UNIVERSIDADE
EDUARDO
MONDLANE

FACULTY OF ENGINEERING
DEPARTMENT OF CHEMICAL ENGINEERING
MASTER'S IN HEALTH, SAFETY AND ENVIRONMENT

MASTER'S DISSERTATION

STRATEGIES FOR IMPLEMENTATION OF THE QUALITY, SAFETY AND OCCUPATIONAL HEALTH MANAGEMENT SYSTEM IN THE CONSTRUCTION SECTOR: CASE STUDY OF MYSOLUTE COMPANY

BY

Júlia Armindo Tomo

Maputo

2022

STRATEGIES FOR IMPLEMENTATION OF THE QUALITY, SAFETY AND OCCUPATIONAL HEALTH MANAGEMENT SYSTEM IN THE CONSTRUCTION SECTOR: CASE STUDY OF MYSOLUTE COMPANY

Dissertation presented to the Faculty of Engineering in Partial Fulfillment of the Requirements for obtaining the academic title of Master in Health, Safety and Environment, by UEM.

BY

Júlia Armindo Tomo

Supervised by:

Prof. Doctor Orlando Zacarias

Maputo

2022

RECOMMENDATION OF THE BOARD OF EXAMINERS

The undersigned certify that they have read and recommend to the Faculty of Engineering a thesis entitled “Strategies for Implementation of the Quality, Safety and Occupational Health Management System in the Construction Sector: Case Study of Mysolute Company” submitted by Júlia Armindo Tomo, in partial fulfillment of the requirements for the degree of Master Program in Health, Safety and Environment Engineering.

_____

Prof. Doutor Orlando Zacarias

Supervisor

_____

Doutor Marcelino Januário Rodrigues, Arq.^{to}

Course Coodinator

DECLARATION

I, **Júlia Armindo Tomo**, declare that this end-of-course work was exclusively carried out by me. The same is now submitted in accordance with all the requirements for obtaining a Master's degree in Health, Safety and Environment at Eduardo Mondlane University.

…….

(Júlia Armindo Tomo)

DEDICATION

I dedicate this Master's Thesis to my son Malik, for providing me with moments of joy.

To my husband Douglas, my Parents, In-laws and Brothers, who closely followed the difficulties and limitations for the development of this work.

ACKNOWLEDGMENT

First, I would like to thank God for the gift of life.

To the coordinators of the Masters in Health Safety and the Environment from Eduardo Mondlane University, Technological University of Troyes and France Education International, who made this master's degree possible and viable.

To my supervisor, Prof. Doctor. Orlando Zacarias, for his support and availability to guide me in carrying out this work.

To the employees of the company INSITE, especially to Dr. Ricardo, for their support and trust, and for having provided all the necessary means to carry out this dissertation.

To the Mysolute Company, for the information provided and for the interest shown in the Project.

To IGREME colleagues, for the constructive debates and moments of joy.

I thank my colleagues for the companionship, union and friendship that were created during these academic years.

To my parents, Armindo Siquice Tomo and Palmira Alexandre Tomo, brothers, Artur, Alda, Floriana, José, Mariza and Regina, nephew, Agnaldo, for their education, example and support received over the years.

Finally, a special thanks to my husband Douglas for his encouragement, support, understanding and absolute love, and to my in-laws Laura Sitoe and Júlio Mandlaze, and brothers-in-law, for their support.

To all, my thanks.

ABSTRACT

Design for occupational safety and health (DfOSH) has been gaining prominence in the construction sector. The inclusion of elements to mitigate occupational health and safety risks in the project design process is fundamental. This study develops strategies for the implementation of a Quality, Safety, Health and Environment Management System in the Mysolute Construction Company, associated with the maturity and capacity model, in order to help the company achieve sustainable development and meet the market needs.

Based on the ISO 9001:2015 standards on quality, and ISO 45001:2018 on safety and health, implementation strategies were defined, and the risks associated with the various organizational processes in the Mysolute Company were identified, through the application of SWOT analysis methods and Failure Mode and Effects Analysis (FMEA).

The results indicate that the company implements risk mitigation processes, having been found that the application of risk management was fundamental to put the company to act preventively in the various processes that encompass the Quality, health, safety and environment Management System. The application of the FMEA method made this process structured and easy to visualize, allowing the identification of the most critical activities and the definition of actions to mitigate the effects of the potential failures identified.

Keywords: Quality, safety, health, environment, capacity, maturity, Management, System.

RESUMO

O design para segurança e saúde ocupacional (DfOSH) vem ganhando destaque no sector da construção civil. A inclusão de elementos de mitigação dos riscos de saúde e segurança ocupacional no processo de desenho do projecto é fundamental. Este estudo, desenvolve estratégias de implantação de um Sistema de Gestão da Qualidade, Segurança, Saúde e Meio Ambiente na empresa de construção Mysolute, associado ao modelo de maturidade e capacidade, com vista a auxiliar a empresa a alcançar um desenvolvimento sustentável e a atender às necessidades do mercado.

Com base nas normas ISO 9001:2015 sobre a qualidade, e ISO 45001:2018 sobre a segurança e saúde, foram definidas estratégias de implementação, e identificados os riscos associados aos diversos processos organizacionais na empresa Mysolute, através da aplicação dos métodos de análise SWOT e *Failure Mode and Effects Analysis* (FMEA).

Os resultados indicam que a empresa Mysolute implementa processos de mitigação de riscos, tendo sido constatado que a aplicação da gestão de riscos foi fundamental para colocar a empresa a actuar preventivamente nos diversos processos que englobam o Sistema de Gestão da Qualidade, saúde, segurança e meio ambiente. A aplicação do método FMEA tornou esse processo estruturado e de fácil visualização, permitindo a identificação das actividades mais críticas e a definição de acções para mitigar os efeitos das potenciais falhas identificadas.

Palavras-chave: Qualidade, segurança, saúde, meio ambiente, capacidade, maturidade, Gestão, Sistema.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEX

LIST OF ABBREVIATIONS AND ACRONYMS

CFC- Chlorofluorocarbon

CMM- Maturity and Capability Model

DfOSH- Design for occupational health and safety

D- Detectability

FMEA- Failure Mode and Effect Analysis

HSE- Health, Safety and Environment

IMS - Integrated Management Systems

ISO - International Organization of Standards

KPI - Key Performance Indicator

MaM - Monitoring and Measurement

MM- Maturity Model

MOPH - Ministry of Public Works and Housing

O - Occurrence

OHS- Occupational health and safety

OHSAS - Occupational Health and Safety Assessment Series

PDCA - Plan Do Check Act

QHSE- Quality, Health, Safety and Environment

QMS - Quality Management System

QHSEMS - Quality, Health, Safety and Environment Management System

MS- Management System

MSS - Management System Standards

RPN - Risk Priority Number

S - Severity

SME - Small and medium-sized enterprises

SHEM- Safety, health and environment management

QHSE-CMM – Health Safety and Environment, and Maturity and Capability Model

SWOT - Strengths Weaknesses Opportunities Threats

UFSA - Functional Unit for Acquisitions Supervision

1. INTRODUCTION

1.1. Contextualization

The construction sector is one of the biggest contributors to work-related accidents and illnesses. The fatal injury rate for workers in the construction sector is 3.5 times the average fatal injury rate for workers in all industries; and the non-fatal injury rate in construction is 1.5 the average rate across all industries (Manu et al. 2018). These accidents have caused loss of human lives and qualified personnel, also affecting the health of survivors, including a high rate of compensation and interruption of production.

Working at heights, use of different types of machinery and equipment, skin and inhalation exposure to various hazardous materials (such as silica dust and asbestos), inappropriate practices, inappropriate postures, hiring workers from other countries with different languages and cultures, and the variable nature of working conditions presents a large number of unacceptable risks for all those dealing with construction projects, including workers, engineers, project managers, and others (Mahmoudi et al. 2014).

Several causes that influence poor safety performance in the construction industry have been identified, which include worker attitudes, company size, safety policy, project coordination, economic pressure, training in construction project management and safety culture. Factors that affect safety on the construction site include poor safety awareness of managers, lack of training, low safety awareness of project managers and reluctance to provide resources for safety and reckless operations (Tam et al. 2004) cited by (Brahmachary et al. 2018).

Studies carried out in this area have revealed that the lack of attention to Occupational Health and Safety (OHS) issues results in irreversible costs, including costs associated with work accidents, rework, delays and loss of reputation of the organization and the contract award (Mahmoudi et al. 2014).

As a consequence, in recent years, in addition to the time, cost and quality triangle**,** OHS issues are being increasingly emphasized as an indicator of the success of construction projects (Mahmoudi et al. 2014). For these reasons, construction companies need a suitable tool to continuously assess and improve their operational conditions in relation to OHS.

In this work, strategies for the implementation of the Integrated Quality, Safety, Health and Environment Management System will be developed based on the ISO 9001:2015 Quality standards, and the ISO 45001:2018 standard on Occupational Health and Safety, having as a study of case, the

construction company Mysolute. The management system will be associated with the maturity and capacity model, to help the company determine the level of performance in terms of Quality, Safety, Health and Environment.

1.2. Justification

The evolution of customer expectations, national and international pressures, as well as technological advances, lead organizations to continually improve their processes, products, services and systems. With the introduction of new products, new equipment and new work techniques, problems can arise for people and the environment, creating new challenges in terms of Quality, Health, Safety and Environment (Calado, 2014).

The aim of this study is to explore the Integrated Management System based on the ISO 9001:2015 Quality Standards, and the ISO 45001:2018 Standard on Occupational Health and Safety, for Sustainable Development and Corporate Safety. And based on some research and interviews, the challenges for the implementation of the Integrated Management System in the company will be identified, with regard to the aspects of risk and accident prevention, as well as the continuous improvement of processes.

The study will raise the main challenges that exist during the implementation of Integrated Quality, Health and Safety Management Systems, including the advantages that can be obtained by the effective implementation of an Integrated Management System in this scope.

This research becomes relevant because it will allow the production of new knowledge about the real benefits of implementing the Integrated Quality, Health and Safety Management System in the construction industry for the improvement of processes, products, services and systems.

The investigation will also serve to recommend measures that can be taken to improve performance in terms of quality, safety and health, based on the knowledge acquired during the training.

1.3. Problem

As organizations continually face pressures to gain and maintain competitive advantage, it becomes increasingly important to identify ways to reduce costs, improve quality, shorten time to market for new products or services, etc.

One of the ways to face this increasingly competitive scenario has been the implementation of a set of practices, which, when properly used, provide increased competitiveness and customer satisfaction. This set of practices, known as a quality, safety and health management system, aims to improve the

organization's ability to meet customer and regulatory requirements and, consequently, bring benefits to the company that implements it.

Although it is recognized that the Quality, Health, Safety and Environment Management System are components of the organizations' management systems, which are essential in creating a healthier and safer work environment, it becomes relevant, however, to meet the issue of defining the most adequate strategy for its implementation.

Different organizations use different models, which is a reflection of increasingly complex and diverse working processes and conditions. In many cases, these systems are incomplete. Like other methods, the Quality, Health, Safety and Environment Management System has strengths and weaknesses, and its effectiveness largely depends on the way it is implemented (understood and applied).

The great challenge of the Quality, Safety, Health and Environment Management System (QHSEMS) refers to its effective application, so that the standards to which they refer can go beyond descriptive definitions.

In view of the aforementioned facts, questions arise regarding the implementation of the QHSE Management System in the Mysolute Company:

- What is the procedure to be adopted in order to achieve the planned QHSE performance results?
- What risks may be associated with the process of implementing the Quality Safety, Health and Environment system?
- What measures are necessary to prevent the occurrence of failures during the implementation of the QHSE management system?

This project aims to carry out a qualitative study on the implementation of an integrated quality, health, safety and environment management system in the construction company Mysolute.

1.4. Objectives

1.4.1. General Objective

The general objective of this study is the elaboration of strategies for the implementation of the integrated and consistent management system in promoting the improvement of quality, health, safety and environment performance, based on the international standards ISO 9001:2015 and ISO 45001: 2018, at the Construction Company Mysolute.

1.4.2. Specific Objectives

- Describe the current Quality, Health, Safety and Environment Management System in the Mysolute Company.
- Identify organizational elements and factors that influence the implementation of a Quality, Health, Safety and Environment Management System (QHSEMS)
- Integrate the Maturity and Capacity Model into the organization's strategy that includes the Quality, Health, Safety and Environment Management System, and propose a structure to assess the company's performance level.
- Present the benefits of implementing the integrated safety, health and environment management system.
- Design and implement the risk assessment and management process in the Mysolute Company.

2. LITERATURE REVIEW

2.1. Construction Industry

Despite considerable efforts and improvements in recent years, (Sousa et al. 2014) cited by (Kissiedu, 2019), state that civil construction still contributes to a high number of work accidents, including injuries, illnesses and deaths. The occurrence of work accidents and fatalities is more significant in developing countries and countries in the Sub-Saharan African region, compared to developed countries (Takala et al. 2014) cited by (Kissiedu, 2019).

According to several studies, every construction process has a measurable environmental impact: it starts from the extraction of raw materials, transport, construction execution, to the process of removing and disposing of waste, when a work reaches the end of its life (Kissiedu, 2019).

On a global scale, construction activities negatively affect the environment in terms of substantial consumption of raw materials and energy, as well as in the generation of water, air and noise pollution, waste discharge and toxic emissions, global warming, destruction of the ozone layer, resource depletion, among others (figure 1).

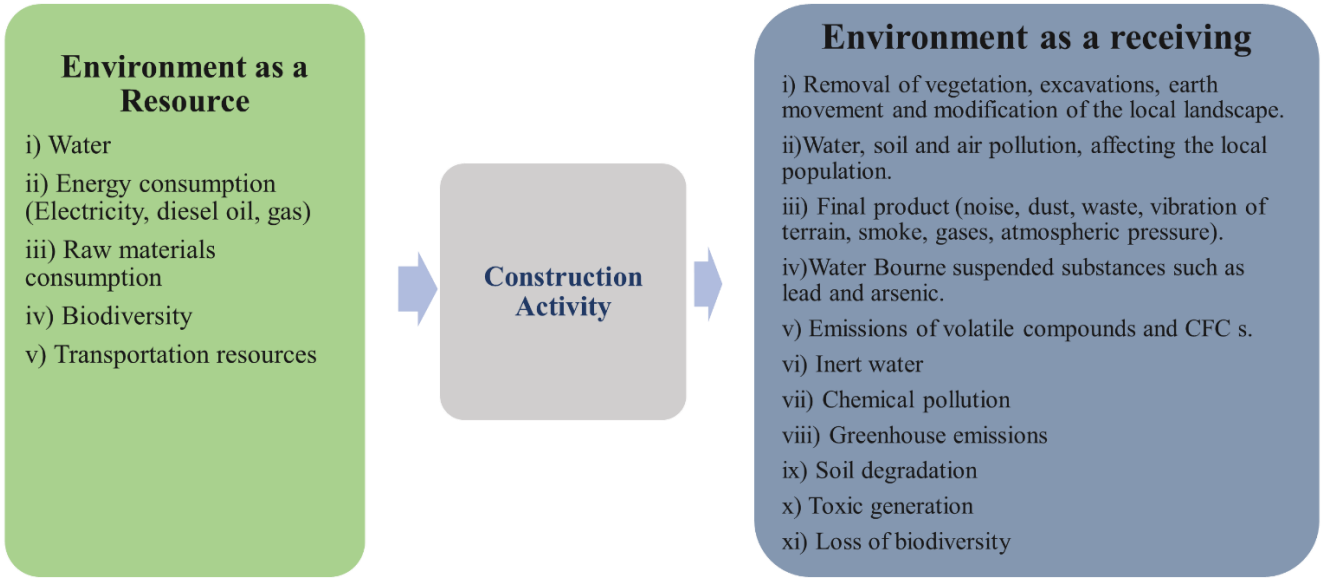

Figure 1. Construction Ecosystem.

The particularity of construction systems consists in the need for construction products to respond to adaptation in physical space (subsystem of geographic space), in order to carry out human activities (modifying space). The diagram below illustrates this particularity (Figure 2):

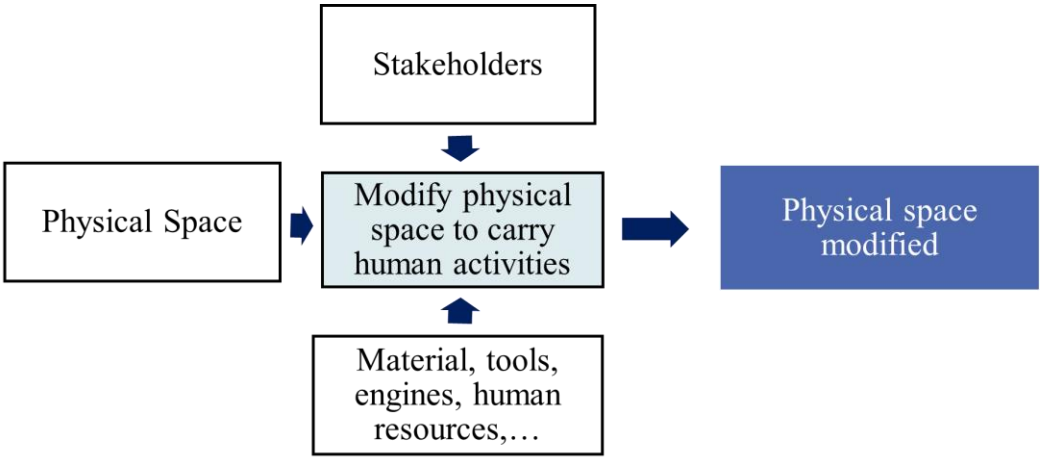

Figure 2. Graphical representation of the building system using the SADT (Structured analysis and design technique) Model.

2.2. Functional Analysis

One of the most used methods in the design phase of a new product/process is the functional analysis, whose objective is to express the need in terms of expected service functions, and in terms of solutions. The purpose is to arrive at a product that satisfies the user's needs. Being a basis for the establishment of technical specifications (Ilie et al. 2011).

The Functional Analysis method, according to the principle proposed by Miles, "*first, establishes functions of a product, and then researches the product to perform the functions".* Therefore, a solution cannot be found without being communicated to the functions that ensure its need. A function is described as the action of a product or one of its constituent parts and is expressed only in terms of purpose. Functions are classified into service functions and technical functions (Ilie et al. 2011).

Service functions are the expected product functions to meet user needs. The establishment and formalization of the function is done by the method of environmental elements. This method uses a tool called "octopus diagram" or "interaction diagram" and is based on product procedures in the context of the elements with which it is related (includes environmental factors).

The "interaction diagram" is represented in the center of the diagram by an oval, and the environmental elements are represented around the product, also in an oval shape.

The service functions and constraints established for a system can be ordered by levels, where the first level is the main function, which corresponds to the fundamental need. This function has a generic expression, and is supported by all other functions and constraints.

The External Functional Analysis assumes the following steps:

1. Identification of the studied system and its life phase (definition of the subject);

2. Inventory of environmental elements of use;

3. Establishment and formalization of functions;

4. Control of the validity of functions;

5. Characterization and hierarchy of functions

2.3. Quality, Health, Safety and Environment Management Standards

According to the statement issued by Insite SA, the company Mysolute started in February 2021, the implementation of the Integrated Management System for Quality, Health and Safety, based on international standards, ISO 9001:2015 and ISO 45001:2018, thus following international standards and best practices in the provision of its services.

The implementation of the Integrated Quality Health, Safety and Environment Management System, aims to improve the internal processes and procedures of the Mysolute Company, with a view to increasing the satisfaction of the needs and expectations of the interested parties, generating value for all and contributing to a better working environment. Business.

2.3.1. Standard ISO 9001:2015 (Quality)

ISO 9001:2015 is the most widely used management systems standard worldwide, being an international reference for Quality Management Systems Certification. This Standard promotes the adoption of a process approach when developing, implementing and improving efficiency of a quality, to increase customer satisfaction by meeting customer requirements (CEN, 2015).

This quality system consists of a set of coordinated activities and rules that are defined by a collection of policies, processes, documented procedures and records that direct and control organizations of any size, for continuous improvement in the provision of their services (CEN, 2015).

ISO 9001 adopts a process approach, which incorporates the PDCA cycle of continuous improvement, and integrates risk-based thinking, allowing not only customer loyalty but also the organization's competitiveness based on the pillars of sustainability.

According to (Carvalho et al. 2015), the implementation of the QMS can bring several benefits to the organization, such as customer satisfaction, reduction of time spent on rework due to errors in the process or poor quality of raw materials; more effective internal and external communications; employee involvement and satisfaction; stabilization of processes and increase in the company's profit.

2.3.2. Standard ISO 45001:2018 (Health and Safety)

ISO 45001 is a new international occupational safety and health management system standard that was developed and published in March 2018 by the Projects Committee, to replace the widely recognized OHSAS 18001. It shares the same terms, definitions and structure as ISO 14001 (management) and the ISO 9001 system (quality management), as it is based on Deming's cycle of continuous improvement.

This framework allows multiple management systems to be integrated and implemented in a harmonized, organized and efficient way to help construction organizations achieve economic safety and health objectives (Kissiedu, 2019).

According to (ABNT, 2018) the new Management System was developed to provide a systematic organizational structure for an organization (from SMEs to large companies) to manage risks and opportunities to help prevent occupational injuries and employee health problems.

ISO 45001 takes a proactive approach to risk control rather than the reactive approach to risk control as required by OHSAS 18001.

Table 1. Comparative table of the two standards for certification of management systems.

Standard	**ISO: 9001 (Quality Management)**	**ISO: 45001 (Occupational Health and Safety Management System)**
Occupation	Customer satisfaction and continuous improvement	Risk control and performance improvement
Focus	Customers	Workers and Stakeholders
Enrollment	Products and services	Risks to the health and safety of workers
Activities Covered	Processes - realization of Products and Services	All activities that involve some type of risk

2.4. Strategy for the Development of Integrated QHSEMS

The IMS is a management system that combines two or more separate systems, their procedures and relevant management requirements into a coherent system, which allows an organization to work together as a single unit with unified objectives, for the equitable satisfaction of the stakeholders' quality and safety factors, health, environment or any other identified requirement.

One of the main characteristics of the strategy is the ability to optimize resources and activities and, consequently, create a competitive and adaptable model to the dynamic and constantly changing world. Once the strategy has been thought out, it will be necessary to formulate the actions that the company must carry out, and the way in which it must proceed.

The integration of strategic planning instruments has been used by organizations with the aim of involving all Stakeholders and not just senior management (Serra et al. 2010) cited by (Calado, 2014).

In the present work, the integration encompasses two main management systems, which are: ISO: 9001 (Quality Management) and ISO: 45001 (Occupational Health and Safety Management System), as shown in Figure 3.

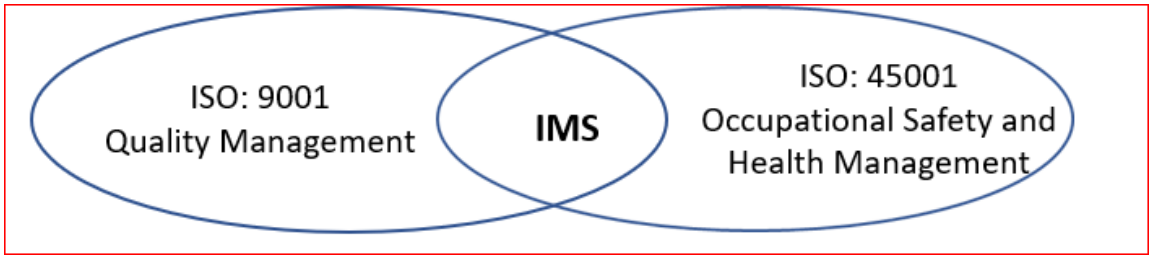

Figure 3. The core of the IMS and the standards on which it can be based (ISO 9001 and ISO: 45001).

According to (Santos et al. 2018) cited by (Tavares, 2019), the best way to start an Integration is to look for common elements in both systems. And according to the experience of several authors, the Integration of Quality Management Systems (ISO 9001:2015) and, Safety and Health (ISO 45001:2018), should not be carried out all at once, and, in first, one must look for the similarity of common requirements between two Systems, and integrate these same requirements in phases. The typical steps of an integration process are according to the figure below (Figure 4).

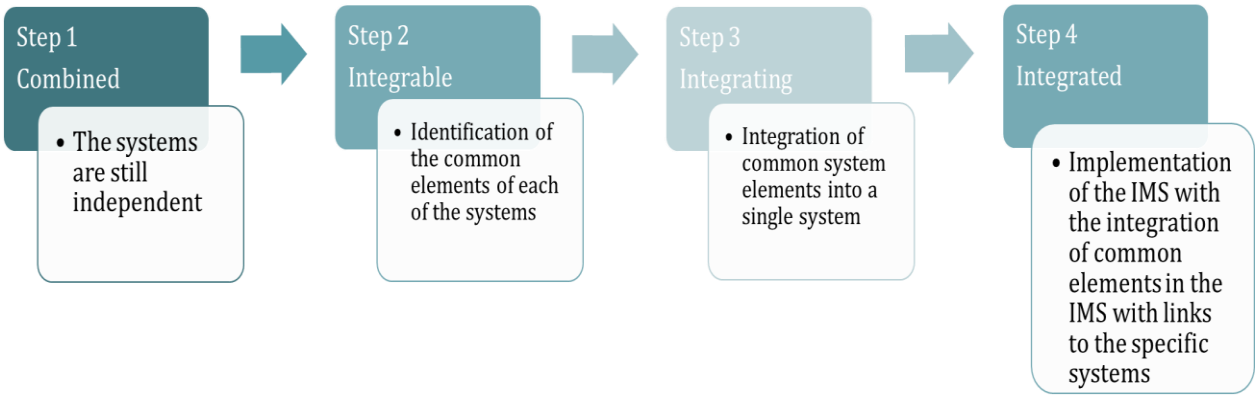

Figure 4. Steps for Integration of the Management System.

2.4.1. PDCA Cycle

Strategy and planning are part of the PDCA (Plan-Do-Check-Act) cycle, starting with the collection of information on the present and future needs of the Stakeholders, and also on the results and impacts, with the aim of providing information for the planning of the process. For this, it is necessary to have credible information, including the perception of all stakeholders to contribute to the formulation of operational policies, planning and strategic guidance. Feedback from an internal review process is equally critical for performance improvement planning (Rohm et al. 2013) cited by (Calado, 2014).

The two standards, ISO 9001 and ISO 45001, have a common underlying principle: continuous improvement, and they share the same structure and can be integrated using the PDCA approach (Muzaimi et al. 2017).

(Hamid et al. 2004) cited by (Kissiedu, 2019), developed a model called the Quality, Safety, Health and Environment Management System (QHSEMS). This system has six main elements that make up a continuous improvement cycle using Deming's PDCA Cycle (Figure 5). These elements are:

i. **QHSE Policy:** An QHSE policy statement is defined to show the organization's intentions and principles, in relation to its overall QHSE performance, and provides a platform for defining QHSE objectives and goals.
ii. **Planning:** This involves formulating a plan to comply with the QHSE policy. Consists of multiple employees identifying significant QSHE impacts of the organization's activities, products and services, along with legal and other standards to which the company subscribes.

iii. **Implementation and Operation:** This step involves putting the plan into action, providing resources and support mechanisms needed to achieve the QSHE Policy, objectives and targets.

iv. **Verification and corrective action:** Implementation of measures that will regularly monitor and evaluate organizations' QSHE performance against their objectives and targets.

v. **Management Review:** Committed to continually reviewing and improving the QSHE Management System, with the aim of improving its overall QSHE performance.

vi. **Continuous Improvement:** The QSHE Management System is subject to continuous improvement to achieve improvements in overall QSHE performance, in accordance with the organization's QSHE Policy.

Figure 5. Integrated safety, health, environment and quality (QSHE) management system model, adapted from (Kissiedu, 2019).

2.5. Benefits of QHSEMS Integration

Integrating quality, safety, health and environment systems can bring many benefits to the company and employees (Carvalho et al. 2015).

Results show that IMS has intrinsic and extrinsic benefits (Kissiedu, 2019). Intrinsic benefits can be categorized into economic, organizational and operational. Some extrinsic benefits of the IMS are related to meeting the requirements of interested parties, mainly customers, public authorities or the local community.

According to (Muzaimi et al. 2017), the benefits of integrating the quality health safety and environmental System are:

a) Improve business focus

The IMS improves the organization's focus, as the system promotes concentration on the organization's activity, improving and strengthening the connections between quality, health and safety of employees; and social responsibility. Management system integration can drive the company's strategy to be more focused on organizational needs and improve business focus.

b) Business Risk Management

The integration of two or more management systems is advantageous in terms of providing a more holistic approach to managing business risks. In the IMS, the system will cover the aspect of quality, environment, occupational health and safety together, with the risk management system simultaneously.

c) Less Conflict between Individual Management Systems

Implementing the IMS identifies and rationalizes conflicts, confusion or redundancy in documentation and also exposes conflicting objectives. In addition, IMS leads to more effective resource management, primarily by entrusting management to a leader rather than appointing separate leaders for each management system, including the certificate.

The IMS helps to promote a single management, as both certifications have an internal audit and management review.

d) Reduction of duplication and bureaucracy

One of the advantages of integration is the elimination of duplication between procedures in systems. IMS allows organizations to lessen the extent of documentation and bureaucracy that arises due to the organization and control of work by referring to separate procedures or different standards.

e) Effective and Efficient Internal and External Audits

IMS has the advantage of reducing external certification costs through single certification audits and integrated audits. In addition, the integration also makes it possible to carry out an internal and external audit more clearly and effectively.

Integration guarantees quality, environmental, occupational health and safety components; and risk that needs to be audited to be verified, so problems of incompatibility or mismanagement can be minimized.

f) Simplifies the Certification Process

Two management systems are combined into one system; it will be easier for each management system to be certified. The implementation of the IMS offers the benefit of simplifying the certification process, as before, the different management systems need to be certified and verified one by one, and the process can take longer due to the need to verify all systems using a lot of manpower, and spending more resources on documentation.

g) Saves Human Resources

The IMS brings benefits in terms of human resources, as it can improve the company's culture. IMS supports human resources as it can improve communication and information sharing at different organizational levels.

IMS can save used human resources in terms of auditing and management. This is because, after integration, the audit process becomes just an audit and a procedure that needs to be managed. The manpower can be reduced, and minimize the complexity of management and lessen the workload for the employees.

h) Decreases Management Cost

The financial benefit refers to financial targets granted by the implementation of the IMS; Integration can lead to direct cost savings through reduced audit cost and reduced certification cost.

i) Decreases the complexity of internal management

The IMS not only lowers the cost of the management system, but also lowers the complexity of internal management. The IMS provides a reduction in the duplication of policies, procedures and records that will provide the advantages in the company's operation. By integrating documents, manual, procedures and others, the task can be simplified, as the system maintains a system of procedures that includes all the requirements required in the management system, therefore, the complexity can be minimized and further simplify the process.

j) Increases Cultural Compatibility

Organizational culture is a pattern of beliefs, values, and learned ways of dealing with experience that have developed over the history of an organization. The culture of the country and the organization is important to ensure that integration can be fully embraced in the organization. A good work practice in the organization can increase the compatibility of the culture and improve the quality in the management.

k) Facilitates Continuous Improvement

IMS is important for organizations that wish to move towards continuous improvement as it can help organizations efficiently and systematically deal with environmental issues more efficiently.

i) Time saving

Systems integration can save time and cost for companies as it saves time in adopting different systems as the common goal of continuous improvement is being followed. After the integration, the system is simplified, therefore, the time for management is reduced.

m) Operational Benefits

The IMS offers the operational benefit of improving multiple audits. In addition, it provides a reduction in the duplication of policies, procedures and records, which will bring an advantage in terms of company operation. The operating system will function based on the requirements for these two systems, and the operation or practice will meet the quality standard, environmental standard, and occupational health and safety standards.

n) Improves the company's external image

The IMS gives a positive point to the improvement of the company's image, as it will improve customer confidence. The integration of the management system involves the organizational culture, brings benefits to the operation and improves the quality of management. When the organization has a good internal culture, it will lead to good management, product quality and business growth.

o) Improves customer satisfaction

There are customer needs and demands for using the IMS as part of the business system and management strategy. The customer is also a factor for the implementation of the IMS in the organization, as they will be more confident to do their business, as they believe that the IMS provides the efficient and effective operational ways, and the business will be firmer and more stable.

p) Increases employee motivation

Implementing the IMS creates a positive culture in the company for employee motivation. The internal benefit of integration is that it can improve team motivation and lessen cross-functional conflict. The simplified management system will make it easier for the employee to understand the system and the process, therefore, it can motivate him to do his assessment and daily task.

2.4.2. SWOT Analysis

It is important to assess and understand the organization's internal and external context, as they can significantly influence the design of the risk management framework.

The SWOT analysis was considered the most appropriate tool to identify the current organizational context, as it is a tool widely used in strategic planning that encompasses an internal and external analysis of the organization and allows the identification of key elements for the management of the company, allowing to establish action priorities. The use of this tool has several advantages, since “it is presented in the form of a table, easy to interpret, helping to trace a path based on relevant information from both the internal and external context”.

2.5. Risk Management

Organizations of all types and sectors face different risks that can have a negative or positive influence on the defined objectives. “To succeed, an organization must commit to approaching risk management proactively and consistently” (Project Management Institute, Inc, 2013), Thus, this management “increases the probability of success and reduces both the probability of failure and the uncertainty of achieving all of the organization's overall objectives. (Ferma, 2003) cited by (Costa, 2017).

The risk management process is a process through which organizations analyze the risks inherent to their activities and which requires the “systematic application of risk management procedures aimed at reducing risks, in order to ensure that objectives are achieved as effectively and efficiently as possible” (Wulf et al. 2005) cited by (Costa, 2017). This systematic application includes procedures for the identification, analysis, assessment, treatment, monitoring and review of risks that may affect the achievement of these objectives.

The ISO 31000:2018 standard, on principles and guidelines for risk management, states that “this process must be part of organizational processes and inserted into all practices and processes of the organization in a relevant, effective and efficient way” (ABNT, 2018).

2.5.1. Risk Assessment

The process of understanding risk is known as risk assessment, and it is at the heart of the risk management process as defined by ISO 31000:2018. The risk assessment process is divided into the Hazard Identification, Risk Analysis and Assessment processes, which are then the basis for building risk treatment plans (also called risk management actions, defined in table 2); these plans are then the subject of records and reports (Gomez, 2021).

The support elements of monitoring and review allow the guarantee of the continuity of the process and measurement of effectiveness, while communication and consultancy allow the establishment of dialogue with the relevant stakeholders. Figure 9 frames this process as a continuous cycle, starting in the early stages of the project through to closure, or even beyond. This ongoing process is necessary to improve the understanding of risks that enable increasingly effective risk management actions. Understanding that all elements of the risk management process are essential, this research focuses on the risk assessment process.

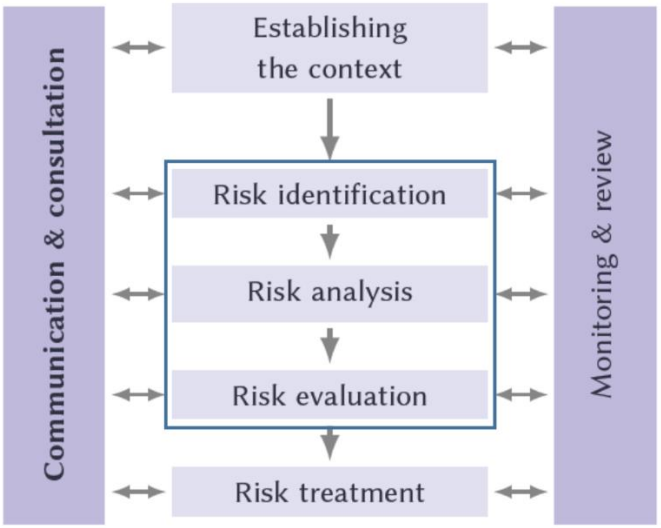

Figure 6. Risk assessment process as part of the risk management process.

The established context must include the definition of the internal context (policy, strategy, objectives, type of management, organizational structure) and the external context (social, political, cultural, legal, financial and economic environment in which the organization operates).

When assessing risk, attention is paid to the probability of occurrence and the severity of the consequences of an initial hazardous event. Based on the risk assessment and to achieve a tolerable risk level, recommendations for risk reduction should be provided as needed. These recommendations may be based on an analyst's judgment or on criteria chosen by the company to guide risk mitigation decision making (Vazdani et al. 2017).

This research focuses on the risk analysis process, which constitutes the central part of risk management, and has a basic structure independent of its application area (Grimvall et al. 2010).

Table 2. Definition of risk assessment steps.

Stage	Description
Hazards and scenario identification	Systematically and comprehensively identifying elements with the inherent potential to cause harm, ie *hazards*, and developing scenarios through which these can lead to undesirable consequences. A scenario is understood as a sequence of events with a set deadline that ends with unintended consequences.
Risk analysis	Understanding of risks and their characteristics, based on the chosen risk definition. It typically includes judging (qualitatively) or estimating (quantitatively) the probability and consequences of specific scenarios.
Risk assessment	Process of comparing risk analysis results with pre-defined criteria to determine if they are acceptable, tolerable or unacceptable.

2.6. Failure Mode and Effect Analysis (FMEA)

Failure Mode and Effect Analysis (FMEA) is a systematic method to analyze and classify hazards associated with different products or processes, and prioritize hazards to propose appropriate corrective actions and achieve a desirable situation (Vazdani et al.2017).

The FMEA was used in this study to identify the possible failures that may occur during the implementation of the QHSE Management System in the Mysolute Company, evaluate their causes and effects on the system, and provide a solution to eliminate or reduce the probability of occurrence and the severity of its effect. This was the tool chosen for the simple way in which it outlines the entire process, and for allowing easy monitoring and risk management.

After identifying the risks inherent to the Management System, we moved on to their quantification through the calculation of the RPN Index (Risk Priority Number). The RPN index is derived from the multiplication of three components: risk severity (S), probability of risk occurrence (O) and detection risk (D), according to the formula below:

$$\boldsymbol{RPN} = \mathrm{S}\ \boldsymbol{x}\ \boldsymbol{O}\ \boldsymbol{x}\ \boldsymbol{D}$$

The RPN number prioritizes the failure modes of a product or system, so the higher the RPN, the more defective, the more dangerous, and the more resources are allocated in terms of time and cost.

The way of scoring is that for each parameter "*Severity, Occurrence and Detection* ", the number is scored between 1 and 10, so that in the extreme case the score is 10 and in the lowest case the score is 1 for each parameter, according to tables 3, 4 and 5.

Table 3. Risk Severity Level Assessment Criteria.

Severity: The highest score (G max) between the internal (downstream) customer and the end customer must be maintained		
End customer (or user) criteria	**Classification (S)**	**"Downstream" customer criteria (company)**
Minimal effect. The customer doesn't understand	1	No influence on manufacturing and/or assembly operations.
Minor effect that the client can detect, but causing only mild discomfort. No noticeable degradation in performance.	2 or 3	Minimal effect detectable during fabrication and/or assembly operations, but causing only slight discomfort without disturbing the flow.
Alert signal effect that leaves the customer dissatisfied or uncomfortable. No noticeable degradation in performance.	4 or 5	Slight interruption of the fabrication and/or assembly flow due to difficult-to-execute operations (difficult-to-execute dimensions).
Effect without warning signal that displeases the customer. It upsets you or makes you uncomfortable. We may notice a performance degradation. Repair costs are moderate.	6 or 7	Moderate interruption of fabrication and/or assembly flow due to operations that are very difficult to perform (tolerances difficult to maintain), but achievable with current techniques.
Early warning effect that causes high customer dissatisfaction and/or high repair costs due to loss of function of a subassembly.	8	High disturbance of the fabrication and/or assembly flow due to operations that are very difficult to carry out (tolerances difficult to maintain), which cannot be achieved with current techniques.
No red flag effect that causes high customer dissatisfaction and/or high repair costs.	9	Very high interruption of fabrication and/or assembly flow due to impossible operations.
Effect involving security issues or non-compliance with regulations in force.	10	Effect involving safety concerns for the operator downstream or at the customer's plant. Shutdown of manufacturing and assembly operations.

Table 4. Criteria for assessing the level of Occurrence of Risks

Criteria and frequency of opposition f	**Classification (O)**	**Frequency of occurrence of the fault. ppm = parts per million**
Non-existent defect in products used in similar functions and conditions. No customer incidents are known ($f \leq 0.01\%$)	1 or 2	10 ppm < k < 100 ppm
Few defects in existing or similar products used in similar functions and conditions. Very few incidents known to customers. ($0.05 \leq f \leq 0.1\%$)	3 or 4	500 ppm < k < 1000 ppm
Defect that occasionally appeared in existing or similar products used in similar functions and conditions. Some incidents known to customers. ($0.2 \leq f \leq 0.5\%$)	5 or 6	2000 ppm < k < 5000 ppm
Defect that has frequently appeared in parts of existing or similar products used in similar functions and conditions. Some incidents known to customers. ($1 \leq f \leq 2\%$)	7 or 8	10,000 ppm < k < 20,000 ppm
Frequent appearance of the defect. Risk of catching up on finished products. ($f \geq 5\%$)	9 or 10	50 000 ppm < k < 100 000 ppm

Table 5. Risk Detectability Level Assessment Criteria.

Criterion	**Classification D**
Cause of 100% failure detected during validation. All validations provided for in the specifications are carried out and their results confirm the project. Proper sampling.	1
Risk r of not detecting the cause of failure during validation: 0 <r≤10% All validations provided for in the specifications are carried out and their results confirm the project; but with insufficient sample.	2 or 3
Risk r of not detecting the cause of failure during validation: 10 <r≤30% All validations provided for in the specifications are carried out and their results confirm the project; but with an insufficient sample and subject to conditions different from those in the specifications.	4 or 5
Risk r of not detecting the cause of failure during validation: 30 <r≤ 50% All validations provided for in the specifications are carried out and their results confirm the project; but with unsatisfactory means, insufficient sample and subject to conditions different from those in the specifications.	6 or 7
Risk r of not detecting the cause of failure during validation regardless of the results of tests performed: r> 50% The plan cannot be validated.	8 or 9
None of the validations provided for in the specifications are performed.	10

After obtaining the value of the RPN index, the matrix for risk qualification (table 6) was applied in each identified scenario.

Table 6. Risk index classification matrix.

RPN = Severity x Occurrence x Detectability	
risk index	**Suggested risk measures**
1 to 50	**Low Risk:** Need for attention. It is not necessary to define actions, or long-term actions, but actions for continuous improvement can be defined. Acceptable risk (the risk is so low that it is insignificant compared to other risks). It becomes necessary to monitor.
>50 to 150	**Medium Risk:** Correction needed. Define medium term actions - 6 months - medium risks. Reduce risk to the lowest possible level. Medium-term actions must be defined.
>150 to 300	**High risk:** Immediate correction required. Define short term actions - 3 months maximum - High risks. It can put the organization at risk, and short-term actions must be taken.
>300 to 1000	**Very high risk:** Consider stopping until risk is adequately controlled or transferred. Set immediate actions. This situation can put the organization at risk.

2.7. Event Tree Analysis (ETA)

Event trees are used to study or model sequences of events that can result in different consequences. The first event in the sequence of events is called the start event. Depending on the occurrence of one or more intermediate events, different outcomes may occur (Schuller et al. 1997). The purpose of an event tree is to provide information about the possible consequences of an initiating event that can lead to different consequences.

ETA is generally applicable to almost any type of risk assessment, but is used most effectively for accident models, where various safeguards are in place as protective features.

A typical Event Tree Analysis scenario is composed of three key elements: an initiating event, a dangerous event, and the final event (figure 7).

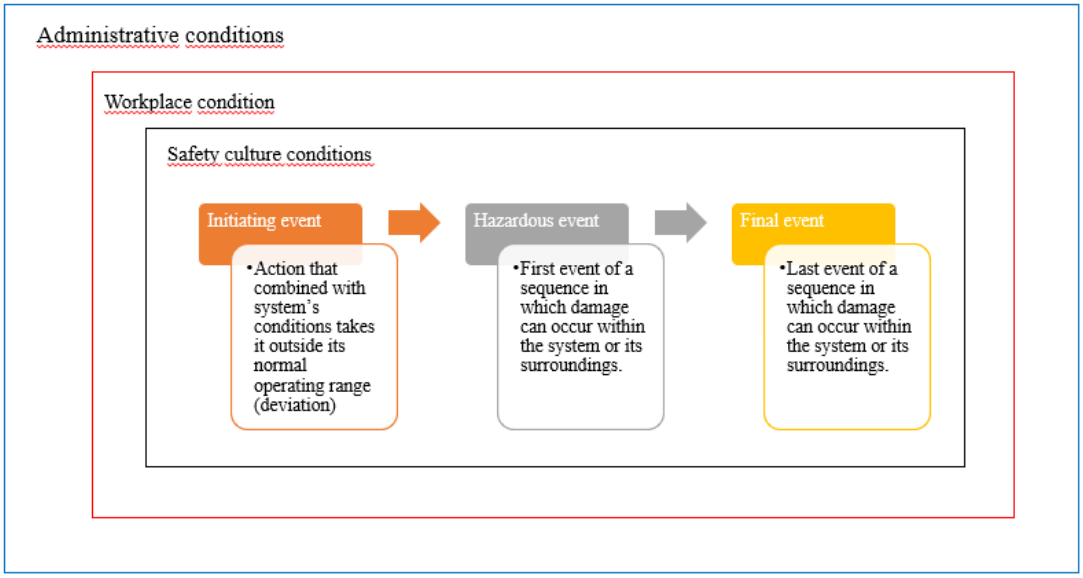

Figure 7. Key elements of a typical scenario.

2.8. Development of an integrated model of maturity of quality, safety, health and environment management capacity

Maturity and Capability Models (CMM) are strategic tools used to assess a company's ability to execute the key practices or processes required to deliver its services or products. The value of a maturity model lies primarily in its focus on the combined set of tasks and management practices essential for a company to achieve strategic objectives, targets and other obligations such as operational safety, health and environmental risks (Kissiedu, 2019).

The MM, in addition to being a tool that helps organizations to identify weaknesses, was applied in this research, as a means of evaluating the level of implementation of the QHSE Management System, which can help the company in the generation of improvement plans. .

To develop a DfOSH maturity and capability model, it is important to establish: (1) the key process areas (ie, the DfOSH capability attributes); and (2) maturity levels (Maier et al. 2012) cited by (Manu et al. 2018). The following subsections present the steps taken to address both.

According to (Manu et al. 2018), the key process areas of a CMM can be derived from: (1) the originator's experience and reference to established knowledge in the relevant domain; and (2) a panel of domain experts, especially where there is limited prior literature on the domain (Maier et al. 2012) cited by (Manu et al. 2018). This study used references already established in the relevant domain of the construction industry, due to the complexity of the empirical work in relation to the DfOSH capability.

Maturity models are regarded as an assessment and improvement tool, which allow an organization to assess its improvements in terms of increasing levels of maturity and capability. Maturity or capability levels are characterized by well-defined evolutionary stages for which the practice, process or capability is defined, controlled or established (Kissiedu, 2019).

This study considered the continuous format as a reference framework for the capacity maturity model for integrated quality, safety, health and environment management (QHSE-CMM), as it provides a generic measure of the level of capacity for each attribute of integrated QHSE management capability. The continuous format allows for flexibility, which means that a company can choose to focus on a few process areas that fit the company's long-term strategies or objectives. In addition, it assists companies in offering opportunities for companies to get to know their competitive environment through introspection (determining their strengths and weaknesses); reviewing key policies and operations; identifying opportunities for change and investment, and prioritizing improvement measures.

2.8.1. Identification of QHSE Management Capacity Attributes

It is of utmost importance when developing a maturity and capability model to establish capability attributes. Identifying the attributes of QHSE integrated management capability begins with a thorough review of management-related literature (not limited to construction), to generate a list of potential QHSE management capability attributes. In addition, the relevant literature related to maturity models in safety, health and environmental management was also reviewed (Kissiedu, 2019).

Literature sources included international standards, published guides on HSE, and academic publications to improve research validity (Charef et al. 2018) cited by (Kissiedu, 2019).

Following the work of (Mahamadu et al. 2017) cited by (Kissiedu, 2019), in relation to the determination of organizational capability attributes for design implementation for occupational safety and health (DfOSH) capability, as well as the categorization of key process areas of the capability and maturity model, the 20 validated capability attributes that form the HSE integrated management framework were categorized into five thematic areas of integrated management capability. The five thematic categories are: strategy; people; process; Resources; and information. And because the two standards applied in this study share the same structure, Quality was integrated for the identified HSE attributes, forming QHSE attributes. Detailed descriptions of the thematic categories and the various attributes within them are presented in Table 7, and the respective model represented in the figure 8.

Table 7. Built-in QHSE management capability attributes.

Thematic Category	Attributes
Strategy (i.e. the organization's vision and top management commitment to QHSE management)	Senior management commitment to safety, health, environment and quality (QHSE) management
	An integrated QHSE policy that serves as the foundation for a company's QHSE development and implementation
	QHSE objectives and targets for a company, in line with QHSE policy
	QHSE management programme i.e. company's action plans for achieving QHSE objectives and targets
Processes (i.e. the organization's procedures, processes and systems for QHSE management)	QHSE risks management i.e. systems, processes and procedures for QHSE hazards identification, risks assessment and identification risks control strategies
	Management of outsourced services i.e. processes and mechanisms for assessing the competence of outsourced personnel, subcontractors and suppliers with regards to management of QHSE
	QHSE operational control i.e. processes, procedures and measures for controlling QHSE risks, to ensure QHSE regulatory compliance in operational functions and to achieve the overall QHSE objectives
	QHSE emergency preparedness and responses i.e. emergency procedures and measures to minimize the impact of uncontrolled events and unexpected incidents.
	QHSE performance monitoring and measurement i.e. systems, processes and procedures to monitor and measure QHSE performance to ensure compliance with QHSE regulations
	QHSE incidents investigation i.e. processes and procedures for investigating the causes of QHSE incidents
	QHSE system auditing i.e. processes and procedures to conduct QHSE audits to assess compliance and QHSE management system effectiveness
People (i.e. organization's human capital, their roles, responsibilities, and	QHSE roles and responsibilities i.e. availability of dedicated QHSE roles and responsibilities within organizational hierarchy
	QHSE Training i.e. provision of suitable QHSE training for personnel

involvement in QHSE management)	Employee involvement and consultation at all levels in QHSE management and operations
	QHSE competence i.e. the skills, knowledge and experience of personnel to undertake responsibilities and perform QHSE activities
Resources (i.e. organization's physical and financial resources required for QHSE management)	Physical QHSE resources i.e. provision of physical resources for QHSE implementation
	Financial resources for QHSE i.e. Provision of financial resources for QHSE implementation
Information (i.e. QHSE related documents, data, lessons, records and their communication across an organization)	Communications i.e. communication of relevant QHSE information and requirements to personnel and other relevant stakeholders
	QHSE documentation and control i.e. provision and maintenance of adequate SHEQ documentation and records
	QHSE lessons and knowledge management i.e. capturing lessons learned and knowledge acquired from historical incidents and management of QHSE

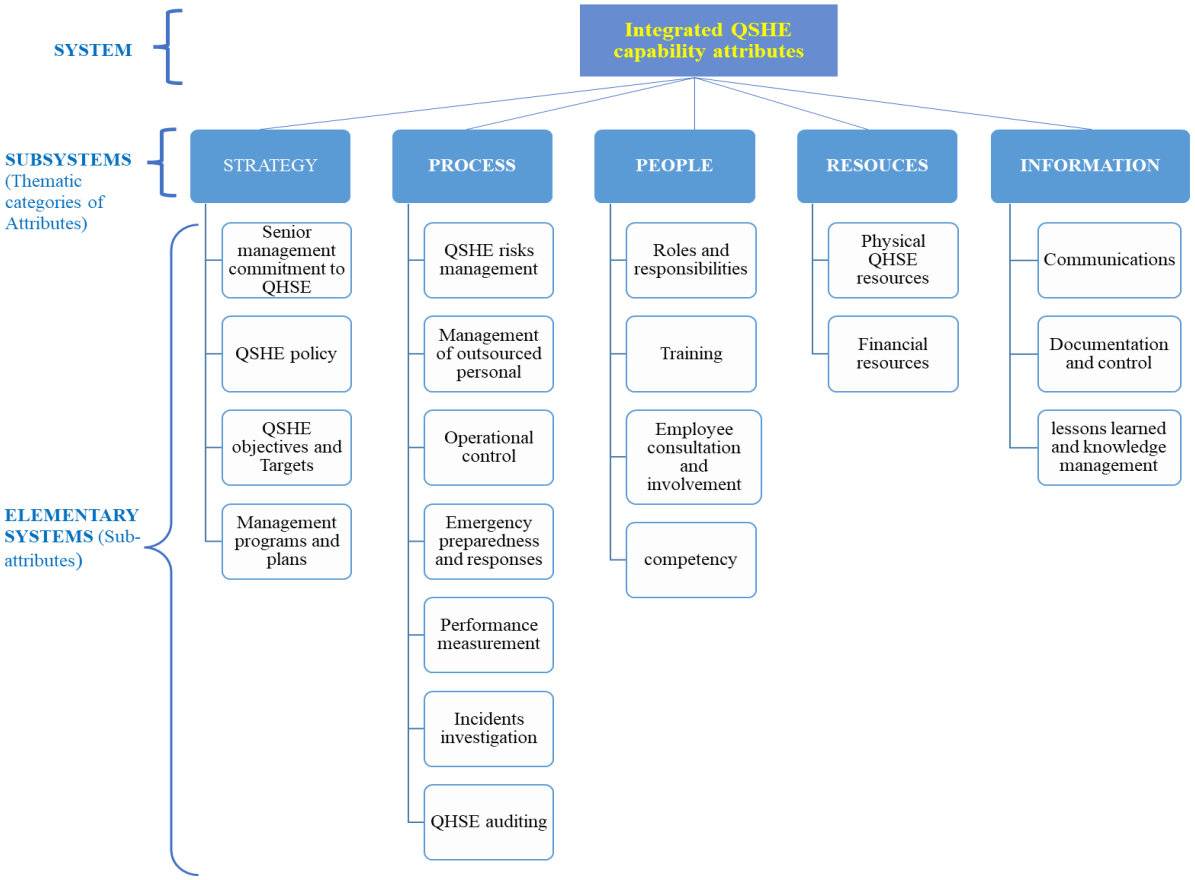

Figure 8. Integrated QHSE Management Capability Attribute Hierarchy Model.

2.8.2. Maturity Levels

Maturity and capability models commonly use five maturity levels (Maier et al. 2012) cited by (Manu et al. 2018) in line with the original CMM determined by (Paulk et al. 1993). Likewise, in this study, five levels of maturity were adopted, with level 1 being the lowest and level 5 the highest. At the first level, the process is mostly chaotic or ad-hoc. It becomes repeatable at the second level, after which it becomes defined or standardized. At the fourth level, the process is usually measured or controlled, before being optimized at its highest level, subjecting it to continuous improvement and feedback cycles (Quaigrain et al. 2015).

The concept of the maturity and capability model is such that progression or the achievement of a higher maturity level is pre-conditioned to the achievement of lower maturity levels.

Based on a review of several CMMs, (Maier et al. 2012) cited by (Manu et al. 2018) noted that the formulation of maturity levels involves:

(1) The top-down or bottom-up approach;

(2) Consideration of the source of information; and

(3) Consideration of the formulation mechanism.

According to (Maier et al. 2012), cited by (Manu et al. 2018), in the *bottom-up approach*, maturity measures are determined first, before definitions are written to reflect the measures. In the top-down approach, the emphasis is first on what maturity represents, before how it can be measured. This approach is most appropriate if the field is relatively new. This approach was used primarily because of limited empirical work on the capability of DfOSH. The Maturity Model is shown in Figure 9.

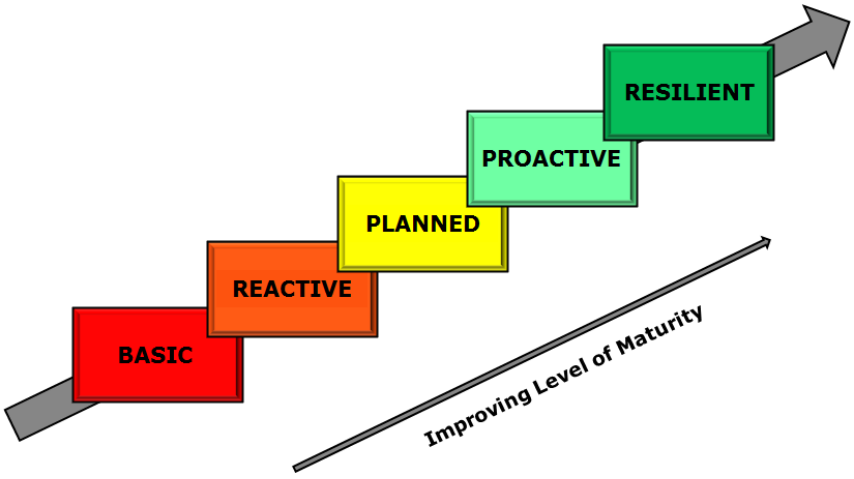

Figure 9. The Maturity and Capability Models (CMM), source: (Foster & Hoult, 2013).

Table 8. Definition of maturity and capability levels (Kissiedu, 2019)

Capacity level	**Definition**
Level 1: Basic	There are no structured processes and procedures in place. Performance is consistently poor.
Level 2: Reactive	Organizational processes and procedures may exist, but are often ad-hoc and unstructured. Procedures and processes are not defined. performance is fair
Level 3: Planned	Organizational processes and procedures are formal and defined. Process and procedure are reactive. Performance is mostly good.
Level 4: proactive	Organizational procedures and processes are planned, well defined, proactive and generally in accordance with best practices. The performance is very good and repeated consistently.
Level 5: Resilient	Organizational processes and procedures are standardized, fully integrated across the organization and continuously monitored, reviewed for continuous improvement. Performance is exemplary and comparable to the best in the industry.

3. METHODOLOGY

3.1. Methodological Approach

The methodology applied for this work followed a qualitative and quantitative approach, where the qualitative analysis consisted of describing and analyzing the importance of implementing the QHSE Management System, through the diagnosis of the main benefits of the QHSE implementation, as well as the explanation of the influence of the implementation in the company Mysolute, and the quantitative analysis, consisted in the application of methods for the analysis and evaluation of risks.

The research followed the following steps, namely: literature review, data collection at the Mysolute Company, function analysis, preliminary hazard analysis based on SWOT, FMEA methods, and event tree analysis.

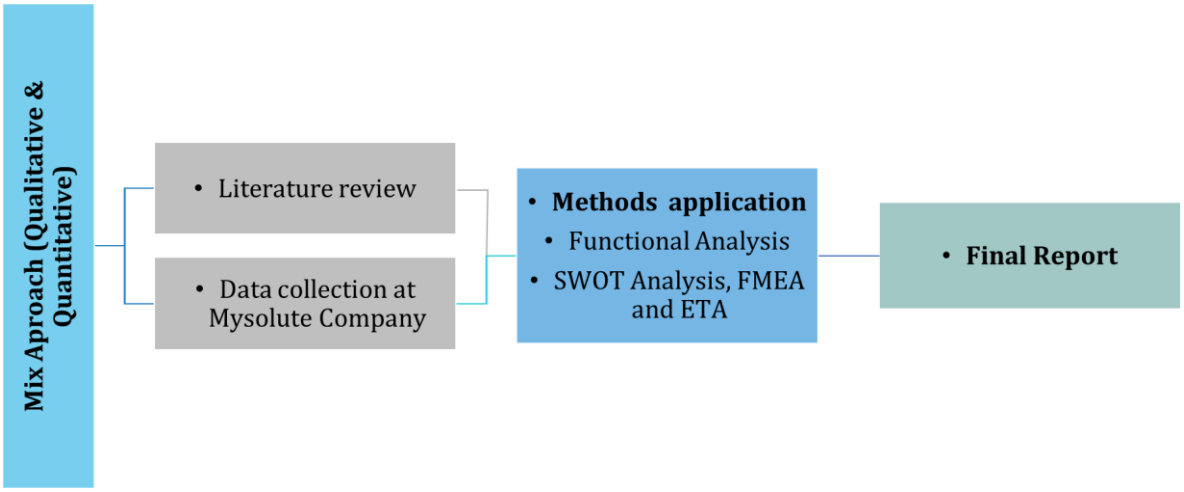

Figure 10. Schematic representation of the methodology of the study. Source: Author

3.2. Literature review

Bibliographic review of the topic with the objective of developing a more in-depth and detailed knowledge about Quality, Safety, health and environment in civil construction, the risk management process and functional analysis.

3.3. Data collection

Visits to the company's facilities to collect information through interviews, document requests and observations, to survey the company's situation in relation to the implementation of the QHSEMS.

Diagnostic results include a list of legal requirements and identification of hazards related to the activity.

3.4. Functional Analysis

The functional analysis method, in addition to helping to understand the operation of the Construction system, through the identification of subsystems and components, and their respective functions, was also applied to propose a useful methodology in the process of integrating the QSHE management system, being an important method for conducting hazard identification and risk analysis

3.5. Preliminary Risk Analysis

Since the company Mysolute, a company subject to several risks due to the complexity of the processes, it was necessary to apply the methods of SWOT Analysis, FMEA and ETA to evaluate the identified failures and propose preventive and corrective measures, during the implementation of the QSHE System, and for the most critical risks, the FMEA method was used, and recommendations were proposed.

After this step, the interpretation of the results and the conclusions were made.

3.6. Work Structure

This work is divided into 6 chapters, of which this chapter is an introduction where the objective is described and the subject under study is framed.

The first chapter – Introduction – of which this text is an integral part, presents the main aspects that motivated this work, the research question and the methodology followed.

The second chapter – Literature review – characterizes the framework and a historical approach to the reasons for the development of Occupational Health and Safety Quality Management Systems. It seeks to highlight aspects related to the application of ISO 90001:2015 and ISO 45001:2018 standards, and to identify strategies for implementing Integrated Quality Management Systems for Occupational Health and Safety.

The third chapter – Methodology – describes the method and techniques used to approach the case study, presents the tools and procedures for collecting and processing data for the study carried out.

The fourth chapter – Characterization of the organization under study – essentially centered on the management of activities related to QHSE, risk management and company involvement.

In the fifth chapter – Analysis and Discussion of the Data Obtained – the QHSE Diagnosis is carried out in accordance with the reference standards, and the results are analysed. as proposed a framework that can help the company to determine the level of performance in relation to the QHSE

This dissertation ends with the presentation of the final considerations, developed in the sixth chapter - Conclusions and recommendations based on the knowledge obtained.

4. IDENTIFICATION OF THE STUDY AREA

InSite, Lda, the company in which the internship was granted, is a private company, founded in Mozambique in 2010, initially under the brand Nutriconsult, whose objective was to support the implementation of international standards in the companies of the agro-food industry, allowing them to qualify as suppliers in the local and/or international market. However, as a result of the experience of its staff, the offer of services soon expanded to a wider range of organizations, with the company operating in sectors as diverse as the automotive industry, development industry, public administration, energy, logistics, construction, logistics, hotels, agricultural production, among others.

With the mission of helping organizations to find, develop and implement solutions that allow them to be more effective, efficient and, consequently, more competitive and sustainable in all markets, InSite currently provides Consulting, Auditing and Training services in the implementation of International management standards (ISO, FSSC, HACCP, BRC, Global GAP, among other references), in five specialized service units, namely:

- Quality and Sustainability
- Energy, Environment, Health and Safety at Work
- Emergency Response
- Nutrition and Food Security, and
- Forest and Agribusiness.

The study was carried out at the construction company, which, for reasons of confidentiality, was named Mysolute, which began in February 2021, the implementation of the Integrated Quality, Safety and Health Management System, based on the ISO 9001:2015 Quality and ISO 45001: 2018 Safety and Health Standards, through assistance provided by the company InSite, Lda.

4.1. Description of the Mysolute Company

The company Mysolute, client of InSite, Lda, is a private company, with financial autonomy, of a legal nature of a limited company and with Mozambican capital in the area of engineering. The company has offices in Maputo and in Tete Province.

Founded in 2015, the company has a human resources maintenance program based on policies that guarantee motivation, teamwork and continuous training for its employees. It is registered in the Single Registry of UFSA and has on its staff technicians with more than 10 years of experience in the field of engineering and skilled labor in various fields of civil construction and building maintenance, which include:

- Construction of civil works;
- Mine infrastructure;
- Maintenance and management of condominiums;
- Maintenance of green areas;
- Hydraulic works;
- Electrical works;
- Topography; and
- Industrial cleaning and maintenance.

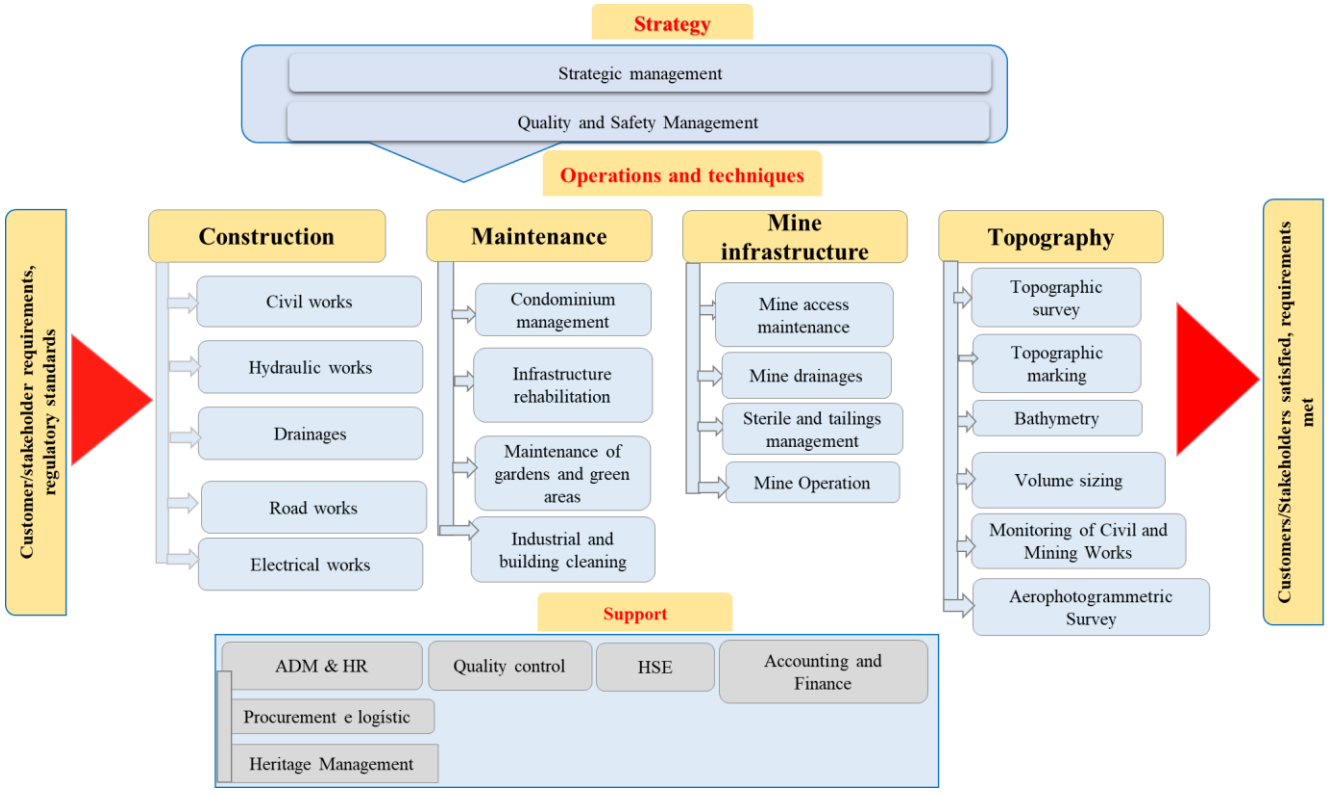

Figure 11. Mysolute Company Process Map.

4.2. Organizational Structure of the Mysolute Company

The structure is composed of a manager and employees from several areas, including QHSE, and professional categories such as engineers, administrators, supervisors, servants, assistants, drivers and mechanics, among others, as shown in the organizational chart below (fig.12).

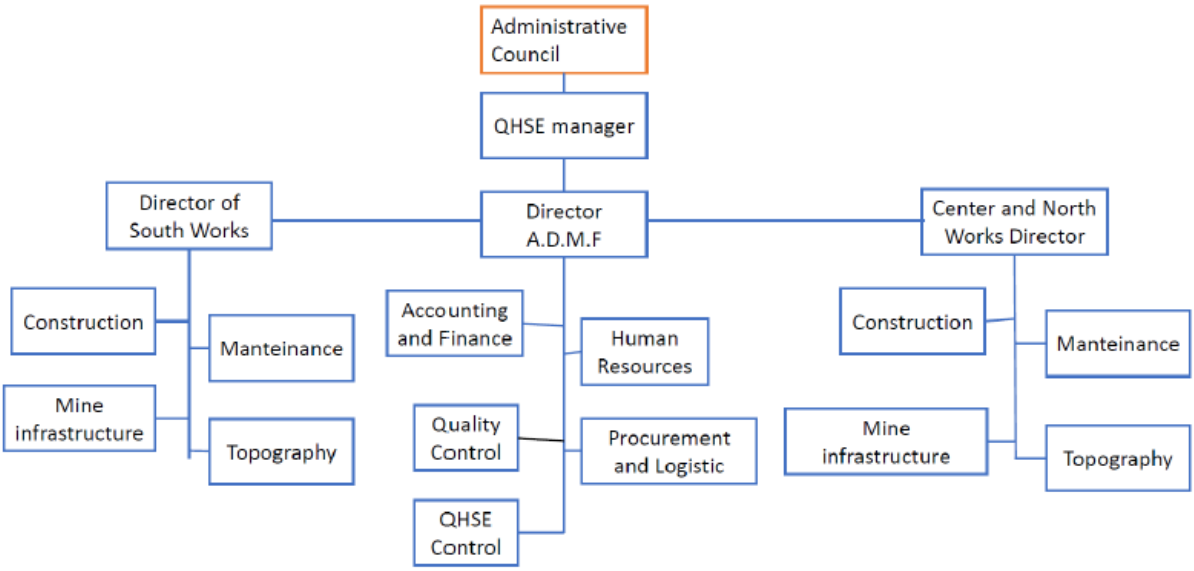

Figure 12. Organizational chart of the Mysolute Company.

4.3. Quality, Health and Safety Policy

The company follows the following code of conduct:

- Provide products and services that meet customer needs and expectations through continuous performance improvement;
- Respond promptly to customers and other partners, developing a relationship of mutual trust between all;
- Promote the development of skills of employees and other stakeholders in order to ensure that all services are performed by competent and responsible professionals;
- Ensure full compliance with legal, regulatory and internal requirements related to the Quality, Health and Safety Management System;
- Establish and periodically review the objectives and the Quality, Health and Safety Management system, in order to continuously improve its efficiency and stakeholder satisfaction;

- Communicate the Quality, Health and Safety Policy to stakeholders, so that consistent practices related to the Quality, Health and Safety Management System are understood and adopted; and
- Reinforce the risk prevention culture based on the identification of hazards and risk assessment, aiming at their elimination/minimization, with the availability of the necessary means.

4.4. Legal Framework of the Company Mysolute

The legislation applicable to the company in terms of QSHE is as follows:

- **Presidential Decree No. 8/95 of December 26, 1995,** which creates the Ministry of Public Works and Housing (MOPH), replacing the Ministry of Construction and Water, with the primary objective of promoting the construction sector.
- **Decree nº 2/2004, of 31 March,** which defines the Licensing Regime for Private Works, that is, those that are not carried out by the State, whether at a local, municipal or national level.
- **Ministerial Diploma No. 77/2015 of 22 May** (which revoked nº 83/2002 of 22 May), of the Public Works and Civil Construction Contractor Licensing Regulation,
- **Decree No. 94/2013 of 31 December** (which revoked Decree No. 38/2009, of 1 September), Regulation for the Exercise of Public Works and Civil Construction Contractor Activity.
- **Decree No. 62/2013, of December 4th,** Regulation establishing the Legal Regime for Accidents at Work and Occupational Illnesses.
- **Decree No. 48/1973 of 5 July** - Regulation on Hygiene and Safety in Industries. It is also general in nature and does not take into account the specifics of the construction area.
- **Legislative Diploma - 120/71 of 3 November, the** only specific legal diploma for the construction sector.
- **Decree nº 5/2016, of 8 March,** requires in paragraph 1 of article 160 that the Contractor submits Technical Safety and Health Regulation for Geological and Mining Activities (Decree 61/2006).
- **Labor Law No. 23/2007 of August 1,** and its Regulation (Decree 13/2015).
- Constitution of the Republic of Mozambique, 16 November 2004
- **Decree No. 18/2004, of 2 June,** Regulation of Environmental Quality Norms and Effluent Emissions.

- **The Environment Law 20/97, of 1 October,** defines the legal bases for the correct use and management of the environment and its components with a view to achieving a sustainable development system in the country.

Compliance with these laws and regulations, in addition to being an obligation of the company and its representatives, guarantees the best development of the company's activities.

5. PRESENTATION AND DISCUSSION OF RESULTS

5.1. Functional Analysis

In this study, for the application of the functional analysis method, the "Construction System" was selected. In the first phase, the environmental elements of the system for the operational phase were established. The environmental elements that are part of the system are: worker, physical space, residential house, energy source, raw material, environment, transport facilities, water, stakeholders and equipment (figure 13). Functional research is carried out by studying the connection between the product/system and its environmental elements.

The methodology presented, provides designers with the possibility of better meeting the wishes of customers, leading to the development of construction activity in accordance with the real needs of customers.

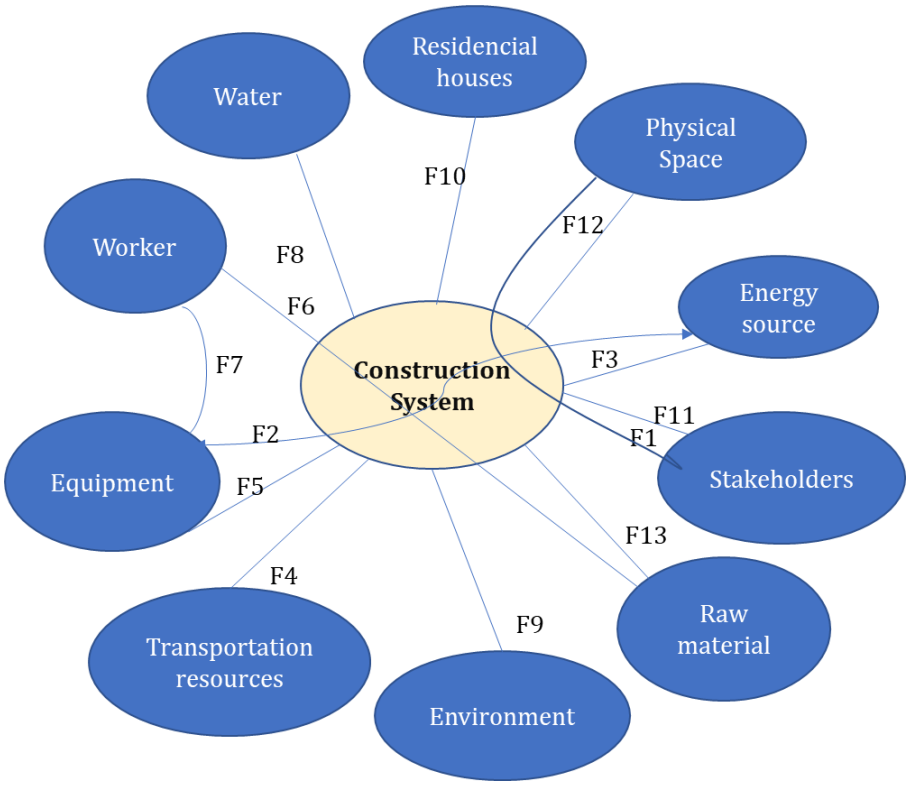

Figure 13. The elements and service functions of the "Building activity" system.

The product's service functions are shown in table 1. These functions are classified taking into account the two methods: The type of function: service and constraint; and the AFNOR standard proposed to

classify the functions in order of importance. The rating levels are as follows: indispensable, important, interesting and accessory.

Table 9. Building System Functions.

Nr.	Functions	classification methods	
		Function Type	**AFNOR**
F1	Allow the possibility to modify the physical space	Service	Indispensable
F2	Allow the physical space to be adapted for construction.	Service	Indispensable
F3	To allow the use of the equipment	Service	Indispensable
F4	To allow the transport of raw material	Service	Indispensable
F5	Allow using energy to modify space	Service	Indispensable
F6	To allow worker to use raw material	Service	Indispensable
F7	Allow worker to use transportation resources	Service	Indispensable
F8	to resist water	Service	Indispensable
F9	Resist the actions of the environment	Service	Indispensable
F10	Be prepared to avoid environmental problems in residential homes	Constraint	Important
F11	To be approved by interested parties	Constraint	Important
F12	To be adapted for the physical space	Constraint	Indispensable
F13	To be adapted to raw material	Constraint	Indispensable

The main function “allowing the worker the possibility of modifying the physical space” is located at the first level of the functional tree diagram. The functions located on the second level answer the question “how” the product can achieve the main function.

5.2. QHSEMS Diagnosis in Mysolute Company

The diagnosis of the QHSE management system carried out in the company consisted of the verification of existing requirements, and requirements that can be implemented in accordance with the normative references of ISO 9001:2015 and ISO 45001:2018.

In this way, a survey of the facts and observations that evidence the current situation of QSHE in the company was made, and suggestions were presented using, in part as a source of information, the guidelines that help in the form of implementation of a management system of the quality, safety, health and environment, established in the aforementioned standards (Table 10).

Table 10. Diagnosis of the current situation of the company Mysolute in relation to the implementation of the standards of Quality, Health, Safety and Environment.

Requirement	**Current situation**	**Suggestions / Observations**
4.2. QHSE Policy	The Mysolute company has a formalized and documented Quality Safety and Health Policy.	The policy must be understood by all company workers.
4.3. planning		
4.3.1. Identification of hazards, risk assessment and definition of controls	The design of the written methodology for the identification of hazards, risk assessment and determination of control measures is in progress, as well as the elaboration of work procedures.	Work procedures must be followed by employees, and promote the involvement of all.
4.3.2. Legal and other requirements	The company is aware of the rules/ legislation that govern QHSE in its sector, and seeks to comply with all requirements.	There is no systematized procedure for accessing and analyzing legislation and regulations. The consulting company must prepare a checklist in order to systematize the identification of all legal requirements that require compliance with legislation.
4.3.3. Objectives and program	There is a formalized QSHE policy, and the company has defined objectives arising from the policy.	Define a procedure for monitoring objectives and goals, and periodically monitor them.
4.4. Implementation and Operation		
4.4.1 Resources, roles, responsibilities, responsibility and authority	Top management tries to ensure the availability of essential resources for the proper functioning of QHSE.	Motivate middle managers and, consequently, operators on issues related to QHSE, including them in their daily routine.

	There is a person responsible for QHSE, but he is not highly qualified to exercise management.	Train the person responsible for QHSE in related matters.
4.4.2. Competence, training and awareness	The company keeps records associated with training actions in the Human Resources section.	Adapt existing procedures in the QHSE Management System to identify training needs and assess the effectiveness of training.
4.4.3. Communication, participation and consultation	Communication with workers is carried out through a board, where relevant information is posted. Whenever possible, it is carried out directly. The participation of employees in the identification of risks and description of situations of exposure to them is carried out through consultation with workers.	Improve communication, using other alternatives in order to pass information efficiently to all employees. Periodic meetings may be promoted in order to assess the problems in the different work sectors.
4.4.4. Documentation	The company does not have a QHSEMS already implemented, however, there are some documents and records that are essential for the proper functioning of the organization.	Prepare the minimum documentation necessary to implement a QHSE (Safety Manual, procedures. Plans, among others)
4.4.5. Document control	There are scattered documents, without the issue criterion.	Develop a document management procedure.
4.4.6. operational control	Activities are carried out where risks can be minimized, if supported by procedures and records. There are technical documents, product safety data sheets in the workplace There are procedures/practices for preventive maintenance of equipment.	Elaboration of additional Procedures identifying operations and activities that are associated with identified hazards and necessary measures. The company Mysolute must in the QHSE management system, adding control measures for activities, with equipment, with visitors, with services, to improve the performance of the implementation of the QHSE.
4.4.7. Emergency preparedness and response	There is an up-to-date Internal Emergency Plan available to all office users. Emergency exits and escape routes are properly signposted and identified. In terms of emergency response equipment, the company has fire extinguishers, a first aid kit, a fire detection system, emergency	Carry out training/ simulacrum periodically. Implement Self-protection Measures

	lighting, evacuation routes and exits, signage, and a meeting point.	
4.5. Verification		
4.5.1. Monitoring and measuring performance	There is a need for the company to systematize all the necessary indicators to periodically monitor and measure QHSE performance.	Implement some target indicators to measure the level of performance and comply with the proposed policy. Cultivate a "culture" of QHSE.
4.5.2. Conformity assessment.	The company is concerned with complying with current legislation and other requirements, but it is not systematized.	Implement a procedure for the systematic assessment of compliance with applicable legal requirements.
4.5.3. Investigation of incidents, non-conformities, corrective and preventive actions	There is no accident record, and no analysis of accidents is carried out, as no accidents have occurred in the company. The consulting company is working on the elaboration of a form to be used in the QHSEMS, for Non-Conformity, Corrective and/or Preventive Actions that can be applied in the company.	Define procedures.
4.5.4. Control of records	Lack of accident records, medical records, training records, maintenance records, and inspection records of first aid boxes.	Develop a procedure for the identification and control of QHSE records.
4.5.5. Internal Audit	Internal audits are carried out as part of the assessment of QHSE implementation at work stations.	Develop an internal procedure with the definition of the audit plan and main responsibilities for carrying it out.

5.3. Risk identification

To carry out this step, and in response to requirement 6.1 of the ISO 9001:2015 and ISO 45001:2018 standards, which states that the organization must determine the risks and opportunities that must be addressed to ensure that the QHSE can achieve the intended results, proceeded to identify the risks associated with the various QHSE processes and the given organizational context.

The risks to which the company's workers are exposed are varied. The survey of dangerous situations was carried out using the information provided by the company, on the activities carried out in the different processes and equipment involved, except in the Maputo office, where it was possible to survey the risks, based on the detailed observation of the facilities, equipment, products used and stored

and working methods. The main objective of the QSHE diagnosis was to present a survey of the hazards, for later application of corrective measures.

Table 11. General list of hazards identified in the company Mysolute in Maputo office, and recommended measures.

Risk factor	Company situation	Proposals
Lighting	Based on the direct observation carried out, the lighting levels prove to be sufficient for the office environment, with additional lamps for each existing table. The office does not provide adequate natural light, as it merely depends on artificial light.	The company must proceed with the measurement of illuminance, in order to comply with the lighting levels recommended in the specific legislation.
Noise	There is no source of noise in the office that could pose a risk to workers.	Carry out regular inspections of the equipment, and keep it in good working order.
Thermal Environment	The office provides a cooler temperature, due to its location in the basement of a building, however, air circulation is limited due to small windows, and there are fans in case of need.	Allocate a ventilation system that promotes sufficient air renewal.
Chemical Contamination	It was determined the existence of organic compounds that are part of the detergents used for cleaning in the company.	Use of personal protective equipment (PPE) during the use of chemical products.
Dust	The office is subject to dust, and its concentration is not an alarming factor.	Carrying out frequent cleanings.
Bacterial and fungal contamination	The existing bathroom in the company, being a place where workers use for their biological needs, is a favorable place for the proliferation of bacteria and fungi.	Clean the bathroom properly and frequently.
Ergonomic factors	Office workers perform most of their activities in a sitting position. However, the height of the office ceiling is very low, which can make it difficult for workers to stay in the raised position, especially for people over 1.7m tall.	Carry out a study of the elements that may affect the position and posture of the worker and, consequently, their comfort and efficiency.
Movement of loads	Workers are subject to manual handling of loads. However, they do not always perform activities with appropriate postures and movements;	Develop procedures for moving loads.
Fire	As a source of fires, flammable chemicals used for cleaning can be found in the company. An automatic system was installed in the company of fire detection, which allows triggering an alarm signal, which makes it possible to take the necessary measures to extinguish the fire; the office also has fire extinguishers and a first aid kit.	Place fire extinguishers and first aid kits in an easily accessible location and train workers in their use.

5.4. SWOT Analysis

Through this tool, internal issues (strengths and weaknesses) and external issues (threats and opportunities) that currently affect, or may affect, an organization's ability to achieve the intended results based on the implementation of a QHSE system were identified. Thus, the result obtained is shown in Table 12.

Table 12. SWOT analysis for the implementation of the QSHE Management System.

Forces	**Weaknesses**
Employee satisfaction and motivation; Promotion and guarantee of a safe and healthy work environment; Improvement of the company's image and internal and external relationship with stakeholders. Reduction of costs with indemnities, insurance premiums, losses from accidents and lost workdays; Dynamics of improvement, through independent assessment carried out by external auditors; Existence of a Quality Safety Health and Environment policy in the company. Increased productivity.	The standards refer to the concept of "continuous improvement", but do not define promotion criteria to measure QSHE performance. The need for documentation, methodologies and procedures can be seen as a bureaucracy of management processes; Need to allocate financial, material and human resources, which represents an additional cost; Time spent preparing documentation. Lack of specialized training on the part of those who implement the QHSE. The organization's current status in relation to QHSE; Small company. Complexity and greater dimension of the risks associated with the company's activities, Diversity of the organization's products and services; Lack of specialized technical training in the area; Company with weak online prominence; Lack of information systems integration
Opportunities	**Threats**
Greater discipline and coordination of efforts for effective QSHE management. Investment in new technologies and/or equipment, bet on generalized preventive measures and changes to the management system;	The need for the participation of all employees so as not to compromise the proper functioning of the system; Financial and human costs, which cause uncertainties associated with QSHE implementation. High risk of "copy-catch", especially by competitors;

Responsiveness and appreciation on the part of legal entities; Fulfillment of the necessary requirements to enter new markets and internationalization. Added value obtained through external audits. Creation of a culture of prevention and safety.	Market pressure to reduce margins due to increased competition; Instability in terms of purchase prices for equipment and machinery; Little known company;

Attention goes to weaknesses and threats, where possible causes and effects will be determined by the FMEA Method, and recommendations will be proposed in order to mitigate the failures.

5.5. Action Plan for the Implementation of QHSEMS

The implementation of a QHSEMS can be divided into 7 stages, and there may be intersections between activities inserted in different stages (table 13).

The numbering of the stages presented here represents the temporal order of their development, however, this ordering is not rigid, and there may be activities inserted in different stages that, for reasons of efficiency, can and should occur simultaneously.

For the system to work, the involvement of all employees is essential. Awareness/training actions must disclose the policy and objectives that are intended to be achieved and clearly explain what is expected of each one's contribution to the success of the system, collecting ideas, suggestions, retaining situations and occurrences that indicate the need for actions corrective actions, immediate action or preventive action. It is important to emphasize that any employee can propose improvements to the system, but that all changes must be properly studied and approved.

The organization's manager and the QSHE management representative are responsible for the effectiveness of the system.

The management representative is responsible for ensuring that the processes of the quality, safety, health and environment, are implemented and maintained, as well as reporting to the top management the system's performance, the minutes of critical analysis and the indicators, including improvements and promoting awareness of the importance of quality, health and safety for all members of the organization.

All employees are involved in the management system where they are responsible for the QHSE of the tasks they perform. For this, the company must provide training or other actions to satisfy

competencies such as education, skill, experience, etc. Staff are also made aware of the importance of their activities and how employees contribute to achieving quality, safety and health objectives.

Another action carried out by the company is the performance of external audits, which ascertain whether the QSHE complies with the foreseen provisions, whether it is implemented and maintained effectively. This audit is carried out by a person independent of the person who has direct responsibility for the activity being audited (Marques, 2006).

Table 13. Summary of the QHSEMS implementation action plan.

Stage	**Description**	**Activities**	**Expected results**	**Responsible**
1	Coordination and awareness	• Introductions • Disclosures • Meetings • Short duration curses • Incentives • Set the minimum structure	**Membership** (participation Attitude, suggestions)	• Responsible for QSHE management • Managers • Consultants
2	Diagnosis of the current situation (internal and external)	• Meetings • Comments • Questionnaires • Interview • To analyze	**Report** Reports Information Special situations Indications Conditions	• Responsible for QSHE • Management • Consultants
3	Strategic planning	• Assign responsibilities • Define indicators • Resource application • Draw up a schedule • Meetings • Trainings	**Action plan** Definitions for: what? Because? When? Who? Where? As? and how much?	• Responsible for QSHE management • Managers • Consultants
4	Process design (mapping and standardization)	• Define processes • Identify hierarchies • Formalize and apply the PDCA cycle • Organize a network of interactions • Flowcharts/ diagrams • Establish standardization (system and technicians) • Assessments	**Documents** Manuals Procedures Specifications Designs Work instructions	• Responsible for QSHE management • Managers • Consultants • Directors • Responsible for the Departments

		• Approvals • Training		
5	Systematic management of processes	Application of the requirements of ISO 9001:2015 and ISO 45001: 2018 • Documentation • Management responsibility • Resource management • Service performance • Training and improvement	**Improvement** Greater efficiency Greater efficiency Greater security Higher performance And lower cost	• Manager • Consultants • Employees
6	Evaluation and support	• Interviews • Measurement • Analysis • Revision • Training	**Evaluation** Report Positive aspects Nonconformities Readjustments	Controller
7	QSHE management and system maintenance	• Improvement as a routine • Total involvement (all) • Motivation • Management by policies/processes • Training • Individual improvement • Meetings	**Continuous improvement** Global culture QSHE as a decision parameter Customer satisfaction Health and safety environment	• Managers • Workers

5.7. Failure Mode and Effect Analysis (FMEA)

The FMEA was used in this study to identify the possible failures that may occur during the implementation of the QHSE Management System in the Mysolute Company, evaluate their causes and effects on the system, and provide a solution to eliminate or reduce the probability of occurrence and the severity of its effect. This was the tool chosen for the simple way in which it outlines the entire process, and for allowing easy monitoring and risk management.

Table 14. Modal Analysis of Potential Failures and Effects for Analysis of Weaknesses and Threats identified in the SWOT analysis.

Item	Fail mode	Causes of failure	Failure effects	S	O	D	RPN	Recommendations
Documentation	Non-compliance with Legislation/ Regulation/ Procedures;	Too much bureaucracy.	Difficulties in starting new projects; Difficulties in entering certain markets. Resistance to change;	9	3	2	54	- Document management;
Financial, material and human resources	Lack of financial, material and human resources	lack of investment	Difficulties for implementing the QHSEMS.	7	3	2	42	To affect investment in financial, material and human resources;
Training	Lack of specialized training	The necessary skills to perform the function were not determined; A survey of real training needs was not carried out;	Problems in the performance of functions	9	4	2	72	Creation of a competence matrix; Performance evaluation; Determine the skills needed to perform the role;
Organization's products or services;	"Copy-catch" by competitors	Competitive market	Equal products or services with lower costs that compete with the Company. Decrease in company profit	7	3	2	35	Market analysis.
Information systems	Lack of information systems integration	Excessive documents/bureaucracy	Scattered information; Information loss;	5	5	2	50	Document management

Company dimension	Little known company. Small organization;	Lack of marketing/dissemination strategy; Poor online prominence; Lack of a prominent factor in the products;	Large investment to recognize products/services;	7	3	2	42	Disclosure of the company's services/products through Social Networks; Adoption of a company marketing strategy; Participation in national and international fairs.
Price instability	Difficulty in determining the real cost of products.	Fluctuation in the price of raw materials and equipment.	Operating costs higher than expected.	7	3	2	35	Regular control of billing indicators. Regular control of financial indicators; Price negotiation with suppliers.

Despite being potential critical failures, most of the threats and weaknesses identified (Table 14), after the application of the RPN index, are within the acceptable level, requiring only monitoring. Only two threats represent any medium risk, due to their high severity, requiring the application of medium term actions to reduce the risk as low as possible.

Table 15. Modal Analysis of Failures and Potential Effects for the QSSMA System management and maintenance process.

Item	Fail mode	Causes of failure	Failure effects	S	O	D	RPN	Recommendations
Definition of goals	Definition of objectives not adjusted to the company's reality	Lack of critical analysis of the company's strategy	It does not allow to demonstrate the continuous improvement of the QHSEMS.	7	3	2	42	Management and Maintenance
Document management	Failure to control documents and computer storage records / Update of legal and regulatory requirements	Computer system failure.	No access to documents and records, loss of information.	9	3	2	54	Document management;
Audits	Internal audit ineffectiveness	Insufficient time to carry out the audit; Lack of competence of auditors; Auditors with conflicts of interest;	Disproportion between the severity of the NCs detected in the Internal Audits and in the audits of the certifying and accrediting entities.	5	2	2	20	Audit Program; Audit Plan. Human Resources Management Process.
	Lack of impartiality of the audit team	The selected audit team is not independent of the activity/process to be audited; Auditors with conflicts of interest;	Lack of detection and correction of deficiencies in the activity/process; No continuous QHSE improvement.	6	3	2	36	Internal audits;

Process Performance Analysis	inappropriate indicator	Indicator was not defined with a clear and specific objective	The indicator does not reflect the performance of the process	7	3	2	42	Monitoring Objectives and Process Performance;
Determining Risks and Opportunities (including context, processes, etc.)	Failure to identify risks and opportunities.	Failure to determine the factors that may cause the QHSEMS to deviate from the established results.	QHSEMS does not achieve the intended results; Failure to define actions to minimize negative effects and maximize opportunities.	5	4	2	40	Management and Maintenance of the QHSEMS
Treatment of Nonconformities / corrective and preventive actions	Corrective/preventive actions are not effective.	The root cause of the problem has not been determined. The implemented actions are not adequate to solve the problem;	Recurrence of non-conformities	7	4	3	84	Always implement corrective actions to address the root cause of the problem and assess its effectiveness. If possible, implement changes to the QHSEMS.
Operationally and continuous improvement of the QMSS.	Insufficient resources (human and material)	The analysis/identification of the necessary resources for the functioning/improvement of the SG was not carried out.	Non-compliance with the QHSEMS.	7	3	2	42	Needs assessment; Planning and improvement;

The failures identified in the QSSMA management system process (table 15) are mostly serious due to the negative effects they have on QHSE. Despite this, they can be easily detected by implementing control measures. However, these are failures with a low probability of occurrence.

5.8. Event Tree Analysis (ETA)

Following the workflow of a typical preventive risk assessment (PRA), an event tree was constructed to identify fire scenarios in the Mysolute company office, located in Maputo, for which their consequences can be estimated.

The probabilities used for this evaluation (1.0E-03/year) are based on subjective probabilities, assigned by the author after consulting the literature. Each node in the event tree (except the initial event) corresponds to a conditional probability of some outcome if the previous event occurred. Thus, the probabilities associated with each member must sum to 1.0 for each node. The frequency of each outcome may be determined by multiplying the initiating event frequency with the conditional probabilities along the path leading to that outcome.

The event tree was built using the security measures available in the office and considering the results of its failure or correct functioning (figure 14). The security measures considered are:

1) Early detection by occupants,

2) Early suppression of fire by occupants,

3) Fire hydrants (ie it does not produce flaming combustion and is considered controlled)

4) Activation of the heat/smoke detector, and

5) Immediate evacuation.

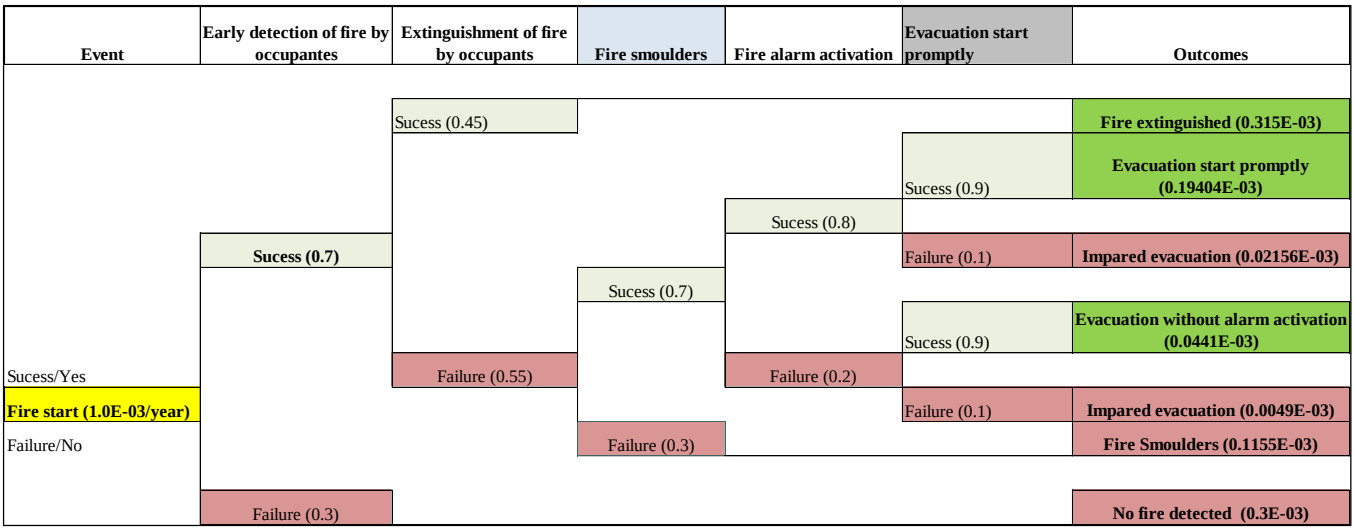

Figure 14. Event analysis tree for the office fire scenario.

Demonstrating adequate building performance through a preventive risk assessment (PRA) requires making assumptions about the specific occupancy, the specific behavior of occupants during a fire, the response of safety measures in place, the intervention of the firefighters and the fire itself. Some of them can be accurately described, but others cannot.

There may be significant sources of uncertainty for carrying out the preventive risk assessment, which are not easily conveyed in its output and which require clear communication between analysts and stakeholders. Due to limitations on both parties (such as biases), this communication may not always lead to a clear understanding of the output.

5.9. Functional Tree for the Integrated QHSE-CMM System

The functional tree gives the possibility to represent a product through the functional view, which is an alternative to the more common physical view. The functional and physical views are complementary and not opposing views. In fact, from the functional point of view, we look at a new product asking ourselves “what does it do?”, while from the physical point of view we look at a new product asking ourselves “what is this?”, which is undoubtedly the most immediate question we have, arises in our mind when we look at something that is unknown (Viola et al. 2012).

Both views are valid, as they are fundamental approaches to analyzing complex systems, subdivided into parts, characterized by a low or high level of detail, depending on the need for rigor and/or the level of analysis itself.

For this study, the functional tree of the QHSE-CMM integration system was applied (figure 15), which made it possible to divide the higher-level functions, which derive from the objectives/ mission requirements of the higher-level system, into lower-level functions and, eventually, allowed identify the basic functions (technical solutions) that must be performed to achieve the system's objective.

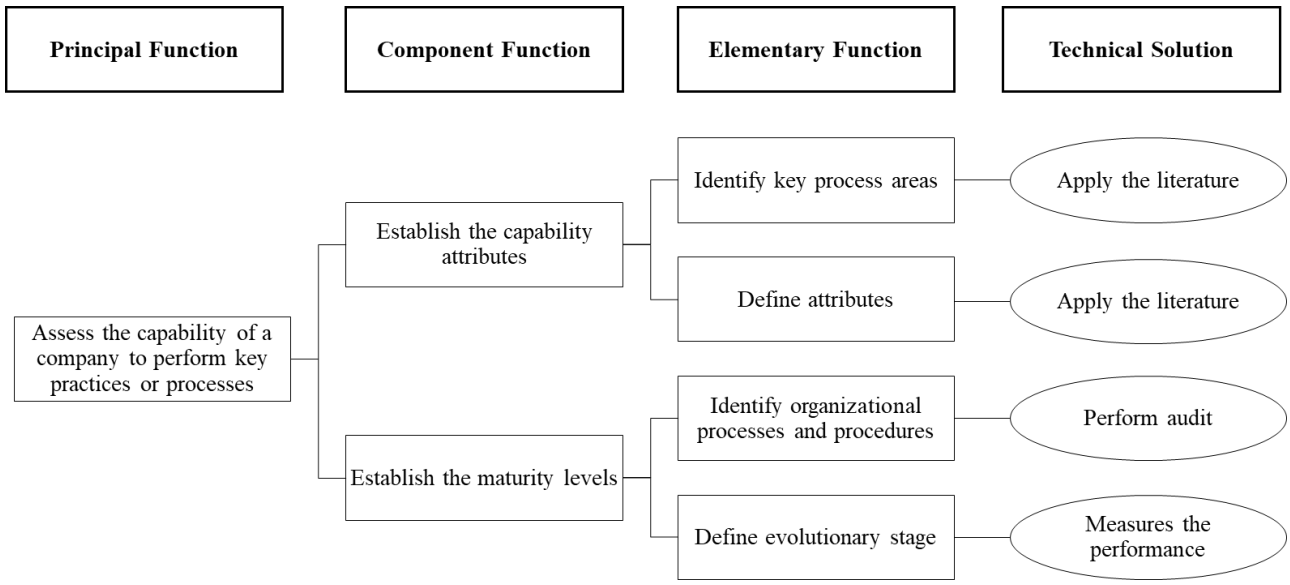

Figure 15. Functional tree for the QHSE-CMM System.

5.10. Structure of the Integrated Model

The maturity model consists of five capability levels and the 20 capability attributes. Capability maturity levels are allocated against attributes, thus creating a series of cells. Each cell contains a short text description for each activity at each capability maturity level. Table 16 illustrates excerpts from the CMM developed, where the maturity level of the QHSEMS implementation in the Mysolute Company was determined, based on the information defined in Annex 1.

Table 16. Framework structure proposal (QHSE-CMM).

QHSE management capability attributes	**Maturity and ability levels**				
	Level 1	***Level 2***	***Level 3***	***Level 4***	***level 5***
Senior Management Commitment			x		
QHSE Policy				x	
QHSE goals and targets			x		
QHSE management program		x			
Risk management		x			
Outsourced personnel management			x		
QHSE operational control		x			
Emergency preparedness and response		x			
QHSE performance monitoring and measurement		x			
Incident investigations	x				
QHSE system audits				x	
Roles and Responsibilities for QHSE			x		
QHSE training			x		
Employee involvement			x		
QHSE Competency	x				
Physical resources			x		
Financial resources			x		
Communication			x		
QHSE documentation and control		x			
Lessons learned and knowledge management	x				

MMs are mainly used for three purposes, namely:

(1) Assessment of strengths and weaknesses (“as-is” assessments) as a descriptive tool;

(2) Development of a roadmap for incremental improvement (“to-be” maturity) as a prescriptive tool; and

(3) For evaluating a company against standards and best practices of other organizations as a comparison tool.

MMs provide guidance for action plans and allow organizations to systematically assess their ability to best manage their business processes and continually monitor their progress.

In practice, MMs are often used to determine current quality in a given area through self-assessments. Based on the assessed level, recommendations for improvement are made and actions are also taken.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

The integration of Quality, Health, Safety and Environment management systems, together with the maturity and capacity model adopted in this study, proved to be one of the most important strategies for the company to ensure survival and savings (time, cost and resources) in today's competitive and strictly regulated business environment.

The adoption of an integrated quality management system, safety, health and environment, based on the ISO 9001:2015 and ISO 45001:2018 standards, in a single system, based on the PDCA cycle, has become more viable, as it avoids the duplication of tasks of management and allows an organization to effectively share information resources and infrastructure, human, material and financial, and also provides important guidelines for the company, and strengthens its positioning in the international market and recognition by other companies, especially for meeting the requirements of stakeholders .

The company's concerns for the safety of its workers are clear, there are already numerous measures implemented, such as the mandatory participation in emergency response drills for all those working inside the premises, mandatory use of PPE's, installation of safety signs in all workplaces, allocation of fire extinguishers, first aid kit, etc.

The capability and maturity model, developed in a continuous format, provides Mysolute's senior management and supervisors with a holistic perspective of QHSE maturity and management capability and allows the company to prioritize its investments and direct efforts to address any identified areas of deficient capacity to ensure continuous improvement.

In the organizational context, based on internal and external issues determined through the SWOT analysis, weaknesses and threats were identified. And by applying the FMEA method, it was possible to identify the most critical risks and define mitigation measures for the scenario under study.

The SWOT analysis proves to be a more appropriate tool in strategic planning to identify the organizational context, as it encompasses an internal and external analysis of the organization and allows the identification of key elements for the management of the company, allowing the establishment of priorities for action.

The application of the FMEA makes the risk identification process structured and easy to visualize, allowing the identification of the most critical activities and the definition of actions to mitigate the effects of the potential failures identified.

Functional Analysis proved to be one of the fundamental tools for the development of a new product, as it guarantees an analysis of requirements, and allows the identification of the physical components of the future product and their relationships, bringing innovative ideas.

The great diversity of processes existing in the company, with different activities and services, and even with diversity of personnel, can lead to some difficulties in the implementation and homogenization of the QHSE.

The Mysolute Company started the implementation and certification of the IMS based on the ISO 9001:2015 and ISO 45001:2018 standards, in February 2021, and it can be seen that it is still in the process of improvement, however the same it will only guarantee better results as time progresses. The practices of several requirements are already evident, but they are not carried out in a systematic way based on defined methodologies and written in the form of procedures. This continuous improvement is justified by the need that companies have to excel in their procedures and processes in order to reach the desired parameters.

In order to guarantee the continuous safety of all workers, it is necessary to carry out a survey of hazards and a risk assessment periodically, controlling the risks that are not eliminated and analyzing new situations that may arise from new practices and/or changes introduced in the company. Due to its importance, and this being a key practice for the prevention of accidents in an organization, this must also be a measure that the company must adopt imperatively.

Integration, in addition to maximizing the effectiveness of the Management Systems, also contributes to an increase in efficiency, minimizing the costs of their implementation and maintenance, as it allows greater rationalization of resources, avoids the multiplication of documents, reduces the time spent on internal audits and external and also certification costs, as the certification costs of an integrated system are lower, due to the simultaneous audits of the system. Together, the management systems influence the degree of satisfaction of all the organizations' *stakeholders.*

On the other hand, integration may entail some risks, when not properly prevented, namely, the problem of contagion of an undesirable situation of one of the systems affecting the other system, which can lead to an increase in the complexity of documents and a greater distance from the manager of the system from the technical aspects of it.

The maturity and capabilities model is designed not to be an audit tool as such, but to take each standard and look at how it is implemented and what happens in practice. To this end, a set of self-assessment questions has been developed that allow companies to determine their level of maturity and, from

there, determine the areas that need improvement and then draw up a specific action plan to help them move up of level.

Implementing Safety Management Systems in the construction industry is a way to minimize safety risks, reduce injuries and deaths, eliminate costs associated with poor safety performance and protect the organization's reputation.

The Maturity Model and SWOT Analysis method have a similarity with regard to the determination of weaknesses and strengths, however the Maturity Model proved to be more complete in allowing the assessment of strengths and weaknesses, through comparison with the standards and best practices from other organizations.

6.2. Recommendations for Mysolute Company

Based on the findings verified during the study, for future research it is recommended:

1. The development of a digital program that integrates the Quality, Health, Safety and Environment management systems, with the Maturity and Capacity Model, for ease of use and accessibility.
2. As the application of the FMEA is a continuous process and constant revisions, it will be important to carry out constant revisions in order to guarantee the implementation of the defined actions within the stipulated deadlines and the identification of new risks and opportunities that influence the organizational objectives.
3. The Mysolute Company must continuously invest in Quality, Health, Safety and Environment training, as a way of improving the safety culture of the company's workers, and consequently the QHSE results.

REFERENCES

ABNT. (2018). ISO 45001 Sistema de Gestão de Saúde e Segurança Ocupacional. ISBN.

Brahmachary, T. K., Ahmed, S., Mia, & Shahed, M. (2018). Health, Safety and Quality Management Practices in Construction Sector: A Case Study. Journal of System and Management Sciences, 8, 47-64.

BSI, G. (2011). BS OHSAS 18001 Occupational Health and Safety Management It's your duty. In A. S. Building, BS OHSAS 18001 - Occupational Health and Safety Management. 1066 JR Amsterdam: BS OHSAS 18001 - Occupational Health and Safety Management.al.

Calado, J. M. (2014). Estratégia de Implementação do Sistema de Gestão da Segurança e Saúde do Trabalho. Estudo de caso na MJO S.A. Instituto Politécnico de Setúbal, Escola Superior de Ciências Empresariais, Setúbal.

Carvalho, K., Picchi, F., Camarini, G., & Chamon, a. E. (2015). Benefits in the Implementation of Safety, Health, Environmental and Quality Integrated System. IACSIT International Journal of Engineering and Technology, 7, 333-338.

CEN, C. E. (2015). Sistemas de Gestão da Qualidade. Requisitos (ISO 9001:2015). Bruxelas: Instituto Português da Qualidade. Retrieved from www.iso.org/directives

Costa, S. d. (2017). Avaliação e gestão do risco na perspetiva da norma ISO 9001:2015. Universidade do Minho, Escola de Engenharia.

Foster, P., & Hoult, a. S. (2013). The Safety Journey: Using a Safety Maturity Model for Safety Planning and Assurance in the UK Coal Mining Industry. Minerals, 59-72. Retrieved from www.mdpi.com/journal/minerals

Gomez, J. E. (2021). Risk Assessment based on Maximum Allowable Damage. The University of Queensland, School of Civil Engineering.

Grimvall, G., Holmgren, Å. J., Jacobsson, P., & Thedéen, a. T. (2010). Risks in Technological Systems. In H. Pham, Springer Series in Reliability Engineering. Stockholm, Sweden: Springer-Verlag London Limited.

Hafizzudin Muzaimi, B. C. (2017). Integrated management system: The integration of ISO 9001, ISO 14001, OHSAS 18001 and ISO 31000. AIP Conference Proceedings.

Ilie, N., Anghel, D. C., & Ilie, a. S. (2011). Aspects on applying of functional analysis method to products design and its relationships with other various design methods. Annals of the Oradea University. Fascicle of Management and Technological Engineering. X (XX), pp. 5.134-5.141. Retrieved from https://www.researchgate.net/publication/259974936

Kissiedu, M. A. (2019). Development of an integrated safety, health and environmental management capability maturity model (SHEM-CMM) for ghanaian construction companies. University of the West of England, Faculty of Environment and Technology, Bristol.

Mahmoudi, S., Ghasemi, F., Mohammadfam, I., & Soleimani, a. E. (2014). Framework for Continuous Assessment and Improvement of Occupational Health and Safety Issues in Construction Companies. Safety and Health at Work, 125-130.

Manu, P., Poghosyan, A., Mahamadu, A.-M., Mahdjoubi, L., Gibb, A., Behm, M., & Akinade, a. O. (2018). Development of a design for occupational safety and health capability maturity model. In ISBN, Joint CIB W099 and TG59 International Safety, Health, and People in Construction Conference. Coping with the Complexity of Safety, Health, and Wellbeing in Construction (pp. 93-102). Salvador-Brazil: Marketing Aumentado.

Marques, A. P. (2006). Proposta de um Programa de Gestão de Qualidade para uma Empresa Genérica de Posicionamento com GPS. Universidade de São Paulo, Escola de Engenharia de São Carlos, São Carlos. Retrieved from https://www.semanticscholar.org/paper/Proposta-de-um-programa-de-gest%C3%A3o-de-qualidade-para-Marques/6a8dc4ee2ccab3564ff9c6c7cc4751a01200c91c

Muzaimi, H., Chew, B. C., & Hamid, a. S. (2017). Integrated Management System: The Integration of ISO 9001, ISO 14001, OHSAS 18001 and ISO 31000. Engineering International Conference (EIC) 2016. City Campus, Jalan Hang Tuah, 75300 Melaka, Malaysia: AIP Publishing. Retrieved from https://doi.org/10.1063/1.4976898

Peinado, H. S. (2019). Segurança e Saúde do Trabalho na Industria de Construçao Civil (ISBN –978-85-5953-048- ed.). (E. Scienza, Ed.) São Carlos. Retrieved from DOI– http://dx.doi.org/10.26626/978-85-5953-048-3.2019B0001

Quaigrain, R. A., & Issa, a. M. (2015). A model to evaluate the maturity of construction organizations' disability management practices. 5th International/11th Construction Specialty Conference, (pp. 123.1-123.10). Vancouver, British Columbia.

Schüller, J., Brinkman, J., Gestel, P. V., & Otterloo, R. v. (1997). Methods for determining and processing probabilities. In J. Schüller, Red book. Hague, Netherlands: Committee for Prevention of Disasters.

Tavares, C. L. (2019). Sistemas Integrados de Gestão da Qualidade, Ambiente e Segurança e Saúde no Trabalho (SIGQASST) – Contributo para a Sustentabilidade Empresarial. ISEL-Instituto Superior de Engenharia de Lisboa, Área Departamental de Engenharia Química. Lisboa: ISEL.

Vazdani, S., Sabzghabaei, G., Dashti, S., Cheraghi, M., Alizadeh, R., & Hemmati, a. A. (2017). FMEA Techniques used in environmental risk assessment. Environment & Ecosystem Science (EES), 16-18. Retrieved from https://doi.org/10.26480/ees.02.2017.16.18

Viola, N., Corpino, S., Fioriti, M., & Stesina., a. F. (2012). Functional Analysis in Systems Engineering: Methodology and Applications. In P. B. Cogan, & I. 978-953-51-0322-6 (Ed.), Systems Engineering–Practice and Theory. Italy: InTech. Retrieved from http://www.intechopen.com/books/systemsengineering-practice-and-theory/functional-analysis-in-systems-engineering-methodology-and-applications

ANNEX

Annex I. Example of a maturity model for an integrated safety, health and environment management capability, adapted from **(Kissiedu, 2019)**

QHSE Capacity Attributes	Maturity model and management capacity integrated with quality, safety, health and environment (QHSE -CMM)				
	Level 1	**Level 2**	**Level 3**	**Level 4**	**level 5**
High Administration Commitment	Lack of senior management commitment to QSHE management. There is no commitment of resources (financial and human) to issues related to QSHE.	Limited commitment from the company's senior management to QSHE implementation. Limited resource commitment for QSHE related issues.	Partial commitment of the company's senior management to the implementation of QSHE. Demonstration of senior management commitment is reactive (eg, when significant risks are anticipated or response to a major environmental impact). An ad hoc implementation committee is established. The QSHE champion is identified. There is a commitment of resources for QSHE-related issues.	Firm commitment from the company's senior management to the implementation of QSHE. Senior management's commitment is in line with the company's policy on integrated QSHE management. Senior management is among the QSHE champions within the organization. Management commitment is well articulated throughout the company Commitment of sufficient resources for QSHE related issues.	There is a total, unwavering and clearly visible commitment from the top management of the company to the implementation of QSHE. Senior management continually and visibly demonstrates their commitment to QSHE and demonstrates shared values aimed at the continued achievement of QSHE objectives safely. A cross-functional QSHE implementation committee is established, including QSHE advocates and members from all key management roles in the company. There is a limited resource commitment for QSHE implementation and maintenance. The company's senior manager(s) are among the champions of QSHE management within the industry and are recognized as industry thought leaders regarding QSHE management.
QHSE Policy	No policy statement on integrated QSHE management.	The QSHE policy statement is outdated and loosely worded. Managed, tracked and reported. The policy meets most legal requirements with some employees actively involved in its development. The policy is communicated at different levels of the company, but management	The QSHE policy statement is clear, setting out the intent(s) for how QSHE is managed, tracked, and reported. The policy meets most legal requirements with some employees actively involved in its development. The policy is communicated at different levels of the company, but management or supervisors and employees have inconsistent	The QSHE policy is clear, comprehensive and well defined, setting out the intent in QSHE. The QSHE policy presents a clear approach to managing QSHE, including the responsibility and accountability required for managing QSHE. The QSHE policy meets all legal requirements and other requirements to which the company subscribes.	There is a clear policy on QSHE management, setting out intent(s) in QSHE management and recognizing that QSHE implementation is not a separate task, but an integral part of the organization's QSHE activities. All relevant people are involved in shaping QSHE policies as well as formulating QSHE strategies, with clear actions, responsibilities and goals.

		or supervisors and employees have inconsistent interpretations and applications of the policy. Policy statements are poorly documented and not displayed in the workplace.	interpretations and applications of the policy. Policy statements are poorly documented and not displayed in the workplace.	Most relevant employees are actively involved in QSHE policy formation and strategy formulation. The QSHE policy is actively communicated within the company and to other stakeholders. The policy is accepted, understood and consistently interpreted and applied in the same way by all managers or supervisors and employees. The QSHE policy is formally documented, displayed in the workplace and available to all interested parties.	The documented policy is in place, consistent with the policies of other top performing organizations, communicated and readily available to all interested parties. The QSHE policy is periodically reviewed to ensure it remains relevant to the company, reflects industry best practices, and demonstrates effectiveness and continuous improvement.
QHSE Goals	No formal QSHE goals and objectives identified and documented.	QSHE objectives and goals are vaguely formulated and are not based on any basic review of the company's QSHE operations. They are not 'specific, measurable, attainable, relevant and timely (SMART) and prioritized. People in the relevant functional area(s) are not involved in defining QSHE objectives and targets. Objectives and goals not included in employee critical tasks or job descriptions. QSHE objectives and goals are poorly documented and not communicated to employees and other stakeholders.	QSHE objectives and targets are formally defined, based on a baseline review and consistent with QSHE policy and applicable legal and regulatory requirements. Some QSHE goals and targets may be SMART and prioritized. Some people in relevant functional areas are involved in setting goals and objectives. Objectives and targets are rarely included in employee job descriptions. QSHE objectives and goals are documented and informally communicated to employees and relevant stakeholders within the company.	QSHE objectives and goals are formal, well defined, primarily SMART and consistent with QSHE policy and applicable legal and other regulatory requirements. More people in relevant functional areas are involved in defining QSHE goals and objectives. Objectives and goals are included in employee job descriptions. Objectives and targets are properly documented and formally communicated to all relevant functions across the company.	QSHE goals and objectives are clear, SMART, prioritized and aligned with the overall QSHE policy and focused on continually improving QSHE performance. All relevant people are involved in defining QSHE goals and objectives. Objectives and targets are included in critical tasks or employee job descriptions. QSHE objectives and goals are properly documented, monitored, reviewed and routinely updated to ensure continuous improvement.

QSHE Management Program	There are no clearer or better defined QSHE management program(s) to achieve objectives and targets.	QSHE plans and program(s) are available, but without a clear definition of specific responsibilities and timeframe. Little employee involvement in establishing QSHE plans and programs.	Formal and detailed management plans and programs are available. Key responsibilities, tactical steps, required resources, and timelines are clearly defined to achieve QSHE objectives and goals. Greater employee involvement in establishing QSHE programs.	QSHE management plans and programs are appropriate, more detailed and integrated with the company's objectives, strategies and budgets. Greater employee involvement in establishing QSHE programs. QSHE plans and programs are clearly communicated to everyone who needs to know.	QSHE management plans and programs are dynamic and integrated into the company's QSHE planning strategies. Full involvement of employees and other stakeholders in the establishment of QSHE programs. QSHE management programs are continually reviewed and modified to address changes in company operations for continuous improvement of QSHE programs.
QHSE Risk Management	There are no processes and procedures for identifying QSHE hazards, assessing and controlling risks.	Informal processes and procedures for identifying QSHE hazards and risk assessments. are in place Risk control measures are poorly defined, understood and have limited application. risk assessments and management are poorly documented	Formal processes and procedures for QSHE hazard identification and risk assessment are in place. Processes and procedures for identification and Risk control measures are poorly defined, understood and have limited application. QSHE risk assessments and management are poorly documented	Formal, more detailed and proactive processes and procedures for QSHE hazard identification and risk assessment. Processes and procedures for identification and management focus on specific hazards and risks, including less obvious and immediate risks. Processes and procedures are consistently applied to identify and manage QSHE risks. QSHE risk control measures are well defined, understood and consistently implemented. All levels of QSHE staff and other stakeholders can contribute to risk assessments. Appropriate QSHE risk assessment records are accurately documented and maintained. Processes and plans for managing QSHE risks are modeled on best practice risk	Well-defined processes and procedures for managing QSHE risks are in place and practicable. QSHE risk management processes and procedures are built into the company's QSHE Planning activities and regarded as a core measure of operational excellence. The QSHE risk assessment approach is routinely applied consistently across the enterprise in a pragmatic manner to drive continuous improvement in the enterprise's QSHE risk profile. QSHE risk management processes, procedures and control measures are regularly monitored, reviewed and improved to deal with changing circumstances and ensure continued success.

				assessment standards, for example ISO 31000.	
Outsourced Personnel Management	No structured procedure is used in the appointment of competent outsourced employees, subcontractors and suppliers with regard to SHE management. There is no structured monitoring and evaluation of the performance of outsourced employees, subcontractors and suppliers.	Informal procedure in place, but rarely used in the appointment of competent third-party QSHE employees, subcontractors and suppliers. Rare monitoring and evaluation of the performance of outsourced employees, subcontractors and suppliers with regard to QSHE management. Procedures are poorly documented and maintained.	Formal procedures in place and used occasionally and reactively, appointing competent third-party employees, subcontractors and suppliers. Punctual and reactive evaluation of the performance of outsourced employees, subcontractors and suppliers in relation to QSHE management. Procedures are properly documented and maintained.	Regular and proactive procedures are in place to appoint competent third party employees, subcontractors on a consistent basis. Regular and proactive evaluation of the performance of outsourced employees, subcontractors and suppliers with respect to QSHE management. All competency definitions are explicitly defined and include industry recognized best practices. Procedures are accurately documented and maintained.	There is a well-structured procedure for appointing, monitoring and evaluating the performance of subcontractors, subcontractors and suppliers. The well-structured and clear competency management system is integrated into the company's QSHE management performance. Competency and performance assessment procedures are regularly reviewed to ensure their current adequacy and continuous improvement.
QHSE Operational Control	There are no procedures for identifying QSHE operations that need to be controlled to ensure that the risk associated with them is minimized or eliminated. QSHE risk control measures are not in place.	Informal procedures are in place to identify QSHE operations and activities that need to be controlled to ensure that the risk associated with them is minimized or eliminated. QSHE control measures are unclear and poorly documented.	Formal procedures are in place to identify QSHE operations and activities that need to be controlled. Control measures for identified QSHE risks are more detailed and clearly indicated. Operation control procedures and measures are properly documented.	Formal and comprehensive procedures are in place to identify QSHE operations and activities that need to be controlled. Control measures for identified QSHE risks are comprehensive and well defined. Identified QSHE operations that need to be controlled and their associated control measures are properly documented and well communicated to relevant employees (eg suppliers, contractors and other interested parties).	Well-structured procedures are in place for identifying QSHE operations and activities that need to be controlled to ensure compliance and achieve objectives. Documented QSHE control procedures and measures are continually reviewed and improved.
Preparation and Response to Emergencies of QHSE	There are no emergency preparedness and response (EPAR) procedures. There are no measures in place to identify potential QSHE emergencies and accidents, and how to respond if they arise.	Undefined and inadequate EPAR procedures and measures for identifying potential QSHE emergencies and accidents and how to respond if they arise. EPAR procedures and measures are poorly documented and not accessible. Employees are rarely trained in emergency responses.	Defined procedures and measures are available for identifying potential QSHE emergencies and accidents, and how to respond if they arise. EPAR procedures and measures are properly documented, but not easily accessible. Employees are trained in formal emergency responses.	Well-defined and sufficient EPAR procedures and measures for identifying potential emergencies with a focus on specific emergency situations. EPAR procedures and measures are properly and accurately documented. EPAR procedures and measures are communicated and accessible to all employees involved.	There are adequate and comprehensive EPAR plans, procedures and measures in place to respond effectively to emergency situations. EPAR plans and procedures are fully integrated with other control measures and consistently benchmarked against best practices. EPAR plans are periodically tested for plan adequacy and the results reviewed to improve their effectiveness for continuous improvement.

				Employees are adequately trained in emergency response.	
Monitoring and Measurement of QHSE Performance	No performance measurement and monitoring system in place. QSHE procedures for performance monitoring and measurement (MaM) are not well developed. QSHE performance indicators and measures are not established. QSHE system performance is poor.	There are vague procedures for the performance of the QSHE MaM. Some QSHE performance indicators and measures are in place but not well defined. Performance MAM is rarely performed. Some employees are aware of the QSHE performance measures in their areas of responsibility. QSHE system performance is fair.	QSHE Performance MAM procedures and performance indicators and other measures are in place and defined. MAM performance are performed occasionally. Monitoring is reactive. More employees are aware of QSHE performance measures in areas of responsibility. QSHE system performance is mostly good.	Well-defined and appropriate performance procedures, key QSHE performance indicators and other measures are in place to monitor QSHE performance. Performance monitoring and measurement is performed regularly with the aim of improving the QSHE system. Performance MaM procedures and measures are compliance driven and used to track QSHE performance. MAM procedures and measures are properly documented and communicated to all employees. Employees at all levels are aware of critical QSHE performance measures in their areas of responsibility. The performance of the QSHE system is very good and constantly repeated.	Well-designed and defined proactive procedures and measures to regularly monitor, measure and record QSHE performance are in place and institutionalized within the company, with a focus on operational excellence and continuous improvement. QSHE MaM performance results are documented and communicated effectively across the enterprise to facilitate subsequent review of corrective and preventive actions. QSHE Performance MaM procedures and measures are used continuously to improve the QSHE management system. Best practices are shared across the company. QSHE Performance The MaM system is periodically reviewed and improved to ensure it remains relevant to the company's risk profile QSHE system performance is exemplary and comparable to the best in the industry
QHSE Incident Investigations	There are no structured processes and procedures for QSHE incident investigations. No organized evidence from QSHE investigations.	Vague processes and procedures for investigations of QSHE incidents are in place. The range of incidents investigated is limited to the immediate causes of accidents and environmental aspects. Limited employee involvement. The processes and procedures of QSHE investigations are not documented.	Formal processes and procedures for QSHE incident investigations are in place. Investigations tend to focus on the proximate and root causes of QSHE incidents, near misses and environmental aspects and their impacts. Incident investigations tend to be reactive. More employee involvement in QSHE investigations. QSHE incident investigation processes and procedures are documented to some extent.	Formal and standardized processes and procedures for QSHE incident investigations. Incident investigations are proactive and delve deeper to identify direct and indirect causes of QSHE incidents and environmental aspects that result in significant QSHE risks. Increased employee involvement in QSHE incident investigations. QSHE incident investigation procedures are communicated to relevant committees for appropriate recommendations and actions. QSHE investigations processes and procedures are well documented and corrective actions well communicated to best utilize any lessons to be learned.	There are documented structured processes and procedures in place for consistently high quality QSHE incident investigations. QSHE incident investigation procedures are linked to the QSHE hazard identification and risk mitigation process and institutionalized within the company. The results of QSHE incident investigations are seen as opportunities for improvement and are documented, monitored and shared with the industry. QSHE incident trends are used to identify and help manage QSHE risks. Lessons learned from incident investigations are shared and implemented across the enterprise. Corrective and preventive actions are regularly reviewed and updated to ensure that the actions taken are effective.

					QSHE incident investigation procedures are routinely reviewed and updated to drive continuous improvement
QHSE System Audits	No QSHE system audit. There are no clear QSHE audit processes and procedures.	The company rarely performs planned audits of the QSHE system. Ad hoc audit without follow-up. QSHE audit processes and procedures are not defined and cannot be documented. Procedures to assess QSHE compliance are limited. Failure to comply with legal and regulatory obligations.	The company occasionally performs planned audits of the QSHE system. QSHE audit processes and procedures are somewhat defined and poorly documented. Most aspects of the QSHE system are audited with some follow-up. Minimum legal and regulatory compliance. QSHE audit processes and procedures are focused on achieving compliance with legal and regulatory obligations.	The company regularly performs planned QSHE audits. QSHE audit processes and procedures are well defined and designed and modeled on audit best practices. All aspects of the QSHE system audited with some follow-up. Full compliance with legal and regulatory obligations Written recommendations (eg non-compliances) are well documented and communicated to form the basis for QSHE improvement and innovation. QSHE audit processes and procedures are modeled on best practice standards for audit management systems, e.g. ISO 19011:2018 guidelines for audit management systems, OHSAS 18001: 2007	There is a standardized company-wide audit system in place and institutionalized within the company, with best practices shared internally with other company functions. QSHE audits are performed regularly by competent employees to demonstrate compliance with required standards, legal and regulatory obligations. QSHE audit processes and procedures are planned and prioritized and cover all aspects of the QSHE system. The QSHE audit process and procedures are periodically reviewed to ensure they are current and consistent with key internal audit practices and standard requirements to ensure continuous improvement in audit processes.
Functions and Responsibilities for QHSE	There are no clear QSHE roles and responsibilities (ie, no roles, tasks and objectives given to people and teams to meet the organization's QSHE objectives).	QSHE roles and responsibilities are unclear with some specific responsibilities and authorities defined and developed. QSHE roles and responsibilities are not recorded in job descriptions.	QSHE roles and responsibilities are primarily defined and assigned to employees. QSHE roles and responsibilities are inconsistently recorded in job descriptions.	QSHE roles and responsibilities are well defined, sufficiently comprehensive, and well communicated to designated employees at all levels. All QSHE roles and responsibilities are consistently recorded in key documentation (eg job descriptions) and appropriate media.	Clearly defined QSHE roles, responsibilities and authorities at all levels of the company. QSHE roles and responsibilities are unambiguous, clearly understood and accurately documented. QSHE roles, responsibilities and authorities are continually reviewed, realigned to effort and tracked to ensure proper distribution and continuous improvement.
QHSE Training	No provision of QSHE-related training for employees. No formal training needs analysis was carried out.	The supply of QSHE-related training for employees is very low and unplanned. QSHE training provision is rarely informed by a formal training needs analysis. Training needs are not well defined and documented.	The delivery of QSHE-related training is reactive. The provision of QSHE training is occasionally informed by a formal training needs analysis. The training needs identified are somewhat defined and based on the	Regular provision of appropriate QSHE-related training to employees, informed by a formal and objective analysis of training needs conducted on a regular basis. Training is generally based on employees' QSHE roles and their respective competency objectives.	Appropriate and timely QSHE training is in place and an integral part of the company's human resources strategy to improve QSHE performance. QSHE training strategies are incorporated into the company's overall QSHE management strategies and policies.

			broader competency and performance objectives. Duly documented training needs.	Training needs are well defined and accurately documented (eg in employee personnel files). Training is often proactive, tracked and evaluated for improvement.	QSHE-related training programs or plans are reviewed for effectiveness and periodically reviewed to ensure their current suitability. The QSHE-related training and training program is continually evaluated and updated to reflect organizational, regulatory and any other changes in technology and techniques to allow for continuous learning and improvement. The various training methods are incorporated into the company's knowledge and communication channels. Training needs analysis procedures are regularly reviewed.
Employee involvement in QHSE	No employee consultation on QSHE related issues. Employees are not involved and have no interest in participating in QSHE-related issues.	Limited consultation on QSHE-related issues, but not carried out on a systematic basis. A minority of employees are involved and interested in participating in QSHE-related issues	More consultations on QSHE issues are carried out on a systematic basis. Most employees are involved and interested in participating in QSHE-related issues.	All employees are regularly consulted on QSHE-related issues and carried out in a variety of ways (eg surveys, workshops, local meetings and committees). The overwhelming majority of employees are involved and interested in participating in QSHE-related issues. Employee involvement and consultation arrangements are documented and stakeholders informed.	All employees are fully consulted and actively engaged on QSHE-related issues at all levels of the company. All employees are interested in participating in QSHE-related issues. The company uses employee engagement to gather ideas for improvement on QSHE issues. The company makes full use of employees' potential to develop shared values and a culture of trust, openness and empowerment.
QHSE Competence	The company's employees do not have the necessary skills, knowledge and experience to manage QSHE.	The overwhelming majority of the company's employees have basic QSHE knowledge and skills, with no employee having advanced or specialized skills and knowledge. Company employees have limited experience in QSHE management tasks.	The majority of the company's QSHE employees have intermediate QSHE skills and knowledge, with very few having advanced and/or specialized skills and knowledge. Company employees have some experience in QSHE management tasks.	Most of the company's employees have sufficient and advanced SHE skills and knowledge, with very few having basic or non-existent QSHE skills and knowledge. Company employees have adequate experience in QSHE management tasks.	The overwhelming majority of the company's employees have specialist QSHE skills and knowledge, with very few or none possessing basic or non-existent skills and knowledge. The company's employees have extensive experience in QSHE management tasks. Company employees feel competent and able to perform their QSHE tasks.
QHSE Physical Resources	There are no physical resources available to allow QSHE personnel	The company is poorly equipped with physical resources for employees to perform QSHE-related tasks.	The company is equipped with adequate physical QSHE resources to enable employees to perform QSHE-related tasks.	The company is well equipped with enough physical resources for employees to perform QSHE related tasks.	The company is fully equipped with sufficient resources in both quality and quantity for employees to perform QSHE related tasks.

	to perform QSHE-related tasks.	Physical QSHE resources are limited. Resource provision is not or rarely informed by any strategic resource plan.	Resource provision is generally reactive and occasionally informed by the strategic resource plan.	A strategic resource plan is available to inform the timely provision of physical resources to enable employees to perform QSHE-related tasks.	The company's physical QSHE resources are considered an integral part of QSHE performance and competitiveness. Physical resources are continuously tested, updated and deployed. Resource plans for the provision of physical resources are documented and integrated into company processes and systems to improve effectiveness and efficiency. Resource plans are regularly reviewed to ensure adequate and current resources are provided to meet planned and agreed goals and objectives.
Financial Resources for QHSE	No financial resources to implement QSHE. Unstable or uncertain funding.	Limited financial resources for QSHE implementation and rarely informed by a strategic resource plan. No established funding sources.	The company has adequate financial resources for QSHE implementation. The provision of financial resources is occasionally informed by the strategic resource plan. Established funding source.	The company has sufficient and well-organized funding lines for QSHE implementation. A strategic resource plan is available to inform the timely provision of financial resources for effective QSHE management. Stable sources of funding.	Dedicated and adequate financial resources for effective QSHE implementation and considered an integral part of the company's financial plan Highly stable funding. Resource plans are reviewed regularly to ensure adequate and current resources are provided to meet planned and agreed goals and objectives.
Communications from QHSE	No formal communication of any QSHE related issues to employees. There are no formal channels of communication for the effective flow of QSHE information internally and externally within the company.	Limited communication of QSHE information to employees. Communication is ad hoc and restricted to those involved in specific incidents. Company employees are unaware of important QSHE information. Some informal and formal communication channels are established so that information flows internally to all employees.	Some communication of QSHE information to employees on a need-to-know basis. There is a communication strategy for the flow of QSHE information internally and externally occasionally to all employees. Employees are aware of relevant QSHE information. There are specific informal and formal communication channels to communicate QSHE issues to employees	Adequate QSHE information is routinely and regularly communicated to all employees. Employees are aware of critical QSHE information. There are established, good and appropriate formal and informal communication channels for communicating critical QSHE information and resulting actions. All levels of employees are involved and there are robust mechanisms in place for them to provide feedback.	There is open, proactive and effective QSHE communication between the company and its employees and stakeholders. QSHE communication is a strong and consistent two-way process. Good practice is communicated externally and internally. The company communicates with its employees about all issues and aspects related to the company's QSHE. Established communication channels and methods are fully adopted throughout the company's supply chain and used consistently for the efficient coordination of QSHE activities. All pertinent QSHE information and resulting actions are well communicated to all employees throughout the company.

					Communication methods for the flow of QSHE information internally and externally are continuously monitored and regularly reviewed against best practices identified in other industries for potential continuous improvement.
QHSE Documentation and Control	No organized documentation (eg QSHE policy, QSHE manual, emergency plans and work instructions, etc.) and records that describe the elements of the company's QSHE system and their interrelationships.	Documentation of some elements of a company's QSHE system and other related QSHE records are available to employees. QSHE documentation and records are unorganized, easily untraceable and accessible.	Documentation and records of further elements of a company's QSHE system and other related QSHE records are available to employees. QSHE documentation and records are compiled and organized in a format that is somewhat traceable and accessible.	Documentation and records of all elements of the company's QSHE system and other related QSHE records are available to all employees. All QSHE documentation is compiled and primarily organized in an appropriate, traceable and accessible format.	QSHE documentation, including other related QSHE records, is compiled and well-organized in a clear, concise and functional format that is traceable and easily accessible to all. QSHE documentation and records are integrated with other organizational documentation (such as human resource plans) for continuous improvement of company functions. QSHE reports and QSHE documentation are systematically reviewed and updated regularly with appropriate version control, based on system improvements, to drive management system efficiency and effectiveness.
Lessons Learned and Knowledge Management	The company does not have a structured lesson capture system to facilitate future improvement of the SHE management system. No promotion of knowledge sharing and lessons learned across the company. There are no lessons learned records. There is a great dependence on individual memory.	The company's processes and procedures for capturing and disseminating lessons learned are characterized by poor or unstructured record keeping and inconsistent data. Limited promotion of knowledge sharing and lessons learned across the company. Reliance on manual recording of lessons. Lessons learned are rarely used for continuous improvement and innovation of the QSHE management system.	The company's processes and procedures for capturing and disseminating lessons learned are characterized by well-structured record keeping and good information. Knowledge sharing and lessons learned are promoted throughout the company. Less reliance on manual record keeping and increased use of digital technologies for record keeping. Lessons learned records are sometimes used for continuous improvement and innovation of the SHE management system.	The company's processes and procedures for capturing and disseminating lessons learned are characterized by routine maintenance of well-structured records and consistent high-quality information. Knowledge sharing and lessons learned are systematically promoted throughout the company. Dependence on advanced digital technologies to capture and disseminate lessons. Class records are consistently trusted for QSHE decision making, continuous improvement and innovation. The processes and procedures for capturing and disseminating lessons learned are modeled on best practice knowledge management standards, e.g. ISO 30401 - 2018, ISO 9001: 2015.	There is a well-structured system in place to capture and disseminate lessons learned and insights across the company. Strong reliance on technological innovations to capture and disseminate lessons. Processes are institutionalized within the company and are considered a key measure of operational excellence. Knowledge and lessons learned are continually shared and used consistently across the company to continually improve QSHE. Processes and procedures for capturing and disseminating lessons learned are routinely reviewed and updated to drive continuous improvement and innovation.

Annex II. Proposal of the simplified table to be filled in by the company.

CAPACITY ATTRIBUTES	**CURRENT LEVEL**					**TARGET LEVEL**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
SENIOR MANAGEMENT COMMITMENT										
QHSE POLICY										
QHSE GOALS AND GOALS										
QHSE MANAGEMENT PROGRAM										
QHSE RISK MANAGEMENT										
OUTSOURCED PERSONNEL MANAGEMENT										
QHSE OPERATIONAL CONTROL										
EMERGENCY PREPARATION AND RESPONSE QHSE										
MONITORING AND MEASUREMENT OF QHSE PERFORMANCE										
INCIDENT INVESTIGATIONS OF QHSE										
QHSE SYSTEM AUDITS										
FUNCTIONS AND RESPONSIBILITIES FOR QHSE										
QHSE TRAINING										
EMPLOYEE INVOLVEMENT IN QHSE										
COMPETENCE OF QHSE										

PHYSICAL RESOURCES OF QHSE										
FINANCIAL RESOURCES FOR DE QHSE										
QHSE COMMUNICATIONS										
DOCUMENTATION AND CONTROL OF QHSE										
LESSONS LEARNED AND KNOWLEDGE MANAGEMENT										