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ANALYSIS OF INTEGRATED MANAGEMENT SYSTEM IMPLEMENTATION IN PROJECT EXECUTION, A CASE OF CONSTRUCTION PROJECTS IN RWANDA

Thesis: Presented and defended in fulfilment of the requirements for the award of the Degree of Doctor of Philosophy in Business Administration and Project Management at Université Privée Africaine Franco-Arabe (U.P.F.A.)

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CERTIFICATION

This is to certify that the thesis entitled: "Analysis of integrated management system implementation in project execution, a case of construction projects in Rwanda" Submitted by GAKWAYA Abdoulbaasit to the **Université Privée Africaine Franco-Arabe (U.P.A.F.A.)** for the award of Doctor of Philosophy (PhD) in Business Administration and Project Management under my direct supervision and guidance. The work embodied in this thesis is original and has not to my knowledge been published or submitted in part or full for any other Degree of this or other University.

Supervisor

Froduard Muhayimana, PhD

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DEDICATION

Dedicated to my father and my mother, most especially to my wife who strived to see my dreams come true.

To my brothers and sisters who taught me that it is never too late to make my dreams a reality

To friends and colleagues who supported me.

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DECLARATION

I, GAKWAYA Abdoulbaasit, declare that the content of this thesis is my own work except where acknowledged. It has never been presented or submitted anywhere else for any other or similar award at any other university or institution of high learning.

GAKWAYA Abdoulbaasit

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ABSTRACT

In line with improving quality levels and waste reduction, some organizations utilize project management tools, integrating them with other management system standards to benefit from the improved process implementation of a project. On the other hand, other organizations do their work within isolated management systems, where gaps are observed according to researchers. This thesis, therefore, presents the implementation analysis of an integrated management system for the success of project management, the case of construction projects in Rwanda. The objective of this study is to show a clarification of literature on researcher's analysis of the implementation of integrated management systems in the AGATARE road construction project in the Nyarugenge District of Kigali - Rwanda. In the research process, where the method was to analyze the use of tools for planning and control measures in project management. However, the research findings show that it is important to implement integrated management system in organizations, expecting waste reduction in the project implementation as the results suggest that it is positively related to operational performance.

Key Words: *Quality, Safety, Risk assessment*

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LIST OF ABREVIATIONS

ABREVIATIONS	MEANING
CEPGL	Economic Community of the Great Lakes Countries
CoK	City of Kigali
COMESA	Common Market of Eastern and Southern Africa
CQM	Centre of Quality Management
EAC	East African Community
EU	European Union
GoR	Government of Rwanda
IMS	Integrated Management System
ISO	International Standards Organization
ISO	International Organization for standards
MD	Major Drains
MIFOTRA	Ministries of Health, Public Service and Labor
MINICOM	Ministry of Commerce
NSB	National Standards Body
NST1	National Strategies of Transformation
OHSMS	Occupational Health and Safety Management System
SDGs	Sustainable Development Goals
SDs	Secondary Drains
TQM	Total Quality Management
USA	United States of America
WB	World Bank
WTO	World Trade Organization

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CHAPTER ONE: GENERAL INTRODUCTION

Based on the context of any organization tailored to improve its performance, the scope of one or more management systems plays an important role. The organization must develop a commitment of implementing management systems through recognized standards certification. An example of one of many is International Standard of Organizations (ISO) standards and any other standardization programs available in the country. The objective of this study is to analyze the application of integrated management system (IMS) in a successful project execution, a case of construction projects in Rwanda. The researcher found that despite efforts made in achieving a successful organization/project execution, it is often challenging if there is no implementation of standard managements systems. However, the implementation of integrated management system (IMS) for successful business running is the best choice.

1.1. Background of the study

After the tragedy of 1994 genocide against Tutsi in Rwanda that made the country to rise from scratch, the governance of Rwanda opted for rebuilding the country through responding to markets demands of quality products and services. It is in this spirit that Rwanda became a member of World Trade Organization (WTO) since 1995 and has joined Regional Economic Communities including (EAC), Common Market of Eastern and Southern Africa (COMESA) and Economic Community of the Great Lakes Countries (CEPGL) which opened access to wider markets and ultimately increasing demand for safe and quality products and services. The Country has also signed several free trade agreements to benefit from advantages offered by the multilateral trading system. Furthermore, Rwanda is among the very few countries worldwide that have embarked on the process of domestication of Sustainable Development Goals (SDGs) targets as reflected in the National Strategy for Transformation (NSTI). (MINICOM, 2018).

It is in the context of enhancing quality products and service delivery that the National quality policy was put in place in 2010 and revised in 2018 where it is clearly mentioned that the issue is that “In the present environment of increased globalization, quality has a very important role to play in technological progress, health, safety, environmental protection, productivity, and trade promotion. Hence, to have competitive products and services on both local and global markets, there is a need to have a fully functional and internationally recognized National Quality Infrastructure (NQI) that can provide the required independent and reliable evidence of product and service compliance supported by well-coordinated Standardization processes

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that involve active participation of key players at all levels and backed by knowledgeable society on matters pertaining to quality. (MINICOM, 2018)

Rwanda as a country with visionary leadership, in its seven years National strategy for transformation known as NST1 which is a tool for implementation of Sustainable development goals, in its rationale the following is mentioned: The Vision 2050 aspires to take Rwanda to high living standards by the middle of the 21st century and high quality livelihoods and the implementation instrument for the remainder of Vision 2020 and for the first four years of Vision 2050 will be the National Strategy for Transformation (NST1). This is expected to provide the foundation and vehicle towards Vision 2050. Specific priorities and strategies are presented in different pillars discussed in Vision 2050 aspirations focusing on five broad priorities among others:

- High Quality and Standards of Life
- Developing Modern Infrastructure and Livelihoods
- Transformation for Prosperity
- Values for Vision 2050
- International cooperation and positioning (NST1, Government of Rwanda,2017).

These pillars are the inspiration of Rwandan government to collaborate with the World bank and the local private Sector in implementation of road project and other public infrastructure where high quality standardized services are to be delivered in providing high quality standard of life to Rwandans through the development of modern infrastructure and general transformation for prosperity.

However, the lack of formal management systems is a reality for most organizations/projects except for standardized quality systems, which are increasingly used globally. **(**Abreu et al. 2008; Maekawa et al., 2013; Neiva Neto et al, 2013).

In this context, this research aims at presenting a study carried out in Rwandan one of asphalt roads project owned by World Bank, constructed in the City of Kigali by one local ISO certified engineering company known as Horizon Construction, more especially to examine the application of an integrated management system (IMS) for the implementation of a successful project execution.

An Integrated Management System refers to integrating more than one organization's management systems into a single system. This integrated management implies a system that is more user friendly, effective, and efficient. The integrated management system is also said

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to reduce waste of work and optimizes time and resources of an organization. Spending time on making improvements magically reduces the time required for compliance activities.

The concept of analyzing the implementation of Integrated Management System (IMS) for successful project execution has become common for over the past 20 years. A variety of standard management systems such as ISO standards and guidelines were developed within public sector and private sector including and non-profit local and international organizations. The idea if IMS implementation sounds unfamiliar in Rwanda. Various organizations implement local management systems which suite the context of their organizations rather than implementing international standard management systems such as Quality Management System (ISO 9001), Occupational Health and Safety Management System (ISO 45001) and Environmental Management System (ISO 14001). There is a need for Rwandan organizations to implement international standards and guidelines in developing various process and procedures as tools to their useful management systems like other countries globally. However, top management of an organization/project requires commitment to focus on continual improvement for successful implementation integrated management system (IMS). Today, it is hard to point a leading country because there are leading companies scattered in many countries. However, as the global economy keeps changing, organizations face tougher competition than in the past. Consequently, they keep looking for better solutions. In 1993, a study carried out showed that organizations which installed total quality management (TQM) did not make much success while successful companies were those that advocated for total quality without limiting themselves to the techniques identified with total quality management (TQM), but rather seek to integrate with other techniques. The most successful managers were those that designed their own management systems based on total quality management (TQM) techniques as well as integrating other techniques such as the management systems. (Lee, Shiba & Wood 1999).

This is because profit will not be achieved if companies focus only on quality and neglect other aspects such as internal and external environment, resource management and social responsibility etc. This is also because interested parties are shifting their measure of quality of a product or service to a more qualitative assessment by paying attention to how organizations treat their environment and workers in addition to the quality standard. (Salomone, 2007). For this study, the assessment of these three standard management systems can positively impact the implementation of organizations/projects by increasing competitive nature and acquire several management systems. Those are Quality management system

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Quality Management System (ISO 9001), Occupational Health and Safety Management System (ISO 45001) and Environmental Management System (ISO 14001). All the above is done in a bid to improve profit and move towards a more sustainable development.

The EU Sustainable Development Strategy was made in June 2006 to identify and develop actions to "enable the EU to achieve a continuous long-term improvement of quality of life through the creation of sustainable communities able to manage and use resources efficiently, able to tap the ecological and social innovation potential of the economy and in the end able to ensure prosperity, environmental protection and social cohesion" (European Commission 2007).

In addition to the above, from the 1960s, more industries, especially in the developing world began to consider the costs of the effect of its operations on the environment. Efficient use of energy and resources were seen as obvious targets for improvement. And since these could lead to cost reduction, there won't be conflicts between its attainment and the industry's aim. Governments across Europe and the European Commission have increasingly been implementing stringent environmental legislation to ensure that industries and organizations consider cradle to grave management of their products (Welford, 1996).

Therefore, the environmental impact should be considered always from the design to the disposal stages of the products. Companies can do so by implementing Environmental Management System ISO 14001. The integrated management system combines health and safety, quality service delivery and Environment protection measures which are in line with the aspiration of Rwandan government towards improving the livelihoods of its citizens.

1.2. Problem statement

This research advanced the notion that although the efforts of the management is ensuring a continual improvement condition. However profitable quality, occupational safety and health measures put in place may depend on everyone. Hence, top management commitment is required to involve physical, human, and financial resources for continual improvement. This is the perspective from which the study derived its purpose to probe into the analysis of application of integrated management system principles in successful implementation of construction projects.

Hence, the lack of the IMS management systems will lead to unexpected compensational costs, by ignoring that prevention cost is much lower to compensational cost. Today, Rwanda does not have such active entity responsible to monitor and evaluate these measures for projects. Because of the existing issue, the researcher got compelled to do research in analyzing the

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application of integrated management system in successful project completion with a case of Rwanda's AGATARE project of Construction works for Nyarugenge District infrastructure upgrading. Integrated management system (IMS) contributes as an integral component to the viability of business for the organizations/projects. Naturally a need for continual improvement is a paramount human concern. Like all companies in Rwanda, organizations/projects should employ the globally accepted ISO 9001, ISO 14001 and ISO 45001 regulatory standards for standard requirements, environmental management, health, and safety administration in workplaces. (MIFOTRA, 2012).

Integrated Management System (IMS) based on ISO 9001:2015, ISO 45001:2018 and ISO 14001:2015 standards are worldwide known for quality management system, occupational health and safety management system and environment management system respectively. All these three standards follow the same high-level structure, which implies to be very easy for organizations looking to integrate any two of these three standards or all the three. To ease the process of integration, a combination matrix of ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018 presents an Integrated Management System (IMS), which fits for an organization or any successful project implementation.

As the researcher analyzed the implementation of quality, safety, and environment management aspect he intended to understand the scope of the project in the first place. The AGATARE project of Construction works for Nyarugenge District infrastructure to be upgraded was divided in 3 categories:

- Access streets sealed with asphalt concrete, with one walkway and one covered channel also to be used as a walkway.
- Drains divided in Major Drains (MDs) and Secondary Drains (SDs)
- Footpaths with different sizes

The initial scope of the project was the construction of 5.11 km of access streets, 3.698 km of footpaths with streetlights, 2.028 km of Major Drains (MDs) and 0.918 km of Secondary Drains (SDs). After a couple of revisions, the final scope of the infrastructure development got upgraded to 6.6 km of access roads and 6.2 km of footpaths, 2.512 km of drainage systems were installed, and 1.5 km of streetlights were installed. Apart from these main components of the project, there were also some other works like relocation of utilities including water pipes, electrical poles, fiber optics and others, addition streetlights to already existing roads and relocation of water tank belonging to the Lycée De Kigali secondary school which was demolished and reconstructed in a reasonable distance away from the roadway.

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All the phases of project execution involved human, physical, and financial resources for a period of three years. The researcher's concern was to find out risks and hazards which were involved in The AGATARE project of Construction works and suggest better options of management systems as a going forward solution to a successful project implementation. That is the application of IMS. The figure below shows Nyarugenge urban upgrading project site map, which includes details of legend.

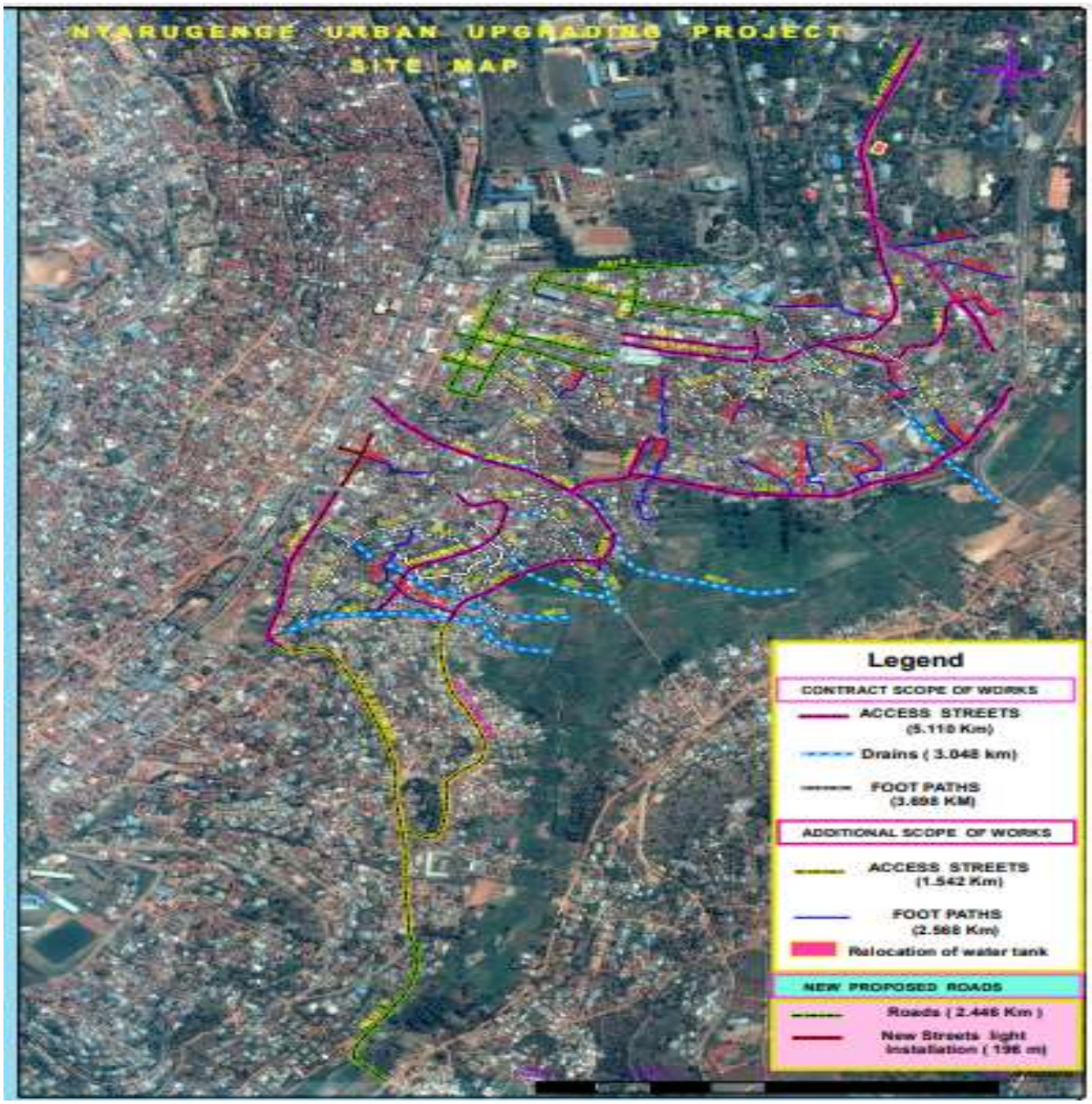

Figure 1.1: *Map of Nyarugenge district urban upgrading project site map*
Source: *Munzenze Report*

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1.3. Research questions

- What are the existing management systems employed in construction projects in Rwanda?
- What are the key roles benefits and challenges of implementing Integrated Management Systems in this context?
- How does the implementation of IMS influence project performance in terms of cost, schedule, and quality (To what extent has integrated management system (IMS) risk management mechanisms contributed to successful project completion)?
- What are the direct jobs created during the implementation of AGATARE asphalt road project and how they contributed to national economy?
- What strategies can be employed to enhance the effectiveness of IMS implementation in Rwandan construction projects?

1.4. Research hypothesis

The implementation of Integrated Management Systems positively impacts project performance indicators such as cost, schedule adherence, and quality in construction projects in Rwanda such as AGATARE project of Construction works for Nyarugenge District infrastructure upgrading, in line with the implementation of pillar of Economic transformation specific objectives of National Strategy for transformation. Effective integration of management systems leads to improved coordination, communication, and decision-making, thereby reducing project delays and cost overruns, which is in line with the implementation of pillar of Economic transformation specific objectives of National Strategy for transformation.

1.5. Objectives of the study

1.5.1 Main objective

To evaluate the level of application of Integrated Management System measures in ensuring successful completion of construction project and the effective delivery of logistic services related to construction project implementation.

1.5.2. Specific objectives

- To evaluate the Role of integrated management system (IMS) regulations on the successful completion of construction Asphalt Road project in AGATARE road project in Nyarugenge district through quality, environmental and Occupation safety, and Health principles compliance.

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- To do the risk assessment related to the successful completion of AGATARE asphalt road project in Nyarugenge district.
- To evaluate the direct job crated, workers category by skills and economic contribution after successful completion of asphalt road project implementation.

1.6. Significance of the study

The effective projects implementation are public infrastructure in which that the government of Rwanda invest a huge part of budget, however it is perceived that local companies are not competent enough to deliver good quality services in this area, with this research the researcher demonstrates the level to which local companies meet international standards through the assessment of Integrate management System level of compliance, hence this research will benefits the policy makers who will rethink about prioritization of Rwandan companies in road projects implementation, the Construction companies which will be informed about their level of complying with Integrated management System evaluated having a benchmark of International Standards, and eventually plot the improvements strategies, and lastly the researchers and public who will be informed about the situation in Rwandan construction companies through which they comply with Integrated management system.

1.6.1. For the researcher

The study holds significance in improving project efficiency, enhancing quality standards, ensuring compliance and sustainability, reducing costs and managing risks, informing policy development, and advancing knowledge and practices in project management within the construction sector in Rwanda. The significance of a study analyzing the implementation of an Integrated Management System (IMS) in project execution, specifically focusing on construction projects in Rwanda, is multifaceted for the researcher as follows:

Contribution to Knowledge and Practice: Research on IMS implementation in construction projects in Rwanda can contribute to the body of knowledge in project management, particularly in emerging economies. The findings can provide valuable insights for practitioners, researchers, and policymakers alike, guiding future practices and research endeavors in similar contexts.

Improving Project Efficiency: Construction projects are notorious for their complexity, involving various stakeholders, processes, and regulations. An IMS, which integrates multiple management systems (such as quality, environmental, and health and safety management), can streamline processes and improve overall project efficiency. Understanding the effectiveness

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of IMS implementation in this context can lead to significant improvements in project management practices.

Enhancing Quality Standards: Quality management is paramount in construction projects to ensure that structures are built to specifications and standards. By analyzing the implementation of IMS, the study can shed light on how effectively quality management systems are integrated within project execution in Rwanda. This can contribute to raising the overall quality standards in the construction industry.

Ensuring Compliance and Sustainability: An IMS often includes components related to environmental management and health and safety regulations. Analyzing IMS implementation can provide insights into the level of compliance with environmental and safety standards in construction projects in Rwanda. Additionally, it can assess the sustainability practices adopted within these projects, contributing to environmentally friendly and socially responsible construction practices.

1.6.2. Social significance

Cost Reduction and Risk Management: Effective management systems can lead to cost reduction through improved resource allocation, risk identification, and mitigation strategies. By examining IMS implementation, the study can identify areas where cost savings are realized and risks are effectively managed in construction projects, which is crucial for sustainable project delivery.

Policy and Regulatory Implications: Understanding the challenges and successes of IMS implementation can inform policymakers and regulatory bodies in Rwanda about the efficacy of existing regulations and policies related to project management in the construction sector. This can lead to the development of more tailored and effective policies to support IMS adoption and improve overall project performance.

1.7. Scope of the research

The scope of the thesis titled "Analysis of Integrated Management System Implementation in successful Project Execution, a Case of Construction Projects in Rwanda" involves examining the implementation of Integrated Management Systems (IMS) specifically within the context of construction projects in Rwanda especially in AGATARE road construction project. The research focuses specifically on the implementation of Integrated Management Systems in construction projects within Rwanda. It involves a detailed analysis of the analysis of integrated management system implementation in successful project execution in Rwanda, case study

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being AGATARE road construction project in Nyarugenge District to provide a comprehensive understanding of the challenges, benefits, and impact of IMS implementation in this context.

1.8. THESIS STRUCTURING

Chapter 1: Introduction: The construction sector in Rwanda has seen substantial growth due to infrastructure development and economic expansion. However, challenges persist in project execution, particularly in management systems. This research aims to analyze the implementation of Integrated Management Systems (IMS) in Rwandan construction projects to improve execution and contribute to sustainable development. Despite efforts to enhance project management, inefficiencies remain, leading to delays, cost overruns, and quality issues. Addressing these challenges requires a thorough investigation into IMS implementation.

Research Objectives: To evaluate the level of application of Integrated Management System measures in ensuring successful completion of construction project and the effective delivery of logistic services related to construction project implementation.

Research Questions:

What are the existing management systems employed in construction projects in Rwanda?

What are the key roles benefits and challenges of implementing Integrated Management Systems in this context?

How does the implementation of IMS influence project performance in terms of cost, schedule, and quality (To what extent has integrated management system (IMS) risk management mechanisms contributed to successful project completion)?

What are the direct jobs created during the implementation of AGATARE asphalt road project and how they contributed to national economy?

What strategies can be employed to enhance the effectiveness of IMS implementation in Rwandan construction projects?

Research Hypothesis:

Hypothesis 1: The implementation of Integrated Management Systems positively impacts project performance indicators such as cost, schedule adherence, and quality in construction projects in Rwanda such as AGATARE project of Construction works for Nyarugenge District infrastructure upgrading, in line with the implementation of pillar of Economic transformation specific objectives of National Strategy for transformation.

Hypothesis 2: Effective integration of management systems leads to improved coordination, communication, and decision-making, thereby reducing project delays and cost overruns,

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which is in line with the implementation of pillar of Economic transformation specific objectives of National Strategy for transformation.

Significance of the Research: This research is significant as it aims to contribute to the body of knowledge regarding project management practices in the Rwandan construction industry. By examining the implementation of IMS, it seeks to offer insights that can inform policymakers, industry stakeholders, and practitioners on strategies for enhancing project execution efficiency and effectiveness.

Scope of the Research: This study focuses specifically on the implementation of Integrated Management Systems in construction projects within Rwanda. It will involve a detailed analysis of selected case studies to provide a comprehensive understanding of the challenges, benefits, and impact of IMS implementation in this context.

Thesis Structuring: The thesis will be structured as follows:

Introduction

Literature Review

Materials and Methods

Results and Discussion

Conclusion and Recommendations

Chapter 2: Literature review: Integrated Management System (IMS) implementation in the context of construction projects has been a subject of interest for researchers globally, with a focus on improving project performance, efficiency, and sustainability. While there is extensive literature available on IMS in various industries, the specific application within the construction sector, particularly in Rwanda, warrants further exploration.

Previous studies have highlighted the benefits of IMS adoption in construction projects. For instance, the main motivation for integrated management system (IMS) implementation is inspired by the non- integrated management system limitations such as the traditional organizational structure's focus on departmentalization, effort duplication and increase in bureaucracy and cost, among others. (Domingues et al., 2015). The integration of systems can save both time and costs in organization. Moreover, the enhancement related to having an integrated system is operational benefits, better external image, improved customer satisfaction and also enhances employee motivation. (Hafizzudin M, et Al, 2017).

However, challenges associated with IMS implementation have also been documented. [Muhammad A., 2008] identified barriers such as difficulties faced in the integration of management system standards having diverse scope and compositions. The guidelines for the

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implementation of individual management systems, such as QMS, EMS and OHSMS do exist but there is no formalized standard for IMS. Furthermore, Kim et al (2014) and Wening & Refflinghaus (2015) noticed an improvement in employees' health and the environment. Similarly, Nunhes et al (2017) pointed to the improvement in operational efficiencies and internal communication as well as the great speed and flexibility in the decision-making process.

In the context of Rwanda, limited research specifically focusing on IMS implementation in construction projects exists. However, studies related to project management practices and challenges in the Rwandan construction industry offer valuable insights. For instance, (SIBOMANA E, 2018) assessed the causes of construction projects delay and their impacts on cost in Rwandan Public institutions in Rwanda.

Despite the scarcity of literature directly addressing IMS implementation in Rwanda's construction sector, broader studies on project management, quality improvement initiatives, and organizational change provide a foundation for understanding the potential implications and outcomes of IMS adoption in this context. While existing literature underscores the potential benefits of IMS implementation in improving project execution and performance in construction projects globally, there remains a gap in understanding its specific application and outcomes in the Rwandan context. Therefore, this research aims to contribute to filling this gap by providing empirical insights into the challenges, benefits, and impact of IMS implementation in construction projects in Rwanda.

Chapter 3: Materials and Methods: The Materials and Methods "Analysis of Integrated Management System Implementation in Project Execution: A Case of Construction Projects in Rwanda" encompasses methods and procedures, instrument definitions, data collection methods and data analysis techniques.

Research design: The research was observational, cross sectional, analytical and descriptive as well. Data were collected from multiple sources using appropriate techniques and the various Integrated Management System aspects were explored and explained.

Presentation of the study area: Adhering to these specified criteria, the participant selection process is tailored to encapsulate a broad spectrum of viewpoints and experiences pertinent to IMS implementation within the AGATARE road project's execution framework.

Sampling methods and techniques: Apart from the general information collected from the project manager, the site engineer, the foreman, the field visits, and secondary data accessed,

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this research used primary data collected through interviewing the employees selected randomly in their respective areas of intervention during the project implementation.

Data Collection techniques: This methodology describes the methods and techniques employed to gather the necessary data for the thesis. This could involve primary data collection through surveys or interviews with stakeholders involved in construction projects in Rwanda. Additionally, secondary data sources might be utilized to supplement primary data.

Data Analysis Techniques: It outlines the techniques used to analyze the collected data. This could involve quantitative analysis methods such as statistical analysis or qualitative analysis methods such as thematic analysis to identify patterns, trends, and insights related to integrated management system implementation in construction projects.

The methodology therefore provides a structured framework for conducting the study, ensuring that the data collected is comprehensive and relevant to the research objectives outlined in the thesis.

Chapter 4: Results and discussion: The analysis of integrated management system (IMS) implementation in project execution within the context of construction projects in Rwanda yielded several noteworthy findings, shedding light on both the successes and challenges encountered. The implementation of an IMS was found to have significantly enhanced project efficiency and coordination. Through the integration of various management systems such as quality, environmental, and occupational health and safety, projects were able to streamline processes, reduce duplication of efforts, and improve communication among stakeholders. This resulted in smoother project execution and timely completion of milestones. The findings also revealed that IMS implementation positively impacted risk management practices within construction projects. By incorporating risk assessment and mitigation strategies across different management domains, projects were better equipped to identify potential risks early on and develop proactive measures to address them. Consequently, this contributed to minimizing project disruptions and avoiding costly delays.

However, despite these benefits, the study also uncovered several challenges associated with IMS implementation in the Rwandan construction context. One significant hurdle identified was the lack of adequate resources and expertise for effectively implementing and maintaining the IMS. Many construction firms struggled with limited financial resources and a shortage of skilled personnel trained in IMS methodologies, which hampered the successful adoption and sustainability of integrated management practices. Furthermore, cultural and organizational

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barriers were observed to impede the full integration of IMS into project execution processes. Resistance to change, hierarchical structures, and ingrained

Chapter 5: Conclusions and recommendations

Conclusions: The analysis of Integrated Management System (IMS) implementation in construction projects in Rwanda demonstrates its effectiveness in streamlining processes and improving project performance. IMS adoption has led to better coordination, cost control, schedule adherence, and quality outcomes. However, challenges such as resistance to change and resource constraints persist.

Recommendations:

Develop comprehensive change management strategies to foster acceptance of IMS principles.

Invest in training and capacity building to equip personnel with necessary skills.

Leverage technological solutions like digital platforms and data analytics to enhance IMS processes.

Promote collaboration and knowledge sharing among stakeholders.

Establish regular monitoring and evaluation mechanisms to assess progress and identify areas for improvement.

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CHAPTER TWO: LITERATURE REVIEW

2.1. Theoretical and empirical studies

The purpose of this chapter is to relate theories of quality and risk issues during the management of a project with those that might have occurred in projects implementation in Rwanda, specifically AGATARE road construction project. This led the researcher to analyze the application of integrated management system (IMS) that would best fit in providing solutions related to quality, environmental including health and safety issues in a successful project execution. ISO 9001, 14001 and 45001 were considered to constitute an integrated management system.

THEORETICAL STUDIES

Theoretical and empirical studies related to the analysis of integrated management system (IMS) implementation in project execution, particularly in the context of construction projects in Rwanda offers general insights and approaches, specific studies, which required up-to-date research in academic databases or contacting relevant institutions in Rwanda. Here the researcher contributes to a deeper understanding of the analysis of integrated management system implementation in project execution, specifically within the context of construction projects in Rwanda. These studies inform policymakers, industry practitioners, and academics seeking to enhance project management practices and promote sustainable development in the construction sector.

The theoretical foundation begins with defining an Integrated Management System (IMS) and its components. This involves understanding the integration of quality management systems (ISO 9001), environmental management systems (ISO 14001), and occupational health and safety management systems (ISO 45001) into a cohesive framework. Theoretical frameworks such as Integrated Management System theory can provide insights into the principles and benefits of IMS implementation.

2.1.1. Project Management Theories

Theoretical studies also are reflected into project management theories and methodologies applicable to construction projects. This includes traditional approaches like the Project Management Body of Knowledge (PMBOK) as well as contemporary frameworks such as Agile and Lean Construction. Understanding project lifecycle phases, risk management, stakeholder engagement, and project success factors are crucial aspects.

Project delays: The occurrence of delays in construction projects inevitably impacts on the project's direct costs. Particularly in the scenario where the project pertains to a public building

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or facility, complications escalate as the client is typically a government department. The repercussions of delays in such instances may encompass:

- Confusion surrounding public development plans.
- Disruption of the budget execution plan for the government entity involved.
- Public inconvenience stemming from project delays.

Delay in construction projects is commonly understood as the failure to complete a project within the scheduled timeframe outlined in the contract or planned schedule. Abbas (2006) characterizes delay as the discrepancy between the actual completion date and the initially planned schedule. This setback occurs when the project's progress lags the predefined timeline. Delays can stem from various factors, including but not limited to, adverse weather conditions, regulatory constraints, fluctuations in market conditions, among others.

Similarly, Assaf, S. (2006) provides a definition of delay as the extension of time beyond the originally anticipated completion date specified in the contract or agreed upon by the involved parties. The complexity inherent in construction processes necessitates the collaboration and concerted effort of all stakeholders involved. Numerous factors contribute to project delays, ranging from the performance and reliability of contractors to challenges in material procurement, site management, and unforeseen events. Effective coordination among stakeholders, suitable site conditions, and the financial stability of project owners are crucial determinants influencing the timely completion of construction projects.

According to Al-Kharashi at Al (2009), differing perspectives exist among parties involved in construction projects regarding project delays. For project owners, delays signify lost revenue and diminished returns, whereas contractors view delays as drivers of increased overhead costs and expenses. Delays stemming from clients, such as tardy submission of drawings and specifications, frequent alteration requests, and inaccurate site information, often result in contentious claims from both primary contractors and subcontractors. These disputes frequently culminate in protracted legal battles, entailing significant financial ramifications. Conversely, delays arising from contractors are often attributed to deficient managerial skills, marked by inadequate planning and a limited grasp of accounting and financial principles, which have precipitated the downfall of many contractors.

Qualities of Project Manager Regarding IMS: According to keoki et al, 2008, the author narrates that the effective project manager must possess four essential attributes.

- First, he must have a considerable background of practical construction experience so that he is thoroughly familiar with the workings and intricacies of the industry. Without such a

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basic grounding in construction fundamentals, the project manager would be completely unprepared to carry out his responsibilities.

- Second, the project manager must have, or have available to him, persons with expertise and experience in the application of specialized management techniques to the planning, scheduling, and control of construction operations. These procedures have been developed specifically for application to construction projects and are those discussed in this book. Because much of the management system is usually computer based, the project manager must have access to adequate computer support services.
- Third, the project manager must have the capacity to step back from the complex details of daily construction operations and look into the future planning for upcoming activities, checking material deliveries, determining manpower and training requirements, identifying possible changes to the work, and other future problem areas. Lastly, the project manager must have the personality and insight that will enable him to work harmoniously with other people, often under very strained and trying circumstances. The manager, after all, cannot accomplish everything through his efforts alone. He must work with and through people in the performance of his duties. Doing this requires an appreciation and understanding of the human factor. Without this, his other attributes, however commendable, will be of limited effectiveness.

This chapter entails how the integrated management system (IMS) system combines all components of a business into one comprehensive system to enable the achievement of its purpose and mission. Some many benefits of implementing integrated management systems are such as Improves customer satisfaction**,** improving the organization's external images**,** managing business risks**,** process continuous improvement**,** and minimize the complexity of internal management**, t**he decrease in management cost and elimination of conflicts between individual systems. PDCA (Plan-Do-Check-Act) as a methodology for continuous improvement of business processes with the backbone of the quality management system based on ISO 9001, including ISO 14001 and ISO 45001 standards is a simple repetitive cycle to drive continuous quality improvement of any business processes.

2.1.2. Implementation Theories

Theoretical perspectives on organizational change management and implementation science are essential for understanding how IMS is adopted within construction projects. Models such as the technology acceptance model (TAM), the theory of planned behavior (TPB), and Kotter's

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Eight-Step change model can provide insights into the factors influencing IMS implementation, including leadership, employee attitudes, training, and organizational culture.

2.1.3. Sustainability Theories

Given the focus on environmental and occupational health aspects within IMS, theoretical studies explore sustainability theories and sustainable development goals. Understanding how IMS contributes to sustainable construction practices and societal well-being is a critical aspect of theoretical analysis.

In the PMBOK, 7th Ed., 2021, it is mentioned that project teams actively engage stakeholders' parties throughout the project to minimize potential negative impacts and maximize positive impacts. Stakeholder engagements also enable opportunities for stronger project performance and outcomes in addition to increasing stakeholder satisfaction. Finally, engaging other stakeholders helps the project team to find solutions that may be more acceptable to a broader range of stakeholders. This is where an integrated management system (IMS) comes in to put together more than one standard in an organization's business to work as a single system with unified objectives. Quality management system requirements (QMS) ISO 9001:2015, Environmental management system (EMS) ISO 14001:2015, and Occupational health and safety (OHSMS) ISO 45001:2018 management system are the examples of existing standards for processes which are often combined and managed as an integrated management system (IMS). The same standards are a subject matter in IMS mentioned in this chapter. These are integrated into a single framework as a management system with linkages to manage and execute processes without duplication. integrated management system (IMS) components that are common to all systems include the documented information such as collapsed IMS manual, and process procedures, behavior change of people, and activities such as management reviews and internal audit. Processes include documented information used in an organization. Recourses include equipment, facilities, people, and others. Risk assessment is another important way of looking into subject matter from existing management systems.

2.1.3.1. Integrated Management Systems Frameworks

Theoretical studies explore various frameworks for integrated management systems, which typically combine quality management, environmental management, and occupational health and safety management. The researcher examined established frameworks such as ISO 9001, ISO 14001, and ISO 45001 and their integration into a cohesive system for project execution.

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2.1.3.2. Structure Of Integrated Management System (IMS)

All the three standards follow the same high-level structure, which implies to be very easy for organizations looking to integrate more than one of these three standards or all the three. To ease the process of integration, a combination matrix of ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018 presents an integrated management system (IMS) where the management systems share many common requirements and the continual improvement goal. The difference is the approach and degree of prescription, but the ISO 9001, ISO 14001 and ISO 45001 standards are compatible in content, terminology, and many of the requirements.

Figure 2.1: *The integrated management system Structure and applied standards*

Source: *Primary data*

Based on the dynamics of market competition, the implementation and certification of quality (ISO 9001), environmental (ISO14001) and occupational health and safety (ISO 45001) systems have been an important activity for many organizations and become a widespread practice around the world (Asif et al., 2009; Nakashima et al., 2006; Rocha et al., 2007). These management systems have received major attention within organizations to create competitive advantages and contribute to a sustainable development (Esquer-Peralta et al., 2008; Gudonavicius et al., 2009; Jørgensen et al., 2006). The ISO 9001, ISO 14001 and ISO 45001 standards require organizations to formulate policies, to define roles and responsibilities, to assign management representatives and to manage processes. In practice, implementing these standards in parallel demands many duplicate management tasks (Fresner and Engelhardt, 2004). To meet satisfactory requirements, each management system demands a lot of documentation, written procedures, checking, control forms and other paperwork. It has been proved that it is a challenge to handle three separate management systems to ensure their

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alignments with the organization's strategy. Hence, a dominant current trend is towards implementing an integrated management system (IMS) (Karapetrovic and Casadesus, 2009; Molina-Azorin et al., 2008; Zeng et al., 2007).

2.1.3.3. Global Perspective on Integrated Management System

The scope of IMS has evolved gradually and continuously in response to social, political, technological, and economic dynamic changes. In recent years, globalization of the world's economies and its repercussions have been perceived as the greatest force for change in the world of work, and consequently in the scope of Integrated management system (IMS) components. (ILO, 2021). From a global perspective, the success enjoyed by the dissemination of management systems seems to be closely linked to the dynamics of the globalization process, mainly of multinational companies. (Paulo S., 2011)**.**

2.1.3.4. Institutional Framework

Rwanda has established institutional framework with mandates on components of integrated management system. The Rwanda Quality policy developed by the ministry of trade and Commerce in 2018 mentioned the existing national institutions with specific missions on quality of both products and services made in Rwanda and imported ones. (MINICOM, 2018, Kigali). Below are responsibilities of those government institutions.

- ***Advisory Committee in charge of implementation of policy:*** Recognizing that the activities of the National Quality Infrastructure are carried out by both the public and private sector and cut across many regulatory bodies and agencies, this policy requires appropriate institutional framework and coordination mechanism among Stakeholders. To ensure proper coordination, an advisory committee will be set in place by the Ministry in charge of trade and industry to fast track and spearhead activities related to the implementation of the policy (MINICOM, 2018, Kigali).
- ***Ministry in charge of trade and industry:*** The Ministry in charge of trade and industry will ensure the setting in place of for a related to standardization; namely the Standards Stakeholder Forum, the Quality Council, the National Testing Laboratory Forum, the National Certification Bodies Forum and the National Technical Regulation Forum and the Advisory Committee responsible for spearheading the implementation of the policy. The ministry will

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chair the Quality Council and the Advisory Committee and mobilize the funds for implementation of the policy (MINICOM, 2018, Kigali).

- ***Regulators and Ministries responsible for development and enforcement of technical regulations:***

- Nominate representatives and participate actively in activities of the above Committees.
- Participate actively in the development of national standards.
- Develop and enforce technical regulations and conformity assessment procedures (MINICOM, 2018, Kigali).

- ***National Standards Body:***

- Developing and publishing national standards
- Monitoring and contributing to international and regional standardization activities on behalf of stakeholders and adopt them at the national level.
- Conducting trainings in the areas of standardization, conformity assessment and metrology activities to promote standardization culture and standards compliance.
- Assisting regulators in the development of technical regulations
- Providing information on standards, technical regulations, and conformity assessment procedures
- Raising awareness and promoting the importance of standards and quality infrastructure as tools to improve market access, technology transfer and sustainable development.
- Carry out research and surveys on standards to ensure development of relevant and market driven standards (MINICOM, 2018, Kigali).

- ***National Metrology Laboratories:***

- Establishing and maintaining national measurement standards demonstrably traceable to international metrology standards for the relevant metrology quantity
- Ensuring that a national calibration system is established and maintained to disseminate metrology standards to industry, the authorities, and the society.
- Representing the country at the international Metrology Associations
- Representing the country in regional metrology

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- Carrying out research in scientific metrology for realization of units and reference materials in the field of chemical metrology
- Controlling the usage of measuring equipment in trade, law enforcement, health services and environmental protection
- Controlling over pre-packaging operations
- Managing regional and international relationships in legal metrology
- Typing approve equipment used in trade, health, and safety.
- Carrying out metrology verification activities (MINICOM, 2018, Kigali).

- ***Private Metrology Laboratories:***

- Providing industrial metrology services
- Participating in awareness related to metrology activities in Rwanda (MINICOM, 2018, Kigali).

- ***National Certification Services Body:***

- Providing product and systems certifications based on the international best practices for market requirements and standards.
- Ensuring public awareness of services rendered by certification bodies.
- Carrying Assessments for compliance of certifications provided.
- Participating in the National Certification Forum (MINICOM, 2018, Kigali).

- ***Private Certification Bodies:***

- Providing system certification services.
- Participating in the activities of the National Certification Bodies Forum.
- Participating in awareness on certification (MINICOM, 2018, Kigali).

- ***National Quality Testing Laboratories:***

- Carrying out testing of products (foods, medicines, materials, chemicals, pesticides, and others) as a way of quality assurance.
- Carrying out proficiency testing with peers nationally, regionally, and internationally.

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- Collaborating with harmonization of activities with other regional and international partners.
- Carrying out awareness on standards and guidelines related to good laboratory practices implementation and East African Community (EAC) laboratory designation procedures (MINICOM, 2018, Kigali).

- ***Private Quality testing laboratories:***

- Providing testing services.
- Seeking laboratory registration, recognition and or accreditation to undertake conformity assessment activities.
- Participating actively in the Quality Testing Laboratory Forum activities (MINICOM, 2018, Kigali).

- ***National Inspectorate Authorities:***

- Controlling the quality of products supplied to the market for their compliance with the obligatory safety and marking requirements set in legal acts, technical regulations, and mandatory standards.
- Monitoring of quality of products and services through import inspection, industrial inspections market surveillance activities.
- Initiating proposals for technical regulations and mandatory standards and submit them to the relevant authorities for approval.
- Providing technical advice to regulators and other relevant authorities on matters related to quality of products and services.
- Participating in national and international events associated with inspections.
- Establishing cooperation with regional and international institutions with similar attributes (MINICOM, 2018, Kigali).

- ***National Accreditation Authority:***

- Providing accreditation services to conformity assessment bodies and personnel
- Monitoring regional and international activities relevant to its own activities
- Representing the country in the relevant regional and international accreditation bodies

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- Entering into agreements on mutual recognition with regional and international accreditation bodies (MINICOM, 2018, Kigali).

- ***National Quality Council:***

- Formulating the strategies, policies on matters related to standardization, conformity assessment, metrology and accreditation in the country.
- Monitoring of all various components of the national quality infrastructure (NQI) to ensure transparency, efficiency, and effectiveness of their operations.
- Monitoring the progress of activities of National Standards Stakeholder Forum, National Certification Bodies Forum, and National Quality Testing Laboratories Forum.
- Handling of appeals regarding standardization and conformity assessment activities in Rwanda.
- Advocating for standards development, conformity assessment, metrology, and accreditation projects.
- Advising the Government regarding strategic direction and working mechanisms of the National Quality Infrastructure (MINICOM, 2018, Kigali).

- ***National Standards Stakeholder Forum:***

- Evaluating areas of National interest for standardization activities to ensure all key national priority sectors are covered.
- Facilitating coordination between agencies and departments to harmonize and align projects pertaining to standardization and related activities.
- Evaluating annual standards action plans according to strategic areas of interest.
- Advising on national standards strategic planning.
- Ensuring that national interests are represented fairly in regional and international standards activities in line with national industrial and export policies (MINICOM, 2018, Kigali).

- ***National Quality Testing Laboratory Forum:***

- Propose regulatory tools which will facilitate the Laboratories to operate in organized manner.

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- Establish testing Laboratory data base in the country which will help in planning and proper management in terms of business development.
- Sharing knowledge and facilities on testing products and maintenance experts.
- Establish assessments tool for testing Laboratory services to identify and evaluate Overall Laboratory system, Environmental factor, testing scope, personnel, techniques, and equipment in use.
- Harmonization of test methods/protocols and laboratory quality controls to minimize the differences, maximize efficiency and expedite practices, and achieve nationally and internationally harmonized and acceptable approaches.
- Establish Laboratory personnel capabilities in trainings through sharing of knowledge and available facilities.
- Establish Inter laboratory comparisons and proficiency testing.
- Sharing expertise on laboratory designation and accreditation requirements.
- Establishment of Laboratory chemical waste management strategy and common site to be used (MINICOM, 2018, Kigali).

- ***National Certification Bodies Forum:***

- Proposing regulatory tools which will facilitate the Certification Bodies to operate in an organized manner.
- Establishing certification bodies data base in the country.
- Sharing Knowledge and experience in providing certification services.
- Establishing mechanisms for peer assessment activities.
- Harmonizing processes and procedures (MINICOM, 2018, Kigali).

- ***National Technical Regulation Committee:***

- Coordinating activities related to technical regulation development and implementation amongst the regulatory authorities and the national quality infrastructure (NQI).
- Ensuring that the regulatory authorities follow the defined Technical Regulation Framework in developing and implementing technical regulation.
- Ensuring that all the regulatory authorities consistently meet the requirements of the WTO-TBT Agreement, the WTO-SPS Agreement and other trade agreements.

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- Overseeing the review of technical regulation already on the statute books by the regulatory authorities, to revise, confirm or withdraw such regulation and to make sure that it complies with the Technical Regulation Framework (MINICOM, 2018, Kigali).

2.1.3.5. Policy Framework

- ***Quality policy:*** Talking about conformity assessment, Rwanda Quality Policy, Sept 2010 informed the researcher that whilst enhancing the capacity of the public institutions, the Government creates a policy environment that will not hinder but facilitate the development of private conformity assessment service providers, and the Government utilizes their services in public procurement and technical regulation if they can demonstrate their competence through accreditation. As a measure to ensure that the state is provided with quality products and services, the Government utilizes national, regional, and international standards to the full extent possible in state purchases and demands independent proof of compliance of delivered products and services with relevant standards through an appropriate use of conformity assessment activities. Establishing an incentive, i.e. preferential treatment, for enterprises that distinguish themselves in the process of quality improvement through product and/or system certification is part of the overall approach. (MINICOM, 2018).
- ***Made in Rwanda policy:*** As the Made in Rwanda (MIR) Policy seeks to address the remaining fundamental barriers to achieving competitiveness, within the existing national development policy framework, it is a cross-cutting, holistic policy that incorporates activities and goals from a range of public and private stakeholders, all of whom need to be aligned within a coordinated framework. The MIR policy builds upon many existing and planned activities across various Government Ministries and Agencies and the private sector, offering a unifying umbrella under which to guide these interventions. The MIR Policy is informed by surveys of both consumers and industrialists, recommending key interventions necessary to boost the competitiveness of locally produced goods, both in terms of price and quality. (MINICOM, 2018).
- *Occupational health and safety policy:* In its article 6, Official gazette N^{o} special of 02/09/2022, it states that according to occupational health and safety risks assessment an employer must carry out occupational health and safety risk assessment before starting an activity for which relevant laws require an environmental impact assessment before commencement. Without prejudice to provisions of paragraph one of this article, an employer

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conducts an occupational health and safety risk assessment at least once a year to identify risks of hazards and diseases. (MIFOTRA, 2022).

- ***Environmental policy:*** Agricultural transformation and rural development must be accompanied by environmental protection activities such as earthworks, reforestation, water management and rational use of wetlands. The Poverty Reduction Strategy also recommends actions in the energy sector by promoting in a special way the rational use of wood and the promotion of alternative sources of energy. It supports water supply and actions likely to enhance rainwater harvesting and utilization in towns and "imidugudu" villages. (Rwanda environmental policy, 2003). AGATARE project management prepared a dumping site which was used as a marram quarry for the same project.

2.1.3.6. Policy framework on IMS components compliance in Rwanda

As explained by Aimable TSINDA, 2011, in his Policies, Regulations and Institutional Framework for Improved Sanitation in Kigali: Rwanda Public Policy Observatory Report 2, the principle of sustainability of environment and equity among generations emphasizes human beings at the core of Sustainable Development. They, therefore, have a right to a healthy and productive life in harmony with nature. Chapter IV of the Organic Law Article 65 clearly calls for the need to subject projects to mandatory Environmental Impact Assessment, more to that, its article three States that every person has the duty to protect safeguard and promote the environment. The State shall protect, conserve, and manage the environment; also, article 65 further specifies that every project shall be subjected to environmental impact assessment prior to its commencement. It shall be the same for programs, plans, and policies likely to affect the environment. The Organic Law also puts in place the National Fund of the Environment in Rwanda (FONERWA). The article 66 of the Organic Law on the environment specifies that it has created, to the level of the provinces, of the City of Kigali, of the Districts, the Cities, the Sectors, and the Cells, Committees responsible for the conservation and the protection of the environment. (TSINDA, 2011).

2.1.3.7. Rwandan Institutions that deal with IMS

In line with the philosophy of making Rwanda a service led and knowledge-based economy, there are numerous institutions dealing with components of integrated management system. Among others, there are NAEB, NIRDA, RSB and RICA about which the researcher wrote.

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- ***Rwanda Housing Authority:*** The law n°40/2010 of 25/11/2010 establishing the Rwanda housing authority (RHA) and determining its responsibilities, organization and functioning in its chapter One, article 3, its responsibilities state that the overall mission of RHA is to implement the national housing and construction policy through coordination, conception, development, monitoring and evaluation of actions and programs set out in its mission. Law N°40/2010 of 25/11/2010.

- ***Rwanda Transport Development Agency:*** The law N°55/2011 of 14/12/2011 governing roads in Rwanda in its chapter two, article 6, it states that the management and maintenance of the National Roads shall be under the jurisdiction of the Rwanda Transport Development Agency. Works meant for national roads maintenance and development shall be funded by the Government. The District or the City of Kigali has the responsibilities as regards to the routine maintenance of the part of the national road passing over it and its surroundings. Furthermore, in the same chapter, article 11, it states that a ministerial shall define the technical and service standards for roads based on the study and research conducted by experts on the entire road network of Rwanda in general. Law N°55/2011 of 14/12/2011.
- ***Rwanda Standards Board****:* The law N°50/2013 of 28/06/2013 establishing Rwanda Standards Board (RSB) and determining its mission, organization and functioning in its chapter one article 4, one of its missions is part 6. It states to participate in monitoring standardization at national, regional, and international level. (MINIJUST, 2013, Kigali). With this law one of the RSB missions is to monitor the fulfillment of international standards that includes the discussed components of integrated management system referred to as Quality management System (ISO 9001), Occupational health and Safety management System (ISO 14001), Environmental Management System (ISO 45001) in this research.
- ***National Industrial Research and Development Agency*****:** The roads sector is an anchor to social and economic transformation, and for this reason, has spider web-like networks with other sectors, including agriculture, international trade, local governance, education, health; etc. The institutional framework for environmental impact assessment in the roads construction and maintenance sector is, therefore, complex. The main institutions involved, and their roles are summarized in Annex 4. (African Development Bank, 2022, Kigali).
- ***Rwanda Inspectorate, Competition and Consumer Protection Authority:*** Rwanda Inspectorate, Competition and Consumer Protection Authority (RICA) was established by the Law Nº 31/2017 of 25/07/2017 to carry out inspection of quality and standards conformity and

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promote healthy competition in the economy by prohibiting unfair business practices as well ensuring consumers protection. Its vision is to strive to be internationally reputed as a reliable and customer-focused provider of inspection services that deliver quality and confidence for safeguard of businesses and consumer protection. Its mission is the promotion of trade through scientific evidence - based decision making and fair professional judgment in order to ensure sustainable business development as well as protection of plant & animal health and consumer rights. Law Nº 31/2017 OF 25/07/2017.

- ***National Agricultural Export Development Board:*** National Agricultural Export Development Board, abbreviated as "NAEB" is a commercial public institution established by the law No 13/2017 of 14/04/2017 determining its mission, organization, and functioning. It has a legal personality and enjoys administrative and financial autonomy and is also managed in accordance with relevant laws. NAEB has the following mission: 1º to advise on the development of policy and strategies for developing exports of agricultural and livestock products meeting international market requirements; 2º to implement policy and strategies for developing exports of agricultural and livestock products meeting international market requirements. Law No 13/2017 of 14/04/2017.

2.1.3.8. Reasons of implementing IMS

The main motivation for integrated management system (IMS) implementation is inspired by the non- integrated management system limitations such as the traditional organizational structure's focus on departmentalization, effort duplication and increase in bureaucracy and cost, among others. (Domingues et al., 2015). Karapetrovic (2003) observed that the need for "business excellence" to meet the growing demands of stakeholders who are not only the customers but also the surrounding communities, employees, investors, and society at large has put pressure on organizations to find cost-effective ways of managing their separate management systems in a better-coordinated manner which has given rise to the integrated management system (IMS). Zeng et al (2010), Garengo & Biazzo (2013), Vitoreli & Carpinetti (2013) on the other hand felt that the challenges of managing separate systems have forced organizations towards the IMS, which provides superior benefits than the individual systems. However, Simon et al (2013); Muzaimi et al (2017); Barbosa et al (2018) differ slightly in that they believe that excessive competition has been the main factor that has forced organizations to implement a unified system as an alternative to single separate standards.

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2.1.3.9. Benefits of Implementing IMS

Having three management systems implemented separately will triple the time resources needed for maintenance. This includes performance of the same activity more than once, such as internal auditor management review, and others. In some cases, each standard is implemented by different team. The system may allow different logic or have different structures. The implementation of integrated management system (IMS) goes hand in hand with benefits of its compliance in an organization as seen below:

- ***Improves Customer Satisfaction:*** There are a series of standards related to quality management in which is one of the elements in IMS that is directed towards assessing and improving customer satisfaction, it provides guidance for planning, developing, implementing maintaining and improving processes to increase customer satisfaction. Customer satisfaction has been a popular topic in marketing practice and academic research since Cardozo's (1965) initial study of customer effort, expectations, and satisfaction. Despite many attempts to measure and explain customer satisfaction, there still does not appear to be a consensus regarding its definition (Giese and Cote, 2000). Customer satisfaction is typically defined as a post consumption evaluative judgment concerning a specific product or service (Gundersen, Heide and Olsson, 1996). It is the result of an evaluative process that contrasts pre-purchase expectations with perceptions of performance during and after the consumption experience (Oliver, 1980). Based on the statement, the customer also is a factor for the IMS implementation in the organization as they will be more confident to do their business as they believe integrated management system (IMS) provides the efficient and effective ways in the operational and the business will be steadier and more stable.
- ***Improving the organization's external images:*** Kotler (1997) explains image as "the set of beliefs, ideas, and impressions that a person holds regarding an object. People's attitudes and actions toward an object are highly conditioned by that object's image." Thus, a person's image of a certain company constructs a corporate image. As stated, Kotler's definition of (corporate) image is just one of many, and in general defining the term is a difficult task. There are practically as many definitions of the term as there are people who use the term. For example, it has been used as a synonym for message, reputation, perception, attitude, among others. On a more emotional level image also has many negative connotative meanings. The average person often sees image as the opposite of reality, an imitation of something. In

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everyday language images are manipulated, polished, enhanced, and tarnished. (Grunig 1993, 121-139).

Having the IMS therefore helps to improve customer confidence and promotes positive company images. While practicing a good internal culture, it will lead to good management, product quality and business growth.

- ***Managing business risks:*** IMS interconnects a set of processes through sharing information, human and financial resources, and infrastructure to satisfy the needs of different stakeholders (Bernardo et al. 2016; Kopia et al., 2016). Also, it was made clear when Zwetsloot (1995) and Karapetrovic and Willborn (1998) mentioned that the areas that comprise the management systems influence each other.

Therefore, the individual optimization of the systems is, at its best, sub optimization if evaluated from a broader managerial perspective. Integration of two or more management systems into an integrated management system (IMS) IMS is advantageous in terms of providing a more holistic approach to managing business risks. In IMS, the system will cover the aspect of quality, environment, occupational health, and safety together with the risk management system simultaneously.

- ***Process continuous improvement:*** Olaru et al (2014) suggested that these benefits can be subdivided into internal and external, with those that are internal to be related to improvement in internal processes; whilst the external ones reflected the overall improvement in business performance in terms of profits, customer satisfaction, and staff motivation. Kim et al (2014) and Wening & Refflinghaus (2015) noticed an improvement in employees' health and the environment. Similarly, Nunhes et al (2017) pointed to the improvement in operational efficiencies and internal communication as well as the great speed and flexibility in the decision-making process.
- ***Minimizes the complexity of internal management:*** IMS does not only decrease management system cost, but also decreases the complexity of internal management. The researcher affirms that by integrating the documents, manual, procedures, and others; task can be simplified as the system maintains a systematic procedure that includes all the requirement required in the management system, therefore the complexity can be minimized and simplify further the process. Certified systems working separately have increasingly been seen as efforts wasted with excessive bureaucratic, costs and redundancies. In this context, the integration of

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management systems that work in a separated way has been pointed out by many researchers to improve the overall management system efficiency (Zeng et al., 2007; Santos et al., 2011; Simon et al., 2012; Oliveira, 2013; Abad et al., 2014; Bernardo et al., 2015).

- ***The decrease in management cost:*** Almost all past researchers agree without contradiction that many benefits can be realized through the IMS. Zeng et al (2010) observed the improvement in the certification process, reduction in management costs and minimum paperwork as the main achievement, while Zeng, et al (2015) and Alexandra, et al (2012) highlighted the operational benefits, better external image, improved customer satisfaction and employee motivation, and Azadeh, et al (2019) noted an opportunity for continuous improvement.
- ***Elimination of conflicts between individual systems:*** An integrated system offers more benefits than single separate standards (Ferron & Darnall, 2016). It eliminates conflicts between individual systems, due to consolidation of some or all components of a business into one coherent Management System (Rebelo, 2014). Hence it would not have been possible to list all the benefits as they are just too many. However, the shortcoming of the past research is that it does not give a direct correlation between the manner and level of implementation and the nature of benefits that are realized at the end of the project. Therefore, there is an opportunity to try and link the implementation methodology to a specific form of benefit to avoid a generic integration approach in future integrated management system (IMS) projects.

2.1.3.10. Implementing ISO 9001, ISO 14001and ISO 45001 in IMS

Research gaps relate to the positive relationship between Project Monitoring and evaluation and the achievement of project outputs. Research is still going on for the conclusion of the effect of project monitoring and evaluation the project success. Previously reviewed studies have not adequately indicated the factors affecting roads construction projects Completion in Rwanda. The previous studies they have not indicated the importance of manager's competence and or implementation of integrated management systems in Rwanda. Pearman (2006) indicated that engineering and construction projects need project managers with qualities such as conscientiousness and transactional styles leadership. These studies haven't yet highlighted the implementation of integrated management systems in construction projects in Rwanda.

Below is the sequence of activities to be performed when analyzing existing gap and requirements to acquire IMS certification to ISO 9001, ISO 14001and ISO 45001 together.

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- Developing a project plan
- Definition of scope of IMS
- Understanding the context of the organization
- Identifying interested parties and their needs
- Demonstrating leadership
- Establishing policies
- Addressing risks and opportunities
- Identification and evaluation of environmental aspects and occupational health and safety hazards
- Compliance obligations
- Setting objectives
- Operational planning and control
- Providing resources
- Monitoring and measuring
- Internal audits and management reviews
- Certification audits

2.1.3.11. What IMS entails in Project Execution

Components here mentioned to be integrated are the manual, management review, resources management, document control and record; process, monitoring and measuring process/ products; audit procedure, legal and other requirement; objectives, target and program procedure; resources, roles, responsibility, training and awareness procedure; communication, operational control in environment management system/ safety management system procedure; and performance measurement and monitoring procedure. Furthermore, it is practically accepted that, all components in management system can be integrated but it is based on an organization requirement. The table 2.1: shows similarity based on their clauses.

There is a market need for separate management system standards to address different aspects, issues or risks that organizations need to manage and how organizations can apply the different standards in a combined way, integrated with their business processes. Some organizations apply not only one management system but rather a range of management system standards to satisfy their own needs as well as those of external stakeholders. Management system standards cover multiple aspects, levels, and functions of an organization to make their implementation have a substantial impact on how an organization operates and manages its business processes.

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IMS system combines all components of a business into one comprehensive system so as to enable the achievement of its purpose and mission. As mention Hafizzudin M, et Al, (2017), IMS is the integration of the systems that are focused on quality, environment, and occupational health and safety along with the process, practices and documentations. The integration consists of three main management systems: ISO 9001, ISO 14001, and ISO 45001. The benefit as resulting from the implementation of IMS are the improvement of business focus, a holistic approach to managing business risk, reduce the clash between individual management systems, minimize duplication and bureaucracy, more effective and efficient internal and external audits, and simpler facilitation of the requirements of any new management system standard that the organization wishes to adopt. Besides, the implementation of IMS can clarify the certification process, save human resources, decrease management cost, and decrease complexity of internal management. The integration of systems can save both time and costs in organization. Moreover, the enhancement related to having an integrated system is operational benefits, better external image, improved customer satisfaction and also enhances employee motivation (Hafizzudin M, et Al, (2017)).

2.1.3.12. Implementation Approach for IMS

PDCA (Plan-Do-Check-Act) as a methodology for continuous improvement of business processes with the backbone of the quality management system based on ISO 9001, including ISO 14001 and ISO 45001 standards is a simple repetitive cycle to drive continuous quality improvement of any business processes. There are four steps of management method that had been developed by the father of quality control, Deming (1950) which is the 'Plan, Do, Check and Act' (PDCA) cycle. The PDCA cycle is the core of the continuous business improvement concept and tt is used as a plan for IMS implementation in a business and it considers the process from the start up until the implementation is completed. This could as well be used in AGATARE road construction project my case study.

- **Plan:** The purpose of planning process stage is to identify problems and their causes and to prioritize corrective actions. The planning plans changes and improvements as well as analyses the current situation. It sets milestone on what the organization would like to achieve.
- **Do:** This step involves activities designed to execute or improve plans. It checks the process to control or to do the improvement. It required monitoring and evaluating process, the results against the objective and specification also to report the outcomes. (FRANZ J. K., LIKER J. K. 2016., KIRAN D. R. 2016 states that the developed plan to make changes in the process is implemented in a company (to raise its productivity or quality and to eliminate the

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causes of problems). It takes place with the support and understanding of the management. In this phase, tools such as an action scheme, benchmarking, flow diagram or check sheet can be used.

- **Check:** It focuses on observing how effective the solution has been and gathers data for further improvement. Here decision may be made to check additional inputs for improvement. In other words, it gives the feedback to the top management on existing problems through a gap analysis, follow up gap analysis and fine tune the management system and do the internal audit. The measurements are taken, and they are compared with the values folded in the plan. Control sheets, control charts, process capability indices can be used to help. If the implementation of solutions proved to be appropriate, it is followed by 4 PDCA cycle step - "Act" (A), if not - one shall return to step 1 - "Plan" (P) (this is a critical area in the process of improvement) FRANZ J. et Al (2016).
- **Act:** This is the final step the management would decide on the future improvement based on the external audit report. Here there is a need to act or to evaluate the effectiveness and of the implementation. This means that PDCA Cycle keeps rolling for continuous improvement. FRANZ J. et Al (2016) states that it relates to the application of the implemented solutions. When these solutions are proven, they are considered the norm and lead to standardization and monitoring of the activities. This step may be necessary in case of tools such as process mapping, an action scheme or benchmarking.

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Project P-D-C-A cycle

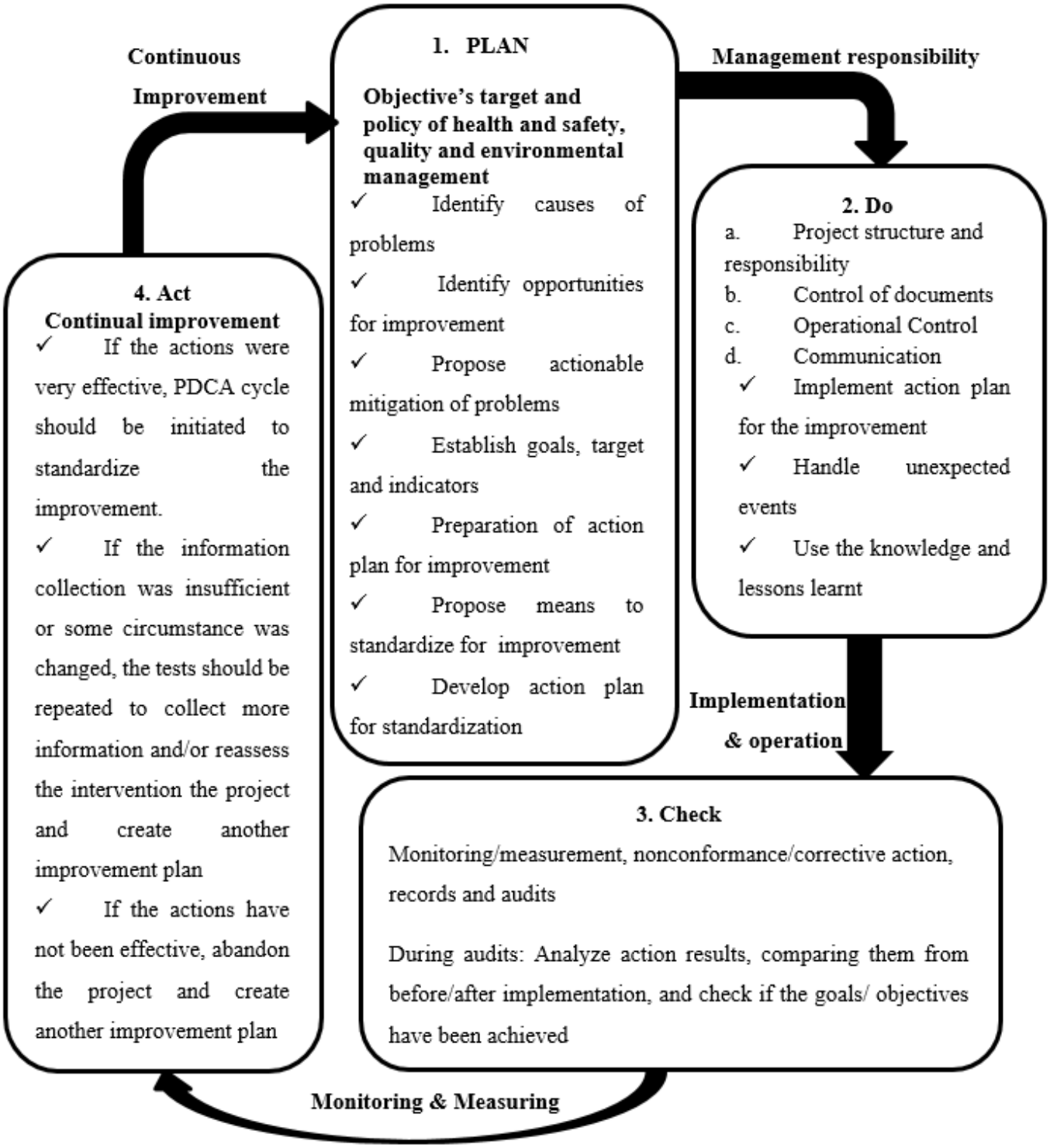

Figure 2.2: *Project P-D-C-A continuous improvement cycle*

Source: *Author*

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2.1.3.13. Similarity of ISO 9001, ISO 14001, AND ISO 45001

While ISO 45001 got published recently in 2018 on occupational health and safety management systems, ISO 9001 and 14001 were both published in 2015. The similarity in the table below shows similarity of the above management systems when playing their roles in any organization.

ISO 9001	ISO 14001	ISO 45001
ISO 9001 helps organizations meet regulatory requirements, to provide customer satisfaction, and quality products and services	ISO 14001 helps organizations prove their commitment to environmental sustainability by reducing industrial waste and environmental damage	ISO 45001 helps organizations provide objective proof to staff, partners, clients, and stakeholders that ensuring health and safety is at the core of the business
While planning to ISO 9001, all actions must address ISO 9001 risks and opportunities	While planning to ISO 14001, all actions must address ISO 14001 risks and opportunities	While planning to ISO 45001, all actions must address ISO 45001 risks and opportunities
Can be used by all organizations, i.e. small businesses, and multinationals across all industries	Can be used by all organizations, such as small businesses and multinationals across all industries	Can be used by all organizations, such as small businesses and multinationals across all industries
Focuses on achieving proposed quality objectives	Focuses on achieving proposed environmental objectives	Focuses on achieving proposed OHSMS objectives
Creating and documenting documented information for future use and reference	Creating and documenting documented information for future use and reference	Creating and documenting documented information for future use and reference

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Performance evaluation includes monitoring, measuring, and analysis	Performance evaluation includes monitoring, measuring, and analysis	Performance evaluation includes monitoring, measuring, and analysis
Continual improvement	Continual improvement	Continual improvement

Table 2.1: *Similarity of ISO 9001, ISO 14001, and ISO 45001*
Source*: https://www.3foldtraining.com/comparison-between-iso-9001-14001-45001/ retrieved on 20 Aug 2023*

All three standards are based on a high-level structure that makes it easy for organizations to integrate all 3 of them if they desire to. The table below provides the comparison between ISO 9001, 14001, and ISO 45001 to give you insightful knowledge on all three standards and the benefits they offer. When comparing ISO 9001, ISO 14001, and ISO 45001 the researcher realized a significant similarity and how they complement each other. The similarity is seen in table 2.1.

2.1.3.14. Developing a Project Plan for implementation of IMS

As soon as the project manager has received his or her brief or project instructions, he or she must produce a document that distils what is generally a vast amount of information into a concise, informative, and well-organized form that can be distributed to all members of the project team and indeed all the stakeholders in the project. This document is called a project management plan. It is also sometimes just called a project plan, or in some organizations a coordination procedure. (Albert L. et Al, 2017).

The project management plan is one of the key documents required by the project manager and his or her team. It lists the phases and encapsulates all the main parameters, standards, and requirements of the project in terms of time, cost and quality/performance by setting out the 'Why', 'What', 'When', 'Who', 'Where' and 'How' of the project. With the permission of the British Standards Institution, the main headings of the model project plan are given in the following but augmented and rearranged in the sections given below. (Albert L. et Al, 2017).

The Why: Project aims and objectives. This includes Business case.

The What: Generally, it describes the scope, project requirement, project security and privacy, project management philosophy and management reporting system.

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The When: Programme management mentions programme method, program software, project life cycle, key dates, milestones, and milestone slip chart, without forgetting bar chart and network if available.

The Who: Project organization talks about project resource management and project team organization (*Project staff director, Organizational chart, and* Terms of reference for staff, including for the project manager, for the committees and working group).

The Where: Delivery requirements (*Site requirements and conditions, shipping requirements and major restrictions).*

The How:

- Project approvals required and authorization limits.
- Project harmonization.
- Project implementation strategy.

- *Implementation plans.*
- *System integration.*
- *Completed project work.*

- Acceptance procedure.
- Procurement strategy.

- *Cultural and environmental restraints.*
- *Political restraints.*

- Contract management.
- Communications management.
- Configuration management.

- *Configuration control requirements.*
- *Configuration management system.*

- Financial management.
- Risk management.

- *Major perceived risks.*

- Technical management.
- Tests and evaluations.

- *Warranties and guarantees.*
- Reliability management

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- *Availability, reliability, and maintainability.*
- *Quality management.*
- Health and safety management.
- Environmental issues.
- Integrated logistic support (ILS) management.
- Close-out procedure.

2.1.3.14. Project Risk Assessment Methods

Risk Assessment Process: As adapted from Risk management Guideline, the risk management process involves the systematic application of policies, procedures, and practices to the activities of communicating and consulting, establishing the context and assessing, treating, monitoring, reviewing, recording, and reporting risk. Furthermore, the risk management process is an integral part of management and decision-making and integrated into the structure, operations, and processes of the organization. It can be applied at strategic, operational, program or project levels. There can be many applications of the risk management process within an organization, customized to achieve objectives and to suit the external and internal context in which they are applied. The dynamic and variable nature of human behavior and culture should be considered throughout the risk management process. Although the risk management process is often presented as sequential, in practice it is iterative. Risk assessment is the overall process of risk identification, risk analysis and risk evaluation. Risk assessment should be conducted systematically, iteratively, and collaboratively, drawing on the knowledge and views of stakeholders. It should use the best available information, supplemented by further enquiry as necessary. (ISO 31000, 2018).

Risk identification: The purpose of risk identification is to find, recognize and describe risks that might help or prevent an organization achieving its objectives. Relevant, appropriate, and up-to-date information is important in identifying risks. The organization can use a range of techniques for identifying uncertainties that may affect one or more objectives.

To get the investigation going, the team may have a brainstorming session and use a prompt list (based on specific aspects such as legal or technical problems) or a checklist compiled from risk issues from similar previous projects. (Albert L. et Al, 2017).

Risk analysis: ISO 31001, 2018 states that the purpose of risk analysis is to comprehend the nature of risk and its characteristics including, where appropriate, the level of risk. Risk analysis involves a detailed consideration of uncertainties, risk sources, consequences,

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likelihood, events, scenarios, controls, and their effectiveness. An event can have multiple causes and consequences and can affect multiple objectives. Risk analysis can be undertaken with varying degrees of detail and complexity, depending on the purpose of the analysis, the availability and reliability of information, and the resources available. Analysis techniques can be qualitative, quantitative or a combination of these, depending on the circumstances and intended use. ISO 31001, 2018.

Risk analysis should consider factors such as:

- The likelihood of events and consequences.
- The nature and magnitude of consequences.
- Complexity and connectivity.
- Time-related factors and volatility.
- The effectiveness of existing controls.
- Sensitivity and confidence levels. ISO 31001, 2018.

The risk analysis may be influenced by any divergence of opinions, biases, perceptions of risk and judgements. Additional influences are the quality of the information used, the assumptions and exclusions made, any limitations of the techniques and how they are executed. These influences should be considered, documented, and communicated to decision makers. Highly uncertain events can be difficult to quantify. This can be an issue when analyzing events with severe consequences. In such cases, using a combination of techniques generally provides greater insight. Risk analysis provides an input to risk evaluation, to decisions on whether risk needs to be treated and how, and on the most appropriate risk treatment strategy and methods. The results provide insight for decisions, where choices are being made, and the options involve different types and levels of risk. ISO 31001, 2018.

Risk evaluation: The purpose of risk evaluation is to support decisions. Risk evaluation involves comparing the results of the risk analysis with the established risk criteria to determine where additional action is required. The researcher got it from, Fundamentals of risk management; the use of a risk matrix is a very simple way of demonstrating the level of risk that a particular event represents to an organization. A risk matrix is normally used to represent the residual or current level of risk. This can also be referred to as the net risk. When the risk matrix is used to illustrate the current level of risk, the vertical axis will normally be labeled as impact. However, the risk matrix can also be used to represent gross or inherent level of risk, which is the level of risk before controls are applied. When the risk matrix is used to illustrate the inherent level of risk, the vertical axis may sometimes be labeled magnitude. (Paul H, 2017)

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2.1.3.15. Construction Project Delays

The occurrence of delays in construction projects inevitably impacts on the project's direct costs. Particularly in the scenario where the project pertains to a public building or facility, complications escalate as the client is typically a government department. The repercussions of delays in such instances may encompass:

- Confusion surrounding public development plans.
- Disruption of the budget execution plan for the government entity involved.
- Public inconvenience stemming from project delays.

Delay in construction projects is commonly understood as the failure to complete a project within the scheduled timeframe outlined in the contract or planned schedule. Abbas (2006) characterizes the delay as the discrepancy between the actual completion date and the initially planned schedule. This setback occurs when the project's progress lags the predefined timeline. Delays can stem from various factors, including but not limited to, adverse weather conditions, regulatory constraints, fluctuations in market conditions, among others.

Similarly, Assaf SA (2006) provides a definition of delay as the extension of time beyond the originally anticipated completion date specified in the contract or agreed upon by the involved parties. The complexity inherent in construction processes necessitates the collaboration and concerted effort of all stakeholders involved. Numerous factors contribute to project delays, ranging from the performance and reliability of contractors to challenges in material procurement, site management, and unforeseen events. Effective coordination among stakeholders, suitable site conditions, and the financial stability of project owners are crucial determinants influencing the timely completion of construction projects.

According to Al-Kharashi at Al (2009), differing perspectives exist among parties involved in construction projects regarding project delays. For project owners, delays signify lost revenue and diminished returns, whereas contractors view delays as drivers of increased overhead costs and expenses. Delays stemming from clients, such as tardy submission of drawings and specifications, frequent alteration requests, and inaccurate site information, often result in contentious claims from both primary contractors and subcontractors. These disputes frequently culminate in protracted legal battles, entailing significant financial ramifications. Conversely, delays arising from contractors are often attributed to deficient managerial skills, marked by inadequate planning and a limited grasp of accounting and financial principles, which have precipitated the downfall of many contractors.

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2.1.4. Organizational Theory

The researcher analyzed theoretical perspectives on AGATARE construction project behavior, culture, and change management inform understanding of how integrated management systems are adopted and implemented within the project.

2.1.5. Sustainability and Green Construction Theory

Given the increasing emphasis on sustainability in construction projects worldwide, theoretical studies explore the integration of sustainability principles into project management processes and the role of integrated management systems in promoting sustainable practices.

EMPIRICAL STUDIES

Case Study Methodology: Empirical studies involved conducting case studies within the context of construction projects in Rwanda that have implemented IMS. This included selecting a representative project namely AGATARE construction project, where collecting primary data through interviews, surveys, and document analysis, and analyzing the data to identify patterns, challenges, and outcomes related to IMS implementation were done.

Quantitative Analysis: Empirical research involved quantitative analysis of data collected from the mentioned construction project, focusing on key performance indicators (KPIs) related to quality, environmental impact, and occupational health and safety. Statistical techniques such as regression analysis, correlation analysis, and variance analysis were employed using SPSS application to assess the impact of IMS implementation on project performance.

Qualitative Analysis: Qualitative analysis involved thematic analysis of interview transcripts and qualitative data collected from project stakeholders. This provided insights into the attitudes, perceptions, and experiences of individuals involved in IMS implementation, as well as the organizational and cultural factors influencing the process.

Benchmarking and Comparative Analysis: Empirical studies may also involve benchmarking construction projects in Rwanda against international standards and best practices in IMS implementation. This comparative analysis can highlight areas of strength and areas for improvement, providing valuable insights for practitioners and policymakers.

2.1.6. SWOT Analysis Monitoring and Review

Monitoring involved data and information collection whereas reviewing concerned checking the sustainability, effective and adequacy of SWOT analysis. As it is mentioned in ISO/TS 9002,2016., it is said that at the strategic level, tools such as Strengths, Weaknesses,

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Opportunities and Threats analysis (SWOT) can be used. A simple approach can be useful for organizations dependent on the size and complexity of their operations, such as brainstorming and asking "what if" questions.

- ***SWOT analysis:*** Strengths and weaknesses sections are meant to convey traits describing the present state of the company in comparison to direct and indirect competition. The opportunities and threats quadrants convey items of anticipated growth and concern over the next three years. This exercise was instructive for developing many summary and competitive insights.

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Strength (S)	Weakness (W)
• Project implemented by a contractor who is ISO 9001 certified. They have competence and skilled labour as ISO 9001:2015 wants it • There were detailed project plans • Local, professional and experienced managers were availed to the project. • Relationship with Rwanda Government • Capability in security related matters • Financial strength	• Project risks related to environment and safety • Non-precise feasibility study • Project duration was not well predicted. • Long processes of expropriation approval. • Lack of adequate skilled staff in key areas • Lack of modern logistical support equipment • Staff capability in key areas
Opportunity (O)	**Threat (T)**
• New business partners on board • Collaboration with government entities • Opportunities in project management. • National Strategy for Transformation (NST-1) implementation. • Certification of ISO 9001, ISO 14001 and ISO 45001	• Lack of team building events due to COVID19 • Lack of information from urban facilities Social and cultural factors in urban projects. • Technology Risk • Cost risk • COVID-19 • Operational risk • Health and safety risk

Table 2.2: SWOT analysis matrix

Source: Primary data 2022

2.1.7. Skills Requirement for Effective Project Management

A project Manager of a road construction project is the top boss of overall project management and project completion. Responsibilities include oversight of project quality control, financial controls, production efficiency, site safety, and project management systems and reporting. He/she must be equipped with adequate leadership and required managerial competencies. Skills required are related to competence is the ability of an individual to do assigned task well. Competency is a set of defined behaviors that provide a structured guide enabling the

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identification, evaluation, and development of the behaviors in individual employees (Chan and Mohan 2009). Competencies are also what people need to be successful in their jobs. Job competencies are not the same as job tasks. Competencies include all the related knowledge, skills, abilities, and attributes that form a person's job. This set of context-specific qualities is correlated with superior job performance and can be used as a standard against which to measure job performance as well as to develop, recruit, and hire employees. As Hwang and Ng (2013) confirmed the construction industry's growing awareness of the relationship between achieving project success and construction project management competencies. Successful construction firms now focus on assuring that project managers acquire the core competencies required to be successful in their assignments. AGATARE road construction involved the process of installing soil stabilizers, asphalt, concrete, and other materials on a defined path to create a paved surface on which vehicles can move between two destinations. This complex activity was done in phases with specific skills requirements as seen below:

- ***Planning:*** Initial step in a road construction project involves assessing the current and future traffic patterns and performing a cost-benefit study to ensure the road will serve its purpose. All issues concerning the commencement of AGATARE project were sorted out during this initial stage to make sure the project runs smoothly. However, quality management system requirements based on ISO 9001:2015 has it that options to address risks and opportunities can include avoiding risk, taking risk to pursue an opportunity, eliminating the risk source, changing the likelihood or consequences, sharing the risk, or retaining risk by informed decision. The requirements further state that opportunities can lead to the adoption of new practices, launching new products, opening new markets, addressing new customers, building partnerships, using new technology and other desirable and viable possibilities to address the organizations or its customers' needs. (ISO 9001,2015).
- ***Site setting:*** Setting out refers to the process of transferring design proposals from drawings into the ground. It demarcates site boundaries, foundations, and other necessary structural parts. In most road construction projects, a series of boards are placed at intervals along the proposed line of the road. A profile board with a fixed height, often referred to as traveler, is deployed to control the excavated levels between the profile boards. The traveler is placed in the sightline between two level boards to ensure it can be seen before and after the excavation to adjust levels accordingly. Like in any other construction project, the level of profile board is measured using a line level – a short spirit level suspended on a nylon string. The string is moved up or down until the bubble is centered (Jane M, 2023).

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- ***Earthworks:*** Earth works involve labor-intensive procedure in road construction. It entails the use of a, excavator, bulldozer, moto grader, and trucks on site to remove the topsoil before scraping and grading the site to expose the underlying ground, often known as formation level. This is the level at which excavation ceases and construction starts. The soil below the formation level is known as subgrade and it should be tested for strength before embarking on excavation. If the quality of the subsoil is undesirable, the material may be removed or stabilized. If the cost of excavation of subsoil is deemed uneconomical, sand wicks and sand drains may be applied. Sand wicks are sand-filled boreholes underneath the road embankment. They offer greater stability to the soil by reducing the length that water travels in a drainage path to disintegrate water pressure. On the other hand, sand drains are used to capture ground water. It is important to provide subsoil drainage to help deal with leakage through pavements and verges from higher ground as well as periodic rise and fall of the water table. Since the thickness of the pavement depends on the strength of the subgrade, it is important to reinforce the subgrade by removing poor material in cuttings and substituting them with selected fill, providing adequate subsoil drainage, and compacting subgrade to a high dry density. The subgrade can also be reinforced through soil stabilization procedures such as the use of chemicals, cement, or bituminous materials. Since the strength of subgrade diminishes as moisture content increases, it is important to cover the surface in case it will be left exposed for some time. This can be done by covering the subgrade with a medium gauge plastic sheet with 300mm laps or spraying a bituminous binder with a sand topping. (Jane M, 2023).

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Figure 2.3: *Earthworks of cutting and filling*
Source: *Primary data September,2022*

- ***Paving:*** This road construction procedure begins once the subgrade has been prepared and drainage systems fitted. Paving can either be rigid or flexible depending on the precise requirements of a project. Rigid pavements have a higher flexural strength, longer design life, and lower maintenance costs, while flexible pavements are cheaper to erect and have a higher capacity to expand and contract with temperature variations, hence they do not require expansion joints. (Jane M, 2023).
- ***Rigid Paving:*** This consists of a reinforced or unreinforced in-situ concrete slab placed over a thin granular base course. The inflexibility and strength of rigid pavements enable the loads and pressures to be dispersed over a wide area of the subgrade to reduce the potential impact. From top to bottom, rigid paving is made up of these layers:

- Subgrade (existing soil).
- Sub-base course of crushed stone with a thickness of 60 cm.
- Lubricous sheath made of polythene sheeting.
- In situ concrete paving slab, which can be reinforced using steel fabric or re-bar.
- Asphalt or similar topping as necessary.

Rigid pavements do not have the capacity to expand and contract due to changes in temperature and moisture changes. Traverse and longitudinal joints are fitted between slabs to prevent

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cracking that happens because of restrained deformations caused by temperature and moisture variations. The spacing of the joints is usually determined by the temperature at which the concrete is laid, the thickness of the slab, expected traffic load, and the presence or absence of slab reinforcement. (Jane M, 2023).

- ***Flexible Paving:*** Flexible pavements are made of several layers of asphalt or bituminous material overlying the ready subgrade to which all the traffic loads are distributed. They are called "flexible' because the entire pavement structure bends or deflects when subjected to traffic loads. The thickness of every individual layer must have the capacity to distribute loads to avert permanent deformation of the road surface. In flexible paving, the subgrade is compressed with the sub-base on top. The sub-base layer is usually made of crushed stone or dry lean concrete that is laid and compressed. The sub-base should not exceed 15 cm and is usually placed once waterproofing is completed. Above the sub-base is the surfacing layer, which consists of the base layer and the wearing course. The wearing layer is the topmost layer of bituminous material and is often thicker and stronger than the base layer. Its thickness depends on the material requirements and the anticipated traffic loads. (Jane M, 2023).

Figure 2.4: *A part of AGATARE road construction project at is completion stage*
Source: *Primary data September,2022*

Materials used for the wearing course include porous asphalt, hot rolled asphalt, dense bitumen tar macadam, and dense bitumen macadam. On the other hand, the sub layer is usually at least 6 cm thick and is made up of dense bitumen macadam or asphalt. It is applied with the suitable cross falls and gradients. (Jane M, 2023).

2.17 Quality Control

After a road surface was put in place, a series of quality tests must be performed before the road construction project can be deemed complete. This procedure involves checking to

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confirm drainage, grading levels and other aspects of the road are satisfactory. Once all the checks return positive results, the road can now be opened for use by motorists. Most roads can last for up to 40 years – with major upgrades due every decade or so. (Jane M, 2023).

2.1.8. Geotechnical Design Specifications for AGATARE Asphalt Road Project

As shown by the typical cross section of the access streets, the structure of the road is made by the following layers:

- Subgrade: The subgrade is the higher part of the earthwork. It is reached either after cutting or after filling.
- Sub-base: For this project, sub-base layer is made of natural gravels materials and have thickness of 10cm after compaction.
- Base course layer: It is made of crushed stone with 0/31 grading and 10cm thick after compaction.
- Prime coat: after the base course layer, a sandy priming was done using a mixture of bitumen and kerosene on the 60%/40% respectively.
- Wearing course: The wearing course of this project is made by a hot mixed asphalt concreate C14 and 3cm thick (Munzenze, 2022).

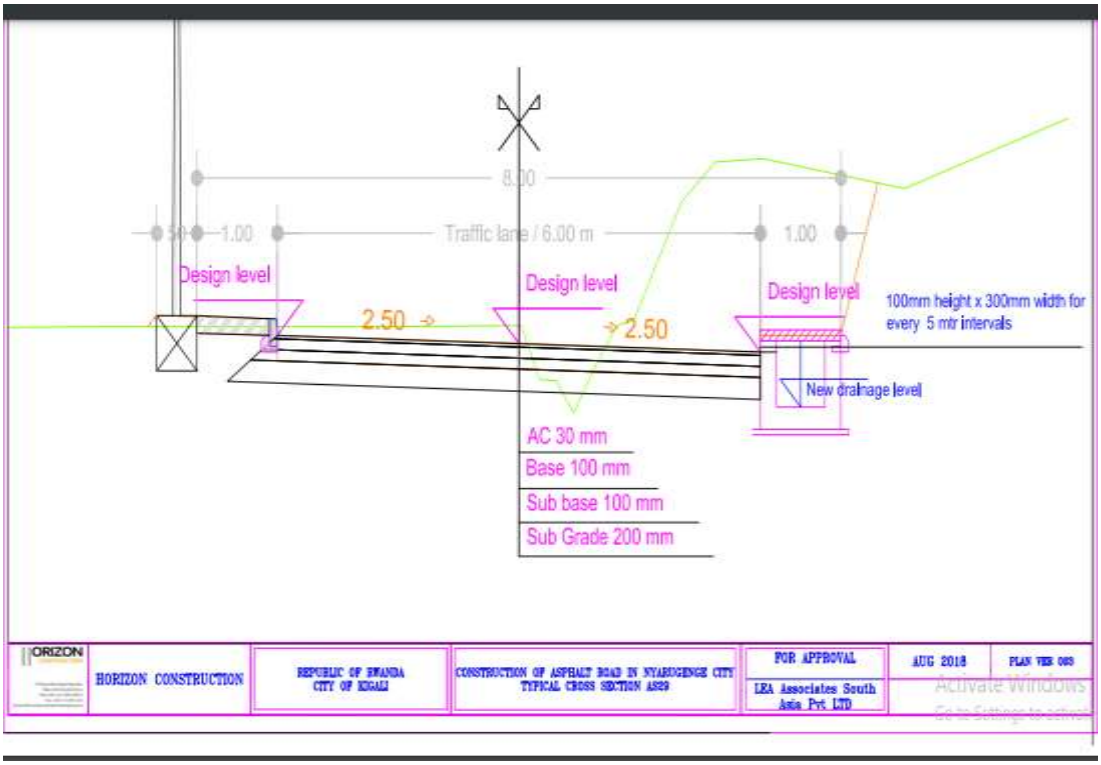

Figure 2.5: *Specifications of Road cross-section and its layers*
Source: *Munzenze, 2022*

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Filling Specifications: On different sections of access streets, filling is a requirement to reach subgrade level. The materials to be used are either from cut or from borrow pit. The materials shall be with their water content optimum of the Proctor test modified and compacted to obtain without tolerance the following values:

- 95% of the density dry maximum of the Optimum Modified Proctor (OPM) for the thirty (30) higher centimeters,
- 95% of the OPM for the body of the embankment.
- California Bearing Ratio (CBR)>15.

Subgrade: After filling/ cutting the subgrade (platform) level of the road was reached. The general compaction place of the platform shall take place to obtain a dry density of the thirty centimeters (30cm) of the road base of the earthworks in the cut zones, as in those in fill, at least equal to 95% of the OPM. Munzenze, 2022.

The control of the compaction of the platform shall be carried out by the test Modified Proctor and the measurement of the dry density (in situ) using a membrane densitometer. The compaction shall be conducted until it reaches at least 95% of OPM. The platform shall not present bumps or depressions higher than three (3) centimeters under the rule of three meter placed transversely or parallel to the axis. Before continuing to the following layer each layer shall be approved by the consulting firm on behalf of client. Munzenze, 2022.

Sub-base layer: The materials of foundation course had to be lateritic gravelly or other similar natural gravel 0/40. They had to be applied to the platform to obtain a thickness of 10cm after compaction and that in accordance with alignments and levels indicated in on the geometric design of an access street. The following are characteristics of materials to be used for sub-base layer as per technical specifications from the tender documents: Degree of compaction: > 98% of OPM, Tolerance of the moisture content: ± 2% of OPM, CBR to 4 days of imbibition: > 30, Plasticity index: < 16, Limit of liquidity: < 35, Size of the thickest element: 40 mm and Linear swelling: < 1%.

The following table shows the requirements to meet for sieve analysis of the materials to be used on the sub-base layer:

Openings of the sieve (mm) (Square or circular)	***Passing (% in weight)***
60.00	*100*
38.00	*100-84*

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19.00	*100-61*
9.520	*96-46*
4.760	*74-34*
2.380	*57-26*
0.710	*15*
0.074	*15-2*

Table 2.3: *Sieve analysis of the materials to be used on the sub-base layer*
Scource: *Munzenze, 2022*

The control of the compaction of the sub-base layer had to be carried out by the test Modified Proctor and the measurement of the dry density (in situ) using a membrane densitometer every 50m. The sampling of materials had to be done regularly to check the compliance of all characteristics required for sub-base layer.

The operations of placing and spreading had to be executed in the conditions of the most satisfactory moisture content to prevent segregation and ensure a uniform and acceptable rolling. Munzenze, 2022.

Base course layer: The materials for the base course shall moreover meet the following characteristics: Crushing Index: > 60%, CBR (4 days soaking) at 98% MDD density: > 80% and Abrasion resistance (Los Angeles): < 35%.

Sieve openings		***Percentage Passing***
40.0	*Mm*	*100 %*
31.5	*Mm*	*85 ÷ 100%*
20.0	*Mm*	*62 ÷ 90 %*
10.0	*Mm*	*40 ÷ 70 %*
6.3	*Mm*	*31 ÷ 60 %*
4.0	*Mm*	*25 ÷ 52 %*
2.0	*Mm*	*18 ÷ 43 %*
0.5	*Mm*	*10 ÷ 27 %*
0.2	*Mm*	*6 ÷ 18 %*
0.08	*Mm*	*4 ÷ 10 %*

Table 2.4: *Sieve analysis of the materials to be used on the base course layer*
Source: *Munzenze, 2022*

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Prime Coat: The prime coat consisted of the application of the cut-back bitumen to form a bitumen primer on a well-prepared base course surface. It was required to apply 1.2L/m2 for this project. The technical specifications for this project were specifying 3 alternatives of type of bitumen to be used for prime coat as indicated by the table 2.5 below.

CUT-BACK ASPHALT	***0/1***	***10/15***	***400/600***
S.T.V. pseudo-viscosity at 25°			
Opening 4 mm	*<30 dry*	-	
Opening 10 mm	-	*10 – 15*	*400/600*
Relative density at 25° C (using pycnometer)	*0.92 – 1.04*	*0.92 – 1.04*	*0.92 – 1.04*
Fractional distillation (% of initial volume):			
Fraction below:			
190°C	*< 9*	-	-
225°C	*10 ÷ 27*	*< 11*	*< 2*
315°C	*30 ÷ 45*	*16 ÷ 28*	*5 ÷ 12*
360°C	*< 47*	*< 32*	*< 15*
Dow penetrability at 25°C, 100g, 5s, of the distillation residue at 360°C (in 1/10 mm)	*70/250*	*70/250*	*70/200*

Table 2.5: *Technical specifications for bitumen to be used s prime coat*
Source: *Munzenze, 2022*

Tack Coat: Prior to the placement of asphalt concrete, the cut-back bitumen necessary for the placement of a tack coat on the road already treated with a prime will have to be applied. The binder to be used will have to be of class 10/15 cut-back bitumen that will have to be applied in less than 24 hours before the placement of concrete bitumen. Cut-back bitumen will have to be spread at normal spreading temperature (150-180ºC) Munzenze, 2022.

Asphalt Concrete: The asphalt concrete to be used for this project had to be 0/10. 0/10 concrete bitumen prepared from a crushed rock supplied without rolled sand and of a 50/70 bitumen.

The grain-size distribution for a 0/10 concrete bitumen was defined in table 2.6.

Description of grain-size distribution	**Range**
Passing through 14 mm	100 %
Passing through 10 mm	97 %

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Passing through 6.3 mm	70 %`
Passing through 4 mm	52 %
Passing through 2 mm	37 %
Passing through 0.08 mm	8 %
Binder content	*4 - 6* %

Table 2.6: *Grain-size distribution for a 0/10 concrete bitumen*
Source: *Munzenze, 2022*

The quality of the binder used in the asphalt concrete was specified as pure bitumen of class 50/70 which had to meet following characteristics:

Description	UoM	Range
Penetrability at 25°C, 100g, 5s	(1/10 mm)	50 - 70
Softening point (marble and brings)	(°C)	43 - 56
Relative density at 25° C (with a pycnometer)		1,00 – 1.01
Packing effect due to heating (163 during 5h)	(%)	< 2
Percentage of remaining penetrability after packing effect due to heating with respect to initial penetrability		> 70
Flash point (open tank)	(°C)	> 230
Ductility at 25° C	(cm)	> 80
Solubility in the tetrachloroethylene		> 80
Paraffine content	(%)	< 4.5

Table 2.7: *Bitumen 50/70 binder quality specification*
Source: *Munzenze, 2022*

The already mixed asphalt (aggregates and binder) shall meet the following characteristics:

Mixed asphalt description	UoM	Range
Unconfined Duriez uniaxial test (8 days – 18°C), 1mm/s		
Density	(%)	92 -94
Compressive strength (at18° C)	(MPa)	6
Water absorption(uptake) rate	(%)	< 3
Marshall Method (50 blows)		
Density	(%)	96 - 98
Stability	(kg)	900
Flowage	(mm)	4

Table 2.8: *Mixed asphalt concrete specification*
Source: *Munzenze, 2022*

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2.1.9. Qualities of Project Manager Regarding IMS

According to keoki et al, 2008, the author narrates that the effective project manager must possess four essential attributes.

- First, he must have a considerable background of practical construction experience so that he is thoroughly familiar with the workings and intricacies of the industry. Without such a basic grounding in construction fundamentals, the project manager would be completely unprepared to carry out his responsibilities.
- Second, the project manager must have, or have available to him, persons with expertise and experience in the application of specialized management techniques to the planning, scheduling, and control of construction operations. These procedures have been developed specifically for application to construction projects and are those discussed in this book. Because much of the management system is usually computer based, the project manager must have access to adequate computer support services.
- Third, the project manager must have the capacity to step back from the complex details of daily construction operations and look into the future—planning for upcoming activities, checking material deliveries, determining manpower and training requirements, identifying possible changes to the work, and other future problem areas.
- Lastly, the project manager must have the personality and insight that will enable him to work harmoniously with other people, often under very strained and trying circumstances. The manager, after all, cannot accomplish everything through his efforts alone. He must work with and through people in the performance of his duties. Doing this requires an appreciation and understanding of the human factor. Without this, his other attributes, however commendable, will be of limited effectiveness.

2.2. INDEPENDENT VARIABLES

By examining these independent variables within the context of construction projects in Rwanda, the thesis aims to analyze the factors influencing IMS implementation and its impact on project execution outcomes, providing valuable insights into the challenges, opportunities, and best practices associated with IMS adoption in the construction sector.

Integrated Management System (IMS) Implementation: IMS implementation serves as the primary independent variable of the thesis, representing the degree to which construction projects in Rwanda integrate various management systems, including quality management, environmental management, and occupational health and safety, into a unified framework. IMS implementation can be measured using qualitative and quantitative indicators, such as the

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extent of IMS adoption, the level of integration achieved across different management systems, the effectiveness of IMS policies and procedures, and the degree of stakeholder engagement in IMS implementation processes.

Stakeholder Engagement and Collaboration: Stakeholder engagement and collaboration represent the extent to which various stakeholders involved in construction projects, including government agencies, regulatory bodies, local communities, non-governmental organizations, and industry associations, actively participate in IMS implementation efforts and collaborate to achieve common objectives. Stakeholder engagement and collaboration can be measured using indicators such as the frequency and depth of stakeholder consultations, the level of participation in IMS planning and decision-making processes, the establishment of partnerships and alliances to support IMS implementation, and the degree of information sharing and knowledge exchange among stakeholders.

Organizational Commitment to IMS: Organizational commitment to IMS reflects the dedication and support of construction project stakeholders, including project owners, managers, contractors, and employees, towards the successful implementation and integration of IMS within their organizations. Organizational commitment to IMS can be assessed through indicators such as leadership support, resource allocation, training and capacity building initiatives, employee involvement in IMS activities, and the alignment of IMS objectives with organizational goals and values.

Organizational Culture and Leadership: Organizational culture and leadership encompass the values, beliefs, norms, and behaviors that shape the attitudes and actions of individuals within construction project organizations towards IMS implementation. It reflects the role of leadership in fostering a culture of quality, safety, and environmental responsibility. Organizational culture and leadership can be measured using indicators such as the commitment of senior management to IMS objectives, the promotion of a culture of continuous improvement and accountability, the empowerment of employees to participate in IMS activities, and the existence of communication channels for sharing IMS-related information and feedback.

Technological Infrastructure and Resources: Technological infrastructure and resources refer to the availability and utilization of information technology systems, tools, and resources to support IMS implementation and facilitate data management, communication, and decision-making processes within construction projects in Rwanda. Technological infrastructure and resources can be assessed through indicators such as the adequacy and accessibility of IMS

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software platforms and databases, the integration of digital tools for monitoring and reporting IMS performance metrics, the provision of training and technical support for IMS users, and the alignment of technological investments with IMS objectives and requirements.

Regulatory Compliance and Legal Frameworks: Regulatory compliance and legal frameworks refer to the adherence of construction projects in Rwanda to relevant laws, regulations, standards, and guidelines governing quality, environmental, and occupational health, and safety management practices. Regulatory compliance and legal frameworks can be assessed through indicators such as the degree of alignment with national and international standards (e.g., ISO standards), the level of compliance with regulatory requirements, the presence of legal mechanisms and enforcement mechanisms to ensure IMS adherence, and the responsiveness of construction projects to regulatory changes and updates.

Project Characteristics and Complexity: Project characteristics and complexity encompass the unique attributes and challenges associated with construction projects in Rwanda, including factors such as project size, scope, duration, budget, location, environmental conditions, and stakeholder dynamics. Project characteristics and complexity can be measured using indicators such as project scale and complexity indices, the presence of specific risk factors and constraints (e.g., time constraints, budget constraints, resource constraints), and the level of uncertainty and volatility inherent in project environments.

2.3. DEPENDENT VARIABLES

By examining these dependent variables, the thesis aims to evaluate the impact of integrated management system implementation on project execution outcomes within the context of construction projects in Rwanda. This analysis provides valuable insights into the effectiveness, challenges, and opportunities associated with IMS adoption in the construction sector, contributing to knowledge advancement and informed decision-making in the field.

Occupational Health and Safety (OHS) Outcomes: OHS outcomes encompass the health and safety outcomes of construction projects in Rwanda, including the prevention of work-related injuries, illnesses, and fatalities among project personnel and stakeholders. OHS outcomes can be measured using indicators such as accident rates, injury frequency and severity rates, near-miss reporting, compliance with OHS regulations and standards, worker absenteeism due to health issues, and the effectiveness of safety training and awareness programs. It may involve conducting safety audits, inspections, and incident investigations to identify and mitigate OHS risks.

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Quality of Construction Outputs: The quality of construction outputs refers to the degree of excellence and compliance with specifications, standards, and requirements demonstrated by the physical infrastructure delivered through construction projects in Rwanda. The quality of construction outputs can be measured using indicators such as structural integrity, durability, functionality, aesthetics, and compliance with building codes and regulations. It may also involve stakeholder assessments of perceived quality and satisfaction with the delivered infrastructure.

Environmental Performance: Environmental performance represents the environmental impact and sustainability of construction projects in Rwanda, including their contribution to resource conservation, pollution prevention, and ecosystem preservation. Environmental performance can be assessed using indicators such as energy efficiency, resource use efficiency, waste generation and management practices, emissions reductions, habitat preservation, and biodiversity conservation measures. It may involve environmental audits, assessments, and monitoring programs to evaluate the environmental footprint of construction activities.

Project Performance: Project performance serves as a key dependent variable of the thesis, representing the overall success and effectiveness of construction projects in Rwanda in achieving their objectives within defined constraints, including time, cost, quality, safety, and environmental sustainability. Project performance can be assessed using various indicators, such as project completion time, adherence to budgetary constraints, conformance to quality standards, incidence of safety incidents and accidents, environmental impact assessments, and stakeholder satisfaction levels.

Stakeholder Satisfaction and Engagement: Stakeholder satisfaction and engagement represent the perceptions, attitudes, and levels of involvement of various stakeholders, including project owners, contractors, employees, local communities, regulatory agencies, and other relevant parties, towards construction projects in Rwanda. Stakeholder satisfaction and engagement can be assessed using indicators such as stakeholder surveys, feedback mechanisms, community consultations, public hearings, and stakeholder participation levels in project decision-making processes. It may involve measuring stakeholder perceptions of project transparency, responsiveness, and accountability, as well as their overall satisfaction with project outcomes and impacts.

Compliance with Regulatory Requirements: Compliance with regulatory requirements entails adherence to relevant laws, regulations, standards, and guidelines governing

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construction activities, including quality management, environmental protection, occupational health and safety, and other pertinent aspects. Compliance with regulatory requirements can be assessed through regulatory audits, inspections, and assessments conducted by government agencies, regulatory bodies, and independent auditors. It may involve monitoring and documenting compliance with specific regulatory provisions, addressing non-compliance issues, and implementing corrective and preventive actions to ensure ongoing compliance throughout construction projects in Rwanda.

Cost and Resource Efficiency: Cost and resource efficiency refer to the optimal utilization of financial resources, materials, equipment, and human capital within construction projects in Rwanda, with the aim of minimizing waste, maximizing value, and achieving cost-effective project outcomes. Cost and resource efficiency can be assessed using indicators such as cost performance indices, resource utilization rates, material wastage rates, productivity metrics, and return on investment (ROI) analyses. It may involve tracking project expenditures, resource consumption patterns, and efficiency improvement initiatives to identify opportunities for cost savings and resource optimization.

2.3.1. Fundamental principles of IMS for effectiveness project management

Analyzing the implementation of an integrated management system in a road construction project execution involves adhering to fundamental principles to ensure its effectiveness and success. Here are some key principles tailored for the AGATARE road construction project in Rwanda:

Performance Measurement and Monitoring: The project management established key performance indicators (KPIs) to measure the effectiveness of the project including elements of integrated management system. Regularly monitored progress against these KPIs to identify areas for improvement and ensured that project objectives were being met.

Legal Compliance and Regulatory Adherence: The project prioritized compliance with national and local regulations governing construction projects in Rwanda. This includes environmental regulations, labor laws, safety standards, and any other applicable legal requirements. Regular audits and assessments verified compliance at various stages of the AGATARE road construction project.

Stakeholder Engagement and Communication: The project management ensured active involvement and transparent communication with all stakeholders, including government agencies such as Ministry of Commerce and Finance (MINICOFIN), Ministry of Infrastructure

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(MINIFRA), Rwanda Transport Development Agency (RTDA), local communities, sub-contractors, and project teams. This involvement fostered cooperation, built trust, and ensured alignment with project objectives.

Risk Management and Mitigation: There was implementation of risk management processes to identify, assess, and mitigate potential risks to the project's success. This involved conducting risk assessments, developing contingency plans, and continuously monitoring and addressing emerging risks throughout the project lifecycle.

Resource Optimization and Efficiency: The project optimized the use of resources, including labor, materials, and equipment, to maximize efficiency and minimize waste. They implemented efficient scheduling and resource allocation strategies to ensure timely project delivery while minimizing costs and environmental impact.

Continuous Improvement and Innovation: The project ensured a culture of continuous improvement and innovation within the project team is put in place. They encouraged the adoption of best practices, and the implementation of lessons learned from previous projects to enhance efficiency, quality, and sustainability.

Training and Capacity Building: There was not enough investment in training and capacity building initiatives to equip project team members with the necessary skills and knowledge to effectively implement the integrated management system. Provision of regular training sessions on relevant topics such as safety procedures, quality standards, and environmental management practices is required.

Documentation and Record Keeping: The project maintained comprehensive documentation and record-keeping processes to ensure traceability, accountability, and transparency throughout the project lifecycle. This included documenting key decisions, actions taken, and any deviations from established procedures.

Community Engagement and Social Responsibility: The project demonstrated a commitment to social responsibility by engaging with local communities, respecting their rights and interests, and mitigating any negative impacts of the project on the community such as easy movement during road construction. They also implemented initiatives to enhance local employment, skills development for the population living in the vicinity of the construction site.

Adaptability and Flexibility: The project remained adaptable and flexible in response to changing project requirements, external factors, and stakeholder feedback. They also

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Continuously reviewed and adjusted the integrated management system as needed to address emerging challenges and seize opportunities for improvement.

2.3.2. Complementary principles

Complementary principles considered during the analysis of the implementation of an integrated management system in the AGATARE road construction project execution in Rwanda include the following:

Environmental conservation and sustainable practices: Emphasize environmental conservation and the adoption of sustainable construction practices to minimize the project's ecological footprint. This includes implementing measures to reduce carbon emissions, protect biodiversity, and conserve natural resources such as water and energy.

Supply chain management and ethical sourcing: Implement ethical supply chain management practices to ensure the responsible sourcing of materials and services throughout the project lifecycle. This includes conducting due diligence on suppliers, monitoring compliance with ethical standards, and promoting fair labor practices and human rights.

Gender equality and social inclusion: Promote gender equality and social inclusion by ensuring equitable participation and representation of women and marginalized groups in all aspects of the project. Implement initiatives to address gender-based disparities, promote women's empowerment, and create opportunities for marginalized communities to benefit from the project.

Cultural sensitivity and diversity: Acknowledge and respect the cultural diversity of Rwanda, including its various ethnic groups and traditions. Incorporate cultural sensitivity into project planning and execution to foster positive relationships with local communities and enhance project acceptance and cooperation.

Technology integration and digitalization: Embrace technology integration and digitalization to streamline project processes, enhance data management, and improve decision-making. Leverage digital tools such as Building Information Modeling (BIM), Geographic Information Systems (GIS), and project management software to optimize project efficiency and performance.

Community empowerment and capacity building: Empower local communities by involving them in project decision-making processes, fostering skills development, and creating opportunities for economic empowerment. Support community-led initiatives that

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contribute to sustainable development and enhance the long-term resilience of local communities.

Long-Term impact assessment and legacy planning: Conduct assessments of the project's long-term impact on the environment, economy, and society to inform legacy planning and sustainability initiatives. Identify opportunities to create positive legacies, such as infrastructure improvements, skills development programs, and enhanced community resilience, that will endure beyond the project's completion.

Health and safety management: Prioritize the health and safety of all project stakeholders by implementing robust health and safety management systems and procedures. Provide adequate training, personal protective equipment (PPE), and medical support to mitigate occupational health risks and ensure a safe working environment for all.

Conflict resolution and mediation: Develop mechanisms for conflict resolution and mediation to address disputes or disagreements that may arise during the project implementation. Establish clear procedures for resolving conflicts in a fair, transparent, and timely manner to prevent disruptions and maintain positive relationships with stakeholders.

Transparency and accountability: Foster transparency and accountability in project governance and decision-making processes. Ensure that project activities are conducted with integrity and in compliance with applicable laws and regulations. Maintain open lines of communication with stakeholders and provide regular updates on project progress and performance.

2.3.3. Expert knowledge and judgment

Overall, the expert knowledge and judgment applied during the analysis of the integrated management system implementation in the AGATARE road construction project were critical in ensuring informed decision-making, risk management, stakeholder engagement, and continuous improvement throughout the project lifecycle. During the analysis of the implementation of the integrated management system in the AGATARE road construction project execution in Rwanda, several key expert knowledge and judgments were made to ensure the effectiveness and success of the system. Here are some examples:

Technology selection and integration: Experts would have evaluated various technologies and tools for their suitability in streamlining project processes, enhancing data management, and facilitating communication and collaboration among project stakeholders. Their judgment

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would have guided the selection and integration of technology solutions, ensuring alignment with project requirements and scalability for future needs.

Local contextual understanding: Experts would have leveraged their knowledge of Rwanda's local context, including regulatory frameworks, cultural nuances, and socioeconomic factors, to tailor the integrated management system to the specific needs and challenges of the AGATARE project. This understanding would have informed decision-making processes and risk assessments throughout the project lifecycle.

Regulatory compliance and legal oversight: Experts would have remained vigilant in ensuring compliance with relevant laws, regulations, and permitting requirements governing construction projects in Rwanda. Their expertise in legal matters and regulatory frameworks would have guided decision-making processes, risk assessments, and documentation practices to mitigate legal risks and maintain project integrity.

Performance measurement and continuous improvement: Experts would have defined key performance indicators (KPIs) and metrics to evaluate the effectiveness of the integrated management system in achieving project objectives. Through regular monitoring and analysis of performance data, they would have applied their judgment to identify areas for improvement and optimization, driving continuous refinement of the system over time.

Risk prioritization and mitigation strategies: Experts would have applied their judgment to identify and prioritize potential risks to the project's success, considering factors such as safety hazards, environmental impacts, regulatory compliance, and stakeholder relations. They would have developed proactive mitigation strategies to address these risks, balancing the need for risk reduction with the project's objectives and constraints.

Community engagement and stakeholder management: Experts would have employed their knowledge of stakeholder engagement principles and best practices to foster positive relationships with local communities, government agencies, contractors, and other project stakeholders. Their judgment would have guided communication strategies, conflict resolution efforts, and community empowerment initiatives to ensure widespread support and cooperation for the project.

Capacity building and training initiatives: Experts would have recognized the importance of investing in the capacity building and training of project personnel to effectively implement the integrated management system. Their judgment would have guided the development of training programs, workshops, and knowledge sharing initiatives to equip team members with the skills and knowledge needed to succeed in their roles and contribute to project success.

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Environmental and social impact assessment: Experts would have conducted comprehensive assessments of the project's potential environmental and social impacts, drawing on their expertise in environmental science, sustainability principles, and social impact analysis. Their judgment would have informed the development of mitigation measures and sustainability initiatives to minimize adverse effects and maximize positive outcomes for the environment and local communities.

2.4. URBAN DEVELOPMENT PLANNING

The Integrated Management System implemented in the AGATARE Road Construction Project has not only enhanced infrastructure but also strengthened community engagement and urban resilience, setting a positive example for similar initiatives throughout Rwanda. The AGATARE Road Construction Project in Rwanda, which is part of the larger Rwanda Urban Development Project (RUDP) funded by the World Bank, has made significant strides in improving infrastructure and living conditions in informal settlements, including AGATARE. There are some key achievements and outcomes from the project namely infrastructure development, community impact, and future plans and expansion.

Infrastructure development:

The project constructed 6.6 km of access roads and 6.2 km of footpaths, greatly enhancing connectivity within the AGATARE area and neighboring sectors. Daniel, S. (2021, June 12). *World Bank Projects Helps Urban Dwellers Feel Part of Kigali City.* KT Press. *https://www.ktpress.rw/2021/06/world-bank-projects-helps-urban-dwellers-feel-part-of-kigali-city/*

2.512 km of drainage systems were installed, addressing previous issues with poor sewage and stormwater management that led to flooding and unsanitary conditions. Daniel, S. (2021, June 12). *World Bank Projects Helps Urban Dwellers Feel Part of Kigali City.* KT Press. *https://www.ktpress.rw/2021/06/world-bank-projects-helps-urban-dwellers-feel-part-of-kigali-city/*

1.5 km of streetlights were installed, improving safety and security for residents. This particularly benefits students who can now commute safely during evening hours. Daniel, S. (2021, June 12). World Bank Projects Helps Urban Dwellers Feel Part of Kigali City. KT Press.

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https://www.ktpress.rw/2021/06/world-bank-projects-helps-urban-dwellers-feel-part-of-kigali-city/

Community impact:

The project achieved an 80% completion rate of its planned activities, incorporating extensive community engagement to ensure that residents directly benefited from the improvements. This participatory approach minimized displacements and involved citizens in the decision-making process. Daniel, S. (2021, June 12). World Bank Projects Helps Urban Dwellers Feel Part of Kigali City. KT Press. https://www.ktpress.rw/2021/06/world-bank-projects-helps-urban-dwellers-feel-part-of-kigali-city/

The installation of essential infrastructure such as roads, pedestrian paths, and drainage systems has substantially improved the daily lives of residents, making previously inaccessible areas more reachable and enhancing overall public health conditions.

Future plans and expansion: Following the success of the pilot phase in AGATARE, similar infrastructure projects are planned for other informal settlements in Kigali and secondary cities across Rwanda. These include ongoing and future projects under RUDP Phase II, which aim to continue improving urban infrastructure and management with additional funding and support.

Urban Development Planning in the Context of Integrated Management System Implementation:

Understanding urban development in rwanda: Comprehensive knowledge of urban development trends, policies, and challenges in Rwanda, including initiatives aimed at promoting sustainable urbanization and infrastructure development. Ability to assess the role of construction projects in urban development, considering factors such as population growth, urbanization rates, infrastructure needs, land use planning, and environmental sustainability. This involves analyzing how IMS implementation can contribute to achieving urban development goals while addressing the unique challenges faced by Rwanda's urban areas.

Infrastructure and construction sector analysis: Understanding of the infrastructure needs and priorities in Rwanda, particularly in the context of urban areas. Capacity to evaluate the state of infrastructure development and construction activities in Rwandan cities, identifying key projects, stakeholders, and investment trends. This includes assessing the impact of construction projects on urban landscapes, livability, and economic growth, as well as

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identifying opportunities for enhancing infrastructure resilience, efficiency, and sustainability through IMS implementation.

Integrated management system integration into urban planning: Knowledge of IMS frameworks and their applicability to urban development planning processes. Ability to analyze how IMS can be integrated into urban planning practices to promote holistic and sustainable development outcomes. This involves assessing how IMS principles, such as quality management, environmental sustainability, and risk mitigation, can inform urban planning decisions related to infrastructure design, construction, maintenance, and management. Additionally, it involves identifying synergies between IMS implementation and urban planning strategies aimed at enhancing livability, resilience, and inclusivity in Rwandan cities.

Governance and institutional frameworks: Understanding of governance structures and institutional arrangements governing urban development and construction sector regulation in Rwanda. Capacity to evaluate the effectiveness of existing governance mechanisms and institutional frameworks in facilitating IMS implementation in construction projects within urban areas. This includes assessing the roles and responsibilities of government agencies, regulatory bodies, local authorities, and private sector stakeholders in promoting IMS adoption, enforcement, and compliance. Additionally, it involves identifying policy gaps, regulatory barriers, and capacity constraints that may hinder IMS integration into urban development planning processes and proposing strategies for overcoming these challenges.

Community engagement and participation: Knowledge of community engagement principles and participatory approaches to urban planning and development. Ability to assess the importance of community engagement in IMS implementation within urban construction projects, considering the diverse needs, preferences, and concerns of local residents and stakeholders. This involves analyzing strategies for promoting community participation, transparency, and social accountability in decision-making processes related to construction project planning, design, and implementation. Additionally, it involves identifying opportunities for leveraging community partnerships, knowledge sharing, and capacity building initiatives to enhance the effectiveness and sustainability of IMS implementation in urban development planning in Rwanda.

Environmental and social impact assessment: Understanding of environmental and social impact assessment methodologies and regulatory requirements. Capacity to evaluate the environmental and social implications of construction projects within urban areas and assess the role of IMS in mitigating potential negative impacts. This involves conducting thorough

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impact assessments, stakeholder consultations, and risk analyses to identify potential environmental risks, social vulnerabilities, and mitigation measures associated with construction activities. Additionally, it involves integrating IMS principles into project planning and decision-making processes to promote environmental sustainability, social equity, and community resilience in urban development initiatives in Rwanda.

2.5. THEORETICAL AND CONCEPTUAL FRAMEWORKS

The theoretical and conceptual frameworks used during the analysis of the implementation of the integrated management system in the AGATARE road construction project execution in Rwanda encompassed a range of theories and concepts from various disciplines. Here's an overview:

Integrated Management Systems (IMS): The project ensured understanding the theoretical underpinnings of IMS, which involved integrating quality management, environmental management, health and safety management, and other relevant management systems into a cohesive framework. Concepts such as ISO 9001 (Quality Management Systems), ISO 14001 (Environmental Management Systems), and ISO 45001 (Occupational Health and Safety Management Systems) provided the foundation for IMS implementation.

Stakeholder Theory: The project recognized stakeholders' diverse interests and needs, as well as their influence on project outcomes. Conceptualizing stakeholders not only as individuals or groups affected by the project but also as active participants whose engagement was crucial for project success.

Sustainability theory: The project ensured understanding sustainability as the integration of economic, environmental, and social dimensions. The project incorporated concepts such as sustainable development, resilience, and resource efficiency into the project's theoretical framework to ensure long-term viability and positive societal impact.

Systems thinking: The project viewed the AGATARE project as a complex system with interrelated components and feedback loops. They also applied systems theory to understand the dynamic interactions between different elements of the project, including technical, social, and environmental aspects.

Risk management frameworks: The project utilized theoretical frameworks such as ISO 31000 to systematically identify, assess, and mitigate project risks. They also conceptualized risk management as an iterative process that involves risk identification, analysis, evaluation, treatment, and monitoring.

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Change management theories: The project drew on change management models such as Lewin's Change Management Model or Kotter's Eight-Step Process to facilitate the adoption of the IMS by project stakeholders. They also conceptualizing change as a process that involves overcoming resistance, building commitment, and fostering a culture of continuous improvement.

Quality management theories: The project incorporated principles of Six Sigma, and Lean Management into the conceptual framework to ensure the delivery of high-quality project outcomes. They also emphasized the importance of customer focus, continuous improvement, and employee involvement in quality management practices.

Ethical and social responsibility frameworks: The project integrated ethical principles and social responsibility concepts into the theoretical framework to guide decision-making and behavior throughout the project lifecycle. They also considered frameworks such as corporate social responsibility (CSR), ethical sourcing, and human rights to ensure that the project adheres to ethical standards and contributes positively to society.

2.5.1. CONCEPTUAL FRAMEWORK

The conceptual framework that was used in the study shows two variables: the independent variables which stand alone; and the dependent variable which changes because of the independent variable manipulation.

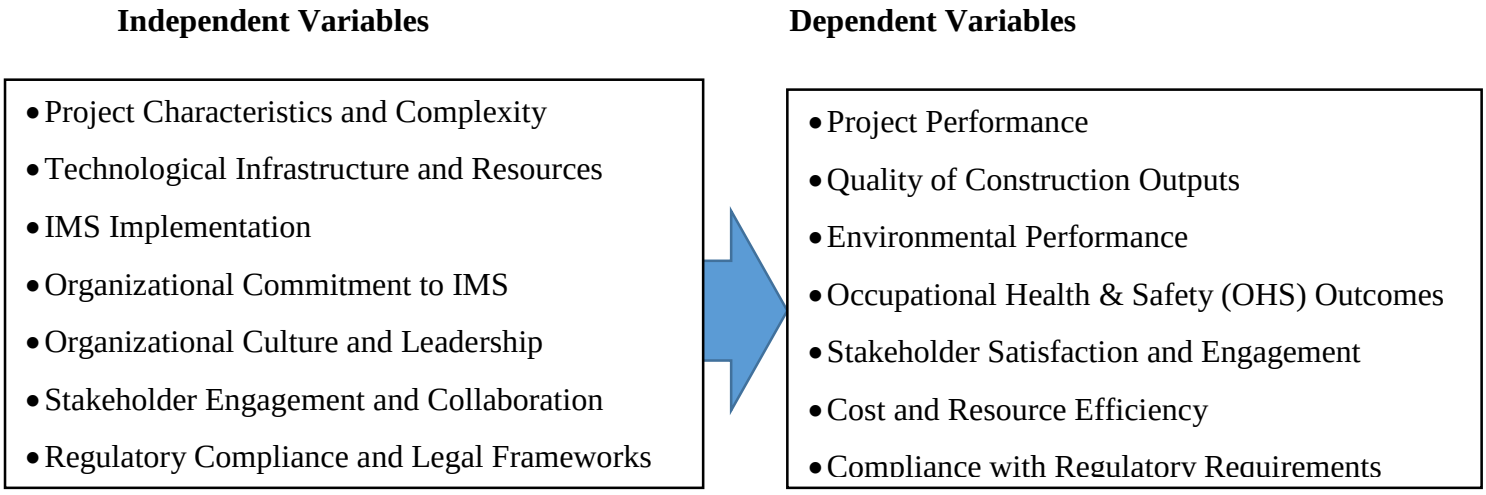

Figure 2.6: *Flowchart for Conceptual framework.*

Source: *Author*

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CHAPTER THREE: MATERIALS AND METHODS

This chapter explains the method that was used in carrying out this research. The researcher stated the research design, the target population, collection techniques; this was also explained in the sampling methodology, data collection and analysis methods. The study followed both quantitative and qualitative approaches using instruments which include surveys, interviews, observations, or document analysis, tailored to gather relevant information on integrated management system implementation.

3.1. Research design

The research was observational, cross sectional, analytical and descriptive as well. Data were collected from multiple sources using appropriate techniques and the various Integrated Management System aspects were explored and explained. The researcher used a cross-sectional approach that analyzes the application of integrated management system in a successful project execution with a case of construction projects in Rwanda whereby he focused on the compliance of ISO 9001, 14001 and 45001 which are Quality management, Environment management System, and Occupational Safety and Health respectively.

The research process was undertaken by the researcher assisted by a team of enumerators. Identification, interviewing and recruitment of qualified enumerators were carried out to ensure the integrity of the process.

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Objectives	Hypotheses	Methodology	Statistics
Main Objectives To evaluate the level of application of Integrated Management System (IMS) measures in ensuring successful completion of construction project and the effective delivery of logistic services related to construction project implementation. **Specific Objectives** • Evaluate the Role of IMS regulations on the successful completion of Agatare road construction project. • Risk assessment related to the successful completion of Agatare asphalt road project in Nyarugenge district. • Evaluate the direct job crated, workers category by skills and economic contribution after successful completion of asphalt road project implementation.	• The implementation of IMS positively impacts project performance indicators such as cost, schedule adherence, and quality in construction projects in Rwanda. • Effective IMS leads to improved coordination, communication, and decision-making, thereby reducing project delays and cost overruns.	**Data Collection:** • **Primary data** collection through surveys or interviews with stakeholders involved in construction projects in Rwanda. • **Secondary data** sources got utilized to supplement primary data. **Data Analysis:** **Quantitative analysis methods** such as statistical analysis or **qualitative analysis methods** such as thematic analysis to identify patterns, trends, and insights related to integrated management system implementation in construction projects.	• The project constructed 6.6 km of access roads and 6.2 km of footpaths, greatly enhancing connectivity within the AGATARE area and neighbouring sectors. • 2.512 km of drainage systems were installed, addressing previous issues with poor sewage and stormwater management that led to flooding and unsanitary conditions. • 1.5 km of streetlights were installed, improving safety and security for residents. This particularly benefits students who can now commute safely during evening hours. • The project achieved an 80% completion rate of its planned activities, incorporating extensive community engagement to ensure that residents directly benefited from the improvements. This participatory approach minimized displacements and involved citizens in the decision-making process.

Table 3.1. *Methodology used for the study.*
Source: *Author*

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3.2. PRESENTATION OF THE STUDY AREA

Adhering to these specified criteria, the participant selection process is tailored to encapsulate a broad spectrum of viewpoints and experiences pertinent to IMS implementation within the AGATARE road project's execution framework. The AGATARE road project, situated in Nyarugenge – within the city of Kigali, serves as the central focus for examining the implementation of an integrated management system (IMS). This project, spanning 6.724 km of access streets, 2.029 km of Major Drains (MDs), 0.918 km of Secondary Drains (SDs) and 5.952km of footpaths with streetlights, represents a pivotal infrastructure initiative aimed at making easy the transportation connectivity and fostering economic development within Rwanda.

3.2.1. Geographical Overview:

Strategically positioned within the City of Kigali – Nyarugenge district, the AGATARE road project interconnects vital urban centers, and transportation hubs. Its geographical significance transcends mere connectivity, as it traverses varied landscapes, encompassing urban and rural and environmentally sensitive areas.

3.2.2. Scope and Objectives of the Project:

The AGATARE road project's scope encompasses [insert project details], comprising road construction, maintenance, and infrastructure enhancement. Its primary objectives revolve around enhancing transportation efficiency, elevating road safety standards, and catalyzing socio-economic progress within the region.

3.2.3. Significance of IMS Implementation:

Given the project's scale and complexity, effective management practices are indispensable to ensure its successful execution. The adoption of an integrated management system (IMS) presents a structured framework to streamline project operations, mitigate risks, and optimize resource utilization across the project lifecycle.

3.2.4. Participant Selection Criteria:

Specific criteria have been delineated to steer the selection of participants for the analysis of IMS implementation within the AGATARE road project. These criteria encompass:

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Roles and Responsibilities: Participants represent a diverse array of stakeholders engaged in the AGATARE road project, spanning project managers, engineers, contractors, governmental officials, and community leaders.

Experience and Expertise: Preference is accorded to individuals possessing hands-on experience in road construction projects, coupled with expertise in project management, quality assurance, health and safety, environmental management, and related disciplines.

Involvement in IMS Implementation: Selected participants exhibit direct involvement in developing, implementing, or overseeing the integrated management system within the AGATARE road project, thereby furnishing firsthand insights into its efficacy and challenges.

Diversity: Endeavors are made to ensure diversity among participants in terms of organizational affiliations, professional backgrounds, demographic profiles, and perspectives, thereby enriching the comprehensiveness and depth of the analysis.

3.3. SAMPLING METHODS AND TECHNIQUES

The sampling technique is a process by which a researcher chooses the sample from the whole studied population (Grinnel & William, 1990). Apart from the general information collected from the project manager, the site engineer, the foreman, the field visits, and secondary data accessed, this research used primary data collected through interviewing the employees selected randomly in their respective areas of intervention during the project implementation.

3.3.1. Population of the study

This study targeted the management of the AGATARE asphalt road project and the employees. Since the project was already completed during this study, the finance office of Horizon Construction provided the researcher the list of all employees with reference to payment list where a month of June 2021 was identified to have employed the biggest number of workers. With this list a sample was calculated scientifically.

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Respondent Role in the project	Targeted population
Project Manager	1
Site Engineer	2
General Foreman	2
Quantity Surveyor	1
Geotechnical technicians	1
Casual Workers (Masons, mason helpers, Topographers helpers)	890
Total	**897**

Table 3.2: *Respondents target population.*
Source: *Primary data,*

3.3.2. Sampling techniques

The sampling technique is a process by which a researcher chooses the sample from the whole studied population (Grinnel & William, 1990). Apart from the general information collected from the project manager, the site engineer, the foreman, the field visits, and secondary data accessed, this research used primary data collected through interviewing the employees selected randomly in their respective areas of intervention during the project implementation. In selecting the most appropriate sampling technique, it's crucial to consider factors like analysis objectives, project population characteristics, available resources, and the desired level of precision and reliability. Moreover, combining multiple sampling techniques or employing a mixed-methods approach can bolster the analysis's robustness.

Analyzing the implementation of an integrated management system (IMS) within the AGATARE road construction project in Rwanda involved the utilization of various sampling techniques to ensure comprehensive and dependable analysis:

Random Sampling: Samples were chosen randomly from the entire project population, encompassing the AGATARE construction sites and personnel involved in IMS implementation. This minimized bias and ensured every element in the population had an equal opportunity for selection.

Stratified Sampling: The population was divided into distinct strata based on age, and sex. Samples were then randomly selected from each stratum for accurate comparisons.

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Cluster Sampling: Population grouping was made into clusters such as role of construction teams or project phases. Entire clusters were randomly chosen for inclusion in the sample, which proves efficient when faced with logistical constraints or when the project naturally presents identifiable clusters.

Convenience Sampling: Samples were selected based on convenience and accessibility, potentially including readily available personnel.

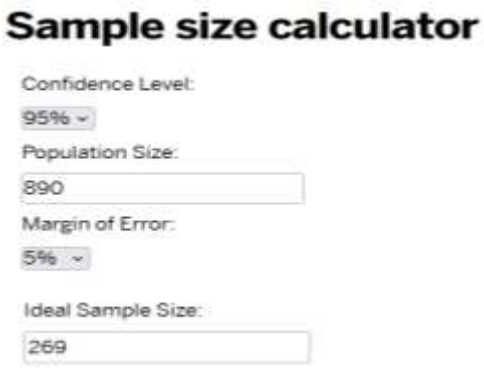
Purposive Sampling: Samples were chosen based on specific criteria, such as targeting key stakeholders or experts directly involved in IMS implementation. This method allows for the focused selection of individuals or groups capable of providing valuable insights into the implementation process.

3.3.2.1. Sample size

The sample size was calculated in considering the level of error margin of 5 %, meaning that the confidence level of the result is expected to be 95 %. A sample of two hundred sixty-nine (269) respondents was taken using the method of Yamane (1967). The formula used to determine the sample is written as follows:

$$\text{Necessary Sample Size} = \frac{(\text{Z-score})2 \times \text{StdDev} \times (1\text{-StdDev})}{(\text{margin of error})2}$$

With the help of an online sample size calculator, the following is the result found on: https://www.qualtrics.com/blog/calculating-sample-size/



Where StdDev: Standard deviation

$(\text{Z-Score})^2$ = 95% = 1.96 since the confidence level is 95%

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Source: Qualtrics, XM. (2023, March 21). Sample size calculator. https://www.qualtrics.com/experience-management/research/determine-sample-size/

3.3.3. Criteria of participants' selection

By adhering to these criteria, researchers meticulously selected participants who offer valuable insights into the integration of a management system within the AGATARE road project's execution context. This meticulous selection process facilitates a thorough analysis, enabling the formulation of tailored, actionable recommendations that address the project's specific requirements and challenges. In analyzing the integration of an Integrated Management System (IMS) within the AGATARE road project execution, precise criteria were employed to guide participant selection. Here's a breakdown of the tailored criteria for this project:

Prioritizing Experience in Road Construction: Emphasis was placed on participants with expertise in road construction projects, particularly those familiar with the distinct challenges, regulations, and best practices associated with road infrastructure projects in Rwanda.

Selecting Participants with Direct IMS Involvement: Participants were chosen based on their direct involvement in implementing the integrated management system within the AGATARE road project. These individuals possess hands-on experience in developing, implementing, monitoring, or enforcing IMS processes and procedures specific to this project.

Identifying Project Stakeholders: This involved recognizing essential stakeholders engaged in the AGATARE road project, including project managers, engineers, contractors, subcontractors, suppliers, environmental specialists, quality control personnel, health and safety officers, and community representatives.

Including Specialized Expertise: Participants with specialized expertise relevant to IMS implementation in road projects were included, such as environmental management specialists, quality assurance professionals, health and safety experts, and project management officials.

Selecting Individuals with Local Context Understanding: Participants were chosen for their deep understanding of the local context, including familiarity with the regulatory environment, community dynamics, cultural considerations, and specific challenges or opportunities related to road construction projects in Rwanda.

Considering Commitment and Availability: Participants were selected based on their commitment to actively engage in the analysis process, which may involve interviews, focus group discussions, or surveys. Their willingness and availability to participate in data collection activities were essential considerations.

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Ensuring Diverse Perspectives: Diversity among participants was ensured to capture a broad range of perspectives and insights. This encompassed diversity in roles within the project, organizational affiliations, professional backgrounds, and demographic characteristics.

Aiming for Representativeness: The aim was to create a representative sample of stakeholders involved in the AGATARE road project, covering various phases of the project lifecycle (e.g., planning, design, construction, maintenance) and organizational levels (e.g., project management, field operations, regulatory bodies).

3.4. DATA COLLECTION TECHNIQUES

In this research Primary data was collected the researcher used a semi structured questionnaires designed to get responses as per the key research questions and answering to the indicators performances was developed and used to collect data at the site and from respondents in their respective locations. The researcher did his own observation during the last phase of asphalt road implementation and had random exchanges with both workers and line managers.

3.4.1. Type of data and techniques of data collection

The researcher used a combination of these methods to triangulate findings to ensure the validity and reliability of the data. Data collection techniques vary depending on the nature of the data, the research objectives, and the resources available. The common data collection technique used include Questionnaire and Observation; the study involved the use of several methodological techniques and tools for assessing the Waste management and occupational health and safety status as by the scope of this study.

Questionnaire Administration: A standardized questionnaire to cover all the sampled respondents was used, to cover all areas of interest open ended questions were used. The standard questionnaire was to be administered respondents. Questionnaires are commonly used to collect important information about a population. Data Collection is an important aspect of any type of research study as inaccurate data collection can impact the results of a study and lead to poor results. It is critical to relate the research questions with the method and type of data to be collected. In this study the following were the key methods of data collections approach. This research used data triangulation approach (questionnaires, documents) to crosscheck and cross-validate the information collected for this study. The data was collected through individual, discussions, review of documents and site visits. The research therefore focused on primary data to answer the identified research questions.

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Primary Data: Primary data is the data that is collected firsthand by the researcher. This is mainly the data that collected from the above stated targeted group that was studied and from other experts that helped to inform the researcher on the issues at hand. The researcher used the following method to collect the data, Cresswell, (2003).

Secondary data: The existing reports within Horizon Construction Company about the AGATARE asphalt road project was consulted and other technical documents were shared to the researcher to fully understand the implementation of integrated management System principles.

Activities	Techniques	Instruments
Surveys involve asking a series of questions to a sample of respondents.	Field surveys	Questionnaires
Interviews involve direct interaction between the researcher and the respondent.	Interviews	Questionnaires
Watching and recording behavior, events, or activities as they occur in a natural setting during project execution.	Field survey	Visual observation
Experiments. This allows the researcher to establish cause-effect relationships.	Experiments	Geotechnical Laboratory
Examining existing documents	Documentary review	Official records, reports
Examination of project execution to understand its complexities and dynamics.	In depth examination	Case Studies

Table: 3.3. *Techniques and instruments during data collection*

Source: *Author*

3.4.1.1. Field Survey

The implementation of an Integrated Management System (IMS) in infrastructure projects, such as road construction, is pivotal for ensuring efficiency, quality, and adherence to standards. This field survey aimed to analyze the deployment and effectiveness of the IMS in the AGATARE road project execution.

Methodology: The researcher **i**dentified key locations along the AGATARE road project on the construction site, checkpoints, and project management offices. Regarding data collection techniques, direct observation of ongoing activities, workflow, and use of IMS protocols was made by the researcher. The researcher engaged with project management, engineers, and

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workers involved in various stages of the project. Furthermore, the researcher examined IMS documentation, including policies, procedures, and compliance records.

Survey Parameters included:

- Assess of the degree of integration across quality, environmental, and health & safety management systems.
- Evaluation of adherence implying compliance to IMS standards, regulatory requirements, and project specifications.
- Measure the impact of IMS as effectiveness on project timelines, resource utilization, and risk mitigation.
- Analyze the involvement and satisfaction of stakeholders, including contractors, government agencies, and local communities.

3.4.1.2. Interviews

Interviews on Integrated Management System Implementation in AGATARE Road Project Execution T provided firsthand perspectives on the integration, compliance, effectiveness, and stakeholder engagement aspects of the IMS implementation in the AGATARE road project execution.

3.4.1.3. Documentary review

During the document review process, the researcher examined the IMS policy documents outlining the overarching objectives, scope, and commitments regarding quality, environmental sustainability, and health & safety management. The researcher also reviewed procedural manuals detailing the step-by-step processes and protocols for implementing IMS practices across different project activities, from planning to execution and monitoring. The compliance records, including audit reports, inspection findings, and non-conformance reports, to assess adherence to IMS standards, regulatory requirements, and project specifications were scrutinized.

3.4.2. Data collection instruments

During the analysis of the Integrated Management System (IMS) implementation in the AGATARE road project execution, various data collection instruments were utilized to gather information and insights. These instruments were tailored to capture different aspects of IMS

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integration, compliance, effectiveness, and stakeholder engagement. Here are the primary data collection instruments used:

Data Collection Forms: Standardized data collection forms were used to record quantitative data related to project timelines, resource utilization, risk mitigation efforts, and other performance indicators. These forms facilitated the systematic collection and analysis of data from various sources, such as project reports, logs, and databases.

Interview Guide: An interview guide was prepared to conduct structured interviews with key project personnel, including project managers, quality control officers, environmental specialists, safety supervisors, and stakeholders. The guide contained open-ended questions designed to elicit insights into various aspects of IMS implementation, such as integration, compliance, effectiveness, and stakeholder engagement.

Observation Checklist: A structured checklist was developed to systematically observe and document IMS practices and activities during site visits. This checklist included items related to quality control measures, environmental sustainability initiatives, safety protocols, and general adherence to IMS standards.

Document Review Protocol: A protocol was established for reviewing IMS-related documents, including policy documents, procedural manuals, compliance records, audit reports, training materials, and stakeholder communication channels. This protocol outlined the specific documents to be reviewed, the key areas of focus, and the criteria for assessing compliance and effectiveness.

Checklists for Compliance Records: Checklists were used to review compliance records, such as audit reports and inspection findings. These checklists helped identify instances of non-compliance, document the nature of deviations from IMS standards, and track corrective actions taken to address non-conformances.

Survey Questionnaires: Survey questionnaires were developed to gather feedback and perceptions from project personnel and stakeholders regarding IMS implementation. These questionnaires included Likert-scale items, multiple-choice questions, and open-ended prompts to assess satisfaction levels, awareness of IMS principles, perceived effectiveness, and areas for improvement.

3.4.2.1. Documentary review chart

The documentary review chart offers a structured overview of the documents examined during the analysis of Integrated Management System (IMS) implementation in the AGATARE road

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project. It categorizes the documents based on their relevance to IMS integration, compliance, effectiveness, and stakeholder engagement, providing a comprehensive understanding of the IMS framework. Document Categories included the following:

- Policy Documents which include IMS Policy Statement, Quality Management Policy, Environmental Management Policy, and Health & Safety Policy
- Procedural Manuals which include IMS Procedures Manual, Quality Control Procedures, Environmental Management Procedures, and Health & Safety Procedures
- Compliance Records which include Audit Reports, Inspection Findings, Non-Conformance Reports and Corrective Action Plans
- Stakeholder Communication which includes Stakeholder Engagement Plan, Meeting Minutes, Correspondence with Stakeholders, and Feedback Surveys

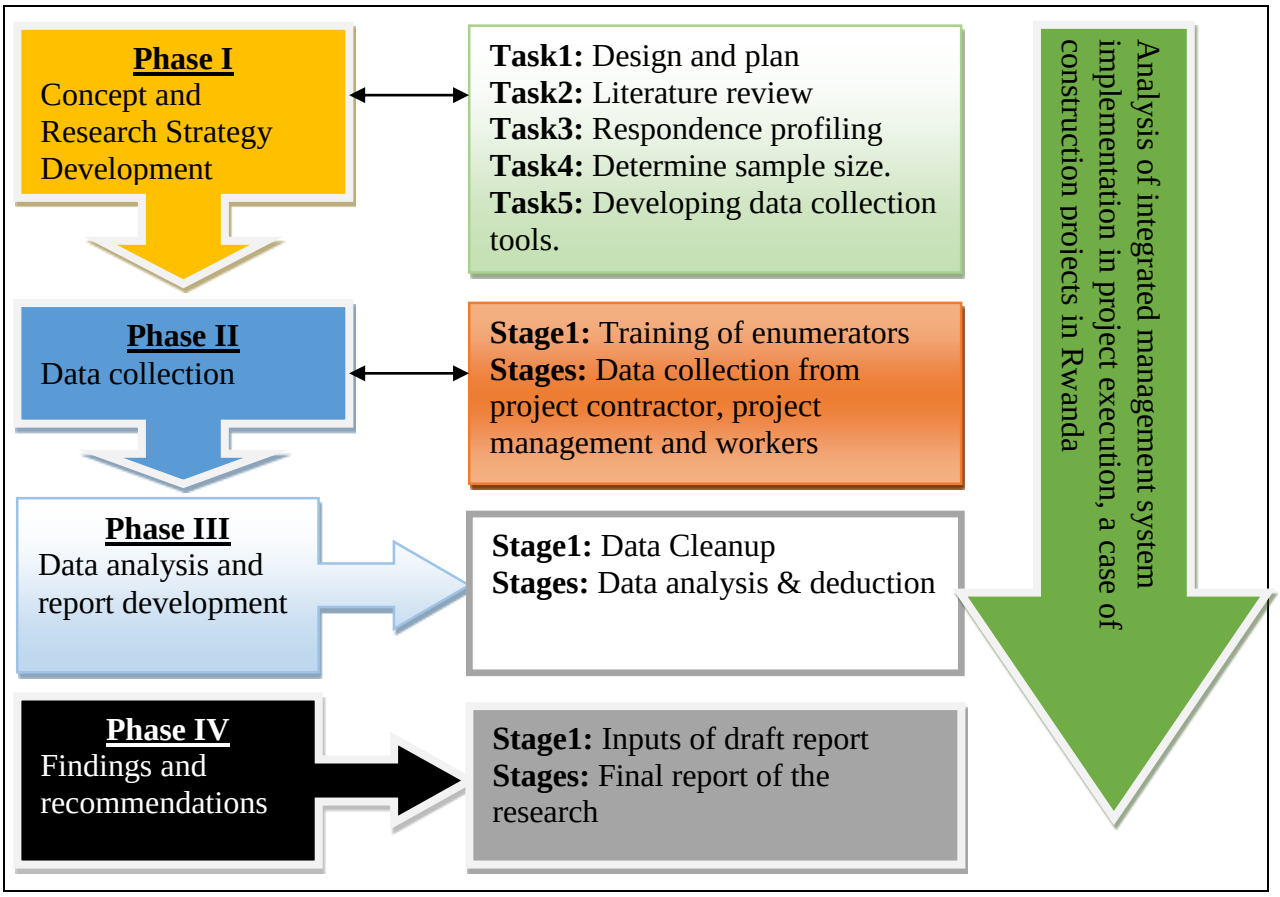

Figure 3.1: *Workflow of the study method*

Source: *Author*

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3.5. DATA ANALYSIS TECHNIQUES

Using these tailored data analysis techniques within the context of the AGATARE road project enables researchers to glean valuable insights into the effectiveness, challenges, and opportunities linked to implementing an integrated management system (IMS). Here are the techniques:

Comparative Analysis: Effectiveness of IMS implementation across different phases of the AGATARE road project or compared with similar projects regionally or globally can be assessed. Comparative analysis identifies best practices, challenges, and areas for improvement.

Quantitative Data Analysis: Structured surveys or questionnaires yield quantitative data analyzed using statistical techniques. Descriptive statistics summarize data, while inferential statistics test hypotheses or relationships, and multivariate analysis explores complex interactions relevant to IMS implementation.

Qualitative Content Analysis: This method involves systematically categorizing and scrutinizing textual data from interviews, focus groups, or open-ended surveys pertaining to IMS implementation. Themes, patterns, and key insights are discerned through coding and thematic analysis.

Stakeholder Analysis: By analyzing perspectives, interests, and influence of various stakeholders involved in IMS implementation, researchers gain insights into their roles, expectations, and potential barriers. This informs stakeholder engagement strategies and communication plans.

SWOT Analysis: This method assesses internal strengths and weaknesses, as well as external opportunities and threats specific to IMS implementation in the AGATARE road project. It guides strategies to leverage strengths, address weaknesses, seize opportunities, and mitigate threats.

Visualizing the workflow of the process: Visualizing the workflow and processes involved in IMS implementation within the AGATARE road project aids in identifying inefficiencies, thereby optimizing the implementation process.

Root Cause Analysis: Uncovering root causes of issues encountered during IMS implementation in the AGATARE road project is facilitated through techniques like fishbone diagrams or 5 Whys analysis, revealing underlying factors affecting success or failure.

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3.5.1. Research procedure

The researcher meticulously explored the integration of an integrated management system into the execution of the AGATARE road project, employing a structured research approach. This method yielded valuable insights and recommendations for enhancement. Here's a structured procedure for researching the implementation of an integrated management system (IMS) within the AGATARE road project execution:

Conduct Literature Review: Undertake a thorough review of existing literature on integrated management systems, road construction projects, and relevant theories and frameworks. This step establishes a theoretical foundation and identifies gaps in current knowledge.

Formulate Research Questions: Develop specific research questions based on the defined objectives and insights gained from the literature review. These questions will guide the investigation into IMS implementation in the AGATARE road project.

Define Research Objectives: Clearly outline the research objectives, focusing on understanding the effectiveness, challenges, and opportunities linked to IMS implementation in the AGATARE road project context.

Obtain Ethical Approval: Ensure compliance with ethical standards by obtaining approval from relevant ethics committees or institutional review boards, especially when human participants are involved.

Select Research Methodology: Choose suitable research methods and techniques for data collection and analysis, including qualitative methods like interviews and focus groups, and quantitative methods such as surveys and statistical analysis.

Analyze Data: Analyze collected data using appropriate qualitative and/or quantitative analysis techniques, such as thematic analysis, content analysis, or statistical analysis. Identify patterns, themes, and insights related to IMS implementation. For example, the primary data collected from questionnaire survey were coded and transferred into the spread sheet. Excel sheets were used through modeled approaches and templates as a tool for data entry, cleaning, and analysis. This analysis of data for the specific objectives on the evaluation of the role of Integrate management System regulations on the successful completion of the AGATARE asphalt road project completion and on the evaluation the direct job crated, workers category by skills and economic contribution after successful completion of asphalt road project implementation.

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Regarding the risk assessment, the equation in ISO 31000:2018, which is a standard codified by the International Organization for Standardization that provides principles and generic guidelines on managing risks faced by organizations. Its recommendations can be customized to any organization and its context. The traditional Risk Index focuses on two aspects: Gravity (or Consequence) and Frequency (or Likelihood) to rank risks and consequently to define improvement actions.

Risk = Gravity × Frequency……. (Equation 3.1)

(Wilkinson G., Dale B.G,1999*)*

Define Participant Selection Criteria: Define criteria for selecting participants, considering factors like roles, experience, expertise, and diversity. Identify key stakeholders involved in the AGATARE road project who can offer valuable insights into IMS implementation.

Interpret Findings: Interpret the findings in relation to the research questions and objectives. Identify key insights, trends, and implications for IMS implementation in the AGATARE road project.

Collect Data: Collect data using selected methods and techniques, which may include conducting interviews, administering surveys, organizing focus group discussions, or collecting relevant documents and records related to IMS implementation in the AGATARE road project.

Generate Recommendations: Based on the interpretation of findings, develop actionable recommendations for improving IMS implementation in the AGATARE road project. Address challenges, leverage opportunities, and enhance effectiveness.

Disseminate Findings: Share the research findings and recommendations with relevant stakeholders, including project managers, policymakers, practitioners, and academic communities. Consider publishing research findings in journals or presenting them at conferences to contribute to knowledge dissemination and exchange.

Write Research Report: Prepare a comprehensive research report summarizing the research process, findings, interpretations, and recommendations. Ensure clarity, coherence, and adherence to academic or professional writing standards.

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3.5.2. Ethical considerations

According to Finnis (1983 cited by Seale C., 2004), ethics is a branch of philosophy, said to have been initiated by Aristotle, which takes human action as its subject matter. A central issue in ethics is the relationship between the individual and the social world (Seale C., 2004). They further argue that, in research, we need to consider how the imposition of the research on individuals (with their consent or otherwise) can be balanced with the benefit of making the world a better place to live in. Indeed, several ethical considerations were considered throughout this study. The questionnaire also was very clear that participation was voluntary, the research was purely for academic purposes and that confidentiality of participants was assured. Before the interview, the purpose of the study was explained to the respondents and their confidentiality was assured. The interview proceeded after their confirmation of willingness to participate. Therefore, this research tried as much as was possible to respect persons that provided information.

In addition to that the researcher is a certified lead implementer and lead auditor in Quality management System based on ISO 9001-2015, this qualifies him to conduct a study about implementation of integrated management system in projects. With this methodology the researcher managed to develop to research questions included in this thesis.

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CHAPTER FOUR: RESULTS AND DISCUSSION

Introduction

The implementation of an IMS was found to have significantly enhanced project efficiency and coordination. Through the integration of various management systems such as quality, environmental, and occupational health and safety, projects were able to streamline processes, reduce duplication of efforts, and improve communication among stakeholders. This resulted in smoother project execution and timely completion of milestones. The findings also revealed that IMS implementation positively impacted risk management practices within construction projects. By incorporating risk assessment and mitigation strategies across different management domains, projects were better equipped to identify potential risks early on and develop proactive measures to address them. Consequently, this contributed to minimizing project disruptions and avoiding costly delays.

This section presents the findings of the analysis conducted on the implementation of an Integrated Management System (IMS) in the execution of construction projects in Rwanda. The analysis delves into various aspects such as the effectiveness of IMS implementation, its impact on project performance, challenges encountered, and potential improvements.

Effectiveness of IMS Implementation: The findings reveal that the implementation of an Integrated Management System (IMS) in construction projects in Rwanda has demonstrated effectiveness in streamlining project processes and enhancing overall project management. Through the integration of various management systems including quality management, environmental management, and occupational health and safety, projects have achieved improved coordination, communication, and control.

Impact on Project Performance: The analysis indicates a significant positive impact of IMS implementation on project performance metrics such as cost, schedule adherence, and quality outcomes. Projects that adopted IMS exhibited better cost control, reduced instances of schedule overruns, and higher adherence to quality standards compared to those without IMS. Moreover, stakeholders reported increased satisfaction levels due to the improved project outcomes facilitated by IMS.

Challenges Encountered: Despite its benefits, the implementation of IMS in construction projects in Rwanda has faced several challenges. These include resistance to change among project stakeholders, resource constraints, lack of adequate training, and cultural barriers. Resistance from within the organization and the wider construction industry has impeded the

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smooth adoption and integration of IMS practices, leading to implementation delays and suboptimal outcomes.

Potential Improvements: To address the challenges identified and further enhance the effectiveness of IMS implementation, several improvements are recommended. Firstly, there is a need for proactive change management strategies aimed at fostering a culture of acceptance and commitment to IMS principles among all project stakeholders. Additionally, investment in comprehensive training programs and capacity building initiatives is essential to equip personnel with the requisite skills and knowledge to effectively implement and sustain IMS practices. Furthermore, leveraging technological solutions such as digital platforms and data analytics can enhance the efficiency and transparency of IMS processes, thereby driving continuous improvement and innovation in project execution.

4.1. Demographic analysis

This study demographic analysis consists of age distribution and Sex distribution as follows:

4.1.1 Sex Distribution

Among the respondent 34% were female, while 66% were male.

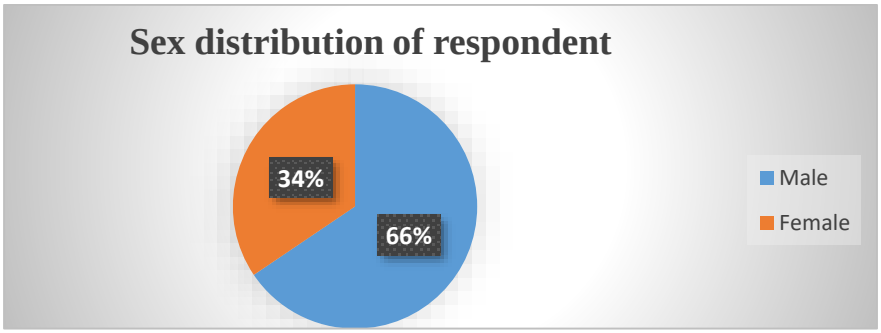

Figure 4.1: *Sex distribution of respondents*

Source: *Primary data September 2022*

The infrastructure construction generates more off-farm jobs as per the vision of Rwanda whereby off farm employments are to be created by both men and women under priority area of economic pillar of NST1 where it was planned to Support and empower youth and women to create businesses through entrepreneurship and access to finance.

The fact that asphalt road construction works are not discriminative in matter of gender, this enables the acceleration of development whereby the earned income is used in the creation of induced jobs in the community hence the application of Integrated management system in asphalt rod construction plays a vital role in development.

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At this specific project the principal site engineer was a woman, Mrs. Furaha KAJYIBWAMI.

4.1.2. Age distribution of respondents

In this research, most of the respondents were aged between 20 and 30 where 31% were aged between 31 and 40 years old whereas 12 % fell into age category of 41- 50 years old and only 5% fell into the age above 50 years old.

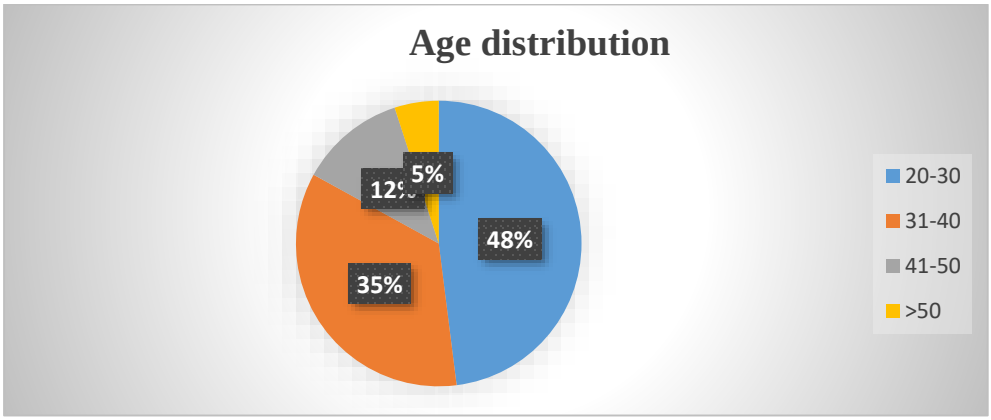

Figure 4.2: *Age distribution of respondents*
Source: *Primary data September 2022*

A total of 83 % of employees during the implementation of AGATARE asphalt road construction was found in age between twenty to forty. According to the site engineer, their experience is that the people of this range of age are in most of cases employed in their works of road construction and the reason is that most of works in construction sites are tenace, hence a requirement of high physical ability to do them. In most of cases the workers aged above fifty are seniors in their respective professions.

4.2. Role of integrated management system in Agatare road construction project

The successful completion of AGATARE road project was a result of compliance with Integrated management System, this includes quality requirement as per client specifications, occupation safety and health and environmental protection parameter fulfilment. The paragraphs below highlight the level of fulfillment of Integrated Management system components.

4.2.1. Asphalt road quality fulfillment through Geotechnical assessment.

The quality compliance during the implementation of AGATARE road project was assessed against geotechnical specifications that were described by the client (World Bank). To assess this, the exchange with both site manager and the project manager (both permanent employees

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of Horizon Construction) and laboratory results were the basis of quality analysis in this research.

4.2.1.1. Filling

On different sections of access streets, filling was needed to reach subgrade level. The material used was either from cut or from borrow pit. The materials were with their water content optimum of the Proctor test modified and compacted to obtain without tolerance the following values: 95% of the density dry maximum of the Optimum Modified Proctor (OPM) for the thirty (30) higher centimeters, 95% of the OPM for the body of the embankment. California Bearing Ratio (CBR) >15.

The filling was done layers by layers and each layer did not exceed 20cm after compaction. After each layer, tests for California Bearing Ratio (CBR) and density in situ were performed to check the compliance of technical specifications. With this procedure, there has been a compliance with predefined technical specifications. Figure 4.3 shows backfilling at AS31 extension, which is one of access streets.

.

Figure 4.3: *Spreading of the backfilling materials*
Source: *Primary data September 2022*

4.2.1.2. Subgrade

After filling/ cutting the subgrade (platform) level of the road was reached. A general compaction was carried out a of the platform to obtain a dry density of the thirty centimeters (30cm) of the road base of the earthworks in the cut zones, as in those in fill, at least equal to 95% of the OPM. The control of the compaction of the platform was carried out by the test Modified Proctor and the measurement of the dry density (in situ) using a membrane densitometer. Each time the dry density (in situ) was found lower than 95% of the OPM; the compaction was repeated until at least 95% of OPM was reached. The platform did not present

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bumps or depressions higher than three (3) centimeters under the rule of three meter placed transversely or parallel to the axis. Before continuing to the following layer each layer was approved by the consulting firm on behalf of client.

Figure 4.4: *Checking the compaction of subgrade by performing in situ density test.*
Source: *Primary data September 2022*

4.2.1.3. Sub-base layer

The materials of foundation course were lateritic gravelly or other similar natural gravel 0/40. They were applied to the platform to obtain a thickness of 10cm after compaction and that in accordance with alignments and levels indicated in on the geometric design of an access street. The control of the compaction of the subbase layer was carried out by the test Modified Proctor and the measurement of the dry density (in situ) using a membrane densitometer every 50m. The sampling of materials was done regularly to check the compliance of all characteristics required for subbase layer. The operations of placing and spreading was executed in the conditions of the most satisfactory moisture content to prevent segregation and ensure a uniform and acceptable rolling. To this effect, the optimal moisture content was frequently controlled and if necessary, water added till moisture content ±1% the optimal is obtained. The homogenous humidification on the entire breadth of the roadway was carried out by the passing of pulverizing water tank.

4.2.1.4. Base course

The figure below shows the sieve analysis performed on the materials to be used for base course. We can see clearly that the curve of the used materials (red curve) is falling within the specified spindle.

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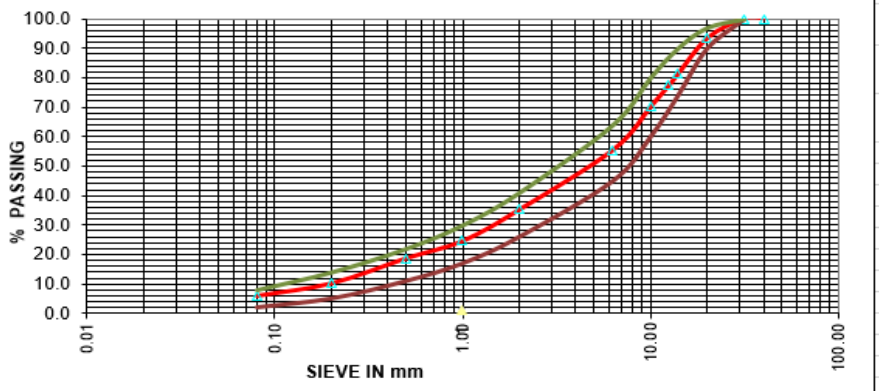
ORIZON CONSTRUCTION

AGATARE PROJECT

LEA Associates South Asia Pvt. Ltd. an ISO 9001:2015 Certified Organisation A LEA Group Company Consulting Engineers and Planners

SITE	AGATARE	SOURCE	
		LOCALISATION	REBERO CRUCHER
SUPERVISOR	LEA	NATURE	0/31.5
		Date	28.09.2017

MASSE TOTALE SECHE AVANT LAVAGE			3,562
Mailles (en mm)	Refus cummulé (en g)	% des refus	% des passants
40.0	0	0.0	**100.0**
31.5	0	0.0	**100.0**
20.0	235	6.6	**93.4**
14.00	665	18.7	**81.3**
12.50	805.5	22.6	**77.4**
10.00	1059	29.7	**70.3**
6.30	1585	44.5	**55.5**
2.00	2306.5	64.8	**35.2**
1.000	2685.3	75.4	**24.6**
0.50	2895	81.3	**18.7**
0.20	3198.5	89.8	**10.2**
0.08	3350.4	94.1	**5.9**



DATE	CONTRACTOR		SUPERVISOR
	OPERATOR	HEAD OF LABO	

Figure 4.5: *The sieve analysis of the materials used for base course layer.*
Source: *Munzenze, 2022*

Base course materials have been provided and spread without segregating fine and coarse particles on a sub-base prepared initially. Materials needed have been supplied in sufficient quantities to enable the installation of the base course at required thickness (10cm after compaction) and only once to obtain a uniform level and rolling over the entire base course width.

Figure 4.6: *Spreading and checking levels of base course materials.*
Source: *Primary data September 2022*

To comply with grain-size classification or improve connection qualities, the necessary mixing with water for rolling has been carried out on-site. Mixing has been carried out such that added

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water or materials are uniformly spread to materials on the road. To that end, water tanks spreaders has been used. These materials were mixed on the entire base course layer using a grader. When a uniform mixture is obtained, it has been spread evenly to obtain a base which, after rolling, complied with the Specifications of plans, and fallen within the margins of error specified subsequently. When completed, compacted, and shaped, the base course got a uniform and smooth surface with respect to alignments and levels and comply with cross-sectional profiles. The inspection of works was related notably to final density attained and base thickness. The inspection of the base course depth and rolling has been carried out every 50m. A Modified Proctor test has been conducted when there is significant change in materials or when directed by the Consultant.

4.2.1.5. Prime coat

For this project, a cut-back bitumen 0/1 was applied with 1.2L/m2. The bitumen was applied only if the base course surface is clean, dust-free, dry, or slightly wet and if there is no threat of rainfall. The equipment used include a cylinder, a mechanical broom, and an independent bitumen pressure spreader. The spreader is designed, equipped, maintained, and used such that the bitumen could be uniformly applied at constant temperature, at a rate that could be rapidly determined and controlled. The sprayer was equipped with a tachometer, pressure gauges, a device to measure exact flow, a graduated tank, and a thermometer to measure the temperature of tank contents. Before applying the prime coat, surfaces on which bitumen is to be applied was verified once more and all variations detected were corrected. Any non-uniform and defective area got removed and replaced with a suitable material. The prime coat was laid only after the Consultant has accepted the base course. Prior to the application of bitumen, any dirt, dust, or other matter was removed from the surface using a mechanical broom. The surface was watered to slightly dampen the base course prior to the application of bitumen.

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Figure 4.7: *Application of prime coat*
Source: *Primary data September 2022*

4.2.1.6. Tack Coat

Prior to the placement of asphalt concrete, the cut-back bitumen necessary for the placement of a tack coat on the road already treated with a prime was applied. The binder used was of class 10/15 cut-back bitumen.it should be applied in less than 24 hours before the placement of concrete bitumen. Cut-back bitumen was spread at normal spreading temperature (150-180^{o}C). Vehicular traffic was strictly prohibited on the tack coat until concrete bitumen is laid. In case of pollution or degradation of the tack coat, it was repaired before laying asphalt concrete.

4.2.1.7. Asphalt Concrete

The asphalt concrete used for this project was 0/10. 0/10 concrete bitumen was prepared from a crushed rock supplied without rolled sand and of a 50/70 bitumen. The manufacture was carried out in a bitumen mix plant. The following figure is showing the typical results of the quality control of asphalt after laying. All tests were performed in Horizon Construction laboratory under supervision of the consultant. The figure is showing the determination of bitumen content to verify if it was meeting the technical specification.

It can clearly be seen that the laboratory tests revealed 5.6% of bitumen content which was in the range specified in the technical specifications (4-6%). It also showed the sieve analysis of the aggregates used for asphalt which is inside the spindle provided in the technical specifications.

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DATA FORM:	QUALITY CONTROLE OF ASPHALT
Number:	HC/LAB/Z/07
Test Method:	BS EN EN 933-1
Project:	AGATARE
Consultant/Client:	LEA

Sample Reference Number:	Z210712-11
Simple location:	KN 121 EXTENSION PK 0+790 RHS
Sample Description:	ASPHALT CONCRETE 0-13
Sampling Date:	21/06/2021
Sample Reception Date:	12/7/2021
Testing Date:	17/07/2021

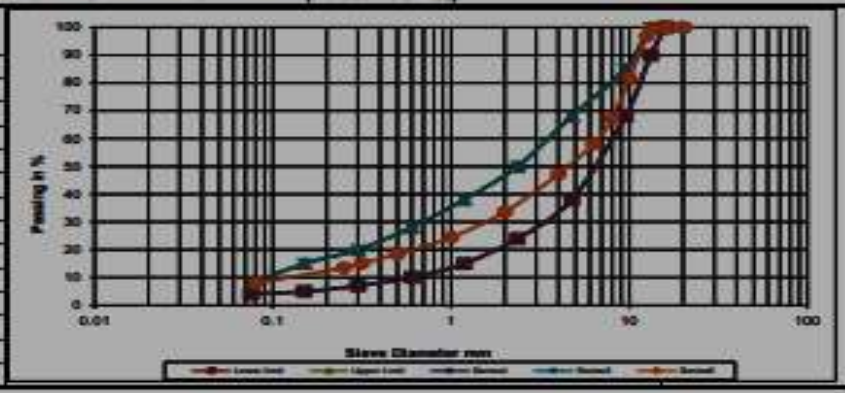
DATERMINATION OF BITUMEN CONTENT FROM ASPHALT CONCRETE

A	weight of sample	707.5	E	weight of filler obtained (C-B)	58
B	weight of empty godet	257	F	Total wieght of aggregates (D+E)	670
C	weight of godet with filler	315	G	weight of bitumen (A-F)	37.5
D	weight of aggregate obtained on seive	612		Bitumen content ((G/F)*100)	5.60

Mixing	%	%	%	Bitume Pur
weight	670			

SEIVE FROM ASPHALT CONCRETE (Passant en %)

Seive	Cumulative weight	Asphalt of test
20	0	100.0
16	0	100.0
13.2	5.5	99.2
12.5	22	96.7
10	122.5	81.7
8	220	67.2
6.3	281	58.1
4	354	47.2
2	445	33.6
1	506	24.5
0.5	546.5	18.4
0.315	568.5	15.1
0.25	579.5	13.5
0.08	617	7.9



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	Done by:	Checked by:	Supervisor	
Title	Geotechnical	Head of Geotechnical Lab	Witnessed by	Apraved by:
Name	NDAYISABA Manasse	Msc. CEng. Benigni. BUTREZI		
Date	July 18, 2021	July 18, 2021		
Signature				

Figure 4.8: *Determination of bitumen and sieve analysis of asphalt at AGATARE project.*
Source: *Munzenze, 2022*

The figure below shows the implementation of laying asphalt concrete at one of Access Streets at AGATARE project. The mixed asphalt is transported from the asphalt mix plant and brought to site by trucks. A finisher (paver) is used to lay it and vibration, and pneumatic rollers are used for compaction. The asphalt is laid after putting a tack coat as explained earlier.

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Figure 4.9: *Paving asphalt concrete activity, Source:* ***Primary data September 2022***

The quality of delivered road was complying with the specifications of the client, this was due to the effective management system that complied with road standards. This was result of the use of local expertise equipped with both management and technical skills.

4.2.2. Fulfillment of environmental parameters

4.2.2.1. Provision environmentally friendly asphalt plant.

As the LJB1500 asphalt plant polluted the air by hot dust going to the atmosphere through the chimney opening. To mitigate air pollution, Horizon construction Ltd which was contracted by the client to construct AGATARE road project altered to purchasing an alternative asphalt plant that have air pollution solution. Below is the view of asphalt plant which pollutes the atmosphere.

The following are the main components of asphalt plant:

1. Dust control and collection
2. Aggregate Drum Drier
3. Charging Conveyor (In the background and not seen)
4. Bucket Conveyor
5. Aggregate Vibrating Screen
6. Aggregate Hot Bin
7. Aggregate Weighing Hopper
8. Aggregate-Bitumen Mixer
9. Cold-feed bins (In the background and not seen)

Figure 4.10: View of Asphalt Plant LJB 1500 and its main parts, **Source:** Author

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However, an alternative model LB2000 of asphalt Plant, got introduced in Horizon Construction Ltd which was contracted to execute road construction project, among activities of NYARUGENGE urban upgrading projects. To mitigate environmental issues related to air pollution, this plant has a dust retainer instead of being allowed to blow out in the air through chimney like the previous LJB1500 asphalt plant.

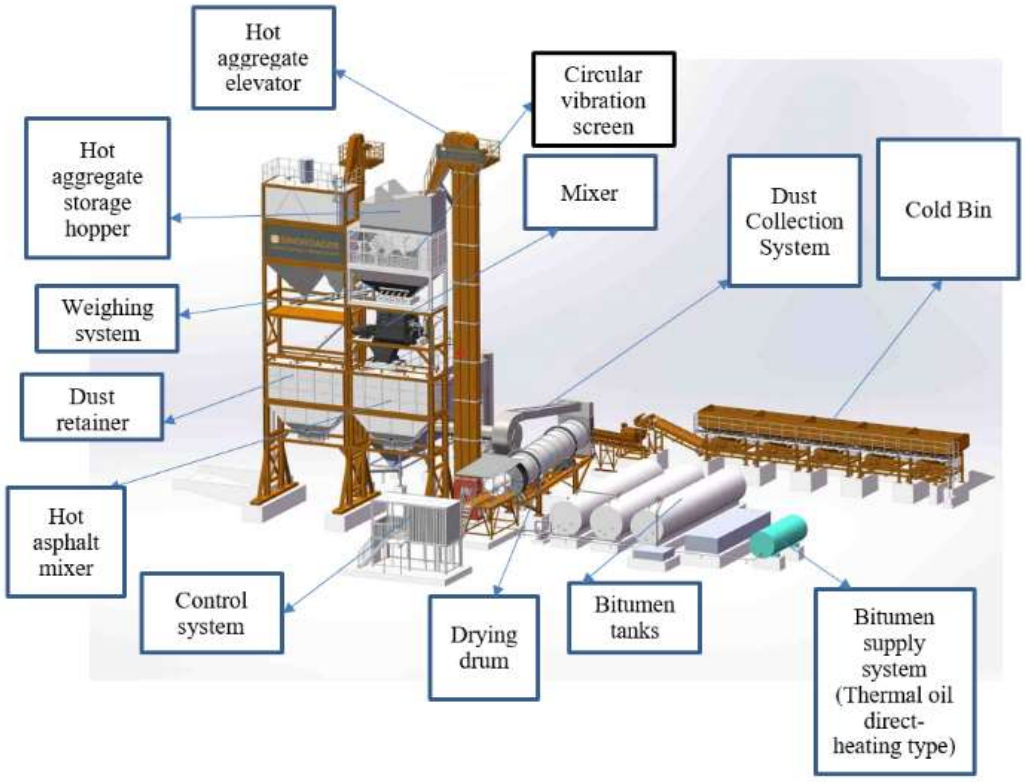

Figure 4.11: *LB2000 Asphalt plant components*
Source: *Fujian Tietuo Machinery, 2018*

4.2.2.2. Provision of plastic Mobile toilets and waste bins

The researcher found out that even though the project management planned for mobile toilets, they did not consider Waste Bins as a collection point of wastes such as food residues and packages. Hence, this would attribute spread of microbes. Mobile toilets were relocated when it deemed necessary to facilitate workers.

However, the city of Kigali emplaced waste bins in various areas where many people converge such as supermarkets, or Zebra crossing points and others.

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Figure 4. 12: Plastic mobile toilets
Source: *Author*

Figure 4. 13: Mobile waste bin
Source: *Author*

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4.2.2.3. Rehabilitation of dumping site to restore ecosystem.

In due course of AGATARE project execution, soil pile cut from retaining wall got used to refill the marram quarry as dumping site. This consequently restored the quarry for ecosystem management to focus on the recovery of the ecosystem integration, which can stimulate the self-repair function of the ecosystem and eventually generate an ecosystem that exhibits a dynamic balance and the relative stability of self-maintenance.

4.2.3. Occupation safety and health (OSH) principles fulfilment

During the implementation of AGATARE asphalt road project, the occupation safety and health principles were taken care. In this perspective the researcher examined the level of likelihood of hazards from respondents as presented in the figure below:

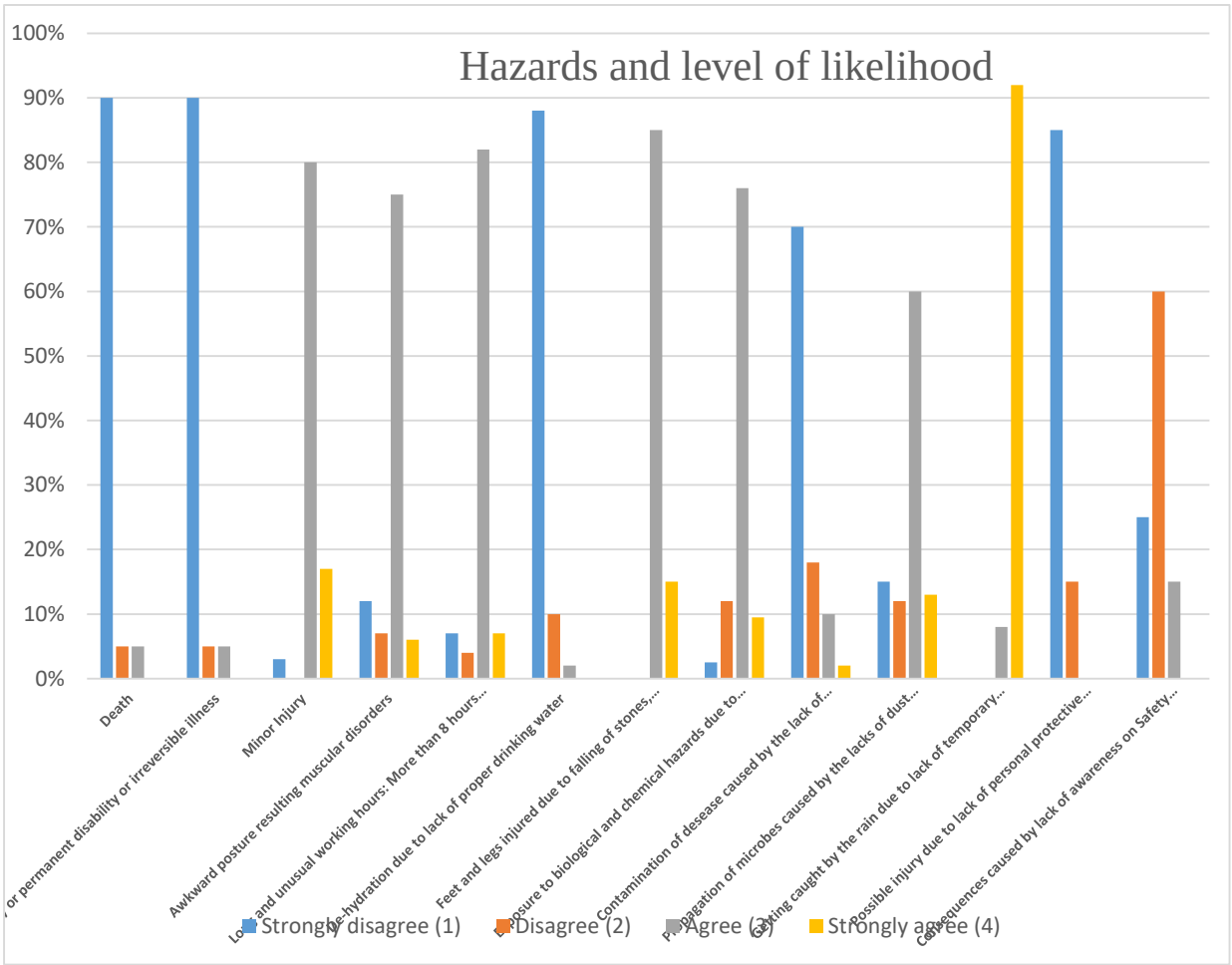

Figure 4.14: *Occupation hazards and their weight of likelihood*
Source: *Author*

It can be seen from the graph that the most potential hazard was Feet and legs injury due to falling of stones, equipment, or unpractical path in the construction site however at the there was a first aid kit and a safety officer who could deliver first aid health problems in case needed.

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However, it can be observed that long working hours was agreed upon to have more weight during this project implementation. In this regard, the policy of the site was to consider extra hours and get paid as night shift. The case of death was reported during the implementation of this project, however due to insurance cover of workers in the construction site, the family of the deceased worker was supported to get entitled compensation defined by law.

4.3. Risk assessment of executing AGATARE road construction project

The table below shows the level of risk during the implementation of AGATARE asphalt road project.

S/Nº	Hazards	Existing mitigation approaches	Likelihood	Severity	Risk	Remarks
1	Death	Provision of gloves and hard hat; safe working procedure; Close supervision.	1	4	**4**	Briefing By safety officer on safety awareness. Additional control shall be made if necessary.
2	Minor Injury	All workers at the site are required to wear long safety boots.	4	4	**16**	Additional control shall be proposed when necessary.
3	Awkward posture resulting muscular disorders	All workers at the site are required to wear long safety boots.	2	2	**4**	Additional control shall be proposed when necessary.
4	Long and unusual working hours: More than 8 hours per day.	Stay away from the working area.	2	4	**8**	Overtime payment was put into consideration

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5	De-hydration due to lack of proper drinking water	Provide safe working procedure on proper lifting and material handling; Provide warning signage.	4	1	**4**	Additional control shall be proposed when necessary.
6	Feet and legs injured due to falling of stones, equipment, or unpractical path in the construction site	To check outrigger and ground condition, Close supervision.	2	4	**8**	Briefing By safety officer on safety awareness. Additional control shall be made if necessary.
7	Exposure to biological and chemical hazards due to working in unsafe place	Proper use of outrigger pad; Use of supporting platform.	3	2	**6**	Hot tar coat and hot asphalt concrete could cause hazards
8	Contamination of disease caused by the lack of toilets and hygiene	Wear proper gloves; Provide warning signage; Close supervision.	1	3	**3**	Mobile toilets were provided
9	Propagation of microbes caused by lack of dust bin facilities	To check on load chart and proper lifting method.	4	4	**16**	There was no provision of mobile garbage bins.
10	Getting caught by the rain due to lack	Provide warning signage; Put	2	3	**6**	Briefing By safety officer on safety awareness.

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	of temporary shelters at the site	barrier on working area; Close supervision.				Additional control shall be made if necessary.
11	Possible injury due to lack of personal protective equipment	Requirements on proper stacking techniques; Close supervision.	2	5	**10**	Briefing By safety officer on safety awareness. Additional control shall be made if necessary.
12	Consequences caused by lack of awareness on Safety at workplace		1	4	**4**	Ignorant workers

Table 4.1: *Risk assessment during AGATARE asphalt road project implementation*
Source: *Author*

Severity being 4, Hazards being minor injury and propagation of microbes due to lack of dust bin facilities which have noticeably higher likelihood. Figure 4.15 shows Risk assessment during implementation of AGATARE road project

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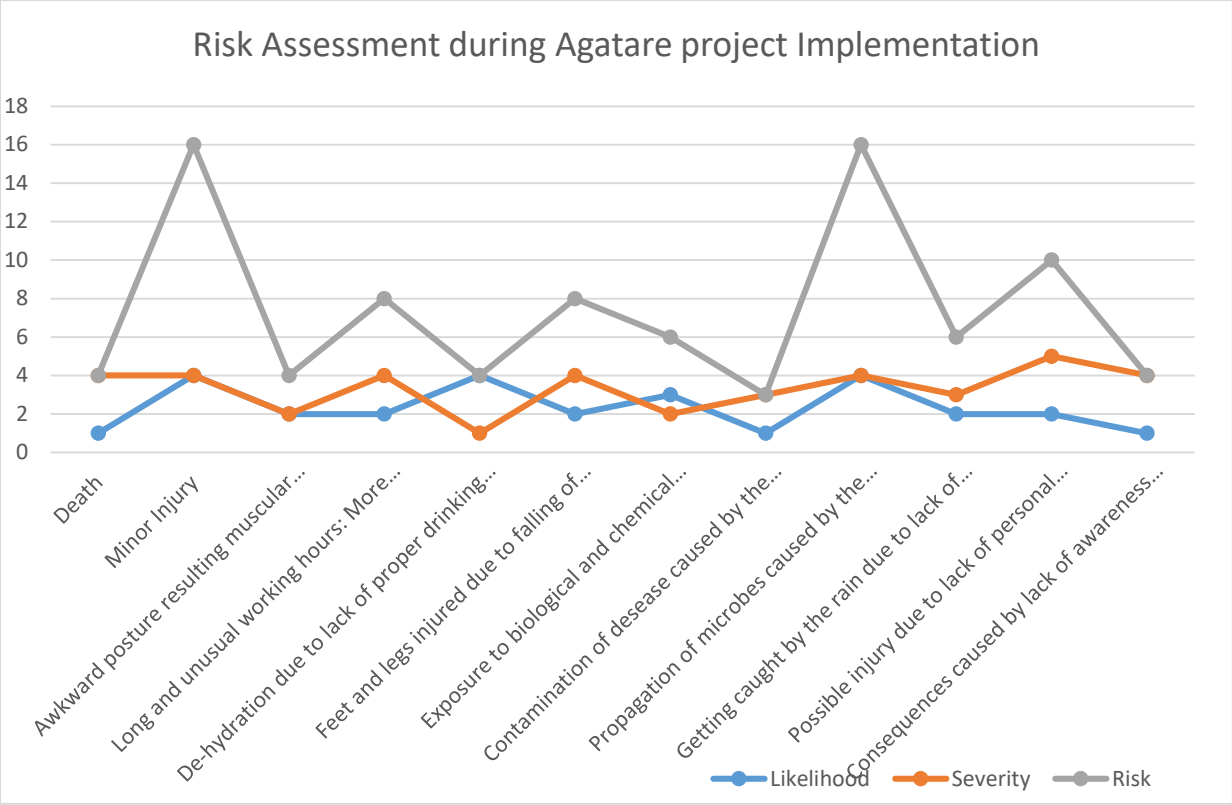

Figure 4.15: *Risk assessment during implementation of AGATARE road project*
Source: *Author*

4.4. Direct job created of workers' category.

During the implementation of this project a total of direct labor of 136,680 man-days was created, for both casual workers and semi-permanent workers. Majority of casual workers were residents who lived in the surrounding vicinity. The average salary for worker's man-day was 4,999 Frw. The table below shows the positions occupied by both casual and semi-permanent labor during AGATARE asphalt road project implementation and the total amount paid to them.

Casuals & semi-permanent labor position	Total Man-days	Sum of Total Amount
Porters	100,757	261,766,691
Masons	19,930	103,576,231
Aide Topo	3,794	11,828,133
Security	3,689	9,584,022
Carpenter	3,582	22,335,301
Headman/Capta	1,588	11,552,700
Helpers/ geo	900	2,338,200

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Helpers/Terrassien	600	3,118,200
Assistant Topo	351	1,824,147
Storekeeper	327	1,699,419
Pointer	303	1,257,493
Helpers/Mechanicians	300	779,400
Site clerk	292	1,517,524
Supervisor	144	1,049,150
social safety	56	232,792
Painter	55	200,408
Technician	8	66,520
Welder	4	24,000
Steel fixer	1	6,236
Grand Total	**136,680**	**434,756,567**

Table 4.2: *Casual and semi-permanent labor position and paid amount*
Source: *Primary data, September 2022*

The above table shows that the implementation of road project requires a big number of workers of porters' category. According to the site manager, this is so, due to high involvement of masonry and carpentry works whereby each mason and carpenter was served by one to two porters while other specialized workers required at least one porter/helper to successfully accomplish the assigned task. The figure below shows the percentage of total amount paid by Casual and semi-permanent Labor position.

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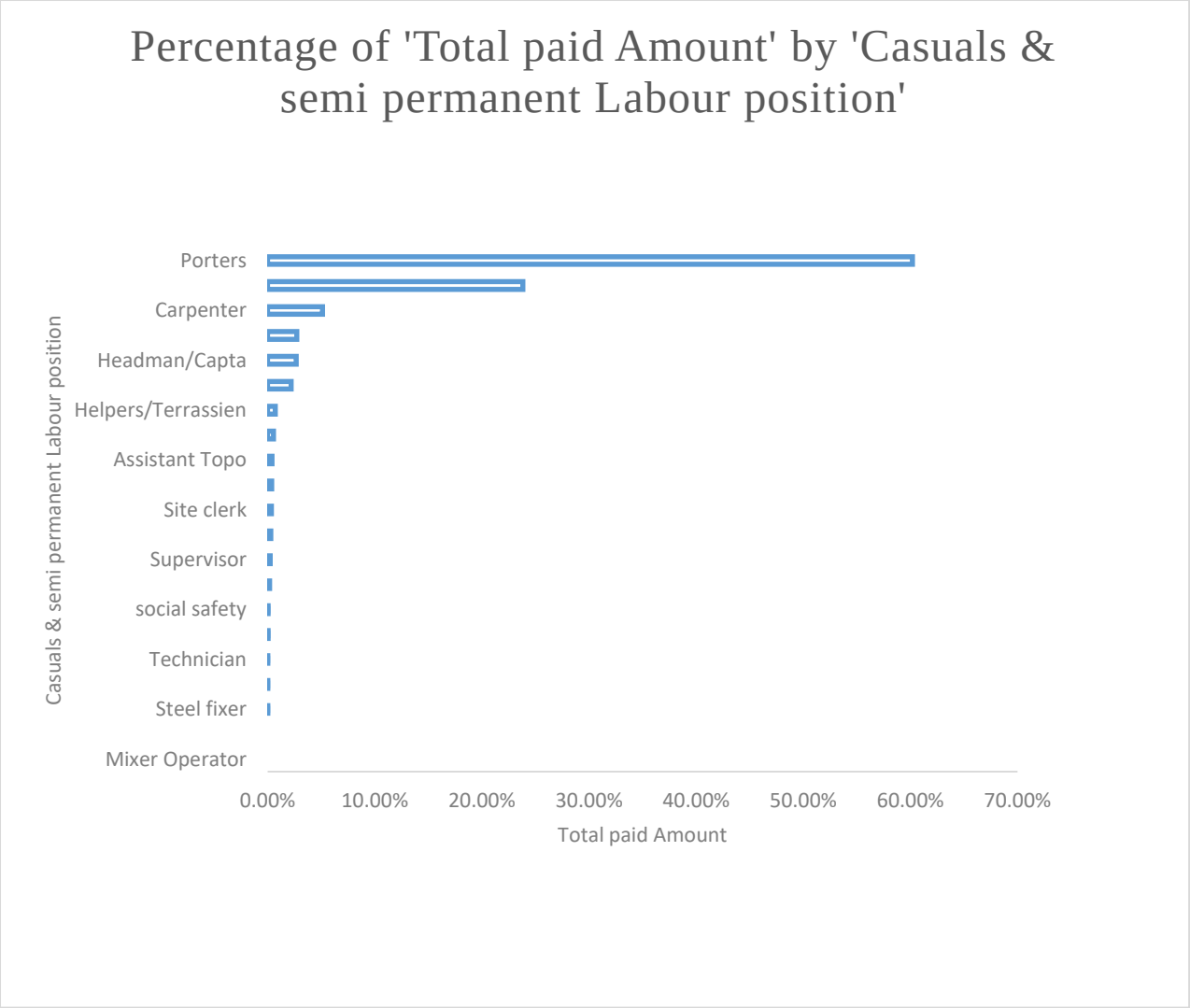

Figure 4.16: *Percentage of payment by Casuals & semi-permanent Labor position*
Source: ***Author***

With the figure above, it is noticed that 60.2% of all payment was paid to porters while 23.8% was for masons. This is a result of their high representativity in labor as summarized in the below pie chart below.

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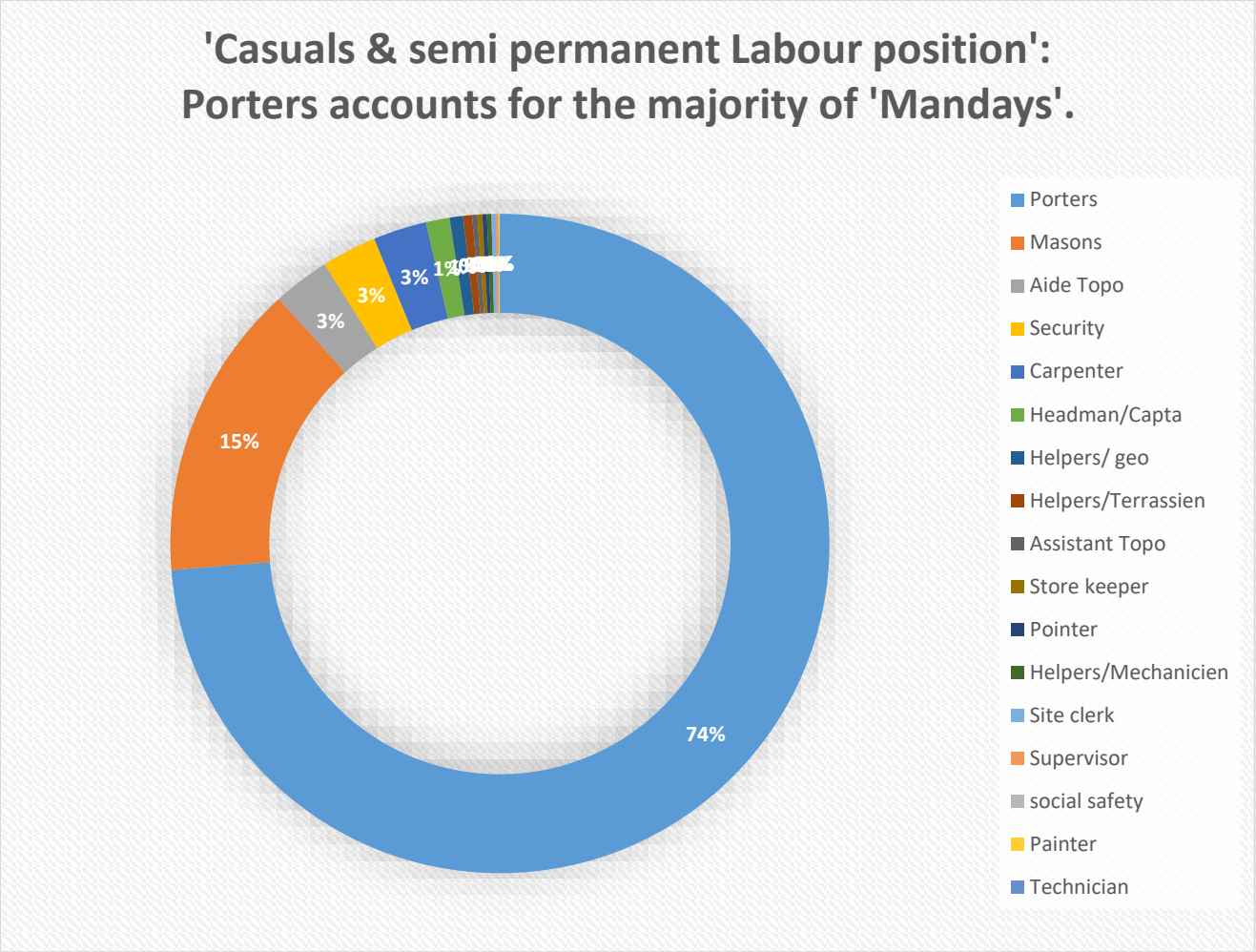

Figure 4.17: *Casual and Semi-permanent workers at AGATARE road project, Source:* ***Author***

The analysis of Integrated Management System implementation in construction projects in Rwanda underscores its significant positive impact on project performance. While challenges exist, proactive measures aimed at addressing resistance, enhancing capacity, and leveraging technology can further optimize the effectiveness of IMS implementation. Overall, IMS represents a valuable tool for improving project management practices and driving sustainable development in the construction industry in Rwanda.

However, despite these benefits, the study also uncovered several challenges associated with IMS implementation in the Rwandan construction context. One significant hurdle identified was the lack of adequate resources and expertise for effectively implementing and maintaining the IMS. Many construction firms struggle with limited financial resources and a shortage of skilled personnel trained in IMS methodologies, which hampered the successful adoption and sustainability of integrated management practices. Furthermore, cultural, and organizational barriers were observed to impede the full integration of IMS into project execution processes. Resistance to change, hierarchical structures, and ingrained.

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4.5. DISCUSSION

The analysis of the Integrated Management System (IMS) implementation in the AGATARE Road project construction in Rwanda yields several significant results. These results can be categorized into several key areas, each highlighting the impact and effectiveness of IMS in enhancing project outcomes.

Occupational health and safety: Adherence to ISO 45001 standards has resulted in a safer working environment. There has been a noticeable reduction in workplace accidents and incidents, enhancing the overall safety performance of the project. Comprehensive health and safety training programs have been conducted, raising awareness and competence among workers regarding safety protocols and practices. This has fostered a safety-first culture on the construction site.

Quality management: The implementation of IMS has led to adherence to international quality standards such as ISO 9001. Regular quality audits and inspections have ensured that construction activities meet the required specifications and standards, resulting in high-quality infrastructure. Through systematic quality control processes, the incidence of defects and the need for rework have been significantly reduced. This has not only improved the quality of the final product but also resulted in cost savings and more efficient use of resources.

Environmental management: The project has successfully integrated environmental management practices in line with ISO 14001 standards. Compliance with environmental regulations and standards has been achieved, minimizing the project's ecological footprint. Implementation of sustainable construction practices, such as waste management, resource efficiency, and pollution control, has been a key outcome. The project has contributed to the sustainable development goals of Rwanda by adopting green construction methods and materials.

Efficiency and productivity: IMS has contributed to the streamlining of various processes, reducing redundancy, and improving coordination among different teams. Efficient project management has led to better resource allocation and utilization, contributing to timely project completion. Integration of management systems has facilitated better communication and collaboration between different stakeholders, including contractors, workers, and management. This improved collaboration has led to more cohesive and effective project execution.

Stakeholder confidence and satisfaction: Demonstrating a commitment to quality, safety, and environmental stewardship through IMS has built trust and confidence among stakeholders, including the local community, government authorities, and investors. Positive

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stakeholder feedback has reinforced the project's credibility and reputation. The project has provided socio-economic benefits to the local community, such as job creation and infrastructure development. The community's positive response to the project's impact on local development has been a noteworthy outcome.

The table below summarizes general outcome from the study.

Objectives	Hypotheses	Result	Comments
• Role of integrated management system (IMS) regulations on the successful completion of construction Asphalt Road project in AGATARE road project • Risk assessment related to the successful completion of AGATARE asphalt road project. • To evaluate the direct job crated, workers category by skills and economic contribution after successful completion of asphalt road project implementation.	• The implementation of Integrated Management Systems positively impacts project performance indicators such as cost, schedule adherence, and quality in construction projects in Rwanda such as AGATARE project of Construction works for Nyarugenge District infrastructure upgrading, in line with the implementation of pillar of Economic transformation specific objectives of National Strategy for transformation. • Effective integration of management systems leads to improved coordination, communication, and decision-making, thereby reducing project delays and cost overruns, which is in line with the implementation of pillar of Economic transformation specific objectives of National Strategy for transformation.	• The quality of delivered road complied with the specifications of the client due to complying with road standards through local expertise equipped with both management and technical skills. • 60.2% of all payment was paid to porters while 23.8% was for masons. This is a result of their high representativity in labour as summarized in the below pie chart below. • Direct labour of 136,680 man-days was created. The average salary for casual and semi-permanent labours' man-day was 4,999 Frw during AGATARE asphalt road project construction.	• The results of analysing the IMS implementation in the AGATARE Road project indicate that the system has significantly contributed to improving quality, safety, environmental compliance, and overall project efficiency. • Challenges in IMS integration and continuous improvement were identified, These outcomes highlight the potential of IMS to set new benchmarks for construction projects in Rwanda and beyond, promoting sustainable and efficient infrastructure development.

Table 4.3: *General outcome from the study.*
Source: *Author*

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CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1. CONCLUSIONS

The analysis of the Integrated Management System (IMS) implementation in the AGATARE Road project construction in Rwanda yields several significant results. The results of analyzing the IMS implementation in the project indicate that the system has significantly contributed to improving quality, safety, environmental compliance, and overall project efficiency. While challenges in integration and continuous improvement were identified, the benefits of IMS in achieving high standards and fostering stakeholder confidence are evident. These outcomes highlight the potential of IMS to set new benchmarks for construction projects in Rwanda and beyond, promoting sustainable and efficient infrastructure.

These results are categorized into several key areas, each highlighting the impact and effectiveness of IMS in enhancing project outcomes.

Quality Management: The implementation of IMS has led to adherence to international quality standards such as ISO 9001. Regular quality audits and inspections have ensured that construction activities meet the required specifications and standards, resulting in high-quality infrastructure. Through systematic quality control processes, the incidence of defects and the need for rework have been significantly reduced. This has not only improved the quality of the final product but also resulted in cost savings and more efficient use of resources.

Occupational Health and Safety: Adherence to ISO 45001 standards has resulted in a safer working environment. There has been a noticeable reduction in workplace accidents and incidents, enhancing the overall safety performance of the project. Comprehensive health and safety training programs have been conducted, raising awareness and competence among workers regarding safety protocols and practices. This has fostered a safety-first culture on the construction site.

Environmental Management: The project has successfully integrated environmental management practices in line with ISO 14001 standards. Compliance with environmental regulations and standards has been achieved, minimizing the project's ecological footprint. Implementation of sustainable construction practices, such as waste management, resource efficiency, and pollution control, has been a key outcome. The project has contributed to the sustainable development goals of Rwanda by adopting green construction methods and materials.

Efficiency and Productivity: IMS has contributed to the streamlining of various processes, reducing redundancy, and improving coordination among different teams. Efficient project

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management has led to better resource allocation and utilization, contributing to timely project completion. Integration of management systems has facilitated better communication and collaboration between different stakeholders, including contractors, workers, and management. This improved collaboration has led to more cohesive and effective project execution.

Stakeholder Confidence and Satisfaction: Demonstrating a commitment to quality, safety, and environmental stewardship through IMS has built trust and confidence among stakeholders, including the local community, government authorities, and investors. Positive stakeholder feedback has reinforced the project's credibility and reputation. The project has provided socio-economic benefits to the local community, such as job creation and infrastructure development. The community's positive response to the project's impact on local development has been a noteworthy outcome.

Challenges and Lessons Learned: The analysis revealed some challenges in integrating different management systems, requiring robust planning and coordination. Lessons learned include the importance of early stakeholder engagement and continuous training to ensure smooth implementation. IMS implementation is an ongoing process, and the project has established mechanisms for continuous monitoring and improvement. Feedback loops and adaptability have been crucial in addressing emerging issues and enhancing system effectiveness.

5.2. RECOMMENDATIONS

Based on the conclusions drawn, the following recommendations are proposed to enhance the implementation of IMS in construction projects in Rwanda:

Change Management Strategies: Develop and implement proactive change management strategies to foster a culture of acceptance and commitment to IMS principles among all project stakeholders. This may include awareness campaigns, stakeholder engagement initiatives, and leadership support.

Capacity Building Initiatives: Invest in comprehensive training programs and capacity building initiatives to equip personnel with the necessary skills and knowledge to effectively implement and sustain IMS practices. This includes training on IMS standards, procedures, and tools, as well as ongoing professional development opportunities.

Technological Solutions: Leverage technological solutions such as digital platforms, data analytics, and Building Information Modeling (BIM) to enhance the efficiency and transparency of IMS processes. This can facilitate real-time monitoring, decision-making, and continuous improvement in project execution.

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Collaborative Partnerships: Foster collaborative partnerships with industry stakeholders, regulatory bodies, and academic institutions to share best practices, lessons learned, and innovative solutions for IMS implementation in construction projects.

Continuous Improvement: Embrace a culture of continuous improvement by regularly evaluating and refining IMS processes, identifying areas for enhancement, and implementing corrective actions as necessary. Encourage feedback from project teams and stakeholders to drive ongoing learning and innovation.

Suggestions for further study: Stakeholders' involvement in project design to minimize project risks during project implementation. Analysis of the effect of integrated management system on the project performance and continual improvement. Further research on greenhouse Gases (GHG) emission in Asphalt production in Rwanda.

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APPENDIX: COMPARIZON TABLE

ISO 9001:2015 - Quality Management System Requirements	**ISO 14001:2015 - Environmental management systems**	**ISO 45001:2018 – Occupational Health and Safety Management System**
1 SCOPE	**1 SCOPE**	**1 SCOPE**
2 NORMATIVE REFERENCES	**2 NORMATIVE REFERENCES**	**2 NORMATIVE REFERENCES**
3 TERMS AND DEFINITIONS	**3 TERMS AND DEFINITIONS**	**3 TERMS AND DEFINITIONS**
4 CONTEXT OF THE ORGANIZATION (Title)	**4 CONTEXT OF THE ORGANIZATION** (Title)	**4 CONTEXT OF THE ORGANIZATION** (Title)
4.1 Understanding the organization & its context	4.1 Understanding the organization & its context	4.1 Understanding the organization & its context
4.2 Understanding the needs and expectations of interested parties	4.2 Understanding the needs and expectations of interested parties	4.2 Understanding the needs and expectations of interested parties
4.3 Determining the scope of the QMS	4.3 Determining the scope of the EMS	4.3 Determining the scope of the OHS management system
4.4 QMS and its processes (Title)		
4.4.1 (paragraph-1 about QMS)	4.4 Environmental management system	4.4 OHS management system
4.4.1 (paragraph-2 about processes of QMS)		
4.4.2 *(about documented information on processes)*		

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5 LEADERSHIP (Title)	**5 LEADERSHIP** (Title)	**5 LEADERSHIP** (Title)
5.1 Leadership and commitment (Title)		
5.1.1 General	5.1 Leadership and commitment	5.1 Leadership and commitment
5.1.2 Customer focus		
5.2 Policy (Title)		
5.2.1 Establishing the quality policy	5.2 Environmental policy, paragraph-1	5.2 OHS policy, paragraph-1
5.2.2 Communicating the quality policy	5.2 Environmental policy, paragraph-2	5.2 OHS policy, paragraph-2
5.3 Organizational roles, responsibilities and authorities	5.3 Organizational roles, responsibilities and authorities	5.3 Organizational roles, responsibilities and authorities
		5.4 Consultation and participation of workers
6 PLANNING (Title)	**6 PLANNING** (Title)	**6 PLANNING** (Title)
6.1 Actions to address risks & opportunities (Title)	6.1 Actions to address risks & opportunities (Title)	6.1 Actions to address risks & opportunities (Title)
6.1.1 *(about requirements when planning QMS)*	6.1.1 General	6.1.1 General
6.1.2 *(about addressing risks & opportunities)*		
	6.1.2 Environmental aspects	6.1.2 Hazard Identification and assessment of risks and opportunities

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	6.1.3 Compliance obligations	6.1.3 Determination of legal requirements and other requirements
	6.1.4 Planning action	6.1.4 Planning action
6.2 Quality objectives and planning to achieve them (Title)	6.2 Environmental objectives and planning to achieve them (Title)	6.2 OHS objectives and planning to achieve them (Title)
6.2.1 *(about quality objectives)*	6.2.1 Environmental objectives	6.2.1 OHS objectives
6.2.2 *(about achievement planning)*	6.2.2 Planning actions to achieve environmental objectives	6.2.2 Planning actions to achieve OHS objectives
6.3 Planning of changes		8.1.3 Management of change
7 SUPPORT (Title)	**7 SUPPORT** (Title)	**7 SUPPORT** (Title)
7.1 Resources (Title)		
7.1.1 General	7.1 Resources	7.1 Resources
7.1.2 People		
7.1.3 Infrastructure		
7.1.4 Environment for the operation of processes		
7.1.5 Monitoring and measuring resources (Title)		
7.1.5.1 General		
7.1.5.2 Measuring traceability		
7.1.6 Organizational knowledge		

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7.2 Competence	7.2 Competence	7.2 Competence
7.3 Awareness	7.3 Awareness	7.3 Awareness
	7.4 Communication (Title)	7.4 Communication (Title)
7.4 Communication	7.4.1 General	7.4.1 General
	7.4.2 Internal Communication	7.4.2 Internal Communication
	7.4.3 External Communication	7.4.3 External Communication
7.5 Documented information (Title)	7.5 Documented information (Title)	7.5 Documented information (Title)
7.5.1 General	7.5.1 General	7.5.1 General
7.5.2 Creating and updating	7.5.2 Creating and updating	7.5.2 Creating and updating
7.5.3 Control of documented information (Title)		
7.5.3.1 *(about purpose of control)*	7.5.3 Control of documented information, paragraph-1	7.5.3 Control of documented information, paragraph-1
7.5.3.2 *(about requirements for control)*	7.5.3 Control of documented information, paragraph-2 & 3	7.5.3 Control of documented information, paragraph-2 & 3
8 OPERATION (Title)	**8 OPERATION** (Title)	**8 OPERATION** (Title)
8.1 Operational planning and control	8.1 Operational planning and control	8.1 Operational planning and control
		8.2 Emergency preparedness and response

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8.2 Requirements for products & services (Title)		
8.2.1 Customer communication		
8.2.2 Determining the requirements for products & services		
8.2.3 Review of the requirements for products & services (Title)		
8.2.3.1 & 8.2.3.2 *(about review, documented info)*		
8.2.4 Changes to requirements for products & services		
8.3 D & D of products and services (Title)		
8.3.1 to 8.3.6 – General, Planning, Inputs, Controls, Outputs, Changes		
8.4 Control of externally provided processes, products and services (Title)		
8.4.1 General		
8.4.2 Type and extent of control		
8.4.3 Information for external providers		
8.5 Production and service provision (Title)		

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8.5.1 Control of production and service provision		
8.5.2 Identification and traceability		
8.5.3 Property belonging to customers or external providers		
8.5.4 Preservation		
8.5.5 Post-delivery activities		
8.5.6 Control of changes		
8.6 Release of products and services		
8.7 Control of nonconforming outputs (Title)		
8.7.1 *(about required control)*		
8.7.2 *(about required documented information)*		
9 PERFORMANCE EVALUATION (Title)	**9 PERFORMANCE EVALUATION** (Title)	**9 PERFORMANCE EVALUATION** (Title)
9.1 Monitoring, measuring, analysis and evaluation (Title)	9.1 Monitoring, measuring, analysis and evaluation (Title)	9.1 Monitoring, measuring, analysis and evaluation (Title)
9.1.1 General	9.1.1 General, paragraph-2, 4, 6	9.1.1 General
	9.1.1 General, paragraph-1, 3, 5	9.1.1 General
	9.1.2 Evaluation of compliance	9.1.2 Evaluation of compliance
9.1.2 Customer satisfaction		
9.1.3 Analysis and evaluation		

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9.2 Internal audit (Title)	9.2 Internal audit (Title)	9.2 Internal audit (Title)
9.2.1 *(about general requirements)*	9.2.1 General	9.2.1 General
9.2.2 *(about audit programmes)*	9.2.2 Internal audit programme	9.2.2 Internal audit programme
9.3 Management review (Title)		
9.3.1 General	9.3 Management review, paragraph-1	9.3 Management review, paragraph-1
9.3.2 Management review inputs	9.3 Management review, paragraph-2	9.3 Management review, paragraph-2
9.3.3 Management review outputs	9.3 Management review, paragraph-3	9.3 Management review, paragraph-3
10 IMPROVEMENT (Title)	**10 IMPROVEMENT** (Title)	**10 IMPROVEMENT** (Title)
10.1 General	10.1 General	10.1 General
10.2 Nonconformity and corrective action (Title)		
10.2.1 *(about required actions)*	10.2 Nonconformity & corrective action, paragraph-1, 2	10.2 Incident, Nonconformity & corrective action, paragraph-1, 2
10.2.2 *(about required documented information)*	10.2 Nonconformity & corrective action, paragraph-3	10.2 Incident, Nonconformity & corrective action, paragraph-3
10.3 Continual improvement	10.3 Continual improvement	10.3 Continual improvement

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