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Functions of the 6th Generation Port in the Context of Environmental, Social and Governance Factors

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Abstract. *Orientation towards environmental, social and governance standards is becoming very important today for the success and sustainability of organizations. In the international context where environmental policies and social responsibility are becoming increasingly important, adopting practices in this regard represents both an ethical and moral commitment and a business strategy. The need to address environmental, social and governance factors in the port organization is becoming more of an obligation than an initiative of its own, but which promises to bring with it a long series of opportunities that will help both port organizations that address environmental, social and governance provisions and their stakeholders. This paper addresses the functions of a new generation of ports, the sixth generation, still in the proposal stage, and environmental, social and governance factors, thus identifying the correlation between the two concepts. The incipient approach to the proposal for the development of a new port concept creates the opportunity to integrate environmental, social and governance factors as a constructive part of the sixth generation of ports.*

Keywords: sixth generation of ports, environmental, social and governance factors, sustainability, port, port organization.

Introduction

As society continues to evolve and its demands grow at an accelerated pace, the necessity for regulations that align with current needs—addressing every fundamental aspect of organizational operations and development—becomes more apparent.

To understand port functions through the perspective of ESG (Environmental, Social, Governance) factors, it's beneficial to examine the components that make up the port system. A port system encompasses all the infrastructure, equipment, activities, and interactions required for a port to operate efficiently. It consists of infrastructure, superstructure, and various port organizations, which are organized under different types.

Ports are pivotal in global trade and transportation, serving as key hubs connecting land and water transport networks. There is a variety of port organizations that help achieve the port's objectives. According to specialized literature and official documents (Ministry of Transport and Infrastructure, 2023), these organizations are categorized into four main groups: port administration, competent authority, terminal operator, service provider.

A fifth category could be represented by stakeholders. However, these cannot be entirely classified as port organizations, as some, like other cargo handling entities, carriers, inspection services, shipping companies, and pilotage/towage organizations, are directly involved in port/logistics activities. There are also other stakeholders, including policymakers, internal stakeholders (such as directors, employees, board members, shareholders), and community groups

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(local residents, consumers, taxpayers, environmental organizations, the media, and others). Although they are not officially part of the port system, these stakeholders play crucial roles in shaping the port's structure (Notteboom, Pallis, & Rodrigue, 2022).

In a country with access to the sea, the port sector is a vital component of the national economy, requiring adaptation to modern standards for effective societal functioning. Port organizations are key contributors to achieving sustainability goals. For a port organization to be recognized for its transparency in sustainability reporting and earn a high rating, it requires significant effort and commitment across all its divisions. A port organization that commits to transparent ESG (Environmental, Social, Governance) reporting is well-positioned to attract investment and new clientele. In an era where climate change is an increasingly urgent issue, organizations seeking investment must also prioritize environmental protection and sustainability. Today, ESG criteria are not just a passing trend in investment circles; they have become essential factors for attracting the attention of investors. The purpose of this work is to assess and evaluate how the 6th generation ports contribute to or are influenced by environmental, social, and governance factors and see how do 6th generation ports incorporate sustainable environmental practices, social and governance factors and how they are incorporated in 6th generation ports in order to address ESG goals.

Literature review

The importance of ESG (Environmental, Social, Governance) orientation for organizational success and long-term sustainability continues to grow. In the global context where environmental policies and social responsibility are gaining greater significance, adopting such practices represents not only an ethical commitment but also a strategic business approach. The surge in global investments directed toward sustainable and responsible strategies over the past decade is expected to continue, with sustainable investing becoming a core element of asset management (European Commission, 2020). Access to high-quality data, ratings, and sustainability-related research plays a crucial role in shaping effective investment strategies. The rising demand for goods and services centered on sustainability has attracted more market participants, fueling a wave of mergers and acquisitions as traditional financial institutions and research companies look to enhance their portfolios by acquiring sustainability-focused offerings.

ESG refers to three crucial factors that have global relevance: Environmental, Social, and Governance. These factors encompass the operational aspects of organizations that affect both the environment and various stakeholders and relate to how organizations conduct their business activities, including corporate governance. When evaluating an organization, these factors are measured through indicators intended to help potential investors assess the organization’s appeal for investment opportunities.

The principles of ESG have their origins in the concepts of corporate social responsibility and responsible investment, which emerged in response to the social manifestations of the 1960s and 1970s. ESG was officially addressed by the United Nations in 2004 with the report "Who Cares Wins", advocating for the integration of sustainability considerations into investment decisions.

The connection between ESG performance and financial performance remains a topic of ongoing discussion. Some studies (Hübel & Scholz, 2019; Busu, 2012) suggest a positive correlation, indicating that organizations with strong ESG practices often achieve better financial outcomes. On the other hand, some research points to potential downsides, such as higher operational costs. Other studies (Vu, Lehkonen, Junttila, & Lucey, 2024) indicate a positive,

nonlinear, or even indirect relationship between ESG performance and innovation or long-term sustainability.

There are various international ESG standards in place (e.g., GRI, International Organization for Standardization, and SASB Standards), as well as rating agencies (such as Bloomberg and MSCI). However, the lack of unified criteria leads to inconsistent assessments across different sectors and raises the risk of "greenwashing," where companies emphasize their ESG efforts more for reputation purposes than for creating genuine impact. To address this, regions like the EU and the US have recently implemented regulations to mandate ESG disclosures, signaling a trend toward standardized and mandatory reporting.

In the port industry, ESG plays a significant role in influencing regional economic and environmental outcomes. While developed nations have explored integrating ESG into port governance more extensively, there is limited research on its implementation in developing economies.

ESG factors can be measured according to the following categories:

- Environment: carbon emissions, water usage and treatment, air pollution effects, waste production and disposal.
- People and Society: workforce involvement, inclusivity, fairness, and diversity, data protection, human rights, social impact, employee well-being and safety.
- Governance: corporate integrity, market conduct, board composition and diversity, executive remuneration, internal risk control, systemic risk oversight.

The ESG concept offers various advantages for organizations that decide to adopt it:

- Reputation and Credibility: Embracing and promoting ESG practices can enhance a company's reputation and credibility, making it more appealing to investors, customers, and other stakeholders.
- Risk Management and Resilience: By implementing ESG factors, organizations can better identify risks regarding climate change, social issues, and governance, thus becoming more resilient in handling these challenges.
- Access to Capital: As responsible investing continues to grow in popularity, companies with strong ESG performance may benefit from easier access to capital and financing opportunities.
- Innovation and Efficiency: Focusing on ESG can encourage innovation and improve efficiency, prompting companies to develop sustainable and creative solutions to both current and future challenges.

ESG serves as a critical framework for assessing the performance and sustainability of organizations in today's business environment. In Romania, ESG (environmental, social, governance) reporting has evolved from being seen as a voluntary initiative to a mandatory requirement for certain organizations. Current and future regulations mandate organizations to disclose ESG-related information, fostering greater transparency and corporate accountability. According to the latest legislation, companies listed on the Bucharest Stock Exchange and those designated as public interest entities must begin submitting ESG reports starting with the 2023 financial year. The European CSRD Directive was transposed into national legislation in 2024 through the Minister of Finance Order no. 85/2024, ASF Norm no. 4/2024, and NBR Order no. 1/2024. By 2025, approximately 5,300 companies will be required to produce CSRD reports, verified by independent auditors.

Although these new regulations primarily apply to large companies, organizations of all sizes and industries are indirectly affected by these reporting requirements if they wish to remain

part of the same supply chain or ecosystem. Therefore, all sizes companies are encouraged to evaluate and report on their environmental, social, and governance impacts.

This shift toward mandatory ESG reporting offers both advantages and challenges for organizations. The benefits include enhancing reputation and credibility in the market, attracting investors who prioritize sustainability, and increasing customer loyalty among those who value sustainable practices. However, organizations also face challenges, including the implementation of robust and standardized reporting systems, the collection and analysis of relevant data, and ensuring compliance with changing legal requirements.

Sustainable investment has been used in Europe for the last two decades, making the market more advanced compared to other areas. The European Union has taken a leading role in regulating sustainable finance, being the most ambitious in this area. In 2018, the European Commission launched an extensive policy framework on sustainable finance (European Commission, 2021), which includes Action Plan for Financing Sustainable Growth and a revised strategy under the European Green Deal (European Commission, 2019). It has implemented various regulations, including the Non-Financial Reporting Directive and the EU Taxonomy Regulation (European Union, 2020), among others. Although sustainability-focused goods and services are not yet subject to direct regulation by the public authorities, certain regulations may apply to specific categories of products.

Sustainability considerations are becoming increasingly important for organizations of all sizes, and they can no longer overlook the increasing number of laws on sustainability reporting but also regulations emerging globally.

ESG regulations are government-imposed standards for actions, reporting, or disclosures related to environmental, social, and governance factors. ESG provides a framework for evaluating an organization's or investment's sustainability and ethical impact. The purpose of these regulations is to improve transparency and accountability, while promoting the adoption of more sustainable practices by organizations. Additionally, they are essential in safeguarding investors against the risk of greenwashing.

At a port organization (Port of Portland Pty Limited, 2023), ESG factors can be tailored as follows (Figure 1):

- Environment: pollution, biodiversity, contamination, reducing energy and water consumption, noise, light and greenhouse gas emissions, and disaster resilience.
- Social: health and safety, community development, employee and customer satisfaction, freedom of association, diversity, and stakeholder relationships.
- Governance: audits, anti-bribery and corruption efforts, data privacy, security, and fraud prevention.

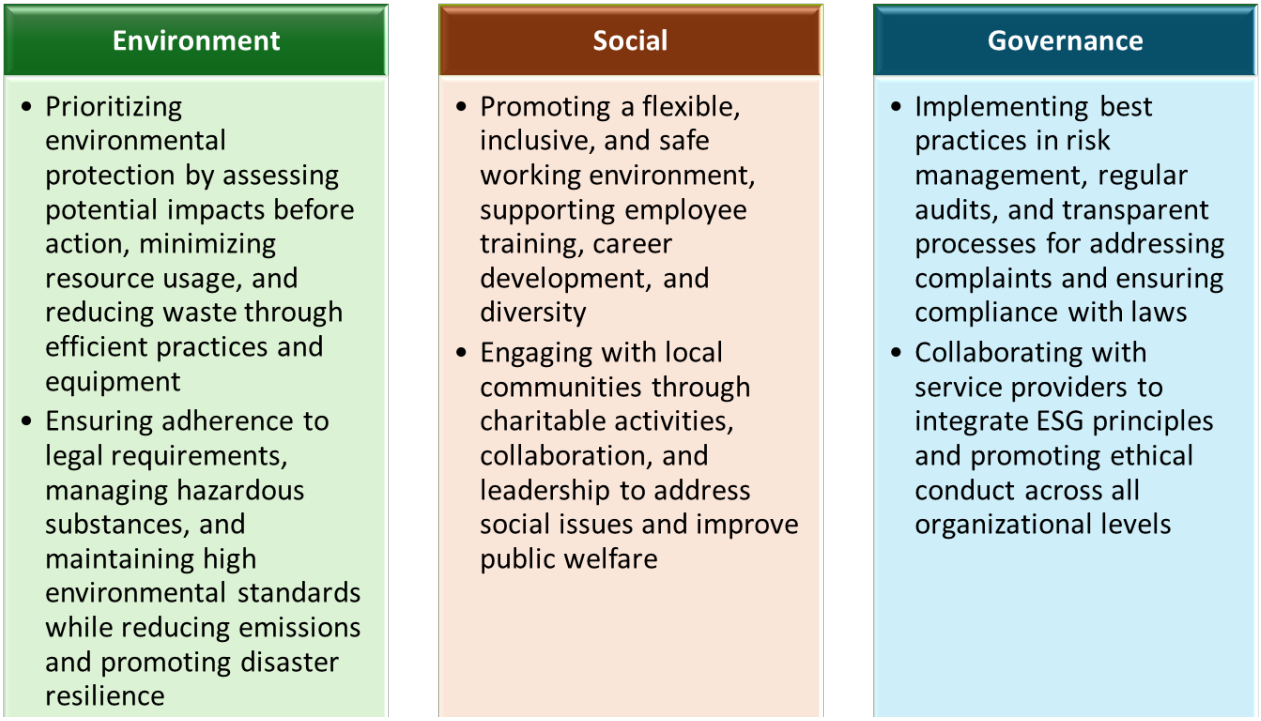

Figure 1. Environmental, social and governance practices at port organization level

Source: (Port of Portland Pty Limited, 2023).

An ESG reporting framework provides a set of guidelines and standards for creating clear, actionable sustainability reports. It's important to distinguish frameworks from standards—frameworks guide how to report ESG, while standards define what should be reported.

In the last years, the significance of sustainable development in the port sector has grown substantially. With the shift toward decentralization and improved governance in port policies, the integration of corporate responsibility is becoming more prominent. Port authorities and organizations are increasingly expected to adopt environmental, social, and governance frameworks. A case study of the Port of Shanghai highlights the significant role ESG plays in promoting sustainable development within the sector. The analysis also offers recommendations to enhance ESG practices for ongoing progress. ESG reports are crucial tools for tracking the environmental, social, and economic impacts of port operations while finding best practices.

Ports are vital to sustainability efforts, influencing areas like the economy, environment, public health, and social welfare. ESG reports from port organizations provide valuable insights into their strategies and allow for the tracking of their environmental, social, and economic effects using quantitative indicators. However, challenges in ESG disclosure, such as inconsistent reporting standards and low-quality disclosures, were identified in Chinese ports, which may also apply to European ports. To address these challenges, regulators need to establish ESG disclosure standards specific to the port industry, which would improve reporting quality and support the adoption of sustainable practices (Gu, Zhu, & Zhang, 2023).

Methodology

The paper was based on a study of the two concepts currently being discussed internationally. In order to discuss the proposal for the 6th generation of ports, a brief review of the evolution of port generations was made and how the sixth generation differs from the other 5. Following research on specialized platforms, we discovered that there are few works on the new generation of ports, but the concept exists. Subsequently, a correlation was made of the defining functions of this new generation of ports with ESG factors and how these factors could be integrated into port functions.

Results and discussions

Correlation of sixth generation port functions with Environmental, Social and Governance Factors

Evolution of port generations

The development of seaports, particularly those managing containerized cargo, has led to a more complex network of links between all the actors involved in the port services market, affecting the supply but also the demand. The significance of seaports is often highlighted by categorizing them into different generations. According to the UNCTAD framework, seaports can be classified into first, second, third, fourth, and even fifth generation ports (Kaliszewski, 2018).

The progression of ports over time reflects advancements in technology, logistics, and management, all aimed at addressing the growing demands of global trade (Musolino, Peda, & Russo, 2022):

- First generation: Ports were primarily limited to basic loading and unloading functions, with straightforward and isolated operations.
- Second generation: Ports began incorporating industrial activities, expanding their scope to handle bulk cargo and improving integration with the transportation sector.
- Third generation: These ports evolved into logistics hubs, emphasizing intermodal connections and the integration of supply chains.
- Fourth generation: Ports became large-scale regional centers, utilizing advanced information technology systems and integrated logistics, while also strengthening ties with both the hinterland (the region where the port holds a dominant market share) and the foreland (the distant markets and ports served by a given port's shipping services). These ports often include public-private partnerships.
- Fifth Generation (5GP): The focus shifts to a customer- and community-driven model, characterized by extensive digital integration, sustainable practices, and active collaboration with local stakeholders to enhance services and promote sustainability. In 2011, M. Flynn proposed the inclusion of two key stakeholder groups—port users (customers) and the local community—as defining elements of the fifth-generation port.

Functions of the sixth generation port

The COVID-19 pandemic has had a profound effect in the shipping industry, port operations, and global supply chains. To address these challenges and help businesses recover, stakeholders have started adopting fusion technologies. These include innovations such as information technology, artificial intelligence, distributed computing, the Internet of Things, and 5G connectivity (Song, Lin, Feng, & Lee, 2024). These technologies are designed to improve communication and interaction among port stakeholders. Particularly, major container ports, which are vital links in the global supply chain, have increasingly focused on digitizing trade operations. Additionally,

there is a growing drive to decarbonize the maritime sector in alignment with global agreements such as the Paris Agreement, the International Maritime Organization's (IMO) sulfur regulations (Van Der Loeff, Godar, & Prakash, 2018), and the 2021 Clydebank Declaration. Consequently, the shipping and logistics industry now faces key challenges in the post-pandemic era, including digitalization, decarbonization, and the impact of COVID-19.

As a result, initial studies on the transition to a new generation of ports, known as the sixth generation, have emerged. These studies advocate for the 6GP model, which is based on three core principles: the "New Economy Concept", "Smart Port/City", "Smart Platform Governance". The model incorporates six key dimensions: "service", "technology", "sustainable development", "cluster", "hub", and "smart port governance and policy". Other research highlights six primary drivers of the new generation of ports: fusion technologies (including AI, blockchain, cloud systems, IoT, and mobile services), the New Economy Concept, smart and sustainable ports, the COVID-19 pandemic, decarbonization, and digitalization (Figure 2) (Lee, Song, Lin, Lam, & Chen, 2024).

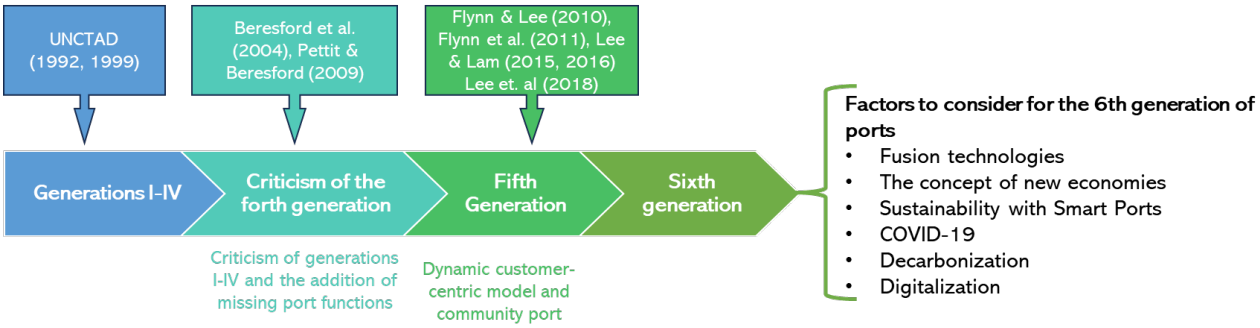

Figure 2. Evolution of port generations

Source: (Lee, Song, Lin, Lam, & Chen, 2024).

The sixth generation of ports (6GP) is designed to handle the growing size of container vessels, such as those with capacities of up to 50,000 TEU, and to integrate cutting-edge automation. Key functions of these ports include (Lee, Song, Lin, Lam, & Chen, 2024):

Large-Ship Handling: Built to accommodate enormous container ships, enhancing the efficiency of global trade.

Automation and Technology: The use of semi- or fully automated terminals to boost efficiency, streamline data management, and optimize logistics operations.

Sustainability and Lower External Costs: Focused on minimizing negative environmental impacts, such as reducing emissions, alleviating congestion, and cutting energy use.

Hinterland Connectivity: Creating robust links with inland transportation systems to ease the flow of goods, minimize bottlenecks, and enhance logistics efficiency.

Linking 6th generation port functions with environmental, social and governance principles

The core functions of sixth-generation ports are closely aligned with the principles of Environmental, Social, and Governance (ESG), supporting sustainable and responsible port operations (Liu & Lyu, 2023):

Environmental: 6GP ports incorporate green technologies like emission reduction systems and energy-efficient automation. These ports focus on lowering pollution, minimizing waste, and embedding sustainability in both planning and operations.

Social: By engaging with local communities, 6GP ports address issues such as traffic congestion, employment opportunities in the ports and logistics sectors, and fostering public-private partnerships that support regional economies. Advanced digital technologies also enhance employee safety and operational transparency.

Governance: 6GP ports prioritize transparency and robust stakeholder engagement, implementing strong IT and cybersecurity measures to secure global supply chains. Furthermore, long-term contracts with shipping companies promote financial stability, aligning with governance objectives focused on responsible and sustainable operations.

This shift towards incorporating ESG principles within port functions positions 6GP as a crucial model for advancing sustainable practices in future global logistics (Adamowicz, 2022).

Identifying the need for environmental, social and governance integration in port organizations and proposing an implementation strategy

EU regulations require large and publicly listed companies to disclose information on the risks and opportunities related to social and environmental issues, as well as the impact of their operations on people and the planet. This disclosure framework helps investors, consumers, and other stakeholders assess companies' sustainability performance, aligning with the goals of the European Green Deal.

A 2019 case study conducted by the European Court of Auditors on sustainability reporting revealed that, at that time, the necessary conditions to create regular and comprehensive sustainability reports were not fully established. The 2030 Agenda for Sustainable Development outlines 17 goals aimed at eradicating extreme poverty, combating inequality and injustice, and protecting the environment by 2030. The European Union is committed to the implementation of the 2030 Agenda. These goals are categorized into three key pillars of sustainability: economic growth, social inclusion, and environmental protection. The Court's findings highlighted several challenges, including the formulation of a strategy that incorporates sustainable development goals, the development and execution of sustainability reporting frameworks, and the need for third-party audits to enhance the credibility of such initiatives.

Organizations are motivated to develop sustainability reports through both internal and external drivers, depending on their objectives and stakeholder interests.

However, on December 14, 2022, the European Parliament and Council published Directive (EU) 2022/2464, which amends several regulations, including Regulation (EU) No. 537/2014, Directive 2004/109/EC, Directive 2006/43/EC, and Directive 2013/34/EU regarding corporate sustainability reporting (European Commission, 2022). This directive entered into force on January 5, 2023, and updates the rules governing the disclosure of social and environmental information by companies. Now, a broader group of large companies, are obligated to provide sustainability reports—affecting approximately 50,000 organizations.

The first companies are required to implement these new rules starting with the 2024 fiscal year, with reports due in 2025. According to the directive, large firms must disclose information on: environmental issues, social aspects, including employee treatment, human rights adherence, anti-corruption and anti-bribery efforts, diversity within organization leadership (addressing factors like age, gender, education, and professional background).

Adopting ESG standards entails implementing responsible practices that demonstrate a strong commitment to sustainability and effective corporate governance. The key steps for incorporating ESG factors into port organizations are:

1. ESG Impact Evaluation: Conducting a thorough initial assessment of the organization's impact on ESG, and identifying the key ESG areas influencing activities and stakeholder relationships. For port organizations with ISO 9001:2015 or ISO 14001:2015 certification, this evaluation can be integrated into the management system planning, along with an analysis of the organization's context (Castka & Corbett, 2015).
2. Commitment from Management: Ensuring that management is actively involved in adopting ESG principles. It is crucial to integrate these principles into the port organization's business strategy and goals. Port organizations implementing quality or environmental management systems must demonstrate leadership and commitment from top management to these systems, including a commitment to ESG practices (Inutsuka, Ichimura, Sugimura, Yoshie, & Shinoda, 2024).
3. Creating an ESG Policy: Developing and implementing an ESG policy that clearly outlines the port organization's commitments and measurable goals, in alignment with the overall vision and strategic direction. For ISO-certified ports, top management is responsible for establishing, implementing, and maintaining policies that reflect these commitments, integrating ESG practices alongside quality and environmental objectives.
4. Stakeholder Engagement: Ensuring ongoing communication with stakeholders such as employees, customers, investors, and local communities. This step can be integrated into an ISO 9001:2015-certified management system, which emphasizes quality management principles, particularly stakeholder relationship management. On February 22, 2024, several ISO management system standards were updated to emphasize the importance of climate change in the organizational context, adding new requirements related to it and its relevance to stakeholders.
5. Transparent Reporting: Establishing a system for collecting and sharing relevant ESG data in a transparent way for investors and regulators. This can be done by adapting existing questionnaires to the organization's specifics, outsourcing the report to a third party, or using reporting frameworks that provide sector-specific guidance for port organizations to create their reports.
6. Incorporating ESG into Decision-Making: Ensuring that ESG considerations are integrated into all high-level decisions, starting with strategy development, to operational activities, investments, and performance evaluations.
7. Training and Ongoing Development: Offering training programs to employees to increase their awareness and understanding of ESG principles, fostering an organizational culture focused on sustainability.
8. Sustainable Innovation: Based on the insights gained from ESG reporting, investing in innovative technologies and solutions to reduce environmental impact, enhance operational efficiency, improve governance, and create products or services that contribute positively to society.

Conclusion

This paper aimed to propose the integration of ESG factors in the new generation of ports, the 6th which is currently under great debate, in order to identify the opportunity to outline the characteristics of the new generation of ports already taking into account these factors that address all current and future societal problems, which will help adapt ports to the current needs of society. This paper is among the first to address the integration of ESG in the port functions of a new

generation of ports. The limitations of the paper were represented by the lack of sufficient information about the characteristics of the 6th generation of ports but it represents an opportunity to develop this topic in the future.

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