping, or being struck by objects.					
6.	Workers without proper training are more likely to cause accidents for themselves or others.					
7.	Working in unsafe conditions causes mental stress and fear among workers.					

8.	Lack of clean water or toilets increases the risk of diseases on site.					
9.	Poor communication between workers and supervisors increases safety misunderstandings.					

Objective D: To identify consequences of non-compliance with OHS

Please rate by ticking your level of agreement with the following statements (5= Strongly Agree, 4= Agree, 3 = Neutral, 2= Disagree, 1= Strongly Disagree).

Identifying consequences of non-compliance with OHS	1	2	3	4	5
CONSEQUENCES					
1. Injuries resulting from non-compliance can lead to long term disability or death.					
2. Non-compliance with OHS can result in legal penalties or project shutdowns.					
3. Accidents caused by safety negligence increases project costs due to medical expenses.					
4. Unsafe working conditions damage the reputation of the contractor or employer.					
5. Workers injured due to non-compliance may lose income while recovering.					
6. Casual workers often do not get compensated after accidents due to unclear policies.					
7. Serious accidents reduce workers' trust in their employers and the project.					
8. Families of injured workers suffer financially due to lack of compensation.					
9. Non-compliance with OHS leads to loss of morale among workers.					
10. Worker's fear speaking up about risks when past accidents were ignored.					
11. Projects with many accidents may face protests or strikes from workers.					

Objective E: To recommend strategies and mechanisms to improve compliance

Please rate by ticking your level of agreement with the following statements (5= Strongly Agree, 4= Agree, 3 = Neutral, 2= Disagree, 1= Strongly Disagree).

Recommending strategies and mechanisms to improve compliance	1	2	3	4	5
1. More regular training would help improve OHS compliance.					
2. Stronger enforcement by government agencies would improve site safety.					
3. Workers should be more involved in site safety decisions					

4.	Management should provide better safety tools and PPE.					
5.	Introducing financial penalties would increase compliance.					
6.	Training should include practical demonstrations, not just lectures.					
7.	Safety information should be shared in local languages spoken by workers.					
8.	Refresher training sessions should be provided regularly throughout the project.					
9.	Workers should elect a safety representative to speak on their behalf.					
10.	Workers should be given anonymous ways to report unsafe conditions.					
11.	Workers should be rewarded or recognized for reporting hazards.					
12.	PPE should be replaced quickly when damaged or worn out.					
13.	Safe resting areas and clean sanitation should be mandatory on all sites.					
14.	Equipment used on site should be regularly maintained to avoid accidents.					
15.	Surprise safety audits by independent inspectors should be introduced.					
16.	Contractors should be held accountable for repeated safety violations.					
17.	Non-compliant sites should face temporary shutdowns until corrected.					
18.	Community members should be involved in monitoring safety near road projects					
19.	Contractors and supervisors should attend safety workshops before projects begin.					
20.	A national database should track accidents and safety issues on road projects.					
21.	More coordination between contractor, consultant, and government would improve safety.					