CSR in Maritime Freight : Can Economic Growth and Pollution Reduction Coexist

Studying the Impact of CSR on the Maritime Freight Sector thought Archival Research

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Description

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Abstract

Maritime freight sector is vital to global commerce but remains a major source of pollution and greenhouse gas emissions. The research explored the way CSR initiatives can help the sector reconcile economic growth with environmental sustainability.
Archival research was conducted by using secondary data in the form of academic journals, institutional reports, and regulatory reports. NVivo 12 software was used to analyze qualitative data and synthesize the findings.

The results showed that the industry is adopting sustainable measures such as alternative fuels, energy-efficient technologies, and slow steaming, new vessels which all reduce emissions while maintaining competitiveness collectively. Legal frameworks, stakeholder engagement, and social standards also assisted in improving environmental, in same time business performance. Issues remain regarding cost, uneven regulation, and slow worldwide uptake.

It was concluded that the incorporation of CSR strategies into innovation and regulation enables more sustainable shipping operations. It is recommended that there should be more research on the effectiveness of these practices through case studies and interviews in different regions, sizes of firms and financial data sources.

Keywords/tags (subjects)

Maritime Freight, Corporate Social Responsibility (CSR), Economic Growth, Environmental impact, Pollution, Impact

Miscellaneous (Confidential information)

This thesis does not disclose confidential information.

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1 Introduction

1.1 Background, motivation, and purpose

Our world is in the grip of an ecological crisis. Manifested thought biodiversity loss, droughts, pollution, and plenty other environmental challenges. This crisis is disrupting our ecosystems and calling into questions the sustainability of our current socio-economic models and their impact on the environment. Although it progresses slowly, this crisis is intricately linked to globalization, immediate demanding and coordinated action from global stakeholders to find short-term solution capable of mitigating and eventually reversing these harmful trends.

Consider, for instance, the product you use daily, like your smartphone or computer. These items are often either manufactured abroad or assembled using components sourced from multiple countries, most of which travel across oceans aboard containers ship. Indeed, over 90% of global goods are transported by sea, according to a united nations study on maritime transport in 2023, Underscoring the fact that, even in our digital age, the global economy remains deeply reliant on maritime freight. This constant flow of goods sustains consumer markets, supplies manufacturers with raw materials, and ensures the availability of everyday electronic devices.

Given the scale of this global dependency on maritime freights transport, important question arises : How does this system function ? And, crucially, how can it be made more environmentally sustainable ?

This study aims to first elucidate the operational mechanisms of maritime freight transport and its pivotal role in the global economy shedding light on the extent of our dependence on it. Second, it will explore the advancements researchers have made in transforming this industry into a more environmentally et socially responsible model, thought a comprehensive analysis of lasts developments. The most significant part of this thesis will delve into how investments aimed at redacting the sector’s environmental impact could, in the long run, foster economic growth, thought CSR. Finally, the study will purpose actionable strategies for meeting decarbonization goals, drawing on internation summits goals, to outline a sustainable future for maritime freight transport in a world increasingly focused on ecological responsibility.

In sum, as global continues to depend on this massive maritime network, it is imperative to explore how the industry can evolve to meet the pressing environmental of our time

1.2 Research objectives, questions and approach

For investigated the environmental impact of maritime transport and identify sustainable practices for reducing its ecological footprint, the following goals and inquiries guided the conduct of this study :

RQ1: What are Sustainable practices in Maritime freight transport sector in the context of CSR ?

RO1: To find out what are Sustainable practices in Maritime freight transport sector in the context of CSR thought archival research based on secondary data in form of relevant publications.

1.3 Thesis structure

The dissertation is structured into six chapters.

Chapter 1 with the research purpose, questions, and methodology, provides the background, motivation, and purpose. In order to assemble and discuss available information enabling the formulation of the research framework, Chapter 2 presents the key concepts from prior research together with available hypotheses. The research strategy, with the analytical frameworks and tools adopted to evaluate the environmental issues and opportunities in the maritime freight industry, are discussed at length in Chapter 3.The results of the analysis are outlined in Chapter 4, in conformity with the study objectives and discussing the contemporary environmental contribution of maritime freight transport and its effects on global eco-systems. Chapter 5 discusses the main findings, emphasizing emerging best practices and strategies for making maritime freight transport more environmentally sustainable, as well as potential economic benefits of such initiatives. Chapter 6 present summary and conclusions.

2 Literature review

2.1 Introduction

Literature review chapter aims to identify and define the most applicable concepts in relation to the thesis topic, dealing with directly related research. For this thesis, exploring sustainable practices in the maritime freight sector through the lens of corporate social responsibility (CSR), targeted searches were conducted using keywords like " Maritime freight", "Maritime transport", "Sustainable", "CSR", and "Maritime transport", "Impact" "Pollution" This approach helps identify significant publications and recent research developments.

Additionally, referencing articles that cite key publications and exploring conference videos transcribed into papers, such as "Impact : Grain de sail, trade under sail", offers a comprehensive overview of the topic. This focused review sets groundwork for understanding the sustainable transformation in the maritime freight sector.

2.2 Maritime Freight Sector

According to Onur Akarca "The idea of utilizing the sea to carry cargo has a history that goes back to 6,000 years ago, but the greatest developments in this field have emerged since the beginning of the Industrial Revolution." The Maritime Freight Sector is à key concept that encompasses the whole activity link to the transport of goods by sea. This sector plays a key role in international commerce. Over 90% of global goods are transported by sea, according to a united nations study on maritime transport in 2023.

There are plenty of different elements involved in this sector. First, it exists different type of freight boat : Container ships: Carry standardized containers, facilitating the transport of various goods 20% of tonnage. Oil tankers: Specialize in the transport of crude oil and petroleum products 35% of tonnage. Bulk carriers: Transport bulk cargoes, such as coal, grain, or minerals 40% of tonnage. Ro-Ro (Roll-on/Roll-off): Ships designed to carry vehicles that can roll on board 5% of tonnage. Those boat are management differently and use for different reason with different stages of pollution.

Not forgetting all the infrastructures, in this sector there is seaports are hubs for loading, unloading, storage and redistribution of goods. Port infrastructure includes terminals, cranes, warehouses and storage areas. To illustrate this, let's take the example of the world's largest port, Shanghai. The epicenter of the global carbon footprint. It is located on the east coast of China, in Jiangsu province.

In 2022, the port handled more than 1.1 billion tons of goods and 47 million containers. These figures represent 12.7% and 23.3% of global maritime trade respectively.The port emitted approximately 110 million tons of CO2, equivalent to the emissions of 25 million cars.These emissions are mainly due to the combustion of fossil fuels by ships, trains and trucks that transport the goods.On average, an item made in China and delivered to France via Amazon emits 2 tons of CO2. A carbon footprint comparable to that of a plane trip from Paris to New York.

This industry, which represents a pillar of our economy, is subject to national and international laws and standards in every aspect. In terms of competition, wage standards and environmental restriction, standards concerning sulfur emissions discharges at sea and ship safety are constantly

evolving to meet environmental concerns. All this information makes it an industry facing many challenges.

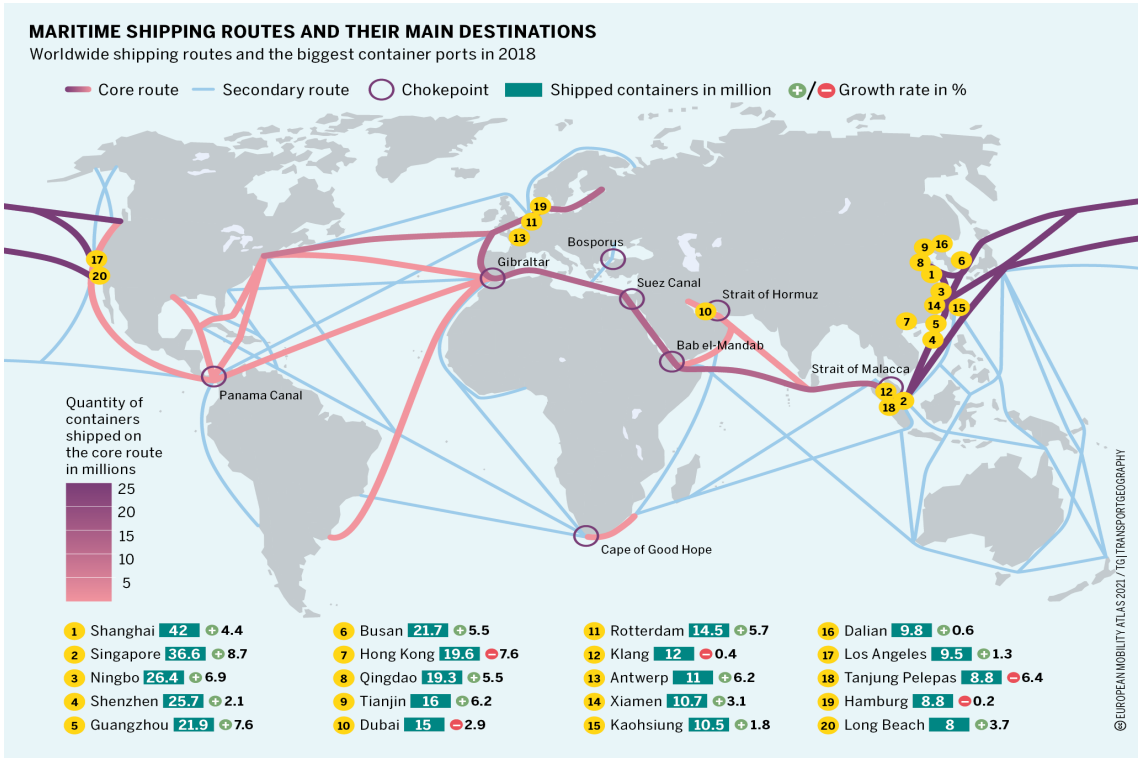

Figure 1 Maritime Shipping Routes and their main destination

2.3 Corporate Social Responsibility (CSR)

The rapid growth of the maritime sector and the way it operates create extensive and large-scale impact on the environment. Such environmental degradation has increased the stakeholders' interest, who have also raised alarm about other aspects of sustainability. In. maritime freight transport, sustainability means organizations are working to meet current needs without harming the ability of future generations to do the same.

In this manner, freight companies can adopt a sustainable management model. Various models exist such as Environmental, Social and Governance (EVG) Triple Bottom Line (TBL) or Corporate Social Responsibility (CSR). They share similar points such as stakeholder satisfaction, society improvement, and environmental impact minimization. In our study, we have opted for the CSR model. Similarly, Anna Drab-Kurowska claimed "Corporate Social Responsibility (CSR) is an important and increasingly important topic for many organizations. So far, there is no common definition of the concept and no general idea of Corporate Social Responsibility in literature."

Most definitions characterize it as the voluntary integration of social and environmental considerations into business operations, emphasizing a responsible approach to managing social, environmental, and economic challenges. This concept requires businesses to go beyond mere compliance with regulations and actively engage in practices that promote sustainability and social welfare. By doing so, compagnies aim to meet the diverse expectations of their stakeholders, which include employees, shareholders, investors, consumers, public authorities, and non-governmental organizations. This holistic approach fosters trust and accountability, enhances corporate reputation, and contributes to long-term success by aligning business objectives with societal values and environmental gestion. In essence, it represents a commitment to sustainable development and ethical business practices, balancing profit-making with the broader impact on society and the planet

Shipping lines ought to adopt a strategic stance, i.e., adopt sustainable measures that harmonize several dimensions of performance, like the improvement in social, economic, and environmental aspects simultaneously. Following Tran et al. (2020), no measure can be considered sustainable when its execution does not affect the economic aspect in a detrimental way, whether or not improvement was introduced in social and environment.

2.3.1 Economics practices

Sustainable practices can boost the financial performance of the shipping companies by improving resource efficiency. For example, reducing speed, optimized road navigationand using more efficient engines can lower fuel consumption, leading to increased profits. Additionally, these savings allow companies to access new markets, expand infrastructure, and enhance their competitiveness.

2.3.2 Social Practices

The social aspect of Corporate Social Responsibility (CSR) emphasizes the well-being of people, including employees and the community. It involves promoting cultural preservation, social welfare, health, and workplace safety. Shipping companies should engage in activities like volunteering and collaborating with educational institutions to support these values. By adopting a responsible and altruistic approach in their operations, companies can improve their reputation, strengthen their infrastructure, and enhance overall competitiveness.

2.3.3 Environmental Practices

Environmental practices aim to minimize greenhouse gas emissions, reduce ballast water discharge, limit hazardous materials, and prevent environmental accidents. Shipping companies address these challenges by acquiring eco-friendly ships and adopting low-carbon alternative energy sources. Additionally, this approach covers activities like improving documentation and shipping processes to reduce material usage and waste.

2.4 Pollution Impact of the Freight Maritime Sector

The maritime freight transport industry, particularly the container industry, is a significant contributor to global greenhouse gas emissions. According to Lu et al. (2022) report that these emissions are generated in two main ways: during navigation and during port activities. They found that between 2015 and 2020, emissions varied, peaking at 264 Mt in 2017 and declining significantly to 226 Mt in 2018, indicating the sector’s vulnerability to changes in global trade and economic conditions.

According to Lu et al. (2022), Heavy fuel oil (HFO) and marine diesel (MDO), which continue to be the main energy sources for maritime transport, are the main drivers of these emissions. In this context, trade variations are important. For example, the industry experienced a decline in 2016 and a 6.4% growth in global container shipping demand in 2017. This demonstrates how vulnerable the industry's emissions and energy consumption are to changes in international trade. Today, with the war in Ukraine, shipping routes are being disrupted, showing the correlation between the shipping market and globalization.

Most emissions occur during the cruise period, averaging 218.1 Mt $CO2_2$ per year. Interestingly, emissions per nautical mile have increased as global trade patterns have shifted towards greater regionalization, such as the growing trade in Asia. This is a result of shorter shipping distances and less efficient use of ships, indicating that balancing economic and environmental goals requires improvements in ship efficiency and trade structures.

A major contributor to the maritime sector's pollution impact is port operations. According to According to Lu et al. (2022), hourly emissions from port operations increased by an average of 1.08 tonnes per hour between 2016 and 2019. Longer handling times and increased emissions are the result of congestion and port administration inefficiencies, which are linked to this increase. While improvements in digitalization and port capacity contributed to a decrease in emissions in 2019 and 2020, the problem of persistent port congestion related to the pandemic has yet to be addressed.

According to Lu et al. (2022), geographically, emissions are concentrated in major ports in North America, Europe, and Asia; about 55% of global emissions are attributable to Asian ports. Ports such as Singapore and Shanghai are major contributors and increasing trade volumes have made new players such as Xiamen and Guangzhou substantial sources of emissions. European ports that stand out for their emissions are Rotterdam and Moerdijk.

According to Lu et al. (2022), the largest contributors to global container shipping emissions are trade between Asia and Europe and North America. The overall trend indicates that emissions are closely linked to trade volumes and patterns, although some regions have experienced brief declines in emissions due to increased energy efficiency and technological advances. This suggests that to mitigate the pollution impact of the maritime freight sector, more environmentally friendly practices and technological advances are needed.

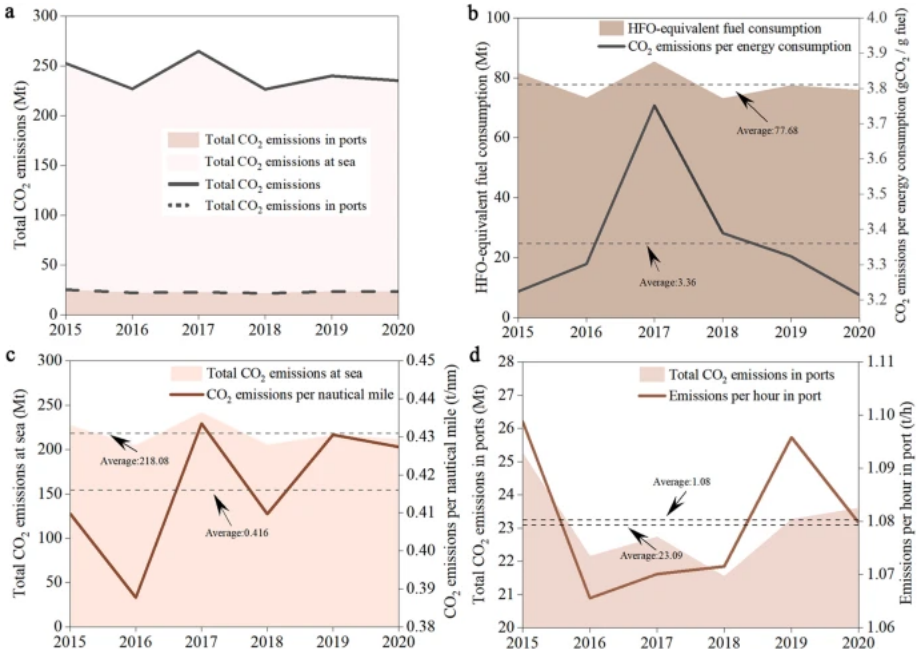

Figure 2 CO2 Emissions of Fret transport

2.5 Improving Environmental Sustainability in Maritime Freight

In addition to being essential to international trade, the maritime shipping sector significantly contributes to environmental degradation. Implementing sustainable practices, embracing new technologies, and reevaluating operational methods are just a few of the many measures needed to address this issue. Recent research's content analysis reveals a considerable concentration on these topics, with studies falling into various important groups such decarbonization, sustainable shipping practices, and the role of ports in environmental sustainability.

2.5.1 Digital Transformation and green Shipping Practices

Blockchain technology, according to Singh et al., is now a vital instrument in maximizing logistics, cutting down on excess fuel consumption, and introducing more transparency and efficiency into maritime operations. All of which translate to lower emissions. Digitalization supports green shipping practices, such as the use of LNG, hydrogen, and ammonia as substitute fuels and smart ship designs. Different research has established that such measures are of high cost and technological

complexity, even though they do manage to reduce emissions greatly. Green shipping is still, however, vital to the industry's move towards a sustainable future, Singh et al. assert.

2.5.2 Port Sustainability and Infrastructure Development

Ports have a major impact on sustainability and are essential to the maritime supply chain (Singh, Dwivedi, and Pratap). Improving port efficiency through digital technology adoption and alternative fuel infrastructure development is crucial to lowering emissions from port operations. Reusing and recycling materials in ports through the implementation of circular economy principles has grown in popularity to reduce environmental impact and enhance logistics efficiency. Additionally, by carefully arranging shipping lanes and port locations, Maritime Spatial Planning (MSP) can aid in optimizing the use of sea space, reducing disturbances, and safeguarding marine ecosystems (Singh et al.).

2.5.3 Decarbonization and Alternative Energy Solutions

In the maritime industry, decarbonization is a key priority that calls for initiatives to cut fuel use, enhance ship designs, and incorporate cutting-edge technology like shore power and electrification (Singh et al.). The lofty emission reduction targets set by the IMO will require strong international cooperation as well as policy assistance to meet. Alternative energy sources like hydrogen, ammonia, and battery-powered propulsion systems are highlighted by Singh, Dwivedi, and Pratap as promising means of lowering greenhouse gas emissions. However, obstacles like exorbitant pricing and scarce resource availability stand in the way of these technologies' broad adoption. Furthermore, the use of contemporary sailing cargo ships—which use wind power for zero-emission transportation is emphasized as a sustainable choice for kinds of cargo, helping to lower the sector's overall carbon footprint (Singh et al.)

In conclusion, achieving environmental sustainability in maritime shipping requires a combination of technological innovation, regulatory support, and strategic planning. By embracing green technologies, enhancing port efficiency, and finding alternative energy sources, the industry can dramatically minimize its environmental impact. In spite of the difficulties, such efforts are obligatory to achieve global climate goals as well as the long-term sustain-ability of maritime cargo transportation.

2.6 Identified Research Gap

Several research have been conducted on the maritime freight sector and how economic growth with social environment.

1 . “Special Issue on Improving the Environmental Performances of Maritime Transport and Ports” from Nadia Giuffrida, Elen Twrdy, Matteo Ignaccolo (2023) The paper discusses the increase in maritime freight transport leading to economic growth while simultaneously highlighting the environmental issues associated with this growth.

2. “Selected aspects of corporate social responsibility in maritime freight services on the example of selected courier companies” from Agnieszka Budziewicz-Guźlecka, Anna Drab-Kurowska (2017) The paper suggest that economic that economic growth and pollution reduction can coexist in the maritime freight sector through the implementation of CSR practices.

3. “Green Maritime Transport as a Part of Global Green Intermodal Chains” from Marko Golnar, Bojan Beškovnik The paper highlights that economic growth and pollution reduction can coexist in maritime freight thought initiative like slow steaming, which significantly lowers emissions while maintaining operational efficiency by reduction ship speeds etc.

4. “Corporate Social Responsibility in the International Shipping Industry: State-of-the-Art, Current Challenges and Future Directions” from Peter Lund-Thomsen, René Taudal Poulsen, Robert Ackrill (2016) The document examines CSR in international shipping, focusing on environmental, social, and ethical challenges, including emissions, labor conditions, and corruption, while questioning the effectiveness of CSR efforts.

5. “Shipping and a “Great Transformation”—some remarks for a new sustainability paradigm” The document discusses the need for a “Great Transformation” in shipping to address environmental and social sustainability. It argues that current efficiency improvements are insufficient and that the industry must rethink its economic model. From Lars Stemmler (2020)

2.7 Theoretical Framework

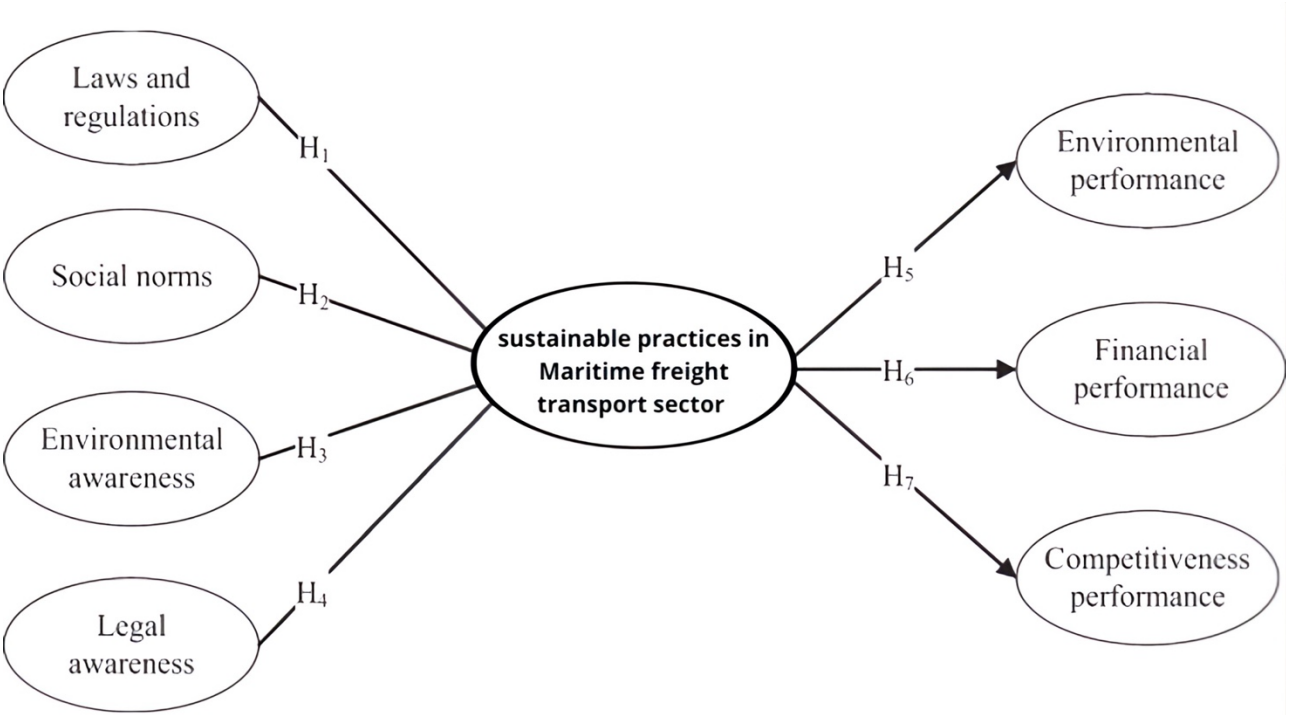

Figure 3 Model of sustainable practices in maritime freight transport sector

The research framework of this thesis was based on Jingjing Xing1 et al. (2023) “The finest diamond must be green: a closer look at the roles of institution in shipping frms’ sustainable practices”

3 Research methods and implementation

3.1 Research context

This study is conducted within the broader context of maritime freight transport, focusing on the ongoing global challenges linked to economic growth and environmental sustainability. Over the past 15 years (2010 – 2024), maritime transport has played a central role in global trade, while also being scrutinized for its environmental impact, particularly in relation to pollution.

This research seeks to understand how the maritime freight industry has navigated the balance between economic expansion and reducing environmental harm. With increasing regulatory pressure for corporate social responsibility (CSR) and more sustainable practices, the industry has been compelled to adapt to both environmental demands and the complexities of global trade. The

long-term analysis highlight how economic growth in maritime transport, pollution reduction strategies, and CSR initiatives have coexisted, evolved, and intersected.

Through an examination of these issues over this critical period, the research aims to contribute to the broader understanding of how the maritime sector has reacted to economic and environmental pressures, providing insight into sustainable transportation practice in the future globalized economy.

3.2 Research design

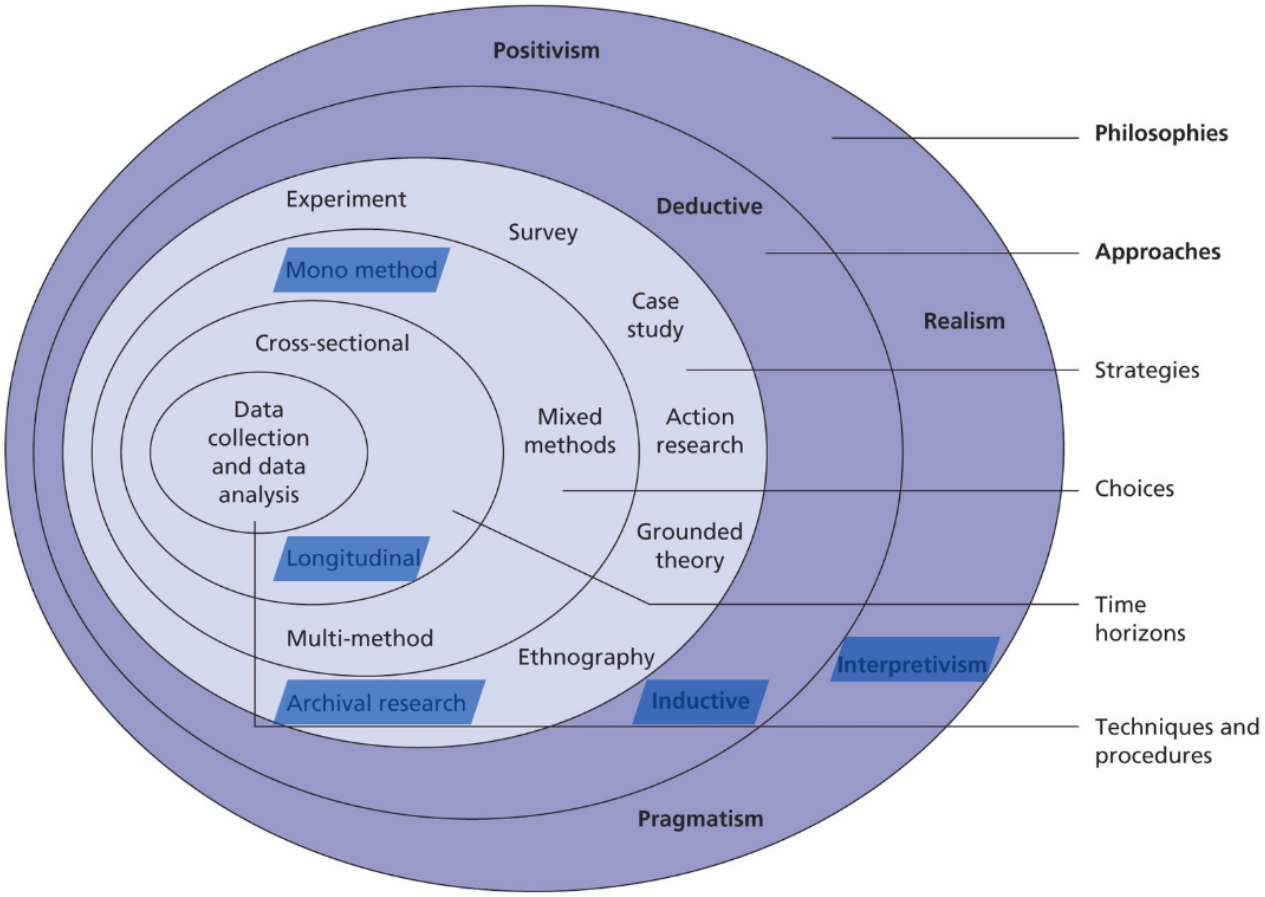

Figure 4 The research 'onion' Source: © Mark Saunders, Philip Lewis and Adrian Thornhill 2008.

3.2.1 Research purpose

The purpose of this research is descriptive, aiming to provide an accurate profile of the current situation regarding Corporate Social Responsibility (CRS) in Maritime freight transport.

This secondary data archival study seeks to build upon previous studies on the subject, starting with an international setting of the issue. Next, response to the main question : Can Economic Growth and Pollution Reduction Coexist in a context of maritime freight transport ?

3.2.2 Research approach

Generally, the research approach refers to whether and how the theory will be addressed in the investigation. There are three different approaches: abductive, inductive, and deductive.

The method of research utilized in this questionnaire is an inductive approach. Under this historical research method, data are collected, analyzed, and interpreted to establish a hypothesis or theory. This method is widely used in qualitative research, and it helps to collect data in a flexible and unstructured manner.

3.2.3 Research strategy/method/s

Archival research using secondary data in the form of relevant publications. This method is suited to conduct abductive type of study and also allows it to be done under circumstances of insufficient access or severe restrictions on acquiring primary data.

3.2.4 Methodological choice

This research is applicable to the mono-methodological approach on the basis of qualitative data. It implies the use of a single method of data collection and related analysis. This will help the authors to delve into a more critical analysis of the research issue because the authors will be focusing all their energy towards analyzing and understanding the data provided in their secondary data.

3.2.5 Time horizon

A longitudinal study of last 15 years have been chosen. A longitudinal study seeks to determine if changes have occurred over time. In the context of maritime freight transport, analyzing such a study provides a comprehensive view of the issues and solutions observed over the past 15 years (2010-2024).

3.3 Data collection

Secondary qualitative data from multiple relevant sources, such as refereed scholarly journals, business publications, reports, and case studies, are used in this work. These sources offer an extensive background of the available body of information and knowledge of the study problem, providing a solid basis for analysis. The information gathered from these sources is crucial for comprehending the larger trends and patterns in the maritime freight sector, particularly with regard to corporate social responsibility (CSR) and striking a balance between pollution control and economic growth.

A comprehensive codebook that was created in compliance with the study framework used for data analysis is shown in the table below.

3.4 Data analysis

3.4.1 Quantitative data analysis

Quantitative data collection and analysis in beyond the scope of the thesis.

3.4.2 Qualitative data analysis

Table 1. Codebook data analysis based on research framework using Nvivo software.

Code	***Definition***	***When to use***	***When not to use***

Laws and regulation in maritime freight transport sector in the context of CSR	Regulation and legislation in the maritime freight transport sector encompasses international and local laws and conventions established by various international and local organizations. These regulatory measures are designed to foster a balanced maritime market and promote collective responsibility. Their primary objective is to oversee the entire maritime industry and to regulate the interactions between the various companies operating in this sector.	Use this code to identify any passage of text in the relevant sources that refer to laws and regulation in maritime freight transport sector in the context of CSR	Do not use this code when the publication talks about anything else than laws and regulation in maritime freight transport sector in the context of CSR
Social norms in maritime freight transport sector in the context of CSR	Social norms in this sector refer to the working conditions of employees, including health, social protection, diversity and inclusion, living conditions on board merchant ships and many others. These standards are intrinsically linked to international organizations, trade unions and governments to guarantee the well-being of workers.	Use this code to identify any passage of text in the relevant sources that refer to social norms in maritime freight transport sector in the context of CSR	Do not use this code when the publication talks about anything else than social norms in maritime freight transport sector in the context of CSR

Environmental awareness in maritime freight transport sector in the context of CSR	The Code, which covers a wide range of topics, addresses the environmental ramifications of the sector's activities. It is the centerpiece of a strong awareness-raising campaign that is evidence-based and focused on consequences. Its scope extends to gas emissions, ship-generated waste, substandard home ports and a variety of other factors that can have an impact on the international shipping industry and the health of our international waters.	Use this code to identify any passage of text in the relevant sources that refer to Environmental awareness in maritime freight transport sector in the context of CSR	Do not use this code when the publication talks about anything else than Environmental awareness in maritime freight transport sector in the context of CSR
Legal awareness in maritime freight transport sector in the context of CSR	Legal awareness in the maritime freight transport sector within the context of Corporate Social Responsibility (CSR) refers to a comprehensive understanding and adherence to the legal frameworks, regulations, and standards governing maritime activities, with a particular emphasis on ethical and socially responsible conduct. In this context, organizations involved in maritime freight transport are expected to not only comply with legal requirements but also to integrate responsible business practices that consider the well-being of society, the environment,	Use this code to identify any passage of text in the relevant sources that refer to legal awareness in maritime freight transport sector in the context of CSR	Do not use this code when the publication talks about anything else than legal awareness in maritime freight transport sector in the context of CSR

	and stakeholders. This entails fostering a culture of legal compliance, ethical decision-making, and a commitment to sustainability within the maritime industry.		
Environmental performance in maritime freight transport sector in the context of CSR	Environmental performance in the maritime freight transport sector, within the context of Corporate Social Responsibility (CSR), refers to the measurement and evaluation of the industry's impact on the environment, accompanied by efforts to minimize negative effects and promote sustainability. This encompasses various aspects, such as reducing greenhouse gas emissions, minimizing pollution, optimizing energy efficiency, adopting eco-friendly technologies, and managing waste responsibly. Environmentally responsible practices into the operations of maritime freight transport companies, considering the broader social and ecological implications of their activities and contributing to sustainable development.	Use this code to identify any passage of text in the relevant sources that refer to environmental performance in maritime freight transport sector in the context of CSR	Do not use this code when the publication talks about anything else than environmental performance in maritime freight transport sector in the context of CSR
Financial performance in	Financial performance in the maritime freight transport sector in the	Use this code to identify any passage	Do not use this code when the publication talks about anything

maritime freight transport sector in the context of CSR	context of Corporate Social Responsibility (CSR) refers to the evaluation and measurement of economic outcomes and profitability achieved by companies operating in this industry thanks to their social and environmental responsibilities. In this context, financial performance extends beyond traditional financial metrics to include factors such as ethical business practices, environmental sustainability, social impact, and adherence to CSR principles. Companies striving for positive financial performance within the maritime freight transport sector in alignment with CSR aim to balance economic success with social and environmental considerations, demonstrating a commitment to responsible and sustainable business practices and to make a profit from their ethical activity.	of text in the relevant sources that refer to financial performance in maritime freight transport sector in the context of CSR	else than financial performance in maritime freight transport sector in the context of CSR
Competitiveness performance in maritime freight transport	Competitiveness performance in maritime freight transport, within the framework of Corporate Social Responsibility (CSR), entails achieving economic success while upholding ethical, social, and environmental standards. This involves	Use this code to identify any passage of text in the relevant sources that refer to Competitiveness performance in maritime freight	Do not use this code when the publication talks about anything else than Competitiveness performance in maritime freight

sector in the context of CSR	ensuring cost-effectiveness, innovation, and financial sustainability in operations. Companies are expected to embrace social responsibility by promoting fair labor practices, safe working conditions, and community well-being. Additionally, a commitment to environmental sustainability, ethical business practices, stakeholder engagement, and regulatory compliance are integral components of competitiveness performance in the CSR context.	transport sector in the context of CSR	transport sector in the context of CSR
Sustainable practices in Maritime freight transport sector in the context of CSR	Sustainable practices in the maritime freight sector within CSR involve minimizing environmental impact through emission reduction, pollution control, energy efficiency, green technologies, and effective waste management. These efforts aim to integrate sustainability into operations, addressing the industry's broader social and ecological responsibilities.	Use this code to identify any passage of text in the relevant sources that refer to sustainable practices in Maritime freight transport sector in the context of CSR	Do not use this code when the publication talks about anything else than sustainable practices in Maritime freight transport sector in the context of CSR

3.5 Ethical considerations

Ensuring that the secondary data used in this study is gathered legally, ethically, and with appropriate respect for data privacy and confidentiality is one of the ethical considerations of this investigation. examining the data and its analysis critically and impartially to identify any limitations and potential biases. Considering this, our study seeks to disseminate the findings in an unbiased and open manner while avoiding harming any individuals or organizations. All things considered; by abiding by these ethical guidelines, this study not only yields accurate and trustworthy data but also adds to the social obligation and liability of the research process.

4 Research Results

The research focuses on corporate social responsibility (CSR) in maritime freight : can economic growth and pollution reduction coexist ? the primary objective is to address the following research question :

RQ1 – What are the sustainable practices in the maritime freight transport sector within the context of CSR

To achieve this, the study employed a dual-metho analysis approach. First, NVivo 12 software was used to systematically analyze date **(Appendix 1)** from a range of relevant publications, organizing the information into coded nodes **(Appendix 2).** Second, the researcher conducted an in-depth review of webpages, journal articles, books, and other relevant publications to gather qualitative insights.

The findings, presented in Section 4, cover key areas such as CSR practices in maritime freight, laws and regulation, environmental performance, environmental awareness, competitiveness, sustainable practices, legal awareness, and financial performance. These insights provide a comprehensive overview of the interplay between sustainability and economic growth in the maritime freight sector.

4.1 Laws and regulations in Maritime Freight sector

Figure 5 Mind map generated from NVivo 12 illustrating Laws and regulations– Computer-Assisted Qualitative Data Analysis Tool.

4.1.1 Economic régulation and market management

The maritime industry operates within a deliciated balance of free competition and regulated oversight. This balance is critical to prevent market abuses while ensuring the efficient movement of goods. The Federal Maritime Commission (FMC), established to safeguard fair practices plays a pivotal role. A report highlights : "The FMC oversees U.S. ports, marine terminal operators, and shippers, ensuring transparency and protecting against anticompetitive behaviors, such as price-fixing or collusion, through its enforcement powers." (Shipping, Ports, and the Federal Maritime Commission, 2021, p. 11)

One of the FMC's major functions is to regulate antitrust immunity granted to liner shipping alliances. While this immunity allows carriers to collaborate on routes and capacity management, it has also raised concerns about over-concentration of market power. A 2020 report states:

"Antitrust immunity for ocean carriers has fostered stability but also amplified their ability to negotiate aggressively with shippers, prompting debates over market fairness." (Shipping, Ports, and the Federal Maritime Commission, p. 15)

Economic regulations are further complemented by efforts to ensure open markets. The Ocean Shipping reform act of 2022, for instance, mandates transparency in freight pricing and dispute resolution, providing shippers with mechanisms to contest unfair practices.

4.1.2 International Lageal Framework

Global trade depends on uniform standards, and the International Maritime Organization (IMO) is at the forefront of establishing such framework. The IMO's conventions, including the MARPOL Convention for environmental protection and the SOLAS convention for safety, are integral to this structure.

One of the most transformative IMO regulations is the sulfur cap introduced under IMO 2020 which limits sulfur emissions from ships to 0.5%. This regulation aims to curb air pollution, encouraging technological innovations such as scrubbers and LNG-powered vessels. A study on the regulation noted :

"IMO 2020 marks a pivotal step in reducing maritime sulfur emissions, though compliance has introduced significant costs for shippers, ranging from fuel switching to retrofitting vessels with scrubbers." (The Likely Implications of the New IMO Standards, 2018, p. 285)

The legal framework also includes conventions like Rotterdam rules, which seek to modernize cargo liability laws. These rules address the challenges of multimodal transportation, offering greater clarity in liability distribution among carriers and shippers. However, as noted in a review :

“While the Rotterdam Rules represent progress in unifying legal standards, resistance to adoption stems from conflicting regional priorities and the persistence of older conventions like the Hague-Visby Rules." (A Close Look at Development and Prospect of Rules Governing Carriage of Goods by Sea, p. 24)

Beyond the IMO, The United Nations Convention of the law of the sea (UNCLOS) provides a legal framework governing maritime zones, access rights, and dispute resolution mechanisms, ensuring equitable resource use and navigation rights.

4.1.3 Legal Responsabilities and securing goods

Maritime law places significant responsibilities on freight forwarders, carriers, and other stakeholders to protect cargo and fulfill contractual obligations. These responsibilities are codified in conventions such as the international convention on arrest of ships, which grants creditors the right to arrest vessels for securing claims. As Stated :

"A ship may be detained or restricted from removal to secure a maritime claim, even if the jurisdiction to resolve the claim lies in another state." (International Convention on Arrest of Ships, 1999, Article 3)

Freight forwarders, acting as intermediaries between shippers and carriers, are subject to rigorous legal expectations. They must ensure proper documentations, insurance coverage, and compliance with international shipping. A study on their role emphasized:

"The duties of freight forwarders extend beyond cargo logistics to include legal compliance and mitigating risks, particularly in cases of disputes or delays." (A Freight Forwarder’s Responsibility, 2017, p. 41)

Furthermore, these legal frameworks extend to environmental and safety responsibilities. Under MPARPOL and other conventions, shippers must ensure proper handling of hazardous materials and waste. Failure to comply can result in significant penalties, as highlighted by case of ship detentions under international pollution laws.

4.2 Legal awareness in maritime freight sector

Figure 6 Mind map generated from NVivo 12 illustrating Legal Awareness– Computer-Assisted Qualitative Data Analysis Tool.

The maritime freight transport sector operates within a dense framework of legal obligations and compliance standard that govern operations, safety, and environmental performance. Legal awareness encompasses multiple dimensions, including compliance with regulations, due diligence, risk management, and stakeholders' engagement. This section provides an in-depth exploration of theses facets with supporting insights from recent studies and international frameworks.

4.2.1 Legal Compliance

Legal compliance is a foundational element of maritime operations, requiring alignment with the international conventions such as MARPOL SOLAS and the STCW convention. A critical example of the IMO's Marpol wich enforces limits on sulfur emissions In marine fuel. Trand (2021, p12) states: "These regulations compel shipowners to adopt low-sulfur fuels or implement exhaust cleaning technologies, contributing to a marked reduction in emissions and fostering environmental sustainability."The financial burden of compliance often necessitates strategic investments in fuel-efficient technologies and partnerships to share costs."

While these efforts reduce environmental harm, they also impose significant financial pressures on smaller operators. According to Sharaburyak et al. (2020, p 165):

"The financial burden of compliance often necessitates strategic investments in fuel-efficient technologies and partnerships to share costs."

Furthermore, the significance of systematic training to improve crew competency is emphasized by the IMO's STCW Convention. According to a recent IMO report:

"Uniform training standards reduce operational risks by ensuring that seafarers worldwide possess the necessary skills to handle emergencies effectively." (IMO, 2019, p. 14).

These illustrations demonstrate how compliance promotes a culture of sustainability and safety by going beyond technical specifications.

4.2.2 Due Diligence

Preventive measures to guarantee the safety, security, and environmental integrity of operations are part of due diligence in the maritime freight industry. This obligation is emphasized by the 2001 Bunker Oil Pollution Convention, which holds shipowners accountable for preventing oil spills by putting in place proactive monitoring systems. According to the IMO (2019, p. 14):

"Shipowners are required to maintain comprehensive emergency response plans, minimizing the risk of environmental disasters caused by oil spills."

Another crucial aspect of due diligence is cybersecurity. The increasing risk of cyberattacks on marine operations, which can jeopardize critical data and vessel navigation systems, is highlighted in the IMO's 2021 recommendations. According to a recent study:

"The maritime industry faces increasing risks of cyber threats, necessitating robust policies and regular audits to safeguard critical systems."

These examples illustrate how due diligence has evolved to encompass emerging challenges such as cybersecurity while maintaining traditional priorities like environmental protection and operational safety.

4.2.3 Risk Management and legal awareness

Risk management within the maritime industry necessitates both the anticipation of potential disruptions and the implementation of strategies to mitigate their impact. The COVID-19 pandemic highlighted the critical role of legal awareness in reducing operational risks. A recent report by ESCAP indicates that:

"Arbitration emerged as an efficient mechanism for resolving disputes over delays and contractual breaches during the pandemic." (ESCAP, 2021, p. 18).

Furthermore, digitalization has become integral to risk management practices. Tools such as ASYCUDA allow customs authorities to conduct pre-arrival risk assessments, thereby enhancing compliance and operational efficiency. Nevertheless, Sharaburyak et al. (2020, p. 170) caution that:

"Increased reliance on digital systems introduces vulnerabilities, underscoring the need for integrated cybersecurity measures across the supply chain."

Consequently, effective risk management must strike a balance between leveraging technological innovations and maintaining strong legal frameworks to counteract emerging threats.

4.2.4 Stakeholder Engagement and Legal Duties

Building a common understanding of legal obligations and operational objectives requires active stakeholder engagement. National Trade Facilitation Committees (NTFCs) are forums for communication between private companies and government representatives. According to an IMO study:

The IMO's fight against fraudulent ship registration is another important activity. The goal of creating a worldwide registry is to safeguard genuine stakeholders and improve transparency. As stated by the IMO:

4.3 Social Awareness in maritime freight transport

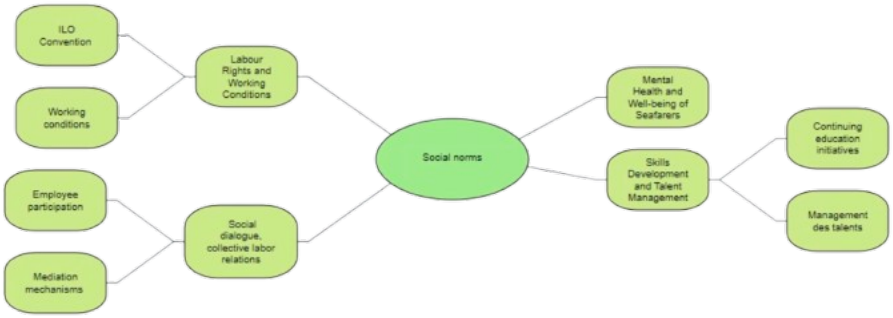

Figure 7 Mind map generated from NVivo 12 illustrating Social norms– Computer-Assisted Qualitative Data Analysis Tool.

This section explores core elements of labor rights and working conditions, social dialogue and collective labour relations, mental health and well-being of seafarers, and skills development and talent management as presented in the mind map. Notions that are key to our understanding of how social norms drive the field of maritime freight.

4.3.1 Labour Rights and Conditions of Employment

In this intervention, we first bring international labour standards to the forefront by discussing the International Labour Organization's Maritime Labour Convention. This convention establishes a "bill of rights" for seafarers to guarantee their basic rights, including minimum wages and safe working conditions. The convention, he noted, "supports decent work by establishing basic rules on living conditions, rest hours and access to medical care" (2017 ITF MLC Guide,p. 4).

For international law, but also working hours and security. The World Employment and Social Outlook 2023 (WESO) states that "in low-income regions, employment in informal economy units tends to be dominant in the absence of minimum wages, largely owing to widespread lax enforcement of labour rights" exacerbating the risks facing workers engaged in informal employment while limiting their access to decent wage jobs (ILO, 2023, p15). In addition, the ILO Violence and Harassment

Convention (No. 190) addresses violence and harassment on board vessels, stressing the importance of zero-tolerance policies by employers. Effective harassment prevention measure would not only improve workplace safety but also the authenticity of inclusion.

4.3.2 Dialogue in the Workplace along with Union-Management Relations

Social dialogue: a foundation for settling workplace disputes and establishing fairer labor circumstances? Based on the Study on Social Dimension of Maritime Transport, it is highlighted that CBAs are necessary to protect workers' entitlements and working conditions in a transnational context. According to the report: “Cross-Border Agreements (CBAs) are still the most potent instrument for securing compliance with social standards across borders” (p.

In addition, unions like the ITF also assist communication between employers and employees, hence working jointly together. As the 2017 ITF MLC Guide puts it, “Social dialogue builds trust and joint action so that government, shipowners and seafarers can work together to tackle issues such as a dispute over levels of wages or safety on board [p.15] These mechanisms are essential in the process of making maritime labour standards equal to global ones.

4.3.3 Mental Health and Well-being of Seafarers

The mental health of seafarers has gained attention due to isolation, long voyages, and stressful working environments. According to the report Empowering Seafarers as Agents of Their Mental Health, “Seafarers often face disproportionate risks of depression, anxiety, and suicide due to prolonged periods of isolation and lack of adequate support” (2024, p. 8).

Employers play a pivotal role in addressing these issues by implementing wellness programs. The report further emphasizes that “mental health initiatives, such as onboard counseling and access to telehealth services, can significantly enhance seafarers’ well-being” (p. 12).

Global initiatives such as those by the ITF are also instrumental in creating awareness and resources. As highlighted in the Maritime Social Sustainability study, “Prioritizing mental health is not only a moral obligation but also a step toward achieving social sustainability in the sector” (2023, p. 20).

4.3.4 Skills development and talent management

The maritime sector faces an urgent need to fill skills gaps through targeted development programs. According to Yıldız et al. (2023), talent management in the container shipping sector requires “effective strategies for recruiting, training and retaining top performers in order to maintain a competitive edge” (p. 320).

Ongoing training programs play an important role in updating seafarers on regulatory changes, technological advances and safety protocols. As the Digital Tools and Human Resource Development Challenges report states, “the introduction of e-learning platforms has democratized access to training, enabling workers to develop essential skills more efficiently” (p. 15).

In addition, skills shortages in emerging economies pose challenges. The ILO working paper (2022) points out that filling these gaps requires “long-term investment in education and vocational training to meet the growing demands of the maritime sector” (p. 19).

4.4 Environmental awareness in maritime freight transport

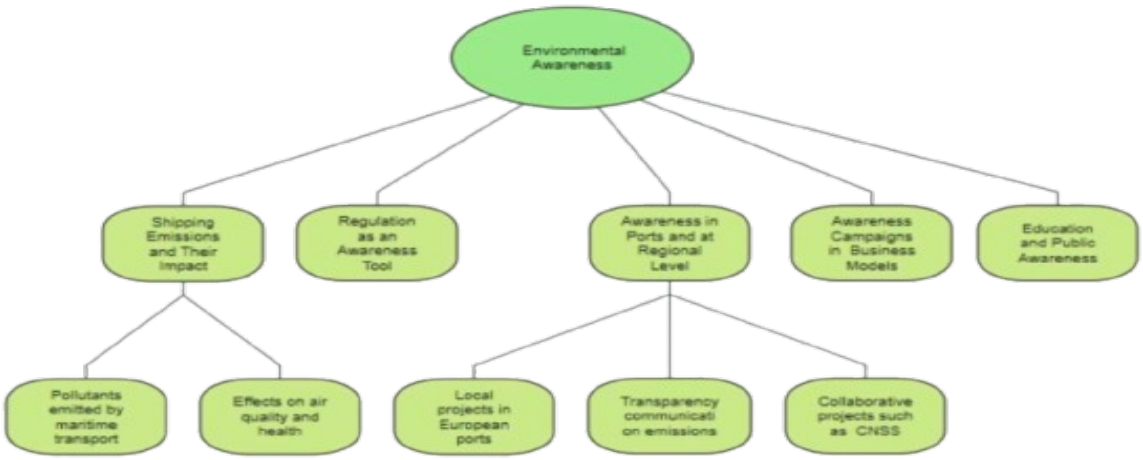

Figure 8 Mind map generated from NVivo 12 illustrating Envrironmental awareness– Computer-Assisted Qualitative Data Analysis Tool.

Environmental awareness in maritime freight transport has become a central element in addressing global sustainability challenges. With maritime transport responsible for approximately 2.9% of

total anthropogenic CO_2 emissions and contributing significantly to other pollutants such as nitrogen oxides (NOx) and sulphur oxides (SOx), the industry is facing increasing pressure to mitigate its environmental impact. This section explores the environmental challenges posed by maritime freight, the regulatory frameworks that guide sustainability, and the role of corporate social responsibility (CSR) in promoting awareness and change.

4.4.1 Shipping Emissions and Their Impact

Maritime freight, while efficient in terms of fuel consumption per tonne-kilometre, has a significant impact on the environment. The Maritime model found that global shipping was responsible for 943 million tonnes of CO_2 emissions in 2017, with sulphur oxides (SOx) and nitrogen oxides (NOx) contributing to acid rain, air pollution and human health problems. These emissions are further exacerbated in high-traffic maritime regions, such as the North Sea and East Asia.

A study by Zhang et al. (2021) found that “94,200 premature deaths worldwide in 2015 were associated with PM2.5 exposure from shipping, of which 83% were related to international shipping”. This highlights the disproportionate impact on vulnerable populations in coastal regions. Furthermore, Aulinger et al. (2015) illustrated the local consequences of shipping emissions in the North Sea region, highlighting those ships contributed up to 25% to NO_2 concentration levels in coastal areas during the summer.

These findings demonstrate the urgent need for targeted emission reductions. As highlighted by Zhang et al. (2021), stricter regulatory frameworks and technological advances are essential to mitigate these negative impacts.

4.4.2 Regulation as an Awareness Tool

The International Maritime Organization (IMO) has implemented various regulatory measures to address the environmental impact of shipping. MARPOL Annex VI, for example, imposes strict limits on the sulphur content of marine fuels, particularly in Emission Control Areas (ECAs). According to IMO (2020, p. 3), “the global sulphur cap was reduced to 0.5% in 2020, a significant decrease from the previous limit of 3.5%”. This has led to substantial reductions in SOx emissions and particulate pollution.

The benefits of these regulations are clear. In the Baltic and North Sea ECAs, sulphur emissions have decreased by around 80%, leading to significant improvements in air quality (Jonson et al., 2015, p. 786). Aulinger et al. (2015, p. 16) noted that “stricter sulphur regulations have been shown to be effective in reducing primary and secondary pollutants, particularly PM2.5, which are directly linked to human health impacts”

However, it remains difficult to implement these regulations uniformly across regions. Denier van der Gon and Hulskotte (2010, p. 22) highlighted that “while developed regions such as Europe have established robust monitoring frameworks, developing countries face significant resource constraints in implementing similar measures”. These disparities highlight the need for international cooperation and capacity building to ensure equitable implementation.

4.4.3 Awareness in Ports and at Regional Levels

Ports play a key role in raising environmental awareness and reducing emissions at the regional level. Initiatives such as the Green Port programme in Rotterdam incorporate real-time emissions monitoring and encourage the adoption of cleaner technologies, such as shore-side electricity (Denier van der Gon and Hulskotte, 2010, p. 24;). These efforts have helped reduce local air pollution, particularly during berthing operations.

Transparency initiatives further enhance awareness. The Clean North Sea Shipping (CNSS) project highlighted the importance of emissions inventories in promoting stakeholder collaboration. Aulinger et al. (2015, p. 18) observed that “the availability of high-resolution emissions data has enabled regional authorities to implement targeted policies and build trust among maritime stakeholders”. These initiatives demonstrate how localized actions can have a broader impact on sustainability.

4.4.4 Awareness Campaigns in Business Models

Shipping companies are progressively integrating Corporate Social Responsibility (CSR) frameworks to better align their operations with sustainability objectives. A notable example of this is the transition to liquefied natural gas (LNG) as an alternative fuel for marine vessels, which marks

a crucial advancement in efforts to diminish carbon emissions. Kramel et al. (2021, p. 12) observed that “LNG-fueled ships emit up to 20% less CO_2 compared to conventional fuel-powered vessels”.

Additionally, collaborative initiatives such as FRET21 in France offer shippers a platform to voluntarily engage in emission reduction efforts. The International Transport Forum (2023, p. 44) states that “Participants in FRET21 adopt measures such as optimizing logistics and shifting to low-carbon transport modes, achieving measurable environmental benefits”. These programs illustrate how CSR can facilitate significant transformations by embedding environmental considerations into corporate strategies.

4.4.5 Education and Public Awareness

Public education and awareness campaigns are essential to foster a culture of sustainability within the maritime sector. Programs targeting maritime professionals, such as training on energy-efficient operations and emission control technologies, equip stakeholders with the tools to implement sustainable practices.

Public engagement initiatives, often led by NGOs, further raise awareness by highlighting the health and ecological impacts of shipping emissions. For example, Denier van der Gon and Hulskotte (2010) highlighted the importance of involving local communities in decision-making processes, noting that “community-level initiatives enhance the legitimacy and effectiveness of sustainability measures.”

Such educational efforts not only build support for stricter policies, but also empower individuals to advocate for cleaner maritime operations. As Jonson et al. (2015), “public awareness campaigns have proven effective in aligning societal values with sustainability goals, thereby encouraging collective action to reduce the environmental footprint of shipping.”

4.5 Environmental Performance in Maritime Freight Transport

Figure 9 Mind map generated from NVivo 12 illustrating Environmental performance– Computer-Assisted Qualitative Data Analysis Tool.

About 80% of all goods traded worldwide are moved by maritime freight transport, which is the foundation of global trade. Nonetheless, it has a significant negative influence on the environment, contributing to air pollution, greenhouse gas emissions, and the deterioration of marine ecosystems. The marine industry has an obligation to improve environmental performance while preserving economic viability as part of Corporate Social Responsibility (CSR). Four key areas—environmental regulation and compliance, clean technologies and innovations, green operational practices, and port management for sustainable development—are the emphasis of this chapter's evaluation of environmental performance.

4.5.1 Environmental Regulation and Compliance

Regulatory frameworks play a significant role in enhancing environmental performance in the maritime transport sector. They enable international environmental standards to be met while encouraging sustainable practice adoption.

The International Maritime Organization (IMO) MARPOL Annex VI is an integral part of maritime environmental regulation, targeting the emissions of nitrogen oxides (NOx) and sulfur oxides (SOx)

in particular. The annex imposes a worldwide 0.5% cap on marine fuels, with even stricter requirements of 0.1% in designated Emission Control Areas (ECAs). Since its imple-mentation, SOx emissions have reduced by more than 70%, particularly reported at the Baltic Sea and North American ECAs (Baltic Sea NECA, 2021, p. 8; Prpić-Oršić et al., 2016, p. 437).

In addition to these regulations, the IMO also established the Energy Efficiency Design Index (EEDI), which demands new vessels to become more and more energy efficient. Vessels brought into service from 2025 have to achieve a 30% improvement on the baseline of 2013. The EEDI encourages innovation in ship design and optimizes the use of new technologies, such as optimized hull design and hybrid powerplants

Besides, the Ship Energy Management Plan (SEEMP) emphasizes efficiency at work, providing shipowners with guidance on fuel efficiency and speed management and maintenance routines. In combination, the SEEMP and the EEDI form an integrated approach to reducing greenhouse gas emissions and attaining sustainability objectives (Facilities for LNG Bunkering, 2020, p. 11; Singh et al., 2023, p. 6).

The regulation of ballast water under the Ballast Water Management Convention seeks to address yet another significant environmental problem. The adoption of mandatory ballast water treatment equipment for foreign vessels seeks to prevent the transmission of alien organisms, which have inflicted environmental and economic harm to vulnerable marine ecosystems, such as the Baltic Sea (Baltic Sea NECA, 2021, p. 9).

4.5.2 Clean Technologies and Innovations

Technological innovations are central to enhancing the environmental sustainability of maritime transportation. These advancements encompass the adoption of alternative fuels, the implementation of dual-fuel engines, and the integration of optimization technologies.

The increasing utilization of alternative fuels, including Liquefied Natural Gas (LNG), biodiesel, and methanol, is pivotal in achieving emission reduction objectives. LNG, for example, virtually eradicates sulfur oxides (SOx) emissions and diminishes nitrogen oxides (NOx) and carbon dioxide (CO2) emissions by approximately 20-25%. Nonetheless, obstacles such as methane slip and insufficient

bunkering infrastructure impede its broader implementation (Du et al., 2023, p. 2; Singh et al., 2023, p. 5).

Dual-fuel engines, which can operate on both traditional fuels and LNG, provide operational flexibility and adherence to rigorous emission standards. These engines have demonstrated efficacy in lowering emissions while ensuring operational efficiency, particularly for vessels navigating in Emission Control Areas (ECAs) (Facilities for LNG Bunkering, 2020, p. 14; Prpić-Oršić et al., 2016, p. 437).

Furthermore, optimization technologies are essential for minimizing fuel consumption. Innovations such as advanced hull designs, energy-efficient propulsion systems, and weather-routing software contribute to reduced drag and enhanced operational efficiency. For instance, real-time weather-routing systems have achieved a 10-15% decrease in fuel consumption, yielding both economic and environmental advantages (The Influence of Route Choice, 2016, p. 439; Du et al., 2023, p. 2).

Electrification represents another promising development, particularly for short-distance vessels. The successful operation of electric ferries in Northern Europe has demonstrated the potential for battery-powered maritime transport to eliminate emissions during service (Sustainability, 2023, p. 6).

Moreover, innovation in termed of transportations VELA young French company has presented a revolutionary innovation: the world's largest sailing cargo trimaran, nicknamed "the plane of the seas". This vessel combines durability, speed and reliability thanks to a 100% sail propulsion system and technologies derived from ocean racing. It ensures transatlantic crossings in less than 15 days while respecting schedules and accommodating sensitive goods in temperature-controlled holds.

This breakthrough significantly reduces the carbon footprint of maritime transport, offering a high-performance ecological alternative. With this vessel, VELA is redefining the future of sustainable transport by combining innovation and environmental responsibility.

The implementation of VELA's sailing cargo trimaran is complex due to technological, financial and logistical challenges. Adapting ocean racing technologies to commercial transport requires major innovations, which increase research, development and construction costs. In addition, international coordination between shipyards, such as Austal, complicates project management.

Furthermore, the maritime sector, historically dependent on fossil fuels, is resistant to change and operational constraints, such as dependence on wind conditions, must be considered to ensure on-time deliveries. Despite these challenges, VELA remains committed to this ambitious vision of sustainable transformation of maritime transport.

4.5.3 Green Operational Practices in Maritime Transport

Operational strategies are essential for realizing immediate and economically viable environmental improvements in maritime transport. By prioritizing sustainable practices, the industry can effectively tackle ecological issues and adhere to regulatory requirements while simultaneously enhancing overall operational efficiency.

Slow steaming, which involves sailing ships at slower speeds to limit fuel consumption, is one of the very specific practices. This approach can lead to a reduction in emissions by as much as 15% per journey, while also prolonging engine life and lowering maintenance expenses. Nevertheless, successful execution of this strategy necessitates meticulous planning, as it often requires modifications to shipping schedules and port activities (Prpić-Oršić et al., 2016, p. 437; Baltic Sea NECA, 2021, p. 11). To maximize the advantages of slow steaming, optimized routing can be integrated. By utilizing real-time meteorological data, sea conditions, and sophisticated predictive models, ships can circumvent unfavorable weather, shorten travel durations, and ensure safe passage. This synergy of strategies illustrates how operational adjustments can produce both efficiency and sustainability benefits (Du et al., 2023, p. 2; Singh et al., 2023, p. 5).

Another vital aspect is ballast water management, which is crucial for safeguarding marine ecosystems. The conventional practice of discharging ballast water can lead to the introduction of invasive species, thereby threatening local biodiversity. However, contemporary systems that utilize filtration and ultraviolet (UV) treatment have proven effective in mitigating these risks. These technologies, increasingly implemented in areas like the Baltic Sea, represent a proactive approach

to ecological conservation, significantly lowering the environmental hazards linked to global shipping (Baltic Sea NECA, 2021, p. 9). As international regulations, such as the Ballast Water Management Convention, become more rigorous, the adoption of these technologies is expected to become standard practice within the industry. Onboard waste management also plays a significant role in promoting greener operations. Implementing robust recycling programs and waste segregation systems not only ensures compliance with strict port regulations but also reduces the volume of waste entering marine ecosystems. Ships equipped with advanced waste treatment systems can process materials such as plastics, food waste, and oils onboard, minimizing the need for disposal at sea. These efforts align closely with corporate social responsibility (CSR) objectives and demonstrate the maritime sector's commitment to reducing its ecological footprint (Facilities for LNG Bunkering, 2020, p. 14).

Ultimately, these green operational practices, when integrated into the broader framework of environmental governance, highlight the potential for maritime transport to transition toward sustainable operations. By prioritizing efficiency, reducing emissions, and safeguarding marine ecosystems, the industry can achieve a balance between economic growth and environmental responsibility.

4.5.4 Port Management for Sustainable Development

Because they serve as centers for innovation and regulation, ports are essential to promoting sustainable maritime practices.

Ships can turn off their auxiliary engines while docked thanks to shore power systems that electrify ports. By doing this, local emissions are eliminated, enhancing the quality of the air in cities close to ports. This technique has been pioneered by ports in Scandinavia and California, which have reduced dockside emissions by up to 98% (Baltic Sea NECA, 2021, p. 10; Facilities for LNG-Bunkering, 2020, p. 15).

In ship recycling, the circular economy strategy has also gained traction. Green recycling techniques minimize hazardous waste while recovering valuable materials in accordance with the Hong Kong International Convention. Environmental damage from shipbreaking operations has

been greatly decreased in European ports that specialize in environmentally friendly disassembly (Sustainability, 2023, p. 6).

Finally, ports that incentivize green shipping practices enhance their competitiveness. Programs such as the Environmental Ship Index (ESI) reward vessels that exceed regulatory standards, fostering widespread adoption of sustainable technologies (Singh et al., 2023, p. 6; Facilities for LNG Bunkering, 2020, p. 15).

4.6 Sustainable Practices in maritime freight sector

Figure 10 Mind map generated from NVivo 12 illustrating Sustainable practices – Computer-Assisted Qualitative Data Analysis Tool.

The shipping industry at sea is a vital foundation of global trade, but it is also a significant source of environmental problems. As the industry faces growing criticism, alternative fuels have emerged as a possible answer to reducing emissions and achieving sustainability goals. Alternative fuels such as liquefied natural gas (LNG), hydrogen, ammonia, and biofuels are leading the way in helping companies make cleaner ways of doing business a reality, promising the possibility of finding a balance between environmental responsibility and operational necessity.

4.6.1 Alternative fuels

Liquefied natural gas (LNG)

LNG has become a popular transitional fuel due to its ability to reduce harmful emissions such as sulfur oxides and nitrogen oxides. Although it is much cleaner than traditional heavy fuel oil, its use is still subject to criticism due to the release of methane, i.e. unburned methane that can escape during operations. This poses a challenge, as methane is a potent greenhouse gas. Despite this limitation, LNG remains a serious contender in the industry's journey towards sustainability.

Hydrogen and ammonia

Hydrogen is often referred to as the “fuel of the future” for shipping, especially when produced from renewable energy sources. Its main appeal lies in its zero-emission potential, but challenges such as high production costs and the need for specialized infrastructure make widespread adoption a longer-term goal. Ammonia, a hydrogen derivative, offers higher energy density and is easier to store, but its toxic nature and limited global supply chain present significant obstacles.

Biofuels

Biofuels are distinguished by their ability to be used in existing ship engines with minimal modifications, making them an attractive option for immediate impact. Derived from organic matter such as algae and waste, biofuels help reduce dependence on fossil fuels. However, their scalability is limited by land-use constraints and competition with food production, raising questions about their long-term feasibility.

Methanol and ethanol

These alcohol-based fuels are attracting attention because of their low sulfur content and biodegradability. Methanol is seen as a practical option for gradual adoption, as it can be blended with conventional marine fuels. However, like hydrogen and ammonia, these fuels require significant advances in distribution networks to become viable on a global scale.

4.6.2 Operational practices

Operational efficiency enables immediate reductions in emissions while improving profitability. Key practices include

Slow sailing: Vessels traveling at slower speeds consume less fuel, reducing emissions by up to 15% per trip (Prpić-Oršić et al., 2016, p. 437).

Optimized routing: using advanced weather routing software can reduce fuel consumption and enhance safety. “Real-time weather routing systems have achieved a 10-15% reduction in fuel consumption on average” (Du et al., 2023, p. 2).

Ballast water management: Preventing the introduction of invasive species by disinfecting ballast water using UV or filtration technologies is now mandatory under the IMO Ballast Water Management Convention (Baltic Sea NECA, 2021, p. 9).

4.6.3 Energy efficiency technologies

Improving energy efficiency is at the heart of maritime sustainability efforts, and technological innovation is driving these changes. One critical area is the optimization of hull design, where advances in hydrodynamic engineering are making ships more aerodynamic. A better-designed hull reduces water resistance (drag), enabling ships to consume less fuel while maintaining the same speed. These improvements are particularly important for large vessels such as bulk carriers and tankers, which consume considerable quantities of fuel.

Another advance is the use of dual-fuel engines, which enable ships to run on both conventional fuels and cleaner alternatives such as LNG. This technology enables companies to comply with emissions regulations without making a full and immediate commitment to LNG infrastructure. Dual-fuel engines act as a bridge, offering immediate environmental benefits while promoting a gradual transition to greener energies.

For shorter sea routes, electrification is gaining ground. Battery-powered ships, such as the electric ferries in Northern Europe, eliminate emissions completely during operation. These ferries prove

that electrification can be viable for local shipping, although challenges such as battery capacity and charging infrastructure remain obstacles for larger or longer-distance vessels.

4.6.4 Innovative shipping models

Shipping models are evolving rapidly to meet the challenges of sustainability. One of the most exciting developments is the rise of wind-assisted vessels, a modern version of traditional sailing ships. Companies like VELA are spearheading this innovation by combining advanced aerodynamics with renewable wind energy. Not only do these vessels reduce emissions to zero, but they also maintain competitive speeds for transoceanic trade. Although they are highly dependent on weather conditions, their potential to revolutionize carbon-neutral transport is enormous.

Similarly, autonomous vessels are beginning to reshape the sector. Thanks to AI and automation, these vessels optimize routes, improve fuel efficiency and reduce human error. Autonomous technology streamlines operations, reducing unnecessary fuel consumption and ensuring safer voyages. These models offer a glimpse into the future of shipping, where technology and sustainability work hand in hand to meet global demand while minimizing damage to the environment.

4.7 Competitiveness in maritime freight transport

Figure 11 Mind map generated from NVivo 12 illustrating Competitive performance– Computer-Assisted Qualitative Data Analysis Tool.

This section is going to explore the drivers for competitive performance in the carriage of seaborne freight and how their adoption can achieve sustainability and long-term economic viability within the industry.

In addressing this question, it is important to understand what "competitive performance" means within the context of marine freight. Competitive performance consists of the capacity of the maritime transport companies to be operationally efficient, to innovate, and differentiate at low regulatory and sustainability costs. In the words of Franc and Van der Horst (2010, p. 560), "the success of a maritime supply chain depends on its capacity to integrate both sea and hinterland networks seamlessly, reducing transaction costs and fostering synergies across stakeholders"

The analysis divides competitive performance into five key aspects, namely: sustainable growth and innovation; economy of scale and consolidation; reduction of operational costs and resource management; economic and ecological performances; and competitive differentiation strategies. These are discussed below.

Sustainable growth and innovation are crucial in maintaining competitiveness in maritime freight. This includes adopting strategic alliances and resource-sharing models that enable firms to pool resources and expertise. As observed in the alliances formed by shipping giants like Maersk and MSC, resource sharing reduces costs and improves service quality (Franc & Van der Horst, 2010, p. 561).

M&A also drives consolidation in the industry. Through their mergers with small companies or the acquisition of terminal operators, companies achieve economies of scale and a stronger market position. The trend is more pronounced in the creation of mega-carriers to meet the high demands for global trades.

Economy of Scale and Consolidation are part and parcel of maritime competitiveness. With a bigger vessel and a greater carrying of containers, the companies are able to carry more goods in one trip and minimize costs per unit. In light of this statement, Rintamäki (2020, p. 23) posits, "Investing in larger vessels not only improves capacity utilization but also aligns with energy efficiency standards, reducing overall environmental impact.".

Consolidation also extends to integrating port operations with inland logistics, creating a seamless supply chain. Vertical integration by firms like CMA CGM into rail and barge services enhances connectivity and reduces delays.

Operational Cost Reduction and Resource Efficiency

Operational cost efficiency is a significant factor that shapes competitive performance. Companies adopt various strategies that help minimize fuel consumption, such as route optimization and slow steaming. According to Muñoz García (2020, p. 14), "slow steaming cuts CO2 emissions up to 30%, hence a must-apply strategy if the IMO 2020 regulations requirements are to be met".

This is further complemented by the use of alternative fuels such as LNG and biofuels. These innovative solutions respond to both economic and ecological imperatives through cost minimization in operation and compliance with highly restrictive emission standards.

In the shipping industry, economic performance does not exist in a vacuum devoid of ecological consequences. So far, DEA has been a popular method for efficiency analysis in shipping operations and port activities, aiding improvement efforts with practical recommendations.

Besides, the usage of environmental KPIs is gaining momentum in corporations to account for ecological performance: "A KPI like CO2 emissions per ton-mile would help align with global sustainability goals and increase transparency in sustainability reporting" (Rintamäki, 2020, p. 38).

Competitive differentiation Strategies through CSR and sustainability initiatives is also gaining momentum. As Saila Rintamäki (2020, p. 87) points out, "corporate social responsibility initiatives, such as investing in reducing emissions and investing in community development, have been important building blocks to stakeholder trust and brand equity.".

Companies like Maersk have used CSR as a competitive advantage, stating that their businesses align with the SDGs of the UN: economic growth concentrated on climate action and innovation in infrastructure.

4.8 Financial performance in maritime freight sector

Figure 12 Mind map generated from NVivo 12 illustrating Financial Performance– Computer-Assisted Qualitative Data Analysis Tool.

This section explores the factors driving financial performance in the maritime freight industry, emphasizing how adopting strategic practices ensures long-term economic sustainability and competitiveness. The analysis follows the structure of the mind map provided and integrates key concepts from maritime business strategies and sustainable practices.

Eco-innovations are essential in enhancing financial performance while addressing sustainability challenges. These technologies enable compliance with international regulations and reduce operating costs through efficiency gains.

The shift towards Liquefied Natural Gas (LNG) as a primary fuel has significantly reduced greenhouse gas emissions and operational costs. LNG adoption not only aligns with International Maritime Organization (IMO) regulations but also provides cost savings by reducing dependency on conventional fuels. As observed, LNG fleets result in fewer emissions fines and long-term savings (Rintamäki, 2020, p. 87).

The maritime industry's focus on lowering CO_2 emissions helps avoid penalties while contributing to corporate social responsibility goals. Technologies such as slow steaming and route optimization

reduce fuel consumption, leading to measurable financial benefits while meeting sustainability standards (Muñoz García, 2020, p. 14).

Compliance with MARPOL Annex VI standards ensures a significant reduction in environmental liabilities. By adhering to these regulations, firms avoid fines and build a reputation as environmentally responsible companies, which is a growing competitive advantage in global markets.

Achieving a competitive advantage in the maritime industry requires a focus on customer satisfaction, brand reputation, and differentiation strategies.

Firms investing in eco-innovative and sustainable practices foster trust among stakeholders and improve brand equity. For instance, companies like Maersk have leveraged CSR initiatives to align with UN Sustainable Development Goals, creating a positive market perception (Rintamäki, 2020, p. 87).

Customer loyalty is enhanced through consistent quality service and sustainability initiatives. Firms that demonstrate environmental responsibility attract clients who prioritize ethical and sustainable business practices, leading to repeat business and higher revenues.

5 Discussion

5.1 Limitations, reliability and validity

First of it is important to note that this paper is based on secondary data and relevant publications. And therefore, gathering sufficient data of good quality was the primary focus. However, gathering data of good quality on the maritime freight transport with such a current subject and define objective was a difficult journey. Maritime freight sector is a sector that are international and national difference but this sector act on international and company don’t communicate easily on their success or failure.

To overcome this limitation, the authors realized methodological research and especially analyzed documents covering large numbers of different sources and subject to find find relevant data to analyse. This allowed the author to get a huge classification of data about, social norms, financial

performance, and how maritime transport are thinking in the future, especially about environmental performance.

Finding relevant research on how effective CSR strategies is wasn't easy. Most of publication explained and gave way of doing this Social and environmental upgradation but few documentshighlight the success of this kind of Methode. It is also important to know that, because of its slow evolution cause of technological issues, grasping financial and ecological performance can be somewhat challenging.

5.2 Answering the research questions

Throughout this research, these main questions were asked by the author ;

RQ1: What are Sustainable practices in Maritime freight transport sector in the context of CSR ?

RO1: To find out what are Sustainable practices in Maritime freight transport sector in the context of CSR thought archival research based on secondary data in form of relevant publications.

The research, relying on secondary data, explored sustainable practices within the maritime freight sector, focusing on their alignment with Corporate Social Responsibility (CSR) principles. These findings highlight how the industry addresses sustainability challenges, emphasizing environmental stewardship while balancing economic objectives.

The maritime freight sector demonstrates a significant commitment to sustainability through the adoption of innovative practices. Key initiatives include the shift to alternative fuels like Liquefied Natural Gas (LNG), hydrogen, and ammonia, all of which aim to reduce greenhouse gas emissions. LNG, for instance, has been pivotal in reducing sulfur oxides (SOx) and nitrogen oxides (NOx), aligning with the International Maritime Organization's (IMO) MARPOL Annex VI standards. However, challenges like methane slip and high implementation costs underscore the complexity of these transitions.

Operational practices also play a critical role. Strategies such as slow steaming and optimized routing have reduced fuel consumption and emissions by up to 15% per journey. Furthermore, ballast water management systems, incorporating UV or filtration technologies, have proven effective in mitigating the ecological risks associated with invasive species.

Technological innovations have further enhanced energy efficiency. Advanced hull designs and dual-fuel engines are fostering significant improvements in fuel economy and emissions reductions. Additionally, the emergence of wind-assisted and autonomous vessels exemplifies the industry's efforts to integrate cutting-edge solutions into sustainable operations.

Port sustainability is another cornerstone of these practices. Initiatives such as shore-side electricity and green port programs have successfully minimized emissions during docking, contributing to improved air quality in port cities. Furthermore, recycling programs and waste management systems align closely with CSR objectives, reducing the maritime sector's ecological footprint.

Despite these advancements, challenges remain, including high adoption costs, regulatory disparities, and technological limitations. Addressing these barriers will require collaborative efforts among stakeholders, innovative financing mechanisms, and supportive regulatory frameworks.

In conclusion, sustainable practices in maritime freight transport underscore the sector's commitment to CSR, aiming to reconcile environmental and economic goals. The findings illustrate a pathway toward a more sustainable maritime industry, driven by innovative technologies, operational strategies, and robust policy support. These efforts are crucial for achieving long-term environmental and economic resilience in the global shipping landscape.

5.3 Dialogue between key results and knowledge base

The findings of this research provide a clearer understanding of how CSR and economic growth are currently connected in the maritime freight sector. While the topic remains complex, this study helps to open up new directions for future exploration.

Among the key sources considered in this work, one study looked into electric propulsion as a potential alternative to traditional marine fuel (Giuffrida et al., 2023). This approach appears promising in terms of sustainability, offering a cleaner solution to tackle maritime pollution. That said, electric propulsion still involves significant costs in terms of R&D, as the technology is not yet fully developed. As pointed out in Chapter 4.6.2, another practical solution could be slow steaming: ships moving at reduced speeds tend to consume less fuel, which can lead to emission reductions of up to 15% per journey (Prpić-Oršić et al., 2016, p. 437).

In Chapter 4.3.1, results suggested that better harassment prevention policies not only enhance workplace safety but also strengthen a culture of inclusion. This aligns with the findings of Budziewicz-Guźlecka and Drab-Kurowska, who showed that raising CSR awareness within maritime freight companies can have a direct impact on environmental practices.

Sustainable strategies in the maritime freight industry were also discussed in Chapter 4.6. These include actions that may lower the environmental cost of transporting goods. According to Golnar and Beškovnik (2020), reducing sailing speed has a major impact on emissions: cutting speed by 20% can reduce energy consumption by 33.8%, and CO_2 and GHG emissions by 33.9%.

Chapter 4.7 focused on the role of competitiveness and how it connects with financial performance through CSR. It became clear that competitiveness in this sector can also support sustainability. Rintamäki (2020) notes that most leading container shipping companies now invest in larger vessels, not just for better capacity, but also because it helps them meet energy efficiency targets and reduce environmental impact overall.

Taken together, the findings of this study suggest that CSR can contribute to better financial performance in the maritime freight sector—often through cost savings. Looking ahead, it would be interesting to further explore how CSR affects financial performance from an accounting perspective, to what extent international CSR regulations are adopted, and what specific practices companies choose to follow (or ignore).

5.4 Compliance with research ethics guidelines

This research adhered strictly to ethical standards in using secondary data from reliable publications. All data were sourced from credible materials and properly referenced.

Additionally, the study ensured confidentiality and anonymity by obtaining appropriate permissions for accessing data and mitigating any potential risks. Ethical considerations were integral to the data analysis process, with biases and limitations identified and addressed transparently.

Recognizing the inherent constraints of secondary data, the author adopted a critical approach to mitigate assumptions and cross-verified findings using multiple sources and methods, ensuring the research's validity and integrity.

6 Conclusions

6.1 Key Findings

The maritime freight sector demonstrates a growing commitment to integrating sustainable practices under the framework of Corporate Social Responsibility (CSR). Key findings highlight the sector’s efforts to minimize environmental impact, enhance social responsibility, and achieve economic sustainability. Initiatives such as the adoption of alternative fuels, operational efficiencies like slow steaming, and advancements in green technologies align with global decarbonization goals and CSR principles.

Progress has been notable in areas such as emissions reduction, adoption of green technologies, and port sustainability initiatives like shore-side electricity and recycling. However, challenges remain in areas such as the integration of circular economy principles, efficient waste management, and the full implementation of sustainable supply chain management practices.

The findings underscore the critical role of CSR in fostering business sustainability in the maritime freight sector. Companies that emphasize social, environmental, and economic values are more likely to achieve resilience and long-term growth while positively impacting global ecosystems and

communities. Nevertheless, the findings highlight the need for continuous improvement to address remaining gaps and overcome economic and technological challenges.

6.2 Managerial implications

Managers in the maritime freight sector can draw actionable insights to align their operations with CSR principles. The adoption of alternative fuels such as LNG and hydrogen, despite cost barriers, can significantly reduce emissions and comply with IMO regulations. Operational practices like slow steaming and ballast water management should be prioritized for their immediate environmental and economic benefits.

Supply chain transparency is essential, requiring robust management systems and collaboration with partners to ensure responsible sourcing and adherence to CSR standards. Social responsibility should focus on improving working conditions, supporting equitable labor laws, and promoting workforce development to address the challenges faced by seafarers.

Environmental priorities should emphasize energy efficiency, resource conservation, and waste reduction. Investments in green technologies, such as wind-assisted propulsion and electrification, can drive sustainable growth. Simultaneously, long-term economic models that integrate sustainability with profitability should be adopted to ensure financial resilience and stakeholder trust.

6.3 Recommendations for future research

Future research should explore the interplay between stakeholder engagement—especially among customers, employees, and regulatory bodies—and the implementation of CSR in the maritime freight sector. Examining how these groups influence sustainability practices can provide deeper insights into collaborative solutions for industry-wide challenges.

While this study relied on secondary data, future research should employ primary data collection methods, such as interviews and surveys, to better understand the operational challenges and opportunities for implementing sustainable practices. Additionally, research on the economic feasibility of emerging technologies, such as ammonia-fueled ships and autonomous vessels, would provide actionable insights for overcoming current barriers to innovation and sustainability. These

efforts would enhance the maritime freight sector's contribution to achieving global environmental and economic goals.

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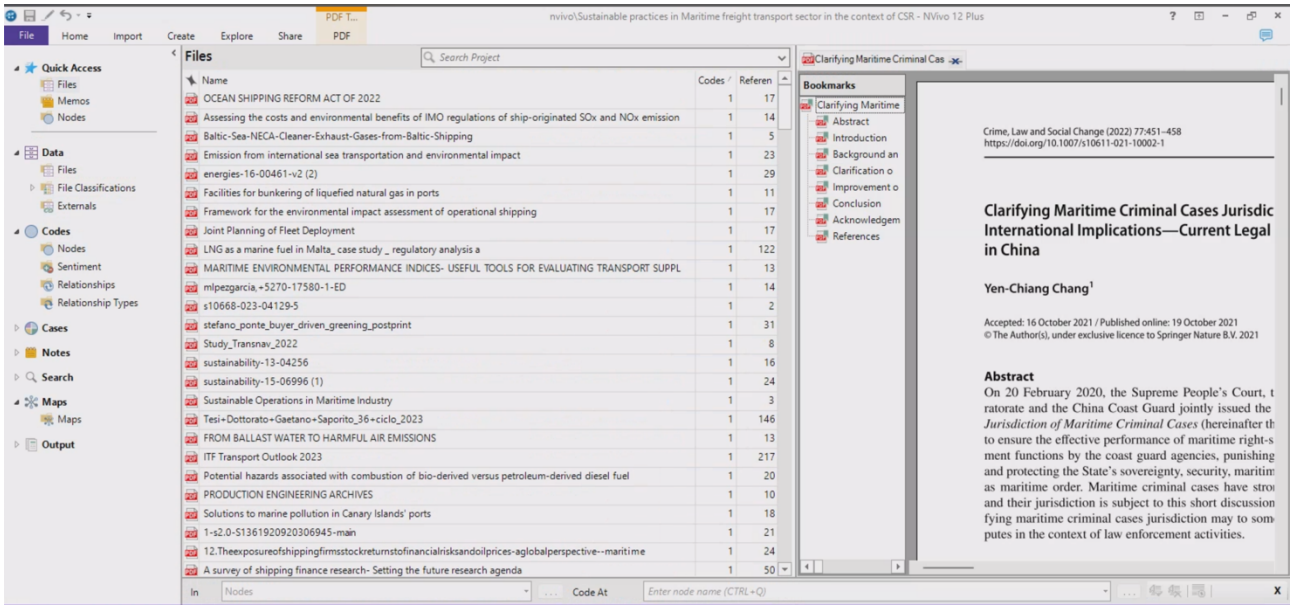
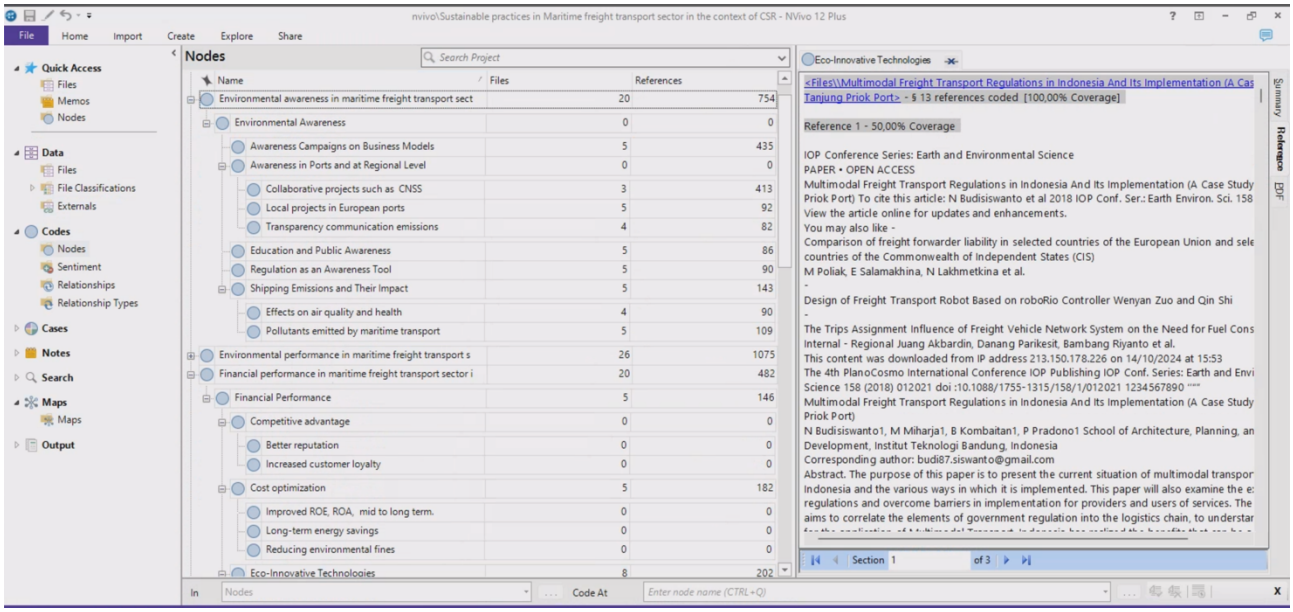
Appendix

Appendix 1. A screenshot displaying the publications uploaded as secondary data in the NVivo 12 program.



Appendix 2. A screenshot displaying the nodes generated during the data analysis phase using the NVivo 12 program.



Appendix 3. Quotes from relevant publications to highlight the evidence of figure 5

Laws and Regulations	
Appendix 3.1: Definition of Terms	"The maritime transport sector… is subject to the regulation of two, running in parallel, although to a large extent independently from each other, and hence, not fully coordinated with each other, regulatory subsystems. Each of them has its own independent regulatory mechanism influencing directly the real activity of the maritime transport sector" (Grzelakowski, 2013, p. 452) "The International Maritime Convention serves as the regulatory framework that outlines the obligations of maritime carriers. It establishes guidelines for the apportionment of risks and the equitable distribution of rights and responsibilities between carriers and goods owners" (A Freight Forwarder's Responsibility, 2017, p. 2) "The term maritime law… refers to the legal aspects associated with ships, the personnel engaged in or in proximity to them, and the transportation of products by commercial vessels" (A Freight Forwarder's Responsibility, 2017, p. 3)

	"The legal framework also includes conventions like the Rotterdam Rules, which seek to modernize cargo liability laws… offering greater clarity in liability distribution among carriers and shippers" (A Close Look at Development and Prospect of Rules Governing Carriage of Goods by Sea, p. 24)
Appendix 3.1.1: Economic Regulation and Market Management	"The purpose of this Act is to promote the growth and development of United States exports through a competitive and efficient system for the carriage of goods by water in the foreign commerce of the United States, and by placing a greater reliance on the marketplace" (Ocean Shipping Reform Act, 2022, p. 2) "Maritime transport sector just like many other forms and areas of international commercial and economic activity has been regulated for ages… subject to regulation of the complex system which consists of two indpendent… subsystems: a public subsytem… and an autonomous subsystem based on freight market regulatory processes" (Grzelakowski, 2013, p. 451) "The fourth listed statutory goal of U.S. regulation of international ocean shipping is to promote the growth and development of United States exports through competitive and efficient ocean transportation and by placing

	greater reliance on the marketplace" (Shipping, Ports, and the Federal Maritime Commission, 2021, p. 3)
Appendix 3.1.1.1: Freight Markets and Free Competition	"The global maritime transport sector performs its duties within a well-developed typical international market framework, still substantially fragmented. It is characterized currently in general by a well-advanced degree of liberalization" (Grzelakowski, 2013, p. 452) "Freight rate volatility and unpredictability undermine the competitiveness of developing countries and expose exporters to unmanageable transport costs" (UNCTAD, 2023, p. 53) "Attempts taken to regulate freight markets are generally focused on the supply side, both on potential and effective one" (Grzelakowski, 2013, p. 453)
Appendix 3.1.1.2: Antitrust and FMC	"The FMC is charged by law with protecting the interests of U.S. shippers in international trade. It oversees the practices of U.S. ports and marine terminal operators, licenses U.S. ocean freight consolidators, and investigates claims by U.S. liner carriers of unfair practices by their foreign counterparts" (Shipping, Ports, and the Federal Maritime Commission, 2021, p. 2)

	"Carriers serving the United States have thus been given a certain amount of antitrust immunity, under the regulation of the FMC, that is not available to most other businesses… The intent is to prevent rate wars and foster a more stable market for ocean shipping" (Shipping, Ports, and the Federal Maritime Commission, 2021, p. 6) "Carriers have traditionally affected their limited antitrust immunity by participating in two types of agreements with one another: rate discussion agreements (RDAs) and vessel sharing agreements (VSAs)… The nonbinding nature of the agreements is a key feature that has limited the carriers' ability to fix prices" (Shipping, Ports, and the Federal Maritime Commission, 2021, p. 7)
Appendix 3.1.2: International Legal Framework	"The United Nations Convention on the Law of the Sea (UNCLOS) is a foundational document that establishes the legal framework for the use and protection of the world's oceans" (Law of the Sea.pdf, p. 1) "While the Rotterdam Rules represent progress in unifying legal standards, resistance to adoption stems from conflicting regional priorities and the persistence of older conventions like the Hague-Visby Rules" (A Close Look at

	Development and Prospect of Rules Governing Carriage of Goods by Sea, p. 24) "The IMO has cemented its role as a global standard-setting institution in maritime affairs over the years by learning to navigate the intricacies of a multi-layered public governance system" (Introduction to the Law and Practice of the IMO, p. 5)
Appendix 3.1.2.1: IMO	"IMO's mandate focuses mainly on the promotion of safe, secure, environmentally sound, efficient and sustainable shipping" (*IMO's Contribution to International Law*, 2014, p. 489). "IMO 2020 marks a pivotal step in reducing maritime sulfur emissions, though compliance has introduced significant costs for shippers, ranging from fuel switching to retrofitting vessels with scrubbers" (*The Likely Implications of the New IMO Standards on the Shipping Industry*, 2018, p. 285). "Following the adoption of a number of short-term measures since 2011, ongoing work at IMO is focusing on medium and long-term measures… A Revised Strategy with strengthened levels of ambition was adopted at the 80th session of the Marine Environment Protection Committee (MEPC 80), held by the IMO

	in July 2023" (*Review of Maritime Transport*, UNCTAD, 2023, p. 59).
Appendix 3.1.2.2: UNCLOS	"The United Nations Convention on the Law of the Sea (UNCLOS) has established a common ground for governments to negotiate, collaborate, and resolve conflicts concerning marine boundaries, resource extraction, and environmental conservation" (*Law of the Sea*, 2023, p. 2) "The preservation of navigation rights is a cornerstone of maritime law. The notion of innocent passage and the right of transit passage in international straits ensure that vessels of all states can navigate freely. This not only helps global trade, but it also promotes economic interconnectivity and peaceful coexistence" (*Law of the Sea*, 2023, p. 3) "The high seas shall be reserved for peaceful purposes. Freedom of navigation… shall be exercised by all States with due regard for the interests of other States in the exercise of the freedom of the high seas" (*IMO's Contribution to International Law*, 2014, p. 533)
Appendix 3.1.2.3: Rotterdam, Hague-Visby, Hamburg Rules	"The first breakthrough took place with the negotiations of the Brussels Convention for the Unification of Certain Rules of Law Relating to Bills of Lading ('Hague Rules') in the 1920s. As the laws lagged behind commercial practice,

	the second attempt at uniformity was the Visby amendments to the prior convention ('Visby Rules')" (*A Close Look at Development and Prospect of Rules Governing Carriage of Goods by Sea*, p. 3) "While the Rotterdam Rules represent progress in unifying legal standards, resistance to adoption stems from conflicting regional priorities and the persistence of older conventions like the Hague-Visby Rules" (*A Close Look at Development and Prospect of Rules Governing Carriage of Goods by Sea*, p. 24) "The provisions concerning the carrier's liability outlined in these regulations merge the negligence liability system from the 'Hamburg Rules' with the burden of proof allocation more akin to that of the 'Hague Rules'" (*A Freight Forwarder's Responsibility for the Carriage of Goods by Sea According to National and International Laws*, p. 4)
Appendix 3.1.3: Legal Responsibilities and Security goods	"The duties of freight forwarders extend beyond cargo logistics to include legal compliance and mitigating risks, particularly in cases of disputes or delays" (*A Freight Forwarder's Responsibility for the Carriage of Goods by Sea According to National and International Laws*, 2024, p. 41)

	"Freight forwarders who play a role and participate in the transportation process, even though they do not participate directly, are still responsible for fulfilling the achievements in the agreement" (*A Freight Forwarder's Responsibility for the Carriage of Goods by Sea According to National and International Laws*, 2024, p. 4) "The freight forwarder assumes the principal role, they will bear liability in most carriage claims, as the agent is typically at the center of the dispute" (*A Freight Forwarder's Responsibility for the Carriage of Goods by Sea According to National and International Laws*, 2024, p. 5)
Appendix 3.1.3.1: Freight Forwarders, contractual duties	"The freight forwarder assumes the principal role, they will bear liability in most carriage claims, as the agent is typically at the center of the dispute. However, agents can also take on the principal role if agreed upon in the contract" (*A Freight Forwarder's Responsibility for the Carriage of Goods by Sea According to National and International Laws*, 2024, p. 5) "Freight Forwarders will be held liable as a carrier, following pertinent provisions, if they arrange transportation of the shipment in accordance with freight forwarding contract, assume contractual responsibility for its fulfillment, and come to an explicit agreement with

	the principal" (*A Freight Forwarder's Responsibility for the Carriage of Goods by Sea According to National and International Laws*, 2024, p. 6) "The legal protection that can be provided and accessed by agents providing sea transportation services is very dependent on the agreement's contents. For this reason, the parties must agree on the carrier's obligations and the burden of proof in transporting goods by sea. Violation of this obligation is a reason for liability" (*A Freight Forwarder's Responsibility for the Carriage of Goods by Sea According to National and International Laws*, 2024, p. 6)
Appendix 3.1.3.2: Ships Arrest	"Arrest means any detention or restriction on removal of a ship by order of a Court to secure a maritime claim, but does not include the seizure of a ship in execution or satisfaction of a judgment or other enforceable instrument" (*International Convention on Arrest of Ships*, 1999, Article 1(2)) "A ship may be arrested or released from arrest only under the authority of a Court of the State Party in which the arrest is effected. A ship may only be arrested in respect of a maritime claim but in respect of no other claim" (*International Convention on Arrest of Ships*, 1999, Article 2(1-2))

Appendix 4. Quotes from relevant publications to highlight the evidence of figure 6

Legal awareness in maritime freight sector	
Appendix 4.1: Definition of Terms	"Legal awareness includes familiarity with the applicable legal framework, obligations, and the consequences of non-compliance." (Giancaspro, 2023, p. 5). "Legal awareness is the foundation for risk management and strategic decision-making in international transport and logistics." (Sharabayko, 2021, p. 3). "Stakeholders must recognize that a lack of legal awareness can increase exposure to liabilities and negatively affect operational continuity." (ESCAP, 2020, p. 2). "Building legal awareness across all levels of staff in logistics and transport enterprises is a key preventive tool against disputes and regulatory sanctions." (ESCAP, 2021, p. 1).
Appendix 4.1.1: Legal Compliance	"Legal compliance in the shipping sector requires the integration of applicable international, regional, and national laws into daily operational practices." (International Maritime Organization, 2019, p. 6).

	"Failure to comply with cyber risk management obligations may lead to detention by port State control authorities, exposing shipowners to contractual and regulatory liabilities." (UNCTAD, 2021, p. 128). "Compliance with IMO's mandatory cybersecurity measures should be embedded in the Safety Management System in accordance with the ISM Code." (BIMCO et al., 2021, p. 2). "Effective legal compliance in maritime operations demands proactive alignment with evolving IMO regulations and conventions." (UNCTAD, 2021, p. 127).
Appendix 4.1.2: Due Diligence	"The duty of due diligence in maritime operations is closely linked to ongoing assessment of cybersecurity and physical risks onboard ships." (BIMCO et al., 2021, p. 4). "Due diligence requires a proactive understanding of contractual obligations and associated liabilities throughout the transport chain." (UNCTAD, 2003, p. 83). "Carriers are expected to exercise due diligence in ensuring vessel seaworthiness, crew competence, and regulatory compliance." (International Maritime Organization, 2020, p. 5).

Appendix 4.1.3: Risk management & Legal Awareness	"Risk management in maritime logistics must integrate legal awareness to identify, assess, and respond to regulatory threats that may affect continuity of operations." (Sharabayko, 2021, p. 6). "Legal knowledge is essential for the identification and prioritization of legal risks that may arise from multimodal transport obligations." (UNCTAD, 2003, p. 44). "Risk management procedures should be legally grounded to ensure accountability and minimize liability in case of disruptions." (International Maritime Organization, 2020, p. 11).
Appendix 4.1.4: Stakeholder Engagement and Legal Duties	"Legal duties in maritime transport are shared among stakeholders, requiring coordinated engagement to ensure compliance with international obligations." (International Maritime Organization, 2020, p. 5). "The successful implementation of legal instruments depends on the ability of all actors to understand and fulfill their duties under complex regulatory systems." (Sharabayko, 2021, p. 9). "Legal awareness fosters inclusive stakeholder participation and ensures that contractual, environmental, and safety responsibilities are effectively fulfilled." (ESCAP, 2020, p. 3).

Appendix 5. Quotes from relevant publications to highlight the evidence of figure 7

Social normal in maritime freight sector	
Appendix 5.1: Definition of Terms	"The cultural component, which concerns seafarers' confidence to interact with their multicultural peers, is part of maritime social sustainability" (Karakasnaki et al., 2023, p. 9) "Cultural and linguistic barriers among seafarers of mixed cultures can cause significant problems in understanding" (Jensen & Oldenburg, 2020, p. 5) "Addressing the cultural component is deemed rather important, as the management of different cultures onboard may bring benefits, such as improving crew team cohesion and performance" (Theotokas & Progoulaki, 2007, p. 8)
Appendix 5.1.1: Labor Rights and Working Conditions	"Seafarers' employment and social rights include the right to a safe and secure workplace, fair terms of employment, decent living and working conditions, and access to medical care and social protection" (ITF, 2017, p. 23) "The MLC incorporates 68 existing maritime labour conventions and recommendations to ensure decent working and living conditions for all seafarers" (ITF, 2017, p. 1) "The study concluded that seafarers working on open vessels were more likely to have temporary

	contracts… almost half reported that their company did not make pension contributions" (Sampson et al., 2018, p. 107) "The Directive specifies maximum hours of work as: 14 hours in any 24-hour period and 72 hours in any seven-day period… with minimum rest of 10 hours per day and 77 hours per week" (European Commission, 1999, p. 109)
Appendix 5.1.1.1: ILO Convention	"The Maritime Labour Convention, 2006 (MLC), otherwise known as the Seafarers' Bill of Rights, incorporates and builds on sixty-eight existing maritime labour conventions and recommendations to ensure decent working and living conditions for all seafarers" (ITF, 2017, p. 1) "The MLC, 2006 is comprehensive and sets out, in one place, seafarers' rights to adequate living and working conditions. However, it is vague or not detailed in some of its provisions, leading to different interpretations by port and flag State authorities" (European Commission, 2020, p. 65)
Appendix 5.1.1.2: Working Conditions	"Participants reported long monotonous working hours and inadequate rest… long working hours per day (i.e. more than ten) were significantly associated with emotional exhaustion and sleepiness" (Brooks & Greenberg, 2022, p. 16) "Poor working conditions cause sickness, occupational accidents, fatigue, tension, and dissatisfaction

	and are also sources of fast seafarer turnover and decreased productivity" (Arslan et al., 2023, p. 5) "Many seafarers wish for shorter or more flexible contracts… They criticize missing clarity and policies regarding their repatriation and rotation, low wages, or unsatisfying working time and rest-time policies and practices" (Gargiulo, 2024, p. 27)
Appendix 5.1.2 : Social Dialogue and Collective Labour Relations	"Social dialogue refers to discussions, consultations, negotiations and joint actions on work-related issues involving organisations representing the two sides of industry (employers and workers)" (European Commission, 2020, p. 77 "In seeking to avoid competition among national trade unions, the ITF has set up the strategy of putting a trade union seated in the country where the beneficial ownership is located in charge of collective bargaining" (European Commission, 2020, p. 62) "Collective bargaining is only possible thanks to the ITF, which coordinates national trade unions across the world and enhances working and living conditions beyond the MLC-2006 minimum standards" (European Commission, 2020, p. 272)
Appendix 5.1.2.1: Employee Participation	"There was feeling among ship crews that they had little control over their job tasks and little participation in decision-making… lack of autonomy was cited as a job stressor" (Brooks & Greenberg, 2022, p. 18)

	"Measuring engagement and happiness: Engagement survey, feedback… Employees of today are purpose-driven, have other attitudes and expectations" (Gargiulo, 2024, p. 23)
Appendix 5.1.2.2: Mediation Mechanisms	"There must be a procedure in place on board your ship enabling you to make a complaint about breaches of the Convention and your rights… It must be handled fairly, effectively and promptly" (ITF, 2017, p. 55) "The complaint mechanism should also protect complainants (including whistle-blowers) and witnesses from reprisals" (ILO, 2020, p. 62)
Appendix 5.1.3: Mental Health and Well-being of Seafarers	"More than one quarter of seafarers suffer from depression and six percent of deaths at sea are attributed to suicide" (National Union of Rail, Maritime and Transport Workers, 2022, p. 24) "Participants reported long monotonous working hours and inadequate rest… significantly associated with emotional exhaustion and sleepiness" (Brooks & Greenberg, 2022, p. 16) "Mental health directly impacts the safe operations of a vessel… without a consistent approach to mental health issues, these are dealt with locally by the crew themselves – without training and with potentially dangerous consequences" (Seatrade Maritime, 2021, p. 24) "Seafarers may not prioritize their mental health because the ship's safe operations take precedence over everything else… but they respond positively

	to ICT-based support that also involves their families" (Abila et al., 2023, p. 4)
Appendix 5.1.4: Skills Development and Talent Management	"Training, upskilling and reskilling for maritime transition to decarbonisation with partners… equip workforce with tools, skills and knowledge to capitalize on opportunities from industry evolution" (Krämer, 2024, p. 19) "Seafarers will need training beyond what is currently in the STCW curriculum… The roles of seafarers are changing and will continue to change as more technology is introduced" (European Commission, 2020, p. 51) "Human capital is a valuable, critical, and rare asset in the shipping industry… recruiting high-quality, competent and rare human capital is essential for shipping companies to achieve their business goals" (Yıldız et al., 2023, p. 327) "Companies should seek for developing such characteristics to their HR, which could not easily be imitated by the competitors… trust, loyalty and adoption of 'company's identity' by Greek seafarers have contributed to the competitiveness of Greek shipping companies" (Progoulaki & Theotokas, 2010, p. 580)
Appendix 5.1.4.1: Continuing Education Initiatives	"A new initiative to promote the lifelong learning of seafarers has increased the flexibility of the MET system… The Special Education Programme (SEP) allows seafarers to actively continue their sea service

	while attending the programme" (European Commission, 2020, p. 149) "Current projects, such as the Horizon 2020-funded Skillful and the SkillSea project, are investigating how to adapt education and training curricula to the new technological paradigms" (European Commission, 2020, p. 51) "Simulator training is being used to substitute sea time… Dutch research has shown that students who both spent time at sea and trained with simulators have a steeper learning curve" (European Commission, 2020, p. 176)
Appendix 5.1.4.2: Talent Management	"Talent management (TM) is a prominent essential factor for shipping companies to achieve their business goals and gain a sustainable competitive advantage" (Yıldız et al., 2023, p. 327) "This study revealed seven core TM functions… which include talent planning, talent identification, talent attraction, talent acquisition, talent development, talent deployment, and talent retention" (Yıldız et al., 2023, p. 327)

Appendix 6. Quotes from relevant publications to highlight the evidence of figure 8

Environmental Awareness in maritime freight sector

Appendix 6.1: Definition of Terms	"Shipping is a significant contributor to global air pollution, emitting approximately 15% of global nitrogen oxides and 16% of sulfur oxides" (Eyring et al., 2005, p. 2). "In 2015, shipping emissions were responsible for approximately 94,000 premature deaths globally, with the majority occurring in coastal areas due to PM2.5 exposure" (Zhang et al., 2021, p. 1). "Sulfur dioxide emissions from ships can account for a substantial share of local pollution near major ports, contributing heavily to acid rain and respiratory problems" (Liu et al., 2016, p. 3). "Despite progress in land-based transport, the maritime sector remains among the least regulated for emissions, with heavy fuel oil usage making it a major source of particulate and nitrogen pollution" (Talley, 2003, p. 287).
Appendix 6.1.1: Shipping emissions and their Impact	"Shipping emissions contribute significantly to the degradation of air quality, especially in coastal and port areas, leading to increased health risks and environmental damage" (Jonson et al., 2015, p. 784). "International maritime transport accounted for 2.9% of global anthropogenic CO_2 emissions, 11% of SOx, and 15% of NOx in 2018" (Kramel et al., 2021, p. 15041).

	"From 1950 to 2001, fuel consumption by international shipping increased more than twelvefold, driving a parallel increase in CO_2 and NOx emissions" (Eyring et al., 2005, p. 1).
Appendix 6.1.1.1: Pollution Emitted by Maritime Transport	"Maritime transport is responsible for significant amounts of NOx (18–30%) and SOx (9%) globally, contributing heavily to air pollution and associated health risks" (Buber, 2020, p. 2) "In East Asia, emissions from ocean-going vessels have been linked to over 24,000 annual premature deaths, primarily due to fine particulate matter exposure" (Liu et al., 2016, p. 3) "Shipping emissions, particularly in coastal areas, have a much greater impact on urban air quality than emissions produced on the high seas" (Buber, 2020, p. 3)
Appendix 6.1.1.2: Effect on Air Quality and Health	"Shipping activities contribute to degraded air quality and premature mortalities worldwide, with 94,200 premature deaths in 2015 attributed to PM2.5 exposure from ship emissions" (Zhang et al., 2021, p. 1) "East Asia alone sees more than 24,000 premature deaths annually linked to PM2.5 emissions from ocean-going vessels" (Liu et al., 2016, p. 2) "Port areas located near densely populated cities face significant air quality challenges due to exhaust gases emitted during hoteling operations" (Buber, 2020, p. 4)

	"SOx and NOx emissions from ships contribute to secondary PM2.5 formation, a major cause of respiratory and cardiovascular diseases" (Zhang et al., 2021, p. 3)
Appendix 6.1.2: Regulation as an Awareness Tool	"MARPOL Annex VI imposes a global sulfur cap of 0.5% on marine fuels, and 0.1% in Emission Control Areas, significantly reducing SOx and particulate matter emissions from ships" (Gauss et al., 2013, p. 786) "The implementation of stricter sulfur limits has led to an estimated 80% reduction in SOx emissions in the Baltic and North Sea ECAs, with corresponding improvements in air quality" (Aulinger et al., 2015, p. 16) "Reducing the sulfur content of marine fuels to 0.1% under SECA regulations contributes significantly to lower PM2.5 concentrations and reduced health impacts" (Liu et al., 2016, p. 3) "Tier I and II standards for NOx emissions, applied globally since 2000 and 2011 respectively, have contributed to a moderate reduction in nitrogen oxide emissions from newly built ships" (Gauss et al., 2013, p. 788)
Appendix 6.1.3: Awareness in Ports and at Regional Level	"Ports play a key role in raising environmental awareness and reducing emissions at the regional level. Initiatives such as the Green Port programme in Rotterdam incorporate real-time emissions moni-

	toring and encourage the adoption of cleaner technologies, such as shore-side electricity" (Denier van der Gon & Hulskotte, 2010, p. 24) "The availability of high-resolution emissions data has enabled regional authorities to implement targeted policies and build trust among maritime stakeholders" (Aulinger et al., 2015, p. 18) "Operational inefficiency in ports leads to increased emissions, posing serious air pollution and health threats to port cities and surrounding regions" (Lu et al., 2023, p. 3) "Port congestion and surging container traffic increase handling times and exacerbate air pollution, especially in major Asian and European ports" (Lu et al., 2023, p. 3)
Appendix 6.1.3.1: Local project in European ports	"Ports such as Gothenburg, Zeebrugge, and Long Beach have introduced 'cold-ironing' systems, allowing ships to plug into the local electricity grid and significantly reduce emissions from auxiliary engines during berthing" (McKinnon et al., 2010, p. 161) "In the Netherlands, specific projects have been launched to update emission factors for port-related ship operations, reflecting increased energy consumption from auxiliary engines during maneuvering and hoteling phases" (Gommers et al., 2007, p. 24)

	"Rotterdam and Moerdijk were among the top European ports for maritime container shipping emissions in 2020, highlighting the regional need for emission management and monitoring systems" (Lu et al., 2023, p. 3)
Appendix 6.1.3.2: Transparency and Communication of Emissions	"The Clean North Sea Shipping (CNSS) project demonstrated that transparency through detailed emissions inventories is essential to foster collaboration and align sustainability efforts at the port level" (Denier van der Gon & Hulskotte, 2010, p. 24) "The availability of high-resolution emissions data has enabled regional authorities to implement targeted policies and build trust among maritime stakeholders" (Aulinger et al., 2015, p. 18) "Shippers and carriers both expect more transparent technological tools to measure CO_2 emissions, as the lack of standard methods limits the visibility and credibility of environmental initiatives" (Bouchery et al., 2021, p. 708)
Appendix 6.1.3.3: Collaborative Project such as CNSS	"The Clean North Sea Shipping (CNSS) project applied a bottom-up approach using Automatic Identification System (AIS) data and ship-specific engine characteristics to calculate emissions with high spatial and temporal resolution" (Aulinger et al., 2015, p. 2) "Emission models developed within CNSS allowed for estimating NOx and SO_2 emissions with greater

	accuracy than previous inventory methods, enabling improved air quality simulations for the North Sea region" (Aulinger et al., 2015, p. 2) "CNSS highlighted that the shipping sector's NOx and SO_2 emissions in the North Sea alone could match or exceed those of a medium-sized European country, underlining the need for regional action" (Aulinger et al., 2015, p. 2)
Appendix 6.1.4: Awareness Campaigns in Business Models	"A notable example of this is the transition to liquefied natural gas (LNG) as an alternative fuel for marine vessels, which marks a crucial advancement in efforts to diminish carbon emissions" (Kramel et al., 2021, p. 12) "Participants in FRET21 adopt measures such as optimizing logistics and shifting to low-carbon transport modes, achieving measurable environmental benefits" (International Transport Forum, 2023, p. 44)
Appendix 6.1.5: Education and Public Awareness	"Training for seafarers in the handling of new fuels and technologies will be essential, as hundreds of thousands may require upskilling for low-emission propulsion systems" (ITF, 2023, p. 131) "Community-level initiatives increase the legitimacy and acceptance of sustainability policies by involving local populations in environmental decision-making processes" (Denier van der Gon & Hulskotte, 2010, p. 24)

	"Public awareness campaigns are crucial to align societal values with sustainability goals and to encourage collective action in reducing the maritime environmental footprint" (Jonson et al., 2015, p. 786) "Despite the uncertainty around future fuels, there is a general trend toward 'higher-skilled' seafarers being needed to support maritime decarbonisation" (ITF, 2023, p. 131)

Appendix 7. Quotes from relevant publications to highlight the evidence of figure 9

Environmental Performance in Maritime Freight Transport	
Appendix 7.1: Definition of Terms	"Maritime transport without exaggeration remains the main mode of transport for the vast majority of cargo types, as the cost of its transportation is competitive and acceptable to all market participants" (Melnyk et al., 2022, p. 723). "The shipping industry has an important place in the problem of climate change, with emissions from more than a hundred thousand ships constituting almost 3% of total greenhouse gas emissions" (Melnyk et al., 2022, p. 723). "Green shipping refers to the set of practices and eco-environmental efficiency adopted in shipping,

	which involves the improvement of procedures and technological innovations for environmental sustainability" (Felício et al., 2021, p. 2). "Sustainable Maritime Freight Transport (SMFT) is not only a means of providing ecological support, but it also addresses economic and social concerns" (Singh et al., 2023, p. 2).
Appendix 7.1.1: Environment regulation and Compliance	"The International Maritime Organization (IMO) has enacted a number of regulations to promote sustainability in the shipping sector, including the Energy Efficiency Design Index (EEDI), emission control areas (ECAs), and carbon intensity index (CII)" (Du et al., 2023, p. 1). "The adoption of MEPC.203(62) introduced into MARPOL Annex VI a new chapter targeting a step-by-step reduction of carbon dioxide emissions from seagoing ships" (Melnyk et al., 2022, p. 723). "IMO regulations require new ships to reduce their EEDI by up to 70% by 2025, promoting eco-efficient or 'green' design aligned with greenhouse gas reduction goals" (Prpić-Oršić et al., 2016, p. 434).
Appendix 7.1.1.1: IMO Regulations Annex VI (SOx, NOx)	"After the 2015 SECA regulation, ship-originated SOx depositions dropped by more than 88%, leading to monetized ecosystem benefits of nearly 130 million USD" (Repka et al., 2021, p. 1720).

	"The more stringent TIER 3 standards under MARPOL Annex VI aim for an 80% reduction in NOx emissions compared to TIER 1" (Repka et al., 2021, p. 1721). "IMO's MARPOL Annex VI established Emission Control Areas (ECAs) with stricter limits on sulfur oxide and nitrogen oxide emissions from ships" (Melnyk et al., 2022, p. 723).
Appendix 7.1.1.2: EEDI and SEEMP	"The International Maritime Organization (IMO) developed the Energy Efficiency Design Index (EEDI), which expresses the emission of CO2 from a ship under specified conditions in relation to a nominal transport work rate" (Prpić-Oršić et al., 2016, p. 435). "IMO developed EEDI values for the existing international fleet by type of ship, establishing a reference line value based on ship type and deadweight" (Prpić-Oršić et al., 2016, p. 435). "Along with EEDI, the Ship Energy Efficiency Management Plan (SEEMP) provides a mechanism for operators to improve the energy efficiency of ships during operation" (Du et al., 2023, p. 1).
Appendix 7.1.1.3: Emission Control Areas (ECAs)	"The introduction of SECA regulations in 2015 reduced ship-originated sulfur depositions by 88% in the Baltic Sea region" (Repka et al., 2021, p. 1720).

	"The designation of the Baltic Sea and North Sea as ECAs has led to significant reductions in SOx and NOx emissions from maritime traffic" (HELCOM, 2021, p. 1). "Ports within ECAs are increasingly providing infrastructure to support cleaner fuels, such as LNG, to ensure compliance with IMO regulations" (Felício et al., 2021, p. 3).
Appendix 7.1.2: Clean Technologies and innovations	"Technological enhancements like improved hull designs as well as improvement in power and propulsion systems could potentially reduce CO_2 emissions up to 35%" (Prpić-Oršić et al., 2016, p. 434). "Modern shipping devotes sufficient attention to improving the environmental performance of the fleet by implementing energy-efficient measures on ships" (Melnyk et al., 2022, p. 723). "Green shipping involves the improvement of procedures and technological innovations for environmental sustainability and trade" (Felício et al., 2021, p. 2).
Appendix 7.1.2.1: Combustion of alternative fuels (LNG, biodiesel)	"Burning liquefied natural gas (LNG) results in negligible SOx, NOx and PM emissions, making it a promising alternative to conventional marine fuels" (Felício et al., 2021, p. 3).

	"Biodiesel combustion produces fewer particulate emissions and is considered a renewable alternative; however, its chemical composition may present operational hazards depending on the feedstock and blending ratio" (Graboski & McCormick, 1998, as cited in Prpić-Oršić et al., 2016, p. 434). "Although alternative fuels like LNG and biodiesel offer environmental benefits, the limited availability of refueling infrastructure and safety concerns impede their widespread adoption" (Du et al., 2023, p. 2).
Appendix 7.1.2.2: Dual-Fuel Engines	"Ships equipped with dual-fuel engines that can operate on both low-sulfur fuel oil and liquefied natural gas offer flexibility in complying with environmental regulations while optimizing operational costs" (Du et al., 2023, p. 2). "Operating dual-fuel engines allows shipping companies to minimize total costs, including carbon emission costs, by selecting fuel types according to availability and price" (Du et al., 2023, p. 2). "Fuel flexibility in dual-fuel systems supports the gradual transition toward cleaner marine energy sources while ensuring compliance with MARPOL Annex VI limits" (Singh et al., 2023, p. 4).

Appendix 7.1.2.3: Optimizing ship performance	"Improving the energy efficiency of the ship means increasing profits and reducing the adverse impact on the environment" (Prpić-Oršić et al., 2016, p. 434). "Accurate estimation of attainable ship speed under real environmental and loading conditions enables reliable prediction of power increase, fuel consumption, and emissions" (Prpić-Oršić et al., 2016, p. 434). "Operational measures such as slow steaming, weather routing, and voyage optimization can lead to up to 50% reduction in fuel consumption and greenhouse gas emissions" (Prpić-Oršić et al., 2016, p. 435). "Optimization of sailing speed under uncertain weather conditions minimizes fuel consumption and contributes to lower air emissions" (Du et al., 2023, p. 2).
Appendix 7.1.3: Green operational practices	"Green shipping involves the implementation of eco-efficient practices across operations, including energy-saving procedures, optimized logistics, and reduction of emissions at all stages of maritime transport" (Felício et al., 2021, p. 2). "Port-based emission control strategies, such as cold ironing and emission inventories, are key for

	promoting environmental performance in maritime logistics" (Singh et al., 2023, p. 5). "Green management encourages practices such as recycling, reusing materials, and reducing gas emissions, contributing to environmental sustainability and operational efficiency" (Felício et al., 2021, p. 3).
Appendix 7.1.3.1: Speed management and optimal routing	"Speed management and fleet planning can lead to up to 50% improvement in fuel efficiency and associated greenhouse gas reductions" (Prpić-Oršić et al., 2016, p. 435). "Slow steaming, super slow steaming, and virtual arrival strategies contribute significantly to minimizing fuel consumption and emissions during voyages" (Prpić-Oršić et al., 2016, p. 435).
Appendix 7.1.3.2: Ballast water and waste management	"Ballast water discharge is a major source of marine pollution, often containing invasive species and chemical residues that threaten local ecosystems" (Du et al., 2023, p. 2). "Case studies reveal that general cargo ships and bulk carriers are the main contributors to ballast water discharges in regional ports" (Du et al., 2023, p. 2). "Green shipping practices include the implementation of onboard waste treatment systems and strict

	controls over the discharge of solid and liquid waste" (Felício et al., 2021, p. 3).
Appendix 7.1.3.3: Adoption of slow steaming	"Slow steaming, super slow steaming, and virtual arrival are widely adopted operational strategies that significantly reduce fuel consumption and greenhouse gas emissions" (Prpić-Oršić et al., 2016, p. 435). "Lower ship speeds reduce wave resistance and engine load, leading to measurable decreases in CO_2 emissions per nautical mile" (Prpić-Oršić et al., 2016, p. 436). "The vessel will be mainly operated at speeds corresponding to slow steaming mode, with main engine capacity not exceeding 50–60% of the nominal, to reduce emissions of harmful gases" (Melnyk et al., 2022, p. 728)
Appendix 7.1.4: Port Management Sustainable Development	"Ports can help reduce GHG emissions by developing policies not only for themselves but also for maritime industries operating within their zones" (Singh et al., 2023, p. 5). "Port authorities play a crucial role in achieving decarbonization goals by implementing emission inventories and monitoring ship performance within port boundaries" (Singh et al., 2023, p. 5).

	"Some European ports have established emission control zones and invested in cold ironing infrastructure to improve air quality and reduce pollution from berthed ships" (Felício et al., 2021, p. 3). "Sustainable port initiatives include energy transition programs, infrastructure upgrades for alternative fuels, and circular economy strategies" (Felício et al., 2021, p. 3).
Appendix 7.1.4.1: Electrification of ports (shore power)	"Cold ironing, or shore-side electricity, allows ships to turn off auxiliary engines while docked, significantly reducing SOx, NOx, and CO_2 emissions in port areas" (Felício et al., 2021, p. 3). "Port-based electrification strategies have emerged as a critical solution for reducing airborne pollution and improving energy efficiency during berthing operations" (Singh et al., 2023, p. 5). "Despite its environmental benefits, the implementation of shore power systems remains limited due to high infrastructure costs and compatibility issues with existing vessels" (Felício et al., 2021, p. 3). "European ports have led the transition by providing electrical hookups at terminals, supporting regulatory compliance with emission limits in urban coastal zones" (Du et al., 2023, p. 2).

Appendix 7.1.4.2: Circular economy in ship recycling	"Ship recycling is an essential part of the maritime circular economy, enabling the recovery of valuable materials while minimizing environmental pollution" (Singh et al., 2023, p. 6). "Adopting circular economy principles in ship dismantling includes safe material handling, reducing hazardous waste, and reusing steel structures and equipment" (Singh et al., 2023, p. 6). "Green recycling practices contribute to the sustainability of the shipping industry by lowering lifecycle emissions and reducing the demand for new raw materials" (Felício et al., 2021, p. 4).
Appendix 7.1.4.3: Port competitiveness	"Ports that invest in green technologies and infrastructure gain competitive advantage by aligning with stricter environmental regulations and customer expectations" (Du et al., 2023, p. 2). "Sustainable development strategies in ports not only enhance operational efficiency but also improve their attractiveness as logistics hubs in global supply chains" (Felício et al., 2021, p. 3). "The ability to offer low-emission services, including LNG bunkering, electrification, and waste handling, strengthens port competitiveness in an environmentally constrained market" (Felício et al., 2021, p. 3).

Appendix 8. Quotes from relevant publications to highlight the evidence of figure 10

Sustainable Practices in maritime freight sector	
Appendix 8.1: Definition of Terms	"Shipping is recognized as an energy-efficient means of transportation compared to road and air transport, due to its large carrying capacity and low fuel consumption per ton transported" (Bouman et al., 2017, p. 409). "Eco-innovation in the shipbuilding industry focuses on integrating green technologies and circular economy principles to mitigate environmental impact while enhancing efficiency" (Paipa-Sanabria et al., 2024, p. 2). "Green shipping reflects the efforts of embodying sustainability imperatives in shipping, by the use of modern technology and innovative alternative renewable types of energy" (Malindretos & Sklavakis, 2011, p. 2).

	"Implementing innovative green ships and adopting sustainable supply chain management (SSCM) practices strengthen the competitive position and sustainability of shipping companies" (Malindretos & Sklavakis, 2011, p. 2).
Appendix 8.1.1: Alternative Fuels	"Methanol and ethanol both have many advantages regarding environmental impacts as compared to conventional fuels – they are clean-burning, contain no sulphur, and can be produced from renewable feedstocks" (Ellis & Tanneberger, 2015, p. 3). "Emissions can be reduced by more than 75%, based on current technologies and by 2050, through a combination of measures if policies and regulations are focused on achieving these reductions" (Bouman et al., 2017, p. 409). "Bio-methanol produced from second generation biomass such as waste wood has a much lower global warming potential than fossil fuels and is lower than ethanol by most production methods" (Ellis & Tanneberger, 2015, p. 3).
Appendix 8.1.2: Operational Practices	"Speed reduction and optimization of vessel capacity utilization are among the most effective short-term measures to increase energy efficiency in shipping" (Pastowski, 2017, p. 19). "The effect of reducing operating speed is immediate and results in both lower emissions and lower

	fuel costs, making it a cost-effective abatement strategy" (Bouman et al., 2017, p. 410). "Optimising the utilisation of vessel capacity and reducing the number of ballast voyages can significantly improve operational efficiency" (Pastowski, 2017, p. 19).
Appendix 8.1.3: Energy Efficiency Technologies ?	"Technological measures such as hull coating, propeller upgrades, and waste heat recovery can significantly enhance energy efficiency on board ships" (Faber et al., 2011, as cited in Bouman et al., 2017, p. 410). "Improvements in design standards and retrofit technologies can enable ships to reduce energy consumption while meeting emission reduction goals" (ICCT, 2011, p. 2). "Propeller polishing and hull cleaning were found to offer considerable efficiency gains at relatively low cost" (Bouman et al., 2017, p. 411). "The Energy Efficiency Design Index (EEDI) and the Ship Energy Efficiency Management Plan (SEEMP) have become crucial regulatory instruments promoting the use of energy-saving technologies" (Pastowski, 2017, p. 22).
Appendix 8.1.4: Innovative Shipping Models	"Eco-innovation promotes close collaboration between industries to reduce the ecological footprint, especially in sectors like shipbuilding where green

	design is emerging as a strategic asset" (Paipa-Sanabria et al., 2024, p. 2). "The development of autonomous and digitally operated ships represents a transformative shift in maritime freight transport, potentially increasing both efficiency and safety" (Alop & Koit, 2024, p. 1). "Sail freight, though historically rooted, is re-emerging as a viable low-emission model for specific cargo routes, contributing to the diversification of sustainable maritime logistics" (Woods, 2021, p. 1). "Innovative green ships... demonstrate the enhancement of the competitive position and sustainability of shipping companies that show vision and discipline in adopting sustainable supply chain practices" (Malindretos & Sklavakis, 2011, p. 2).

Appendix 9. Quotes from relevant publications to highlight the evidence of figure 11

Competitiveness in maritime freight transport	
Appendix 9.1: Definition of Terms	"Competitiveness is defined as the ability and performance of a firm, sub-sector or country to sell and supply goods and services in a given market, in relation to the ability and performance of others in the same market" (Franc & Van der Horst, 2010, p. 558).

	"Improving competitive performance increasingly depends on firms' ability to differentiate through service quality, cost control, and innovation in logistics integration" (Franc & Van der Horst, 2010, p. 561). "Carriers gain a competitive advantage when inland transport and terminal integration reduce logistics costs and improve schedule reliability" (Franc & Van der Horst, 2010, p. 562). "Sustainability reporting is becoming a tool to enhance competitive positioning by demonstrating transparency, commitment to environmental goals, and stakeholder engagement" (Olsen, 2015, p. 23).
Appendix 9.1.1: Sustainable Gowth and Innovation	"Innovation in logistics services is a critical element in ensuring long-term competitive advantage and sustainable growth in maritime transport" (Franc & Van der Horst, 2010, p. 561). "Sustainable growth strategies increasingly rely on environmental innovations, digitalization, and the integration of greener technologies" (Muñoz García, 2020, p. 18). "Shipping companies are now investing in sustainable practices and innovations not only for compliance but also as a means to improve efficiency and competitiveness" (Olsen, 2015, p. 26).

	"Strategic investments in cleaner technologies and collaborative innovation efforts are central to building resilience and long-term value in the shipping industry" (Cariou, 2011, p. 13).
Appendix 9.1.2: Economy of Scale and Consolidation	"Economies of scale in shipping are primarily achieved through the deployment of larger vessels and consolidation of services, which reduce unit costs" (Franc & Van der Horst, 2010, p. 560). "Consolidation in the maritime sector enables companies to strengthen their market position and leverage operational synergies" (Cariou, 2011, p. 10). "The tendency towards mergers and alliances among shipping lines is driven by the need to improve cost efficiency and service frequency" (Franc & Van der Horst, 2010, p. 559).
Appendix 9.1.2.1: Strategic Alliances and Resource Sharing	"Strategic alliances between shipping lines allow for resource sharing, joint scheduling, and cost reductions through better vessel utilization" (Franc & Van der Horst, 2010, p. 559). "Alliances help reduce uncertainty and transaction costs by coordinating operations across multiple actors in the maritime supply chain" (Franc & Van der Horst, 2010, p. 558).
Appendix 9.1.2.2: Mergers and Acquisitions in the Maritime Sector	"Mergers and acquisitions are a key strategy for achieving market consolidation and gaining access to strategic assets in the maritime sector" (Franc & Van der Horst, 2010, p. 559).

	"Recent consolidation trends among global carriers aim to reduce excess capacity, increase bargaining power, and enhance economies of scale" (Cariou, 2011, p. 9). "Through mergers, firms seek to expand service coverage, rationalize fleets, and streamline management structures to improve competitiveness" (Franc & Van der Horst, 2010, p. 560). "Acquisitions in the shipping industry often serve as a response to financial pressure and overcapacity, enabling companies to survive market downturns" (Olsen, 2015, p. 27).
Appendix 9.1.3: Reducing Operational Costs and Managing Resources	"Vertical integration and better coordination of inland transport services allow shipping lines to reduce uncertainty and control operational expenses" (Franc & Van der Horst, 2010, p. 561). "Shipping companies are increasingly investing in technologies and infrastructure that optimize resource allocation and reduce fuel consumption" (Muñoz García, 2020, p. 16). "Cost-efficiency in maritime logistics is achieved through improved vessel scheduling, port operations, and hinterland connectivity" (Olsen, 2015, p. 24).
Appendix 9.1.3.1: Route Optimization and Slow Steaming Strategies	"Slow steaming has emerged as a key operational strategy to reduce fuel consumption and lower emissions, while also cutting costs" (Muñoz García, 2020, p. 16).

	"Optimizing shipping routes and sailing speeds allows companies to align vessel schedules with port availability and cargo flows, enhancing efficiency" (Franc & Van der Horst, 2010, p. 562). "By adjusting speed and routing, carriers can significantly decrease bunker fuel usage, which constitutes a major share of operational costs" (Olsen, 2015, p. 25).
Appendix 9.1.3.2: Use of alternative fuels (LNG, biofuels)	"Alternative fuels like LNG significantly reduce suphur oxide (SOx), nitrogen oxide (NOx), and CO2 emissions, aligning maritime operations with sustainability goals" (Olsen, 2015, p. 25). "The use of low-sulphur fuels and innovative propulsion systems is part of the sector's long-term strategy to achieve emission-free maritime transport" (Muñoz García, 2020, p. 19). "Investments in alternative fuels are driven by both regulatory pressure and the pursuit of competitive advantages through environmental performance" (Cariou, 2011, p. 14).
Appendix 9.1.4: Economic and ecological performance	"Balancing economic growth with ecological responsibility has become a core challenge in maritime transport strategy" (Olsen, 2015, p. 23). "Shipping companies increasingly link their environmental performance to operational efficiency and long-term cost savings" (Muñoz García, 2020, p. 18).

	"Ecological performance metrics such as emissions per TEU are now used alongside financial KPIs to evaluate company success" (Olsen, 2015, p. 26). "The industry seeks to optimize both economic and environmental outcomes through cleaner technologies, efficiency measures, and integrated logistics" (Franc & Van der Horst, 2010, p. 561).
Appendix 9.1.4.1: DEA analysis	"Data Envelopment Analysis (DEA) is commonly applied in the maritime sector to measure the relative efficiency of shipping companies by comparing input usage with output performance" (Cariou, 2011, p. 12). "DEA allows for benchmarking environmental and economic efficiency, identifying best practices and performance gaps among carriers" (Olsen, 2015, p. 24).
Appendix 9.1.4.2: Incorporation of environmental KPI indicators	"Shipping companies are increasingly incorporating environmental KPIs such as CO_2 emissions per TEU, energy efficiency, and sulphur output into their performance evaluations" (Olsen, 2015, p. 26). "Including environmental indicators in corporate reporting reflects a shift towards integrated sustainability management and transparency" (Muñoz García, 2020, p. 19).

	"Environmental KPIs are used to track progress toward regulatory compliance and to assess the effectiveness of eco-innovation strategies" (Cariou, 2011, p. 14). "The adoption of KPIs aligned with GRI and IMO frameworks strengthens accountability and supports continuous improvement in ecological performance" (Olsen, 2015, p. 27).
Appendix 9.1.5: Competitive differentiation strategies	"Shipping lines seek competitive differentiation through value-added services, reliability, environmental responsibility, and integrated logistics solutions" (Franc & Van der Horst, 2010, p. 561). "Providing inland transport and end-to-end service coverage strengthens customer loyalty and distinguishes carriers in a commoditized market" (Franc & Van der Horst, 2010, p. 562). "Differentiation is increasingly driven by the ability to offer sustainable solutions and advanced digital tools tailored to client needs" (Muñoz García, 2020, p. 18).
Appendix 9.1.5.1 CSR: As a Competitive advantage	"Corporate Social Responsibility (CSR) initiatives are becoming a source of competitive advantage by aligning company values with stakeholder expectations" (Olsen, 2015, p. 23). "Shipping companies leverage CSR to differentiate themselves in the market, attract environmentally conscious clients, and comply with global regulations" (Muñoz García, 2020, p. 19).

	"CSR strategies contribute to long-term value creation by fostering trust, improving brand reputation, and mitigating regulatory risks" (Olsen, 2015, p. 27). "In the maritime sector, CSR is not only a reputational tool but also a framework for innovation and performance improvement" (Franc & Van der Horst, 2010, p. 561).

Appendix 10. Quotes from relevant publications to highlight the evidence of figure 12

Financial performance in maritime freight sector	
Appendix 10.1: Definition of Terms	"Higher CSR performance may lead to enhanced financial results through improved reputation, customer loyalty, and risk management" (Saeidi et al., 2015, p. 342). "Our empirical findings indicate that fleet diversification into LNG carriers resulted in higher profitability and better operational efficiency" (Lim & Lim, 2020, p. 2). "CSR has a neutral impact on firm performance, when controlling for a number of other relevant factors" (Belu & Manescu, 2011, p. 4).

	"CSR initiatives can indirectly contribute to profitability by enhancing competitive advantage and customer satisfaction" (Saeidi et al., 2015, p. 347).
Appendix 10.1.1: Eco-Innovative Technologies	"Shipping firms… are strategically reducing their risk exposures to profit fluctuations… as the world seeks gas technology amongst the alternative energy sources for a sustainable future" (Lim & Lim, 2020, p. 2). "Eco-innovation in shipping is increasingly driven by the need to comply with stricter environmental regulations and to achieve long-term competitiveness" (Yuen et al., 2017, p. 3). "LNG carriers… promote eco-innovation and technology development in the power, industry, and consumer household sectors" (Lim & Lim, 2020, p. 2). "Environmental strategies such as green logistics and eco-innovation improve firm performance through stakeholder satisfaction and regulatory alignment" (Abbas, 2020, p. 2).
Appendix 10.1.1.1: LNG fleet adoption	"Fleet diversification into LNG carriers resulted in higher profitability and better operational efficiency" (Lim & Lim, 2020, p. 2). "Shipping firms… introducing LNG capacity into their fleets… are strategically reducing their risk exposures to profit fluctuations in the short-term as well

	as securing their long-term viability" (Lim & Lim, 2020, p. 2). "LNG is seen as a cleaner source of energy in replacing or else supplementing coal and oil" (Lim & Lim, 2020, p. 2). "The wider use of LNG would help reduce carbon emissions due to the burning of other fossil fuels" (Lim & Lim, 2020, p. 2).
Appendix 10.1.1.2: Reducing CO2 emissions	"By using LNG to power ships… the shipping industry can reduce the level of polluting emissions of nitrogen oxides and sulphur oxides by 90 to 95%" (Lim & Lim, 2020, p. 2). "LNG's widespread use as a marine transport fuel… is primarily constrained by limited LNG bunkering infrastructure" (Bakkali & Ziomas, 2019, p. 1). "The burning process of marine diesel engines can cause HFO to emit air pollutants… including carbon dioxide (CO2)" (Lim & Lim, 2020, p. 2). "The adoption of LNG helps shipping firms align with MARPOL's sulphur emission regulations, reducing overall GHG emissions" (Bakkali & Ziomas, 2019, p. 2).
Appendix 10.1.1.3: MARPOL compliance	"On January 1, 2020, the International Maritime Organization (IMO) will introduce increased limitations

	on sulphur emissions by ships" (Bakkali & Ziomas, 2019, p. 1). "MARPOL bans the use of any bunker fuel in which sulphur content exceeds the 0.5 percent threshold—unless a vessel has the right equipment onboard" (Bakkali & Ziomas, 2019, p. 2). "To comply with MARPOL, LNG carriers face most of the same options as the broader shipping industry" (Bakkali & Ziomas, 2019, p. 2).
Appendix 10.1.2: Cost optimization	"Eco-innovation practices such as alternative fuels and energy efficiency initiatives contribute to cost savings and performance improvements" (Yuen et al., 2017, p. 3). "Total quality management significantly enhances organizational capabilities to achieve green performance objectives… and leads to the development of competitive products and services with superior quality, at minimum cost" (Abbas, 2020, p. 2). "Diversification is only good if companies understand the reasons why they are doing it and the risks involved" (Lim & Lim, 2020, p. 2).
Appendix 10.1.2.1: Reducing environmental fines	"Environmental strategies such as CSR initiatives allow firms to align with regulations, thereby reducing the risk of fines and sanctions" (Abbas, 2020, p. 2).

	"The adoption of LNG helps shipping firms align with MARPOL's sulphur emission regulations, reducing overall GHG emissions and compliance costs" (Bakkali & Ziomas, 2019, p. 2).
Appendix 10.1.2.2: Long-term energy savings	"LNG is seen as a cleaner source of energy… and is an energy source that complements the efforts toward building alternative renewable energies" (Lim & Lim, 2020, p. 2). "Green logistics and energy-efficient technologies can lead to long-term savings in fuel consumption and emissions management" (Yuen et al., 2017, p. 4). "TQM… is believed to be an environment-friendly system as it aims to minimize waste through efficient utilization of resources" (Abbas, 2020, p. 2).
Appendix 10.1.2.3: Improved ROE, ROA, mid to long term.	"Our empirical findings indicate that fleet diversification into LNG carriers resulted in higher profitability and better operational efficiency" (Lim & Lim, 2020, p. 2). "CSR can lead to improved financial indicators such as ROA and ROE through enhanced customer satisfaction and competitive positioning" (Saeidi et al., 2015, p. 342).

	"Firms with higher CSR scores demonstrate stronger return on assets, supporting the business case for social responsibility" (Belu & Manescu, 2011, p. 3).
Appendix 10.1.3: Competitive advantage	"CSR contributes to firm financial performance through the mediating effect of competitive advantage" (Saeidi et al., 2015, p. 347). "Strategic CSR can create competitive advantages when aligned with core business capabilities and stakeholder expectations" (Belu & Manescu, 2011, p. 4). "Shipping firms that proactively integrate environmental innovations into their strategy are more likely to secure sustainable competitive positions" (Yuen et al., 2017, p. 3).
Appendix 10.1.3.1: Better reputation	"CSR improves firm performance by enhancing reputation, which acts as a key intangible asset in competitive markets" (Saeidi et al., 2015, p. 347). "Firms with a good reputation are perceived as less risky… and enjoy higher return on assets" (Saeidi et al., 2015, p. 343).
Appendix 10.1.3.2: Increased customer loyalty	"CSR positively influences customer satisfaction, which in turn enhances customer loyalty and firm performance" (Saeidi et al., 2015, p. 344).

	"More satisfied customers means enhanced reputation, more sales growth, more competitive advantage, and finally higher levels of firm performance" (Saeidi et al., 2015, p. 344). "Customer loyalty is a consequence of customer satisfaction, and leads to increased financial returns and repeat business" (Saeidi et al., 2015, p. 343). "Firms that demonstrate strong CSR performance tend to retain customers more effectively, especially when values align" (Belu & Manescu, 2011, p. 4).