UFSM

REVISTA DE ADMINISTRAÇÃO DA UFSM
Brazilian Journal of Management
ReA UFSM

ISSN 1983-4659
OPEN ACCESS

Rev. Adm. UFSM, Santa Maria, v. 18, n. 1, e10, 2025 https://doi.org/10.5902/1983465989619
Submitted: 01/11/2024 • Approved: 04/30/2024 • Published: 06/06/2025

Original Article

Environmental management systems: analysis of the degree of maturity of companies in the Rio Grande port complex

Sistemas de gestão ambiental: análise do grau de maturidade de empresas do complexo portuário do Rio Grande

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ABSTRACT

Purpose: To analyze the maturity levels of the environmental management system of private sector companies in the port of Rio Grande.
Methodology: As a method, this study applied a mixed quantitative and qualitative research approach. The method included multiple case studies in two companies, evaluated based on an instrument developed by Peixe (2014), which measures the maturity of EMSs on a five-level scale, ranging from reactive initiatives to formalized proactive practices.
Findings: The findings indicate that both companies are in the "Proactive Initiative" stage, showing significant commitment to formal environmental practices, but without reaching the "Proactive" stage, in which all actions are fully implemented.
Research limitations: Limitations of the study include the small number of companies and the reliance on self-reports, which may compromise the objectivity of the data. In addition, interviews with environmental managers were not possible.
Originality/value: The study adapts and applies an environmental maturity methodology specific to the Brazilian port context, providing a detailed view of the progress of sustainable practices in this sector. The research contributes by demonstrating the importance of EMS for environmental sustainability and offers managerial insights to improve the integration between environmental and operational practices.

Keywords: Environmental management; Maturity; Port companies; ISO 14001

RESUMO

Finalidade: Analisar os níveis de maturidade do sistema de gestão ambiental das empresas do setor privado do porto de Rio Grande.
Método: o presente estudo aplicou uma abordagem de pesquisa mista - quantitativa e qualitativa -, com base em casos múltiplos em duas empresas. A fonte de dados emergiu da aplicação do instrumento desenvolvido por Peixe (2014), que mensura a maturidade dos SGAs em uma escala de cinco níveis, variando de iniciativas reativas a práticas proativas formalizadas e um questionário com perguntas abertas.
Descobertas: ambas empresas estão em estágio "Iniciativa Proativa", mostrando comprometimento significativo com práticas ambientais formais, porém sem alcançar o estágio "Proativa", em que todas as ações são totalmente implementadas.
Limitações da pesquisa: incluem o pequeno número reduzido de casos investigados e a dependência de auto declarações, o que pode comprometer a objetividade dos dados. Além disso, a metodologia poderia se beneficiar da inclusão de uma análise qualitativa mais robusta, como entrevistas em profundidade com gestores ambientais e demais atores chaves envolvidos no processo.
Originalidade/Valor: o estudo adapta e aplica um instrumento de maturidade ambiental específico para o contexto portuário brasileiro, proporcionando uma visão detalhada sobre o progresso das práticas sustentáveis no setor. A pesquisa contribui ao demonstrar a importância do SGA para a sustentabilidade ambiental e oferece insights gerenciais para aprimorar a integração entre práticas ambientais e operacionais.

Palavras-chave: Gestão ambiental; Maturidade; Empresas portuárias; ISO 14001

1 INTRODUCTION

An environmental management system (EMS) is an element linked to an overall management model, establishing various practices, processes, and responsibilities aimed at the development of environmental policies (Dantas & Passador, 2020; Valero-Gil et al., 2023). The use of an appropriate EMS can benefit the environmental outcomes of organizations (Tong, Linderman, & Zhu, 2023), as well as positively impact sales, productivity, and innovation, thereby highlighting its importance (Fernandez, 2022).

Environmental management may require high costs; however, the economic and social gains often outweigh these expenses (Andersen & Bams, 2022). Considering that companies do not perform equally in the implementation of green practices, it is important to observe different levels of environmental management maturity (Bai, Xu, & Jiao, 2022). Environmental management maturity constitutes a relevant factor

as it reflects an organization's level of advancement in environmental management practices. The implementation of effective environmental training, for instance, positively influences this maturity by enhancing employees' awareness, knowledge, and skills concerning environmental issues, which consequently drives the adoption of more mature and integrated practices. Jabbour, 2015).

The port environment serves as one of the main entries and exit routes for goods in global trade, representing a large portion of a country's international and domestic commerce (Ziran et al., 2022). In this way, assumes, it plays a prominent role in the process of global economic integration and socio-economic development (Li, Haralambides, & Zeng, 2022).

Additionally, ports play a crucial role in the supply chain and global transportation networks, becoming central hubs within this environment (Filom, Amiri, & Razavi, 2022). However, they are also significant contributors to environmental pollution and greenhouse gas emissions (Okşaş, 2023). In response, there has been a shift in mindset, as ports began to create and introduce strategies to reduce their environmental impact, incorporating the concept of a green port (Arslan, 2023).

Studies have highlighted the relevance and concern regarding the improvement of ports' sustainable performance, offering alternatives to assist in monitoring CO emissions (Hoang et al., 2022) and environmental sustainability maturity systems (Housni et al., 2022), which contribute to enhancing environmental management. This demonstrates the use of an environmental management maturity system in ports, as it provides relevant information to address and assess specific issues that can help managers achieve environmentally sustainable development goals (Housni et al., 2022).

The pursuit of continuous improvement in environmental programs becomes a relevant solution to current environmental challenges, enhancing a company's public image and reducing its ecological footprint (Aslam et al., 2021; Lima et al., 2018). Given the need for an effective and efficient environmental management maturity process in third-party-managed port companies, together with the importance of ports in

logistics and their environmental impact (Loza & Veloso-Gomes, 2023), where mature systems can proactively identify environmental risks and implement effective control and mitigation measures, the guiding research question arises: *What are the maturity levels of the environmental management systems of the companies operating the facilities of the Port of Rio Grande?* To address this research problem, this study aims to analyze the maturity levels of the environmental management systems of private sector companies at the Port of Rio Grande.

It is noteworthy that the Port of Rio Grande offers significant transportation infrastructure, including road, waterway, railway, and airport modes. The multimodality of the Port of Rio Grande is an essential factor for reducing costs and increasing logistics efficiency, adding value to the goods that pass through its facilities. Benefiting from its geographical features, the Port of Rio Grande has consolidated its position as the port of the Southern Cone, with a strong presence in southern Brazil.

This research is organized into seven distinct sections. The initial section introduces the topic and objectives of the study. Sections two and three present the theoretical framework underpinning the analysis. The methodology adopted is described in section four. The research results are presented and discussed in sections five and six. Finally, section seven concludes the work, addresses its limitations, and suggests directions for future research.

2 ENVIRONMENTAL MANAGEMENT

Many studies and discussions on environmental management actions and sustainable methods in organizational development gained momentum at the end of the twentieth century (Dos Santos et al., 2024). Environmental management involves the effective administration of all aspects related to the environment within an organizational setting, aiming for continuous improvement both internally and externally—thus benefiting society at large (Aslam et al., 2021; Dantas & Passador, 2020). It is a system that includes planning actions, responsibilities, practices, procedures,

processes, and resources to develop, implement, achieve, critically evaluate, and maintain environmental policies. Its objective is to minimize or eliminate the negative effects of company activities on the environment (Tinoco & Kraemer, 2011).

According to Lima et al. (2018), companies are moving towards the adoption of an EMS to build a competitive advantage, anchored both in consumer expectations and ISO 14001 standards. However, adopting regular, occasional, or isolated actions is not sufficient to constitute an EMS (Barbieri, 2007). An EMS requires the organization to systematically plan principles, establish objectives, and periodically verify results (Aslam et al., 2021; Barbieri, 2007). This process involves all departments, enabling the integration of activities and creating greater opportunities to achieve superior results with fewer resources through planned and determined actions (Aslam et al., 2021; Barbieri, 2007).

The basic requirements of an EMS are divided into five fundamental elements: (1) assessing the environmental impacts of the organization's activities; (2) identifying environmental legislation (laws, standards, resolutions, and federal, state, and municipal regulations), along with government contracts, installation and operation licenses, and agreements with environmental agencies; (3) establishing environmental goals through continuous actions and programs, primarily aimed at pollution prevention; (4) ensuring organizational conditions, resources, and adequate personnel to achieve the defined objectives; and (5) conducting periodic audits and management reviews to validate the EMS (Sell, 2016). In this regard, there are various types of EMSs, such as those developed based on ISO 14001. This standard provides guidelines, principles, objectives, procedures, and requirements for implementing an EMS, although it does not define detailed operationalization. It is understood that the implementation actions of an EMS must be detailed and presented to employees within a planned and systematic structure to achieve promising results in internal acceptance. Thus, to reduce the environmental impacts generated by companies, actions cannot be applied in an isolated manner; an EMS must be established to carry out activities that promote the well-being of society (Seiffert, 2008).

In this context, the implementation of an EMS in ports is relevant to ensure compliance with environmental legislation, promote operational efficiency, and contribute to sustainable development. By establishing a clear environmental policy, identifying environmental interfaces, and investing in team training, ports can optimize the integration of economic, social, and environmental benefits, contributing to the construction of a more sustainable future (Bankuti, 2014; Housni et al., 2022).

The development of an EMS, whether formally based on ISO 14001 or informally, allows for the identification of environmental impacts related to the port, while also highlighting the demands of various stakeholders (Housni et al., 2022). However, an environmental management structure in the port context, whether anchored by ISO 14001 or another certification, is not sufficient, as it provides only the basic requirements for a company. A more robust approach in terms of environmental sustainability actions is necessary (Housni et al., 2022). In light of this, there is still a long way to go in the pursuit of an environmental vision that goes beyond incipient actions in the business environment, requiring attention to the maturity of environmental management.

3 MATURITY

Maturity is conditioned by the mastery of administrative methods through a development trajectory, directly linked to resource management (Trierweiller, 2012). The benefits of measuring a company's results allow for a structured response and a clear direction for necessary strategic changes. This measurement enables the identification of how management is organized, the knowledge it possesses, and how this translates into results (Trierweiller, 2012).

The guidelines, objectives, and goals of environmental management, which encompass all processes involved in defining an organization's environmental policy, reflect the level or degree of EMS maturity (Peixe, 2014). Through maturity models, it is possible to measure an organization's performance, ensuring the necessary support and results (Maier, Moultrie, & Clarkson, 2011; Housni et al., 2022). These models can be

used as evaluation, improvement, or benchmarking tools. A maturity model represents stages of change, demonstrating the quantitative or qualitative capacity of a given element to analyze its development within a defined work area (Kohlegger et al., 2009).

The importance lies in the logic that by assessing an organization's environmental maturity, it is possible to establish clear and measurable parameters for its environmental performance, ensuring that processes are well-defined, managed, and controlled (Ashrafi et al., 2020). In this context, maturity model tools are categorized into four or five sequential levels, ranging from low to high, with each level indicating a stage of maturity (Foley, 2019). Thus, a maturity model describes the development of specific capabilities over time (Hynds et al., 2014).

A company's maturity level changes as it achieves attributes associated with a specific stage, reflecting an advancement in maturity (Housni et al., 2022). In the port context, maturity, constructed as a guide, can become a valuable tool for achieving environmental management goals, offering both stakeholder contributions and an evaluation of company operations (Housni et al., 2022).

Although methods and tools are available to improve environmental management, companies are at different stages of maturity, and few classifications deeply explain how a company can achieve and exceed evolved maturity levels (Ormazabal, 2013). According to Ormazabal et al. (2017), despite the utility of maturity stage constructs in management, the true value of a maturity model lies in its processes and causal analyses, which help companies improve and progress along maturity scales.

In this regard, it is worth highlighting the Environmental Management Maturity Model for Industrial Companies (EMM), a prescriptive model for assessing environmental management practices (Ormazabal, 2013), developed through an iterative process based on structured interviews with 19 basque companies, located on the northern coast of Spain, and a workshop with environmental experts. The model was refined and is now in its third version (Ormazabal, 2013).

The EMM model proposes six stages of maturity: legal requirements; assignment of responsibilities and training; systematization; ECO 2; eco-innovator; products and services; and leading green company. Each maturity stage is defined in terms of descriptions, involved parties, various policies, indicators, causal links, and behavior diagrams and charts over time. That way, the maturation stages and the different parts of each research phase provide valuable guidance for companies to advance on environmental issues. The model helps identify the stage of maturity an organization is in and defines the necessary steps to evolve to the next stages (Ormazabal, 2013).

Additionally, Moutschnik (2015) developed a Corporate Environmental Management Maturity Model, which considers optimization as a process of continuous organizational improvement, typically based on small iterative steps (Moutschnik, 2015). The study proposes a framework suggesting that business management evolves through four maturity stages: basic, standardized, automated, and continuously improved. These stages are generic in nature and can be applied to virtually any type of company. However, a company dedicated to continuous improvement without implementing information technology, adequate communication, and process modernization may lack a common foundation and understanding of how processes are managed (Moutschnik, 2015).

Moreover, Peixe (2014) developed a maturity scale in his study to measure EMS maturity in industrial companies in southern Brazil. Using the research instrument, he aimed to classify companies into defined phases/levels created through response categories, identifying new phases/levels that structurally contributed to the research focus on EMS maturity within companies.

It is noteworthy that the research consists of 55 items measured on an EMS maturity scale, validated with industrial companies with more than 100 employees, making it applicable to any type of company with an evolving management system (Peixe, 2014). The items were constructed using parameters from ISO 14001 requirements, theoretical constructs, and aspects and principles of the standard, which were adjusted within the

Plan-Do-Check-Act (PDCA) planning cycle (Peixe, 2014). The research confirmed that the analyzed elements fit into a well-established environmental management model that includes planning, implementation, and continuous improvement.

In this context, the key to continuously improving the EMS as a tool for environmental sustainability involves defining the port's environmental sustainability goals, ensuring senior management commitment, selecting an implementation team to ensure compatibility between EMS objectives and other organizational goals, as well as ensuring efficient communication throughout the company (Housni et al., 2022).

4 METHODOLOGICAL PROCEDURES

This study is characterized by a mixed-methods approach, that is, both quantitative and qualitative (Creswell, 2010), in order to gain insights into EMS Maturity in seaports through multiple case studies (Yin, 2015). The selected study objects are justified by the fact that they possess environmental actions managed directly by their administrative sectors, ensuring a coordinated approach, as well as by their representativeness and consolidated operational history within the Port of Rio Grande, in the state of Rio Grande do Sul, Brazil.

The research encompasses two private companies based at the Superporto of Rio Grande, referred to in this study as Company (A) and Company (B). Company (A), established in a leased area of 735,386.95 m², holds the milestone of being the first container terminal to be privatized through public bidding after the enactment of the Ports Law of 1993. With a history of over 83 years in the port sector of Rio Grande, including 23 years under lease, this public-use terminal plays a significant role, handling approximately 98% of the container cargo passing through the Port of Rio Grande. Its handling and storage capacity are supported by a 300,000 m² container yard and three warehouses, focusing on operations in both domestic and international markets.

Company (B) occupies an area of 37,344.88 m². Its facilities handle and store fertilizers, raw materials, supplies, shipments, and trade raw materials and fertilizers

destined for or originating from waterborne transport. The storage facilities of this Private Use Terminal (TUP) consist of tanks and warehouses with a total static capacity of 121 thousand tons for solid products and 60 thousand tons for liquid products (sulfuric acid, treated and rainwater, and fertilizers). Its primary market focus is the domestic market. Although the company was founded over 50 years ago, its private terminal has been operating under contract for 5 years.

The companies were contacted via email and telephone to verify their availability to participate in the study. Data collection was carried out during 2021 through a questionnaire made available on the Google Forms platform, applied to the Environmental Manager of Company A and the Environmental Coordinator of Company B. Notably, to measure the maturity level, the EMS research instrument developed by Peixe (2014) was employed, along with open-ended questions to obtain a deeper understanding of the investigated context.

The instrument included 55 items divided into five blocks: (i) Environmental Policies (items 1 to 10); (ii) Planning (items 11 to 19); (iii) Implementation and Operation (items 20 to 31); (iv) Verification and Corrective Action (items 32 to 41); and (v) Continuous Improvement – Assessment and Analysis (items 42 to 55). These were measured using a 5-point scale, where: (1) NAP (no, the company does not carry out this practice or action); (2) NIP (no, but the company intends to carry out this practice or action); (3) NEIP (no, the company is beginning to implement this practice or action and plans to formalize it); (4) SFF (yes, the company is executing the practice or action and is in the formalization phase); and (5) SPF (yes, the company carries out this practice or action and it is formalized). Moreover, according to the procedure of the instrument developed by Peixe (2014), the EMS maturity levels are divided into: (1) Reactive Initiative (IRea), (2) Reactive (Rea), (3) Preventive Initiative (IPrev), (4) Preventive (Prev), (5) Proactive Initiative (IProa), and (6) Proactive (Proa).

For the results analysis, the companies' maturity levels were estimated through frequency analysis at each maturity scale level of the EMS, as suggested by Peixe (2014). To discuss the results of the investigated companies, the collected data were analyzed in

blocks: (1) Adopted Environmental Policy; (2) Planning; (3) Implementation and Guidance; (4) Verification and Corrective Action; and (5) Continuous Improvement. Figure 1 below represents the calculation performed in each block for each company (A and B).

Figure 1 – Equation

$$Block_{i,(A,B)} = \frac{Frequency\ of\ scale\ (j)}{k}.100 \quad (1)$$

Fonte: Elaborado pelos autores (2024)

It is noteworthy that: *i* corresponds to the number of the block, *j* refers to the scale from 1 to 5, *k* represents the total number of items in each company (A, B): 'A' represents Company A, and 'B' represents Company B. Subsequently, the maturity level of each company was analyzed according to the scale levels across all instrument blocks, as shown in Table 1. These levels are composed based on the predominant category in the 5-point scale, with the first level (20) reflecting a majority of responses in category (1) NAP; level (30) with a majority in category (2) NIP; level (40) predominantly in categories (2) NIP and (3) NEIP; level (50) predominantly in categories (2) NIP, (3) NEIP, and (4) SFF; level (60) with predominance in categories (4) SFF and (5) SPF; and the sixth level (70) predominantly represented by category (5) SPF.

Table 1 – Relationship between maturity level and level category scale

Where are they? Where do they want to go? How to get there?	Maturity Levels	Scale levels	Scale by level category	Predominance of the 5-point scale category
	(6) Proactive		**70**	(5)FFF
	(5) Proactive Initiative		**60**	(4)SPF and (5)SFF
	(4) Preventive		**50**	(2)NIP,(3)NEIP and (4)SPF
	(3) Preventive Initiative		**40**	(2)NIP and (3)NEIP
	(2) Reactive		**30**	(2)PNI
	(1) Reactive Initiative		**20**	(1)NAP

Source: Adaptedby the authors (2024, based onFish (2014)

It is important to highlight that frequency determines the construction of the scale and establishes the maturity level of each company based on the distribution of their responses. Thus, all items responded to in category 1 can be positioned at the first level (20) of the created scale. In the second level (30), all items and companies that have not reached the third level (40) are positioned. Items at this level, when adopting environmental practices or actions, are considered incipient, as they exhibit limited initial perception regarding the establishment of an environmental policy, focusing more on technological changes, consumption reduction, and recycling programs, while neglecting critical aspects necessary to institutionalize a corporate environmental policy.

The third level (40) of the scale is characterized by an initial reflection on the adoption of environmental practices or actions concerning EMS maturity. The fourth level (50) defines companies that intend to adopt environmental practices or actions that contribute to the continuous improvement of EMS maturity. This level includes responses in categories 2, 3, and 4, indicating initiatives in environmental practices and actions aimed at adopting an environmental policy based on the PDCA cycle, with critical analysis and evaluation by senior management.

The fifth level (60) reflects greater engagement of the respondents in environmental issues, with responses predominantly in categories 4 and 5, where respondents demonstrate a higher commitment to adopting environmental practices or actions aligned with the PDCA structure.

The PDCA cycle defines the structure of ISO 14001: (1) Environmental Policy, (2) Planning (Plan), (3) Implementation and Operation (Do), (4) Verification and Corrective Action (Check), and (5) Continuous Improvement (Act). Companies advance on the scale as their EMS maturity evolves, by meeting the defined environmental practices and actions and progressing through the PDCA cycle.

5 ENVIRONMENTAL MANAGEMENT IN PRIVATE COMPANIES IN THE PORT OF RIO GRANDE

Environmental management provides more than just a regulatory pathway for companies; it serves as an appropriate response to all stakeholders, recognizing the social role of each organization (Tachizawa, 2008). Based on the analysis conducted in this study, the Environmental Manager of Company A observes that the environmental sector is integrated into all processes, including strategic planning, financial management, asset management, and risk management.

The company has been ISO 14001 certified for three years and shares its environmental information through reports such as the Global Reporting Initiative (GRI), Social Balance (BS), Corporate Social Responsibility (CSR), and Environmental Social Responsibility (ESR). The company demonstrates strong engagement and commitment to environmental issues, developing projects to understand the environmental aspects and impacts of its activities, setting excellence criteria in its management, including the planning and monitoring of air emissions, electricity and fossil fuel consumption, and water use.

Regarding Company B, the Environmental Coordinator highlights the integration of the environmental sector with other areas, such as quality management, and shares information through the Social Balance (BS) report. The company has been ISO 14001 certified both in Brazil and abroad for 15 years. It emphasizes and consolidates in its planning projects aimed at reducing water, energy, and raw material consumption.

Among the various port management tools, the Environmental Management System (EMS) has been widely promoted on a global scale (Le et al., 2014). ISO 14001 certification data illustrate this trend: in 2019, 312,580 certifications were recorded worldwide, representing a 1.8% increase compared to 2018. Specifically, in the transport sector, the growth was even more significant, with 9,610 ISO 14001 certificates in 2019, an increase of 24.8% compared to the previous year, according

to data from the Conformity Assessment Committee (ISO/CASCO, 2020). Anchored to this, it is important to highlight that ISO 14001, due to its adaptability, provides an ideal framework for port managers to integrate sustainability principles and ecological practices into their operations (Akgul, 2017). The following subsection addresses the level of EMS maturity in the ports operated by Companies A and B.

6 INVESTIGATING EMS MATURITY IN PRIVATE PORTS

Ports undertake environmental management initiatives both to maintain their social license to operate and expand (Kitzmann & Asmus, 2006), and to enhance international competitiveness (Lam & Notteboom, 2014). However, the main objective of port environmental management remains the mitigation of adverse impacts (Walker, 2016). While some ports adopt environmental management initiatives primarily for regulatory compliance, others go beyond compliance, recognizing sustainability as a key element of their operational strategy (Kitzmann et al., 2014).

In light of this, Caralli et al. (2012) listed six objectives for a maturity model, including knowing where to start, learning from others, having a common language, understanding what improvement means, choosing what to address first, and planning for return on investment. Complementarily, Katuu (2013) discusses a synthesis encompassing two primary functions: describing the organization's current state and proposing plans to enhance performance. Thus, the maturity system supports port environmental management programs by showing port managers the progress and utility of their environmental management initiatives (Housni et al., 2021), as demonstrated by the results presented in this study.

In this context, based on the Environmental Policies adopted — Block 1/Figure 2 — represented by their characteristics and composed of 10 items: 1) The company considers its Environmental Policy (EP) in its strategic planning; 2) The company considers the environmental risks related to its operations when developing its EP; 3) When analyzing the EP scenario in its strategic planning, the company considers

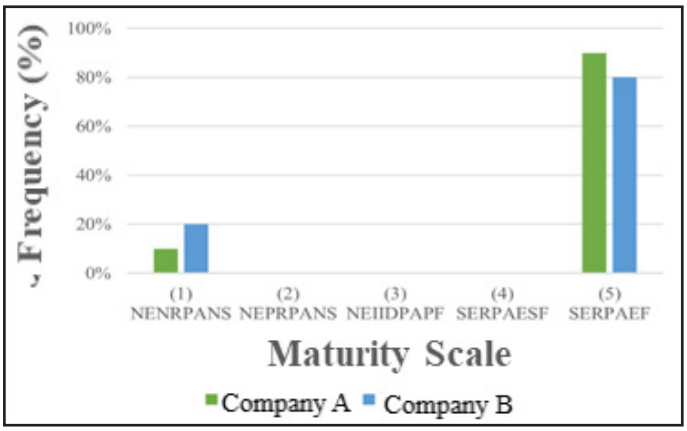
whether competitors are certified or have Environmental Management Systems in place; 4) There is a responsible party for leading the development and implementation of the EP within the company; among others: etc.

It is identified that both Company A and Company B have over 70% of their responses categorized as (5) SPF (yes, the company carries out this practice or action, and it is formalized). When analyzing the EP scenario in their strategic planning, the companies consider themselves certified or having an EMS implemented.

The growing environmental awareness and public pressure have driven companies to adopt more sustainable practices. In planning their actions, companies seek environmental certifications and implement EMS, considering competition and the requirements of certification bodies. This pursuit of certifications demonstrates the companies' commitment to sustainability and positions them more competitively in the market.

In a recent study, Housni et al. (2022) emphasize the importance of a sustainability maturity system guide as a key operational tool for port managers to achieve their sustainability goals. The analysis of maturity indicators revealed, at the Port of Aalborg, the need for greater resource investment by leadership to fulfill their political commitments. This includes stakeholder engagement in environmental actions, efforts to meet percentage targets defined in studies, and managing the impacts of their main environmental aspects.

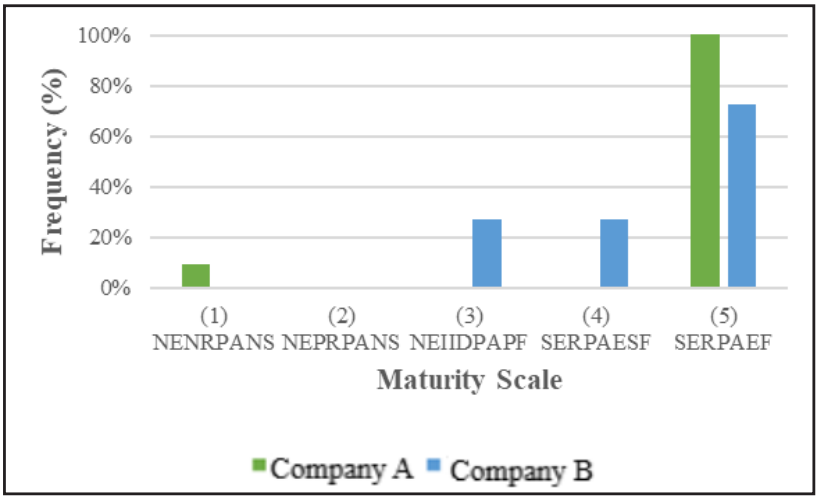
Figure 2 – Block 1 – Adopted Environmental Policy (n = 1)



Source: Research Data (2024)

In Block 2/Figure 3, which represents the characteristics of planning and is composed of 9 items: 11) When defining objectives and targets, the company considers stakeholders' opinions; 12) When defining objectives and targets, the company includes technological changes; 13) When defining objectives and targets, the company includes changes and updates to environmental legislation; 14) When defining objectives and targets, the company includes information regarding its public environmental image; among others. Both companies (A and B) share the same perspective regarding the planning of investments in research and development in environmental management. They establish indicators to monitor and assess the achievement of environmental objectives and targets. This practice is in the process of being formalized and institutionalized by both companies — (4) SFF (yes, the company carries out this practice or action, and it is being formalized). The companies have aligned in a common vision regarding the need to invest in environmental research and development, establishing performance indicators to monitor their progress.

Figure 3 – Block 2 – Planning (n = 8)



Source: Research Data (2024)

Block 3/Figure 4 is characterized by Implementation and Operation and is composed of 11 items, detailed as follows: 20) The company considers whether resources (material, financial, human, and technological) are used efficiently to implement EMS programs; 21)

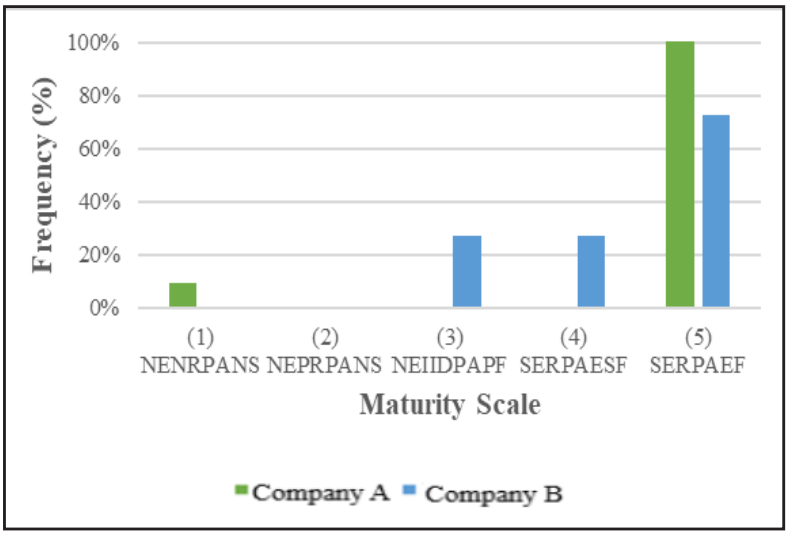
The company has a plan to raise employees awareness regarding the importance of the EMS; 22) The company's employees receive training to operate in accordance with the EMS; 23) The company has a structured communication plan to share its environmental actions with internal and external opinion leaders; among others, etc.

It was observed that Company A considers that its resources (material, financial, human, and technological) are used efficiently to implement EMS programs and has a plan to raise employees' awareness, with training on the importance and operation of the EMS. The company adopts procedures to control operational activities that may impact the environment, implementing procedures to identify, prevent, and respond to environmental risks, and disseminating them across the company's areas.

Additionally, Company B also considers that its resources are used efficiently and has a structured communication plan to share environmental actions with internal and external opinion leaders. However, the company is still in the initial stages of developing procedures to identify, prevent, and respond to environmental risks, with plans to publish them across the company's areas.

From this perspective, Charłampowicz and Mańkowski (2024a) propose in their study a model to assess the environmental maturity of logistics operators, structuring the improvement of sustainability in the sector. The model defines six maturity dimensions (Policy, Operations, Performance, Stakeholders, Digital, and Continuous Improvement) with progressive levels. It enables the diagnosis of the current level, identification of improvements, and achievement of greater sustainability through best practices, technology, and engagement. In summary, it supports action plans, monitoring, and decision-making to optimize environmental performance, with potential benefits in efficiency, compliance, reputation, and cost savings.

Figure 4 – Block 3 – Implementation and Guidance (n = 11)



Source: Research Data (2024)

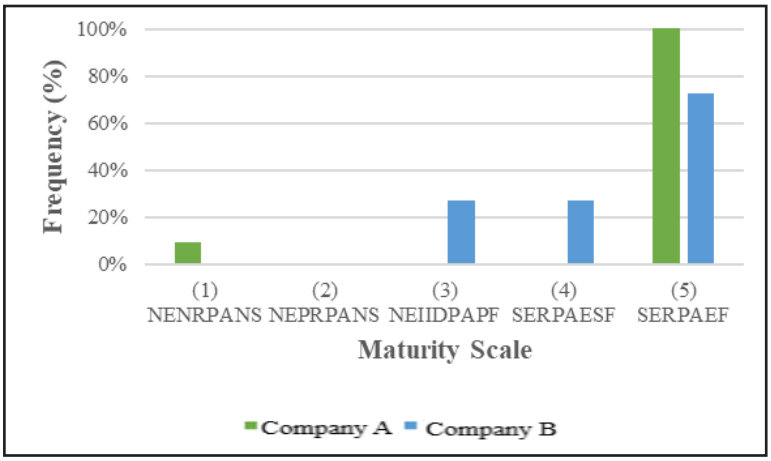
Regarding the diagnosis for preventive and corrective actions by accredited bodies — Block 4/Figure 5 — described as: 32) The company periodically reviews non-conformity reports to implement preventive and corrective actions; 33) The company conducts diagnostics for preventive and corrective actions through accredited bodies; 34) The company undertakes compensatory actions for the recovery of degraded areas; 35) There are procedures in place to verify the effectiveness of preventive actions within the company; among others, etc.

In this context, Company A implements compensatory actions for the recovery of degraded areas, assessing the impacts, costs, and risks associated with EMS non-conformities. However, Company B did not indicate any responses in the questionnaire and stated via email that no compensatory actions for the recovery of such areas are undertaken, as its focus is on preventing disasters and impacts from occurring in the area where it operates.

Anchored in this, Chlomoudis et al. (2024) emphasize in their investigations on EMS in Greek Ports the need for indicators to achieve environmental and sustainability objectives, highlighting that substantial changes at various levels are essential within ports. Although there is considerable potential to raise the maturity levels of the

prerequisites for a successful EMS, these transformations are complex, time-consuming, and effort-intensive, and the obstacles to implementation moderate initial optimism, raising questions about the trajectory toward greater environmental maturity.

Figure 5 – Block 4 – Verification and Corrective Action (n = 11)



Source: Research Data (2024)

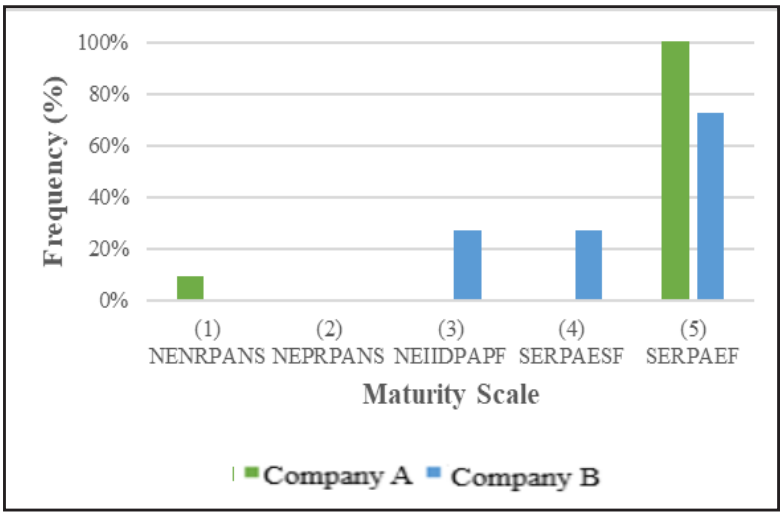
Regarding Block 5/Figure 6, which is characterized by Continuous Improvement and represented by 14 items: 42) The company holds periodic meetings to map the strengths and weaknesses identified in the EMS; 43) The company analyzes threats and opportunities related to the environmental policy; 44) The company analyzes threats and opportunities related to stakeholders (the organization's interested parties); 45) The company analyzes threats and opportunities arising from technological changes; 46) The company analyzes threats and opportunities for the development of new products and services; among others, etc.

Company A states that it does not analyze environmental management in terms of significant aspects that could be beneficial for understanding and creating competitive advantages. On the other hand, Company B is developing preventive measures regarding the importance of analyzing threats and opportunities, as well as technological changes and the development of new products with potential for future integration. Regarding the periodic verification and review of environmental

aspects and impacts, Company B highlights that it remains attentive to concerns about anticipating problems and environmental impacts arising from its operational activities. Thus, by adopting a significant stance, prevention ensures organizational investment security expectations in the short and medium term.

According to the study by Charłampowicz and Mańkowski (2024b), port maturity facilitates the identification of environmental areas to be improved and the prioritization of resources for sustainability strategies aligned with local and global challenges. Another advantage highlighted by the authors is the comparative basis offered by the model used, allowing Polish ports to measure their progress against others and against industry leaders, a fundamental aspect for aligning with the European Union's sustainability agenda while maintaining their competitiveness in the region (Charłampowicz & Mańkowski, 2024).

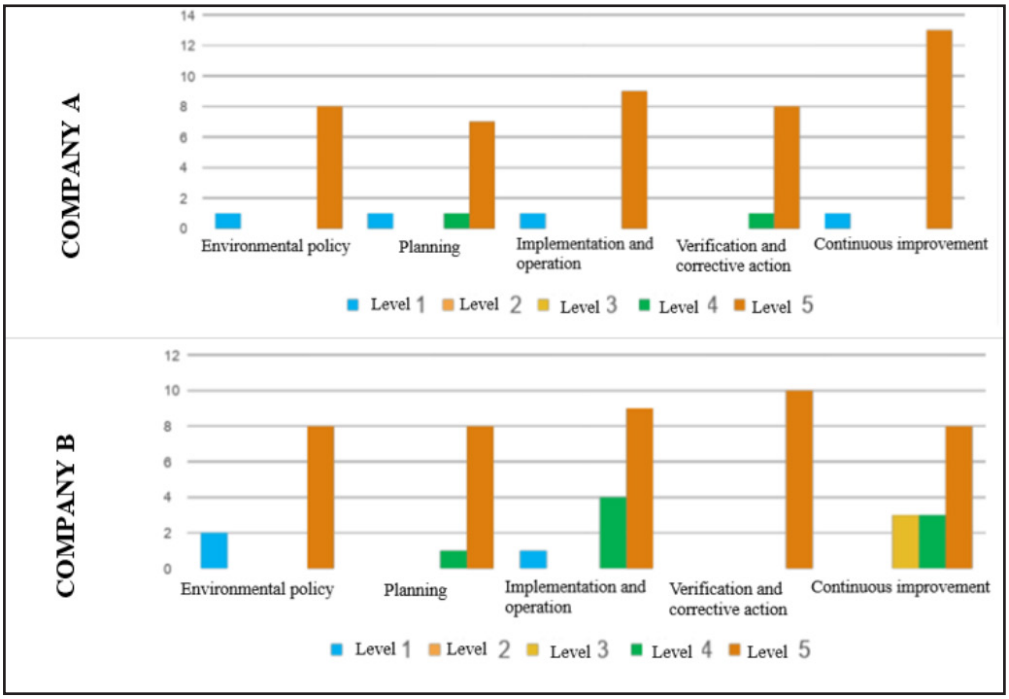
Figure 6 – Block 5 – Continuous Improvement (n = 14)



Source: Research Data (2024)

Finally, to analyze the results of the blocks and levels by company and determine which theoretical construct of EMS maturity companies A and B belong to, graphs were created containing all the blocks and levels, separated by company (Figure 7).

Figure 7 – Block Results and Maturity Levels by Company



Source: Research Data (2024)

According to the maturity measurement instrument proposed by Peixe (2014), both companies fall into Level 60, classified as Proactive Initiative (Ipro), as indicated by the percentages of respondents per categories and scale levels, with the highest responses in levels 4 and 5. Company A registered 7.2% of its responses at level 4 and 83.64% at level 5. In contrast, Company B had 14.55% at level 4 and 78% at level 5. The percentages of respondents per categories and scale levels show that the majority of responses fall within levels 4 and 5, indicating a tendency towards "yes" answers for the items related to the theoretical construct of EMS maturity, assessing that Companies A and B are considered within the level between 60 and 70 of the instruments used.

It is worth noting that the analyzed companies (A and B) presented a higher level of "EMS maturity"; however, to be classified as Proactive (Pro), they should have a comprehensive response—everything—in category (5) SPF (yes, the company performs this practice or action, and it is formalized). Thus, they are considered as Proactive Initiative (Ipro), meaning they have an initial perception to anticipate environmental

issues and impacts in the execution of practices and actions to be formalized. This marks the beginning of concerns with the strategic vision for the establishment of the environmental policy, emphasizing the need to formalize environmental practices or actions in a more integrated manner with the company's areas.

This finding is supported by the literature, as ISO 14001 Certification is one of the most significantly related factors to the level of EMS maturity, since having the certification increases the estimated value for the maturity levels within companies (Peixe, 2014). A more proactive approach involves risk management, pollution prevention, and communication so that companies manage their environmental policies for the future (Sanches, 2000). Therefore, improving customer satisfaction, operational efficiency, cost reduction, enhancing public image, reputation, and improving risk management practices are important aspects to consider when seeking EMS certification (Lima et al., 2018).

7 FINAL CONSIDERATIONS

This study aimed to analyze the maturity levels of the environmental management system of private sector companies in the Port of Rio Grande. It was evidenced that the investigated companies (A and B) fall under the Proactive Initiative (Ipro) based on the parameters of Peixe's instrument (2014).

The increasing concern with environmental impacts has driven the search for more sustainable solutions in the port sector. The integration of regulatory bodies, by unifying enforcement actions, promotes awareness and engagement of companies, contributing to the sustainable development of ports. This integrated approach allows for the creation of a clearer and more efficient regulatory framework, encouraging companies to adopt more sustainable practices in their operations.

The study contributes to encouraging projects that monitor ongoing changes; the environmental maturity system of ports aims for agility, innovation, and the achievement of concrete results in the field of sustainability. The environmental

maturity system serves as an evolutionary benchmark, continuously adapted to respond to new demands and drive sustainability in global ports.

The evaluation of the maturity level finds support in the theory of strategic environmental management, which advocates the integration of environmental dimensions into the strategic objectives of organizations. By aligning the maturity level and the actions of regulatory bodies with the principles of sustainability, it contributes to the construction of a fairer and more equitable port development model, aligned with the Sustainable Development Goals (SDGs) of the 2030 Agenda. This innovative approach provides insights for academic research and can serve as a reference for other sectors of the economy.

With this in mind, the theoretical contributions brought by the study indicate that the EMS alongside the maturity level can be a management tool that drives sustainability, as well as significantly contributes to theoretical development in various areas. Reinforcing the integration of the environmental dimension, it demonstrates that environmental performance can be measured and quantified, becoming an important strategic indicator for decision-making, stimulating the search for new solutions and improving existing practices.

From a managerial perspective, the study offers a robust set of analyses that promote practices applicable to daily port management, providing several benefits. It allows for the identification and management of environmental risks associated with port operations, minimizing potential negative impacts, facilitating the establishment of ambitious and challenging goals, encouraging the search for innovative solutions, pursuing continuous improvement, and enabling differentiation from competitors, attracting customers and investors who value sustainability.

The main limitation of the study lies in the fact that Peixe's instrument (2014) presents a scale that demonstrates the evolution of levels as respondents answer the questions: Where are they? Where do they want to go? and How do they get there? Therefore, the change in level depends solely on the company's self-declaration. There

is no framework that employs a security strategy to ensure the objectivity of actions with regulatory bodies such as the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) and the State Foundation for Environmental Protection (FEPAM). Thus, there is a gap regarding more robust parameters for monitoring results, disregarding that there is a structured and compatible environmental management system that can ensure a more objective construction regarding the EMS and the maturity of these companies.

Additionally, the method of evidence collection also reveals a limitation, as it could be complemented with other qualitative data collection techniques, such as semi-structured interviews with key individuals related to the environmental area. Furthermore, the number of companies was limited to only two, due to difficulties in access and willingness to participate in the study. Finally, regarding suggestions, there is potential to improve instrument Peixe (2014) in conjunction with the data revealed in this research, to make it more robust and apply it to a larger number of port cases, including private and public companies.

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3. Development of theoretical propositions (theoretical work)	√	√	√	√
4. Theoretical foundation / Literature review	√	√	√	√
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9. Critical revision of the manuscript	√		√	√
10. Manuscript writing	√	√	√	√
11. Other (please specify)				

Conflict of Interest

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