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Sustainable Development Goals in a Maritime and Port Maintenance Company in Tuxpan, Veracruz, Mexico

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Abstract

This study analyzes the contribution of a maritime and port maintenance company located in Tuxpan, Veracruz, Mexico, to the Sustainable Development Goals (SDGs) of the 2030 Agenda. The research analyses the company's maintenance management practices using the Port Maintenance Management Model (MSGMP) proposed by González and Gómez (2016), which integrates technical, organizational, environmental, and social dimensions of port operations. A qualitative case study methodology was employed, including document analysis, internal process evaluation, and assessment of sustainability indicators aligned with selected SDGs. The analysis focused on operational efficiency, environmental management, occupational safety, and organizational structure. Results indicate that the company demonstrates strengths in structured maintenance planning, environmental compliance, and safety protocols. However, opportunities for improvement were identified in systematic SDG integration, performance measurement, and continuous sustainability monitoring. This research contributes to the literature by providing a practical application of the MSGMP framework within a real port maintenance company in Mexico, offering a replicable model for sustainability integration in maritime infrastructure management.

Keywords
Port maintenance, Sustainable Development Goals, Sustainability Management, Maritime Infrastructure, Maintenance Management Model

1. Introduction
Maritime and port infrastructure plays a fundamental role in global trade, regional economic development, and supply chain connectivity. According to the United Nations Conference on Trade and Development (UNCTAD, 2021), more than 80% of international merchandise trade by volume is transported by sea, making ports strategic nodes in global logistics systems. The operational efficiency, safety, and sustainability of ports largely depend on the effectiveness of their maintenance management systems.

Port maintenance encompasses a set of technical, organizational, and preventive activities aimed at preserving infrastructure functionality, ensuring navigational safety, and extending asset life cycles (López, 2024). In recent decades, maintenance practices have evolved from reactive approaches toward more systematic and preventive models that integrate risk management, environmental protection, and performance monitoring (Wireman, 2014). This transformation has been driven by increasing regulatory requirements, technological advancements, and growing environmental concerns.

Simultaneously, the concept of sustainable development has gained global relevance following the adoption of the 2030 Agenda and the Sustainable Development Goals (SDGs) by the United Nations (United Nations, 2015). The SDGs provide a comprehensive framework that encourages organizations to balance economic growth, social responsibility, and environmental protection. In the maritime sector, sustainability has become a key strategic objective, particularly in relation to climate change mitigation, resource efficiency, and occupational safety (OECD, 2020).

Previous studies have highlighted the importance of integrating sustainability principles into port management systems (Acciaro et al., 2014; Lam & Notteboom, 2014). Sustainable port development requires the alignment of operational practices with environmental management, stakeholder engagement, and long-term planning. However, many port-related companies, especially in developing countries, still face difficulties in translating international sustainability frameworks into concrete operational strategies (UNCTAD, 2021).

In this context, maintenance management models represent valuable tools for evaluating and improving organizational performance. González and Gómez (2016) proposed the Port Maintenance Management Model (MSGMP), which integrates technical efficiency, human resource management, safety, and environmental responsibility. This model enables organizations to assess their maintenance processes systematically and identify opportunities for continuous improvement.

In Mexico, ports such as Veracruz, Manzanillo, and Tuxpan have experienced significant growth in recent years, increasing the demand for efficient and sustainable maintenance services (Secretaría de Marina, 2023). The Port of Tuxpan, in particular, has strengthened its role in energy, industrial, and commercial logistics, supported by private companies that provide specialized maritime maintenance services.

Despite this growth, empirical research on the contribution of port maintenance companies to the SDGs remains limited, especially at the organizational level. Most existing studies focus on port authorities or terminal operators, leaving service companies underrepresented in academic literature (Acciaro et al., 2014; OECD, 2020). This gap highlights the need for case-based research that examines how maintenance practices are aligned with global sustainability objectives.

Therefore, this study analyzes the contribution of a maritime and port maintenance company located in Tuxpan, Veracruz, Mexico, to the Sustainable Development Goals, using the MSGMP framework. By examining organizational processes, environmental management practices, and operational performance, this research seeks to provide empirical evidence on sustainability integration in port maintenance activities. The findings aim to support decision-making processes and contribute to the development of replicable strategies for sustainable maritime infrastructure management.

1.1 Objectives

The main objective of this study is to analyze the contribution of a maritime and port maintenance company located in Tuxpan, Veracruz, Mexico, to the Sustainable Development Goals (SDGs) of the 2030 Agenda through the application of the Port Maintenance Management Model (MSGMP) (Gozález & Gómez, 2016). To achieve this objective, the following steps are carried out:

The specific objectives are:

1. Identify the environmental impact of the company's port maintenance by analyzing the life cycle of materials, identifying sources of pollution, and monitoring water and seabed quality in the affected areas; to understand its contribution to the SDGs.
2. Distinguish the company's sustainable strategies for managing port maintenance by identifying the use of environmentally friendly materials, the optimization of machinery and equipment, the reuse and recycling of waste, and the application of nature-based solutions for environmental conservation; to understand their contribution to the SDGs.
3. Identify the occupational safety and training of the company's port personnel by identifying safety protocols, assessing risks associated with exposure to hazardous materials, and providing training in sustainable maintenance practices; to understand their contribution to the SDGs.
4. Establish the company's port maintenance performance by identifying key indicators that allow measuring emissions reduction, energy consumption, waste management, and infrastructure optimization through the adoption of innovative technologies and strategic alliances; to understand its contribution to the SDGs.

2. Literature Review

Ports constitute critical nodes in global supply chains, facilitating more than 80% of international trade by volume (UNCTAD, 2021). Their infrastructure—including berths, breakwaters, cranes, storage facilities, and dredged channels—operates under highly demanding environmental and mechanical conditions. Consequently, structured maintenance management systems are essential to ensure reliability, safety, and long-term asset preservation (PIANC, 2014).

Maintenance management has evolved significantly over the past decades. Traditional corrective approaches have gradually been replaced by preventive, predictive, and reliability-centered strategies (Moubray, 1997; Wireman, 2014). Preventive maintenance aims to reduce failure probability through scheduled interventions, whereas predictive maintenance relies on condition-monitoring technologies to anticipate equipment degradation (Mobley, 2002). Reliability-centered maintenance further enhances decision-making by prioritizing critical assets based on failure impact analysis (Smith & Hawkins, 2004).

In maritime environments, maintenance complexity increases due to corrosion, saline exposure, hydrodynamic forces, and operational intensity (PIANC, 2014). Dredging operations, quay wall stabilization, and crane structural integrity require systematic planning and performance monitoring (Bichou, 2013). Ineffective maintenance can generate operational disruptions, safety incidents, and economic losses.

Moreover, infrastructure asset management frameworks emphasize life-cycle costing and long-term planning to optimize maintenance investment decisions (ISO 55000, 2014). The integration of maintenance strategies with risk assessment methodologies has become standard practice in modern port management (Aven, 2015).

Sustainable development gained institutional recognition following the Brundtland Report (World Commission on Environment and Development, 1987), which defined sustainability as development that meets present needs without compromising future generations. This concept has progressively influenced port governance structures.

Ports generate economic growth but also produce environmental externalities, including greenhouse gas emissions, air pollution, underwater noise, and habitat alteration (Acciaro et al., 2014). Consequently, sustainability has become a strategic imperative within maritime logistics (OECD, 2020).
Research on green port strategies highlights measures such as shore power systems, electrification of equipment, energy efficiency programs, and environmental monitoring systems (Lam & Notteboom, 2014). Environmental management systems, particularly ISO 14001 certification, have been widely adopted to formalize compliance and performance monitoring (ISO 14001, 2015).

In addition to environmental performance, social dimensions such as occupational health and safety are fundamental components of sustainable port operations (International Labour Organization [ILO], 2018). Ports are labor-intensive environments with elevated safety risks, requiring structured training and risk prevention mechanisms.

Governance plays a decisive role in sustainability integration. According to Notteboom and Winkelmans (2001), effective port governance requires coordination between public authorities, private operators, and service providers. Fragmented governance structures may limit the implementation of sustainability initiatives.

The adoption of the 2030 Agenda by the United Nations (2015) established 17 Sustainable Development Goals (SDGs) that provide a global framework for sustainability. Infrastructure-intensive industries, including maritime logistics, are particularly linked to SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action).

Corporate engagement in SDGs requires measurable indicators and structured reporting mechanisms (GRI, 2020). However, several studies report that companies often struggle to operationalize SDG commitments due to a lack of standardized methodologies (Van der Waal & Thijssens, 2020).

Port-related sustainability studies have mainly focused on terminal operators and port authorities (Acciaro et al., 2014; Lam & Notteboom, 2014). Limited attention has been given to maintenance service providers, despite their direct impact on infrastructure resilience and environmental performance.

Private-sector participation is considered essential for SDG achievement, particularly in developing countries where infrastructure gaps remain significant (UNCTAD, 2021). Empirical research on how maintenance practices contribute to SDGs remains scarce, highlighting a relevant research opportunity.

Integrated Maintenance Management Models combine operational efficiency with safety and environmental considerations (Madu, 2001). These models emphasize continuous improvement, performance measurement, and organizational learning (Deming, 1986).

The Port Maintenance Management Model (MSGMP), proposed by González and Gómez (2016), integrates technical diagnostics, sustainability criteria, talent management, and safety systems into a structured evaluation framework. Unlike conventional maintenance approaches focused solely on cost reduction, the MSGMP model incorporates sustainability performance as a core component.

Model-based evaluation enables systematic identification of strengths, weaknesses, and improvement opportunities (Smith & Hawkins, 2004). When sustainability criteria are embedded in maintenance planning, organizations enhance infrastructure resilience and regulatory compliance.

Nevertheless, comprehensive model implementation requires technical expertise, monitoring systems, and managerial commitment (González & Gómez, 2016). Small and medium-sized enterprises may encounter structural limitations in adopting advanced frameworks.

Although sustainability in port governance has received increasing scholarly attention, research remains concentrated on large-scale operators and public port authorities (OECD, 2020). Maintenance service companies—particularly in emerging economies—have been largely underexamined.

In Mexico, port development has expanded significantly in recent years (Secretaría de Marina, 2023). However, empirical analyses linking maintenance management practices with SDG contributions at the company level remain limited.
Therefore, this study addresses a relevant gap by applying the MSGMP framework to evaluate SDG alignment in a maritime maintenance company located in Tuxpan, Veracruz. The case-based approach contributes context-specific empirical evidence to the broader literature on sustainable infrastructure management.

3. Methods

The objective of this research is to analyze the contribution of a maritime port maintenance company in Tuxpan, Veracruz, Mexico, to the Sustainable Development Goals of the 2030 Agenda, through the Port Maintenance Management Model (MSGMP) (González and Gómez, 2016).

It is developed in four stages:
Stage 1. Identification of the environmental impact of port maintenance
Stage 2. Classification of sustainable strategies for maintenance management
Stage 3. Identification of occupational safety and training for port personnel
Stage 4. Port maintenance performance

The research followed a non-experimental, no variables were manipulated during the study, and data were collected at a single point in time. This design was appropriate for analysing existing management practices without altering organizational operations (Creswell & Poth, 2018).

The study was conducted as an intrinsic case study, focusing on a single organization due to its relevance within the regional port maintenance sector. This approach facilitated detailed analysis of internal processes and contextual factors influencing sustainability performance.

A qualitative research approach was employed to explore perceptions, practices, and organizational structures related to maintenance and sustainability management. Qualitative methods are particularly suitable for analyzing managerial processes and institutional dynamics that cannot be fully captured through numerical indicators (Denzin & Lincoln, 2018).

To enhance research credibility, methodological triangulation was applied by combining multiple data sources and analytical techniques (Patton, 2015). Internal reports, operational records, and stakeholder perspectives were cross-validated.

Dependability was strengthened through detailed documentation of data collection and analysis procedures, enabling methodological transparency and replicability (Lincoln & Guba, 1985).
Researcher reflexivity was maintained throughout the study to minimize interpretive bias and enhance analytical rigor.

4. Data Collection

Data collection was conducted in January 2025 at a maritime and port maintenance company located in Tuxpan, Veracruz, Mexico. Multiple data sources were employed to ensure methodological triangulation and enhance the credibility of the findings (Yin, 2018; Patton, 2015).
The data collection strategy combined documentary analysis, semi-structured interviews, and direct field observations. This mixed qualitative approach allowed the integration of organizational records, managerial perspectives, and operational practices.

4.1 Documentary Analysis

Internal and external documents were systematically reviewed to obtain contextual and operational information. The analyzed materials included:

- Maintenance schedules and work orders
- Environmental management reports
- Occupational health and safety records
- Internal policies and operational manuals
- Regulatory compliance documentation

- Sustainability-related reports

Document analysis enabled the identification of formal procedures, performance indicators, and historical trends in maintenance and environmental management (Bowen, 2009).

4.2 Semi-Structured Interviews

Semi-structured interviews were conducted with key organizational stakeholders involved in maintenance, safety, and environmental management. This method was selected due to its flexibility and capacity to generate in-depth qualitative data (Kallio et al., 2016).

A purposive sampling strategy was applied to select participants with direct responsibility for operational decision-making and sustainability implementation (Palinkas et al., 2015). Interviewees included:

- Operations managers
- Maintenance supervisors
- Environmental management officers
- Safety coordinators
- Technical personnel

A total of 10 interviews were conducted, each lasting between 45 and 60 minutes. The interview protocol was designed based on the MSGMP dimensions and previous sustainability assessment studies.
Interviews were audio-recorded with participant consent and transcribed verbatim for subsequent analysis.

4.3 Field Observations

Non-participant field observations were carried out during routine maintenance activities, safety inspections, and environmental monitoring procedures. This method allowed direct assessment of operational practices and workplace conditions (Angrosino, 2017).
Observations focused on:

- Equipment maintenance procedures
- Use of personal protective equipment
- Waste management practices
- Environmental risk controls
- Compliance with safety protocols

Standardized observation checklists were developed to ensure systematic data recording.

4.4 Data Recording and Management

All collected data were organized using a secure digital database and the Atlas ti, software. Interview transcripts, field notes, and documentary evidence were coded and stored following data management best practices (Guest et al., 2012).

Unique identification codes were assigned to each participant and document to preserve confidentiality. Access to sensitive information was restricted to the research team.

4.5 Data Saturation

Data collection continued until theoretical saturation was achieved, meaning that additional data no longer generated new analytical insights (Guest et al., 2006). Saturation was confirmed after repeated patterns emerged across interviews, documents, and observations.

This strategy strengthened the depth and consistency of the analytical findings.

5. Results and Discussion

This section presents and discusses the findings obtained from the application of the Port Maintenance Management Model (MSGMP) (Gozález & Gómez, 2016) to the analyzed company. Results are organized according to the four stages

Stage 1. Identification of the environmental impact of port maintenance

In this stage, an environmental impact analysis of the company's port maintenance activities is conducted. The effects of these activities on the marine environment are identified, and their contribution to achieving the Sustainable Development Goals (SDGs) is analyzed, with an emphasis on protecting aquatic ecosystems.

As part of the methodological process, a structured questionnaire was administered to operational, technical, and administrative personnel involved in port activities, as well as to environmental specialists. This instrument allowed for the collection of key information on the processes implemented, the types of materials used, environmental management practices, and workers' perceptions of potential ecological effects. Based on this information, a life cycle analysis of the materials used during port operations is developed. This analysis identifies the environmental impacts generated at each stage of the cycle, from extraction to final disposal. This approach facilitates the detection of critical processes with high polluting potential, as well as opportunities to optimize resource use and reduce emissions. Sources of direct and indirect pollution associated with maintenance activities are identified, such as discharges into water, solid waste, and air emissions. To complement this information, water and seabed quality were monitored in the affected areas to obtain empirical data supporting the results of the documentary and field analysis.

Figure 1 shows the findings, demonstrating that while the company has procedures in place to mitigate environmental impact, several areas for improvement remain, primarily related to waste management, the handling of chemical substances, and the continuous monitoring of environmental conditions.

The results established a direct link between the observed practices and their impact on achieving the Sustainable Development Goals (SDGs), particularly SDG 6 (Clean Water and Sanitation), SDG 12 (Responsible Consumption and Production), and SDG 14 (Life Below Water). This stage was a crucial step in diagnosing the current situation and guiding the strategies that will be proposed in the subsequent phases of the study.

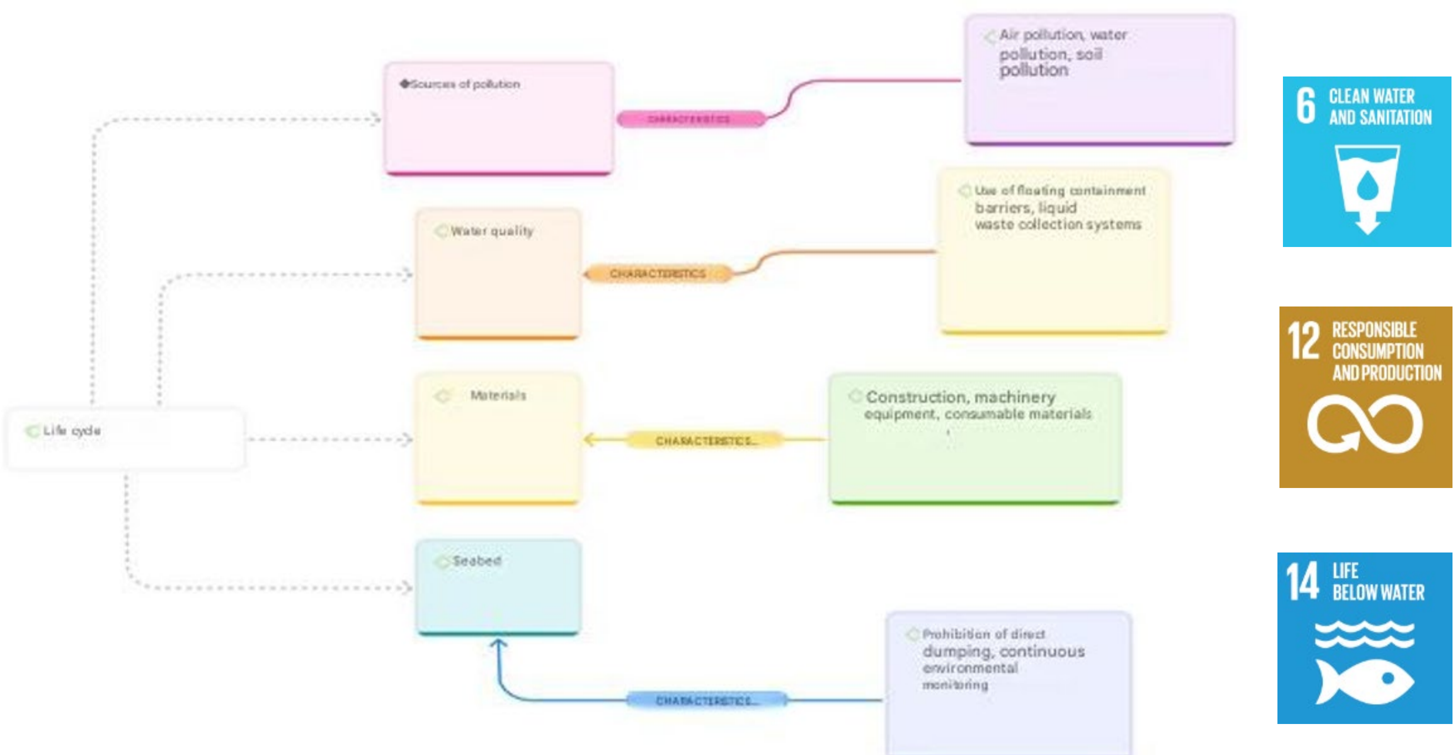

Figure 1. Life cycle
Source. Own based on data processing from Atlas.ti software

Stage 2. Classification of sustainable strategies for maintenance management

The second stage involves identifying the sustainable strategies applied in the company's port maintenance management. The purpose is to determine the extent to which these strategies contribute to environmental sustainability and the achievement of the Sustainable Development Goals (SDGs). First, the use of environmentally friendly materials is identified, considering their origin, composition, life cycle, and capacity to minimize negative impacts on the marine and coastal environment. The optimization of machinery and equipment use is also identified, paying attention to factors such as energy consumption, operational efficiency, and emissions generated during maintenance work. The results show that the company has begun to adopt various sustainable measures, although progress varies. Notable initiatives were identified, especially regarding the rational use of materials and certain recycling efforts; however, the need to strengthen the systematization of these actions and to further integrate clean technologies and natural solutions into its operations was observed. This stage (Figure 2) allowed us to establish the relationship between these strategies and the SDGs most directly involved, including SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 14 (Life Below Water). This analysis provided fundamental elements for assessing the company's level of commitment to sustainability and will serve as a basis for designing improvement proposals in subsequent stages of the work.

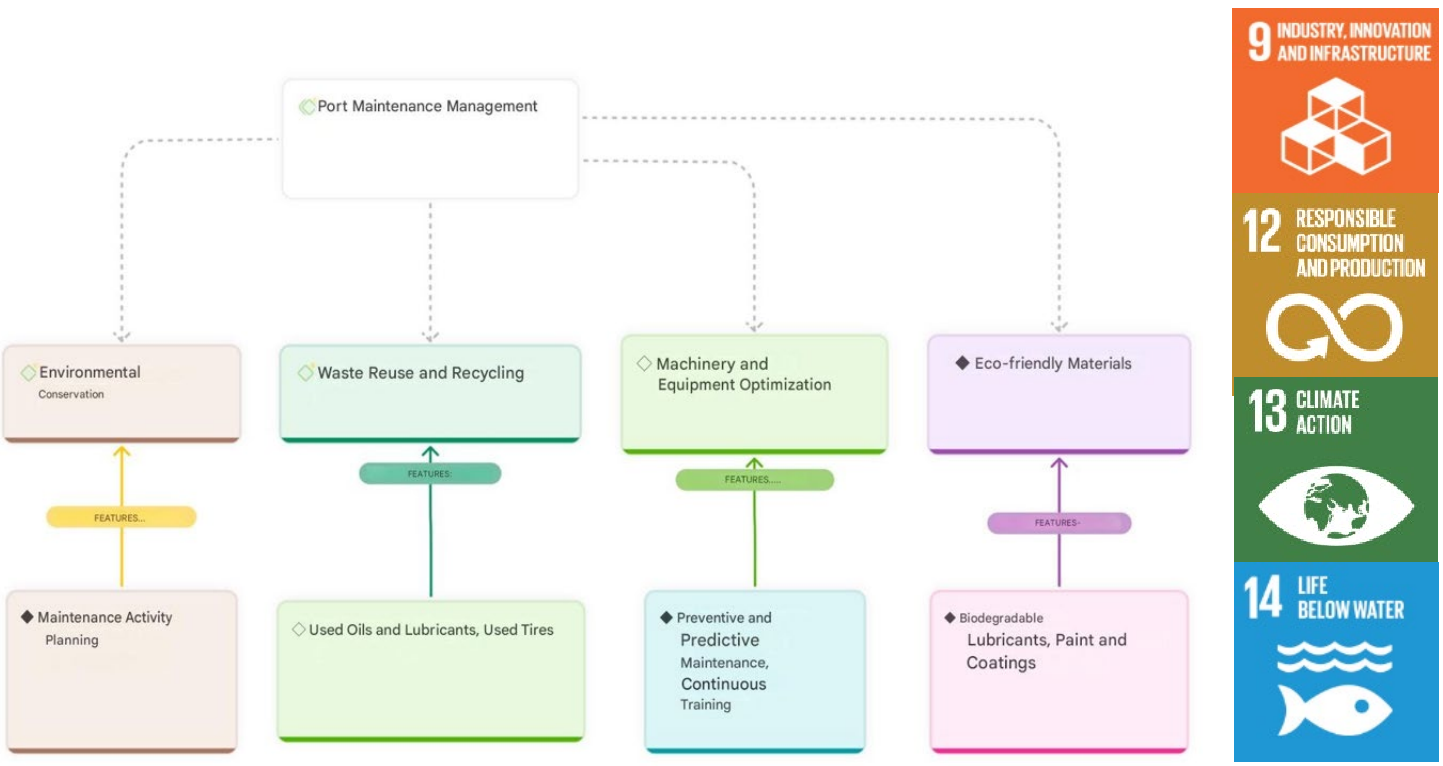

Figure 2. Sustainable strategies for maintenance management
Source. Own based on data processing from Atlas.ti software

Stage 3. Identification of occupational safety and training for port personnel

In this stage, working conditions are analyzed from a preventative and training perspective, with the aim of understanding their contribution to achieving the SDGs related to decent work, health, and operational sustainability. This involves an analysis of occupational risks, primarily regarding exposure to hazardous materials such as solvents, fuels, lubricants, paints, and other supplies used in port operations. This analysis allows for the establishment of risk levels, storage and handling conditions, as well as the availability and use of personal protective equipment. The findings of this stage revealed that, although the company has basic safety protocols and has provided training in various operational areas, limitations remain in terms of the constant updating of training plans and full staff coverage. Furthermore, these actions reflect a direct contribution to several Sustainable Development Goals (SDGs) (Figure 3), such as SDG 3: Good Health and Well-being, by promoting safe working environments; and SDG 4: Quality Education, through the continuous improvement of technical skills. SDG 8: Decent Work and Economic Growth, by ensuring more dignified working conditions; SDG 9: Industry, Innovation and Infrastructure, through the adoption of sustainable practices; and SDG 12: Responsible Consumption and Production, through the responsible management of chemicals in port activities. The need to strengthen a culture of risk prevention was identified, especially regarding the handling of hazardous substances and the systematic incorporation of sustainable practices into technical training.

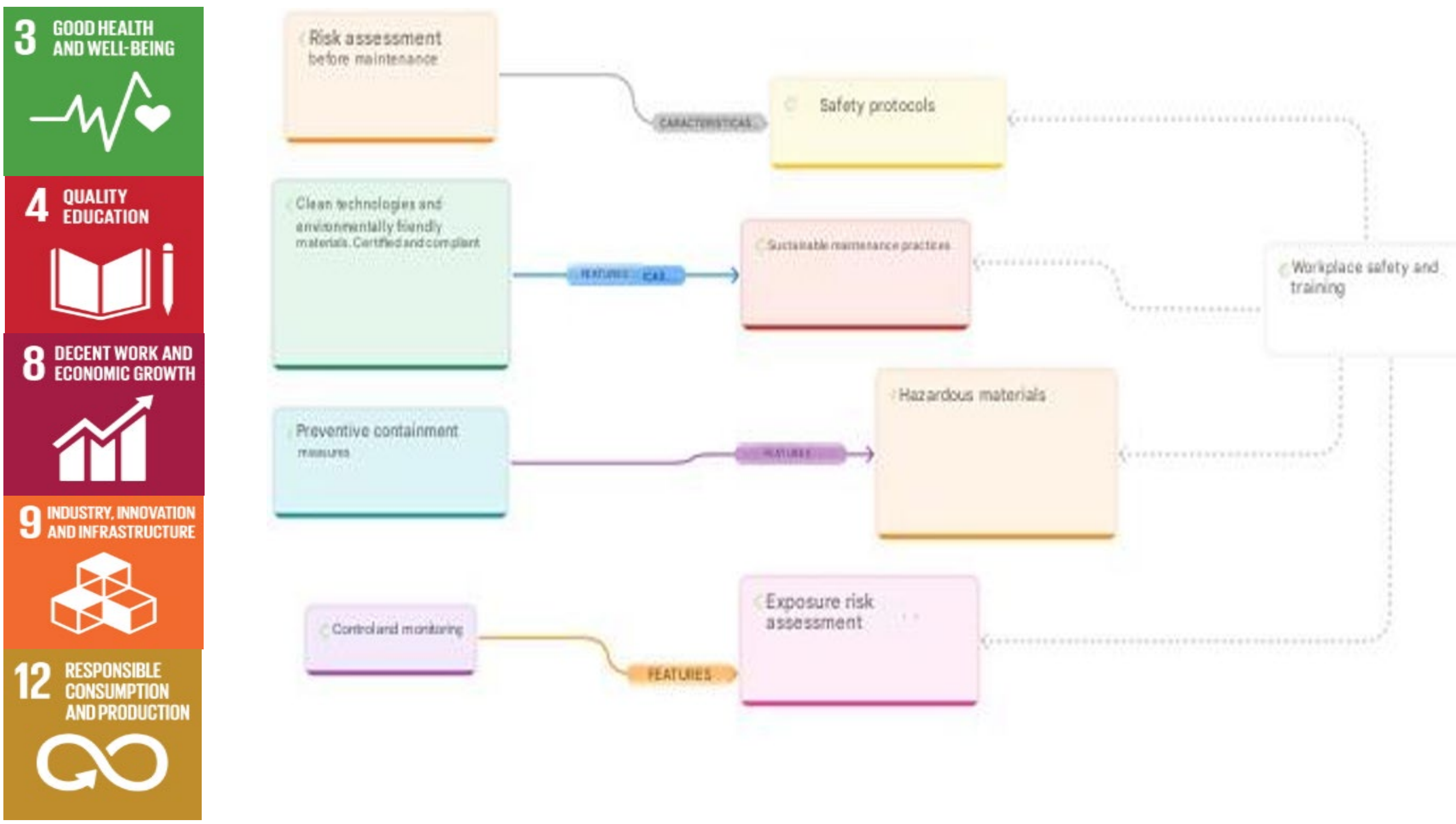

Figure 3. Occupational safety and training for port personnel
Source. Own based on data processing from Atlas.ti software

Stage 4. Port maintenance performance

In this stage, the company's port maintenance performance is assessed by identifying key sustainability indicators. Its purpose is to measure and identify the degree of efficiency and environmental responsibility in the execution of port activities, thereby evaluating their contribution to achieving the SDGs. One of the key elements in this stage was identifying the impact generated by maintenance in terms of pollutant emissions, particularly those derived from the use of heavy machinery and fossil fuels. The level of energy efficiency achieved through the use of cleaner technologies or optimized processes was also considered. This stage allowed for a direct link between the measured indicators and several SDGs (Figure 4), especially SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation and Infrastructure), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). The analysis carried out served as the basis for consolidating a comprehensive approach that allows for evaluating and improving the environmental performance of port maintenance from a strategic and sustainable perspective.

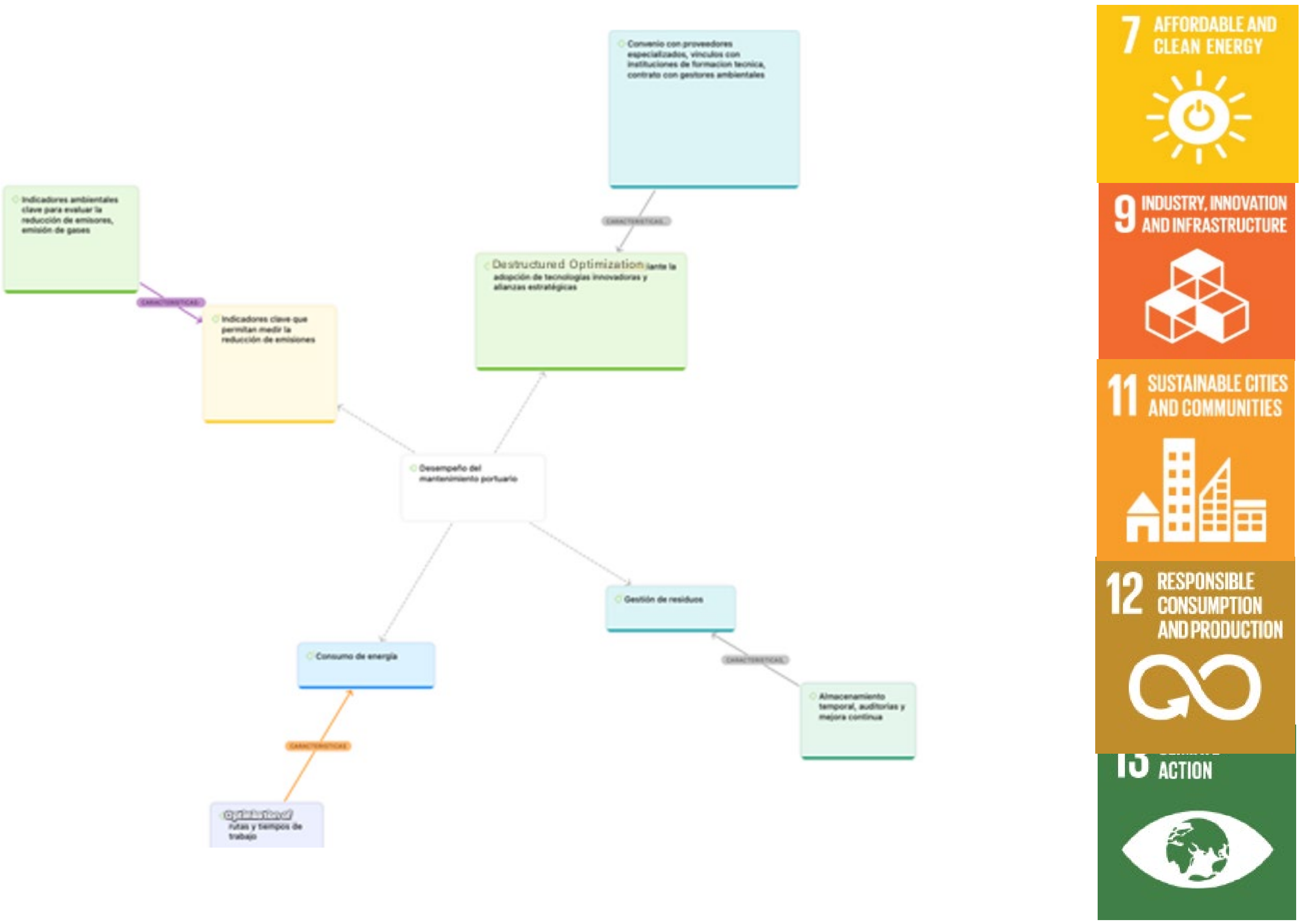

Figure 4. Port maintenance performance
Source. Own based on data processing from Atlas.ti software

The predominance of preventive maintenance aligns with international best practices in asset management (Wireman, 2014; Moubray, 1997). Reduced downtime suggests that structured maintenance planning contributes significantly to operational reliability. Nevertheless, the relatively high proportion of corrective maintenance indicates opportunities for further improvement through expanded predictive maintenance technologies (Mobley, 2002).The decline in safety incidents reflects effective training programs and enforcement of safety protocols, consistent with ILO (2018) recommendations. These measures are expected to enhance failure prediction accuracy and reduce corrective interventions (Mobley, 2002).

The environmental management enhancements are: Development of comprehensive carbon footprint inventories, Adoption of energy efficiency indicators, Installation of emissions monitoring equipment. These actions support alignment with SDG 13 and OECD (2020) recommendations.

Organizational Strengthening are: Continuous professional training programs, Creation of sustainability performance committees, Integration of SDG indicators into management dashboards. These initiatives promote institutional learning and accountability (GRI, 2020).

Validation of findings was conducted through triangulation of data sources and analytical methods (Patton, 2015; Yin, 2018). Internal consistency was verified by cross-referencing interview statements with documentary evidence and observation records. Convergent patterns were identified across all data sources, reinforcing result credibility.

Additionally, preliminary findings were presented to managerial staff for feedback and clarification. Their responses confirmed the accuracy of operational descriptions and interpretations. Although statistical hypothesis testing was not applicable due to the qualitative research design, methodological rigor was ensured through transparent documentation and systematic analysis procedures.

6. Conclusion

This study evaluated the contribution of a maritime and port maintenance company located in Tuxpan, Veracruz, Mexico, to the Sustainable Development Goals (SDGs) of the 2030 Agenda through the application of the Port Maintenance Management Model (MSGMP). The findings demonstrate that structured maintenance management plays a significant role in enhancing operational reliability, environmental compliance, and occupational safety within maritime infrastructure services.

The analysis of maintenance management practices revealed a predominance of preventive maintenance strategies, supported by systematic planning and standardized procedures. These practices contributed to improved equipment availability and reduced operational downtime.

The assessment of environmental management and occupational safety systems confirmed the effectiveness of existing regulatory compliance mechanisms and training programs. However, limitations were identified in carbon emissions monitoring and formal sustainability performance measurement, highlighting areas for improvement. The evaluation of organizational structures further showed that continuous improvement mechanisms were present but not yet fully institutionalized.

Based on the empirical evidence, the proposed improvement strategies—including predictive maintenance technologies, comprehensive environmental indicators, and integrated sustainability dashboards—represent viable pathways for strengthening long-term performance. These measures are expected to enhance transparency, accountability, and adaptive capacity in response to regulatory and climate-related challenges.

From a theoretical perspective, this research contributes to the literature by demonstrating the practical applicability of the MSGMP framework for sustainability assessment in port maintenance companies. Methodologically, the case study approach provides context-specific insights that complement existing large-scale studies focused on port authorities and terminal operators.

Despite these contributions, the study presents certain limitations. The focus on a single organization restricts the generalizability of the findings, and the qualitative design limits statistical inference. Future research should consider comparative multi-case studies and the integration of quantitative performance modeling to strengthen analytical robustness.

In conclusion, this study confirms that sustainability-oriented maintenance management constitutes a strategic tool for improving maritime infrastructure resilience and supporting SDG implementation. The findings provide valuable guidance for practitioners, policymakers, and researchers seeking to promote sustainable development within port-related service industries.

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Biographies

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Dr. Hiram Alejandro Wall Martínez is a Food Engineer from the Benemérita Universidad Autónoma de Puebla (BUAP). He holds a Master of Science in Biochemical Engineering and a PhD in Food Science, awarded by the Tecnológico Nacional de México, Campus Veracruz, in collaboration with the University of Western Brittany (Université de Bretagne Occidentale), France. He completed a postdoctoral research fellowship at the University of Lleida, Spain, and previously served as President of the State Commission for Higher Education Planning (COEPES).He is currently a Research Professor at the Instituto Tecnológico Superior de Álamo Temapache and a Level I member of Mexico’s National System of Researchers (Sistema Nacional de Investigadores, SNII), under the Secretariat of Science, Humanities, Technology and Innovation (SECIHTI). His research interests include food risk analysis, access to higher education in Mexico, and social economy studies.

MBA. Lilia Lizbeth Cortes Flores holds a Master's Degree in Business Management for Sustainability and Bachelor's Degree in International Business for the Escuela Superior de Comercio y Administración Unidad Santo Tomás, Instituto Politécnico Nacional, Mexico. She has developed technological innovation projects. MBA © Cortes, has work experience in companies managing businesses toward sustainability.

M.Sc. Oscar Eduardo Rivas- Aguilar is a PhD student at the Doctoral Program in Science in Environmental and Sustainability Studies at Centro Interdisciplinario de Investigaciones y Estudios sobre Medio Ambiente Desarrollo, Instituto Politécnico Nacional. He has led climate change projects in municipalities and companies in the metalworking area for compliance with applicable regulations and projects to reduce greenhouse gas emissions, he is an advisor to the Secretary of the Environment of the State of Veracruz, for carrying out municipal agendas on climate change for the municipalities of the north of the state of Veracruz. Master Oscar is responsible for the electrical energy consumption area and is an internal auditor for the ISO 14001:2015 Environmental Management System. His research is applied in climate change, quality management, and business sustainability.

B. Eng Kathya Guadalupe Montes Leyva is a Administration Engineer from the Instituto Tecnológico Superior de Álamo Tempache. She has developed technological innovation projects. B.Eng Montes, has work experience in international companies managing businesses toward sustainability.