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Review

Sustainable Solutions for Small/Medium Ports a Guide to Efficient and Effective Planning

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Abstract: Ports are under increased pressure to reduce their negative climate and environmental impacts. Their roles and functions in transportation systems and the economy make them a key industry in promoting sustainability. In particular, small- and medium-sized ports (SMSPs) should serve as lighthouses or flagships of environmental and digital transformation, allowing access to remote locations and integrating peripheral regions. Their sustainability planning faces significant challenges in this context, such as limited resources, access to technical expertise, and stakeholder involvement. Sustainable planning strives for long-term viability, while balancing economic, social, and environmental goals. Ports can ensure that they are cost-effective, environmentally sustainable, and capable of satisfying local people's and companies' long-term demands by applying sustainable planning methods. This research aims to assist stakeholders in designing and implementing activities that will optimize the sustainability of SMSPs, promote the sustainable development of the neighboring communities, and encourage the sustainable use of coastal and marine resources.

Keywords: small/medium ports; sustainable port planning; stakeholders' participation; energy efficiency; environmental pollution

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1. Introduction

Over time, a new environment of activity for ports has been created. In today's era, this is characterized as quite competitive, with a large capacity, bringing about significant structural changes [1]. Initially, the phenomenon of globalization of markets and, in general, the substantial growth in international trade, with the high demand for products, such as from various Asian countries to the rest of the world, as well as each other, in combination with both the modern needs of consumers and the development of combined transport (land, road, and sea) have resulted in significant investment in port infrastructure and superstructures [2]. At the same time, there have been changes due to rapid developments in technology, such as various information systems and technological changes to the ships themselves, such as their size, to make fewer trips by transporting more cargo, as well as specialization in specific markets, so that they can accept modern ships and new products [3]. As a result, ports are now complex enterprises with quite specialized modes of operation, requiring their continuous development and finding enough capital to create the right conditions to provide high-quality services in combination with an attractive package (cost savings, speed of transport, and cargo security) that responds to the requirements of the trade [4].

Sustainability is becoming an increasingly significant aspect of port effectiveness, and small/medium-sized ports (SMSPs) are no exception. SMSPs are essential for regional and local economies, since they facilitate commerce and transport [5]. In contrast, port operations can harm the environment and local population through air and water pollution, habitat destruction, and increased noise and traffic [6]. Sustainability planning is essential to maintain the long-term survival of SMSPs and advance sustainable development. By

adopting a proactive sustainability posture, SMSPs can enhance their operations, minimize their environmental impact, and contribute to a more sustainable future. Numerous factors necessitate sustainability port planning, such as the worldwide trend toward sustainability, the increasing public awareness of the environmental impact of port activities, and the need to comply with legal requirements [7]. Nevertheless, many ports face formidable obstacles, such as limited resources, congestion, and air and water pollution. The ultimate objective of port sustainability planning is to guarantee that ports continue to service the demands of their customers, while preserving the environment for future generations.

Moreover, sustainability planning for SMSPs can provide significant social and community benefits, as well as environmental and economic benefits. SMSPs can improve the quality of life for nearby people by improving working conditions for port workers and supporting local communities. This can result in increased community engagement and support for the port and a positive reputation as a responsible and socially conscious entity.

Much research has been carried out to plan the sustainability of large ports. However, sustainable planning differs between small and large ports, as they face different challenges and obstacles. Some of these differences focus on the following issues: stakeholder engagement, funding, technical expertise, and technological implementation [8,9]. Furthermore, while several studies have focused on individual initiative solutions to sustainability problems [10], the literature needs to consider the sustainability-oriented planning approach for SMSPs.

The complexity of the sustainable planning of SMSPs over time has attracted the interest of many researchers [11], as developments and innovations in the field of transport and technology have had a direct impact, affecting and redefining the relationships between ports and the economic, social, and spatial systems to which they belong. The main obstacles to planning a small/medium port's viability are the complexity of how it is administered, financed, and legislated. More specifically, SMSPs face unique challenges when it comes to implementing sustainable planning practices, including:

1. Limited resources: SMSPs often need more financial and personnel resources, making it difficult to invest in sustainable infrastructure and technology;
2. Competition with larger ports: SMSPs often face competition from larger ports, which may offer more attractive amenities and services, making it challenging to attract cargo and shipping businesses;
3. Environmental concerns: SMSPs are often located in environmentally sensitive areas and must consider their operations' impact on the surrounding ecosystem;
4. Ageing infrastructure: SMSPs may have infrastructure that needs to be replaced or upgraded, which can be challenging due to limited resources;
5. Technological challenges: SMSPs may need more access to technology and technical expertise, to implement sustainable practices and modernize resources [12];
6. Lack of governmentsupport: SMSPs may receive less additional support and funding from government agencies than larger ports, making it difficult to implement sustainable practices.

Based on the above-described conditions, this paper aims to present a holistic framework for sustainable planning and development of small and medium ports, addressing the pressing need for environmental stewardship and economic viability, and offering actionable insights for policymakers, port authorities, and stakeholders, to collaboratively navigate the complexities of sustainable port development in an era of heightened environmental awareness.

The current survey's goal was to create a methodological guide that illustrates appropriate steps toward a fairer, more direct, efficient, and innovative phase, using technological developments that will serve as a policy tool for public authorities, stakeholders, and citizens, to ensure a high level of sustainable port facilities in the future. The identification of objectives, goals, and research gaps is simultaneously linked to the primary research question, which is formulated as follows:

What are the steps for the sustainable development of SMSPs?

Innovative planning and management strategies must be implemented considering these ports' unique challenges and opportunities, to ensure port sustainability and success. As a result, the proposed guide is an original approach to addressing the challenges of SMSPs. It provides ports with the tools and framework they need to create a sustainable and livable environment that is accessible, affordable, and safe for all, by focusing on local conditions, collaboration, and adaptability. Rather than simply replicating existing solutions (plans) from other ports, the proposed methodology aims to create unique approaches to port planning tailored to each SMSP's individual needs and characteristics. More specifically, it encourages community engagement and collaboration, which fosters a sense of pride and ownership among community members, resulting in increased usage and a thriving local economy.

Furthermore, it proposes steps to achieve a balance between economic development and environmental protection through the sharing of best practices among ports. Finally, it is intended to be adaptable and flexible, allowing ports to modify their approaches as conditions change and new challenges emerge. This means that the strategy is constantly evolving, and ports can continue experimenting with new and innovative solutions, learning from their successes and failures and refining their approaches over time.

The paper is structured as follows: Section 2, titled "Literature Review", attempts to critically assess relevant research, case studies, and best practices, offering insights into the challenges faced by ports, the effectiveness of different strategies, and the evolving role of ports in the context of environmental conservation and community development. Building upon the literature review, the "Methodology" in Section 3 explicates the research design and sequential steps undertaken in the research process. Following that, Section 4 is dedicated to the discussion of the results, where the findings of each step are presented, analyzed, and compared against the existing literature and goals set in the introduction. The "Conclusion" in Section 5 summarizes the key findings, highlights their implications, and underscores their contribution to advancing sustainable planning practices in small and medium ports.

2. Literature Review

A thorough literature analysis of small/medium port sustainability planning should seek to consolidate existing research and best practices in this sector and propose areas for future study and action. In recent years, port sustainability planning has changed drastically, reflecting a greater understanding of port operations' environmental and social implications and the rising significance of sustainable practices in the marine sector [13].

Developing integrated planning techniques that address a port's interconnected physical, economic, and social components and the surrounding community is an essential research topic in small port sustainability planning [14]. These techniques strive to identify significant problems and possibilities for sustainability planning and to design comprehensive and integrated plans to address these concerns. For instance, research has investigated the use of systems thinking and integrated coastal management as approaches for sustainable port planning, which take into account the impact of the port on the surrounding environment, economy, and social fabric, as well as identifying interrelated factors that contribute to the sustainability of the port and the community [15].

The importance of stakeholder involvement and community participation is another crucial face of SMSPs. Developing sustainable port plans that represent the interests and goals of all stakeholders requires effective communication and collaboration among port officials, local enterprises, environmental groups, and community members [16]. This research area has used instruments such as public fora, stakeholder surveys, and community-based participatory procedures to solicit input and feedback from local citizens and engage the wider community in the sustainability planning process.

In addition, research has investigated the use of innovative and sustainable technologies for the planning and operations of small/medium ports, such as using renewable energy sources [17], implementing sustainable transportation systems, and adopting green

infrastructure and land-use practices [18]. Some ports, for instance, have developed wind and solar energy systems to minimize their dependency on fossil fuels and have embraced sustainable mobility systems, such as electric trucks, to lessen the environmental impacts of travelling to the port [19].

SMSPs are taking a proactive approach to sustainability, recognizing that sustainable operations are an ethical imperative and a strategic business opportunity. Best practices and frameworks such as the United Nations Sustainable Development Goals and the World Ports Sustainability Program guide small ports in their planning for sustainability. The growing focus on stakeholder engagement and the implementation of specific measures and technologies, such as renewable energy sources and waste management programs, is helping small/medium ports to reduce their environmental impact and contribute to sustainable development [20]. The potential for digitalization and innovation in the maritime industry for enhancing sustainability is also significant and an area to watch for future results in port planning sustainability [21].

Small/medium ports play a significant role in the global supply chain and frequently act as vital links between local communities and businesses. In contrast, limited resources, access to technical expertise, and stakeholder engagement complicate implementing sustainable planning techniques for these ports. From the study of academic surveys, it emerged that there is a significant research gap in sustainable planning for small/medium ports, particularly in areas such as environmental impact assessment, energy efficiency, stakeholder engagement, and best practices, which are described as follows:

2.1. Environmental Impact Assessment

Long-term planning requires assessing the possible environmental implications of port growth and operations. This involves examining the environmental effect of maritime activities such as dredging and reclamation, as well as port facility design and function. Long-term planning approaches that limit environmental harm, while guaranteeing the port's long-term survival, require a complete understanding of the environmental implications of port activities. While considerable research has been conducted in this area [22–24], much of it has focused on larger ports, thus creating a knowledge vacuum about the unique environmental implications of smaller port growth. SMSPs have not been able to analyze the possible environmental effects of their activities and apply sustainable planning techniques that are appropriate for their circumstances.

2.2. Energy Efficiency

Another crucial part of sustainable design is energy efficiency, which may lower the carbon footprint of port operations and the environmental effect of port activities [25,26]. When installing energy-efficient systems and infrastructure, SMSPs usually need more support, such as limited finances and access to technical knowledge. Consequently, SMSPs need help implementing new technology and best practices that increase their energy efficiency. Small port research is required to discover cost-effective and scalable solutions, to increase energy efficiency, minimize carbon footprints, and encourage sustainable practices.

2.3. Stakeholder Engagement

Effective stakeholder involvement is a vital component of sustainable planning, and it is essential for SMSPs, which are usually situated near local communities and companies [27]. As small port operations may substantially influence the lives of local communities and the environment, all stakeholders must be included in small port planning and development procedures. More study is required to understand how to engage and involve stakeholders in small port planning and development processes and guarantee that all stakeholders' needs and concerns are met. This may assist in building confidence and support for long-term planning initiatives and encourage sustainable practices in the port.

2.4. Best or Most Suitable Practices

Finally, research on best practices and case studies of sustainable planning in SMSPs are necessary. This data could be used to identify and distribute successful examples of sustainable planning in SMSPs and to provide assistance and lessons learned to other SMSPs striving to implement sustainable planning methods. By exchanging knowledge about best practices and case studies [28], the port sector could promote sustainable practices, improve capacities, and guarantee that SMSPs are constructed and run appropriately.

Addressing these research gaps is crucial to ensure that SMSPs can be constructed and operated sustainably and to encourage sustainable practices in the port sector. New approaches to port planning are being developed, as local governments attempt to avoid the patchwork approaches of the past and design plans that facilitate a seamless transition to cleaner and more sustainable forms of transportation.

Various plans have been proposed for the transition of ports towards sustainability, such as the Environmental Port Energy Plan [29], Green Port Program, plans for environmental protection, climate protection, Climate Initiative, Pollution Prevention and Reduction Plan, Green Port Plan [30], and Clean Air Plans [31], aiming to promote balanced development. Furthermore, energy management appears to be a prominent tool for sustainable port planning, and a large portion of the literature on energy management refers to environmental management systems (EMS). While the European Seaports Agency (ESPO) encourages European ports to develop environmental management plans, only a portion has implemented EMS. Energy management plans serve as a precursor to port energy certification based on ISO 5001 and EN standards 16001, as well as the identification of various efficient energy measures and technologies that meet their specific needs.

Several ports have implemented sustainable planning practices and serve as good examples, such as

- Port of Damietta, Egypt: It has implemented a comprehensive sustainability plan that includes renewable energy sources, such as wind and solar power [32];
- Port of Gijón, Spain: It focuses on economic and social sustainability and has implemented various initiatives to support local businesses and engage the community. For example, the port has developed a business incubation program to support local startups and has established a community engagement program to foster dialogue and collaboration with residents [33];
- Port of Bar, Montenegro: This port focuses on the development of an inventory of existing equipment that includes detailed data on energy consumption and the compilation of a prioritized list of feasible and promising energy sustainability measures for the port as a whole, but also for specific areas/facilities (e.g., buildings, warehouses, storages, etc.) and operations/equipment (e.g., ship loading/unloading equipment, yard operations equipment, terminal vehicles) [34].

3. Methodology

Sustainability planning for small and medium ports is a multifaceted endeavor that requires a systematic and tailored approach. This methodology outlines a structured process that empowers port authorities to develop effective sustainability plans, addressing these ports' unique challenges and opportunities.

The starting point for drawing up a sustainable port development plan (SPDP) should be the decision to improve the current situation and a strong belief that change is needed to enhance sustainability. An SPDP could therefore be considered "a strategic plan to address the demands of residents and businesses in the ports and neighboring communities to improve their quality of life". More specifically, an SPDP is a comprehensive and forward-looking strategy designed to guide the growth, operation, and management of a port facility in a manner that harmonizes economic, environmental, and social considerations.

This methodology begins with a comprehensive baseline assessment of the port's environmental, social, and economic dimensions. This assessment involves a detailed analysis of energy consumption, greenhouse gas emissions, waste management practices, local economic contributions, and community well-being. These quantitative and qualitative data, gathered with the use of questionnaires from stakeholders and relevant reports from the responsible port agencies, provide a clear understanding of the port's current sustainability performance and areas for improvement.

An embedded step in the above-described assessment is the identification of the port critical stakeholders, such as port authorities, local communities, shipping companies, regulatory agencies, and environmental organizations, and through a combination of interviews, surveys, and workshops, valuable insights are gathered regarding each group's current challenges, opportunities, and sustainability aspirations. This step ensures that the subsequent sustainability plan is well-aligned with the expectations and concerns of the local context.

After recording the key stakeholders' different perspectives and priorities, a range of strategies and actions are developed to achieve the established sustainability goals. These strategies include energy efficiency improvements, emission reductions, waste reduction, community engagement initiatives, and economic diversification projects.

The plan is designed for adaptability, recognizing that sustainability planning is an evolving process. Regular monitoring and evaluation mechanisms are embedded within the plan to assess progress, identify deviations, and gather data on the effectiveness of the implemented strategies. This iterative approach enables port authorities to make informed adjustments, ensuring that the sustainability plan remains responsive to changing circumstances and aligns with the port's and stakeholders' evolving needs.

The significant phases and targets of the proposed methodology are illustrated in Table 1.

Table 1. The elements on which the proposed planning should be focused.

TARGETS					
Logistics	**Mobility**	**Environment**	**Economy**	**People**	**Governance**
Real-time information	Sustainable transport	Pollution reduction	Competitiveness	Social cohesion	Transparency
Smart maintenance	Mobility management	Energy efficiency	Employment	Collaboration	Security
Efficiency and predictability	Smart traffic management	Waste/Water management	Cost reduction	Training and knowledge	E-administration
Automation and robotization		Alternative fuels	Circular economy		

4. Results

Recently, the approach to port plans has changed academically and professionally. Unlike traditional plan techniques, the proposed SPDP prioritizes citizen participation, stakeholder coordination, policy domains, and collaboration between government entities and corporate players at multiple levels [35]. The most significant distinctions between the traditional plan methodologies and the proposed SPDP are listed below in Figure 1:

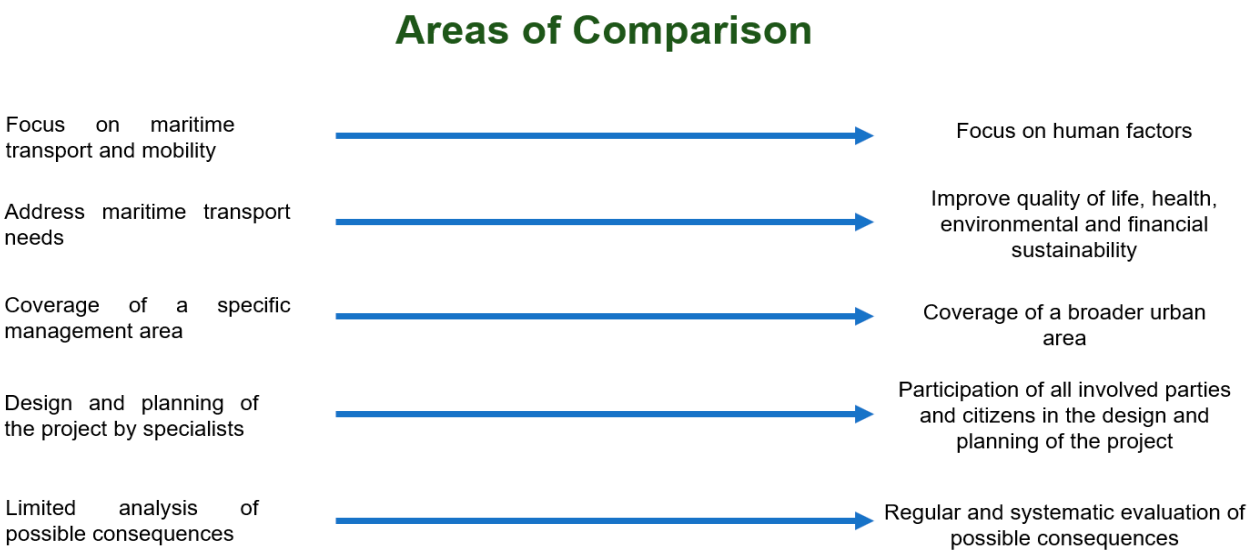

Figure 1. Areas of comparison between the traditional and proposed planning.

Figure 2 details the exact step-by-step implementation and the precise structure of the tasks recommended by word-for-word guidelines. The challenge of implementing an SPDP is to adapt it to a given local context, taking into account the specific characteristics of each separate port, while maintaining ambitious goals and avoiding inappropriate compromises. The plan presented here is meant to describe these stages in depth. However, because various activities must be conducted in tandem, it can be challenging to establish which processes and activities should come first during the plan practice stage.

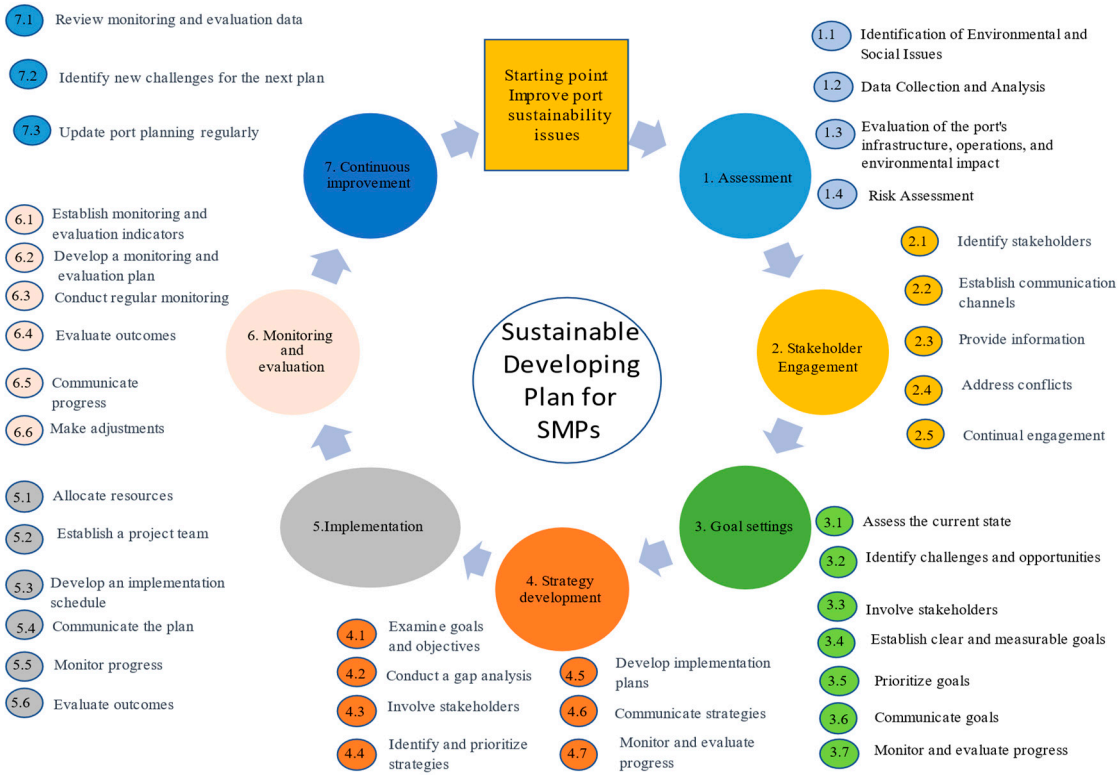

Figure 2. Phases and steps of the proposed methodology.

4.1. Phase 1: Assessment

The assessment phase, the first step in the planning process, describes the current situation of the port, including its advantages, disadvantages, opportunities, and threats. Obtaining information on energy use, water use, waste production, and emissions is required [36]. These data identify improvement opportunities and create a long-term plan for the port's future [37]. This phase should involve thorough data collection, analysis, and stakeholder engagement, to ensure that all opinions and needs are considered when identifying crucial environmental and social concerns. The data gathered during this phase will be used to develop a sustainable strategy using sustainability concepts such as economic, social, and environmental sustainability. In order to identify potential risks and challenges that could jeopardize the port's sustainability, a risk assessment is also necessary. The Port of Antwerp, Port of Rotterdam, Port of Istanbul, Port of Los Angeles, and Port of Melbourne are just a few of the case studies used by Schippel et al. [38] to apply a port assessment methodology. The purpose of this research was to create and implement a comparative methodology for evaluating the sustainability of port long-term management plans and port–city development, as well as to confirm the actual impacts in terms of social, economic, and environmental factors.

The following is a description of the assessment phase's steps and activities:

4.1.1. Identify Environmental and Social Issues

During the assessment phase, the first step is identifying the environmental and socioeconomic problems that could influence the port's sustainability [39]. It is crucial to locate possible pollution sources and assess environmental and public health hazards, to guarantee that ports run sustainably [40,41]. Environmental problems that typically affect ports include habitat deterioration and destruction; water pollution from ships and cargo handling activities; and air pollution from trucks, cars, and other vehicles [42,43]. It is crucial to recognize possible societal problems and provide solutions. Ports frequently face social issues such as noise [44], traffic congestion, and health and safety risks. A thorough literature review and stakeholder consultation should be performed to identify these issues.

4.1.2. Data Collection and Analysis

If ports are to meet future demands, frequent data collection and analysis of port operations, infrastructure, and environmental impacts are required. These data can be gathered using various resources, such as operational reports, infrastructure assessments, and environmental monitoring programs [45]. The kind and amount of information collected will depend on the specific needs of the port, but it should be exhaustive and cover all aspects of operations and impacts [46]. The process of data analysis follows the stage of data collection. To accomplish this, it is necessary to analyze the data to identify trends, patterns, and problem areas. In order to identify areas for potential improvement, this step aims to better understand the port's operations and effects. Ports can create sustainable plans to help ensure their long-term success by routinely gathering and reviewing information about the port's functions, infrastructure, and environmental impact.

4.1.3. Evaluation of the Port's Infrastructure, Operations, and Environmental Impact

Ports must regularly examine their infrastructure, operations, and environmental effect to guarantee that they can meet future needs [47]. This includes evaluating the present status of the port's physical infrastructure, such as buildings, docks, and equipment, and identifying areas that require modifications and enhancements. This evaluation should consider aspects such as the age of the infrastructure, its current usage, docks, and potential to meet future needs. Examining the port's operations is the next stage in establishing its long-term sustainability. This entails evaluating the port's present procedures, such as cargo processing, vessel traffic, and maintenance. The port's environmental impact is the final step in determining its sustainability. This includes assessing the port operations' impact on air and water quality, soil and habitats, and wildlife [48]. The assessment should

identify potential pollution sources, such as ships and cargo handling operations, and assess the risks to human health and the environment. Ports can maintain operational efficiency while protecting the environment and the health and well-being of the local community by regularly assessing these areas and implementing sustainable solutions [49].

4.1.4. Risk Assessment

A risk analysis should be conducted as part of the assessment phase to identify potential threats to the port's sustainability [50]. Risks related to human activities, such as industrial accidents and the release of toxic pollutants, may be included, in addition to risks associated with natural hazards, such as sea level rises and extreme weather events. Ports can enhance their performance by identifying potential threats and devising plans to lessen or manage them. The risk assessment should be based on a thorough analysis of the available data and consider the likelihood and effects of the scenarios.

4.2. Phase 2: Stakeholder Engagement

Engaging with stakeholders is crucial, to ensure that the sustainability plan is comprehensive and satisfies the requirements and expectations of all parties involved [51]. Stakeholders may include port users, local communities, regulatory organizations, and other parties interested in the port's long-term success. Interacting with stakeholders and identifying potential hurdles or issues that need to be addressed can determine the sustainability strategy's potential impact on diverse groups. In general, including stakeholders enhances openness and accountability, fosters trust, improves decision-making, and increases community ownership [52]. Studying the port of Souda in Greece, Argyriou et al. [53] addressed some of the advantages and disadvantages of stakeholder/citizen involvement in the decision-making process for the development of a sustainable port. They examined issues such as citizens' familiarity with sustainable development issues, the way the latter addressed the measures undertaken for the development of sustainable ports, anticipated obstacles in carrying them out, and alternatives that could be put forward.

The steps, as well as the activities of the stakeholder engagement phase, are described below:

4.2.1. Identify Stakeholders

The first step in the stakeholder engagement process is identifying and understanding the relevant parties' interests, motivations, and potential concerns [54]. Once the stakeholders have been identified, they must be classified according to their level of influence and interest. This will aid in prioritizing which stakeholders to engage with first and in determining the most effective engagement methods. This will, in turn, assist in including all relevant stakeholders in the engagement process. All stakeholders must be able to share their perspectives and feedback and address any concerns. Ports can build positive relationships with stakeholders and ensure they operate sustainably and responsibly by collaborating [55].

4.2.2. Establish Communication Channels

The success of stakeholder engagement is dependent on effective communication. Setting up transparent and open communication channels, such as public meetings, focus groups, and online fora, will ensure that all stakeholders can provide feedback [56]. By building clear and effective communication channels, ports can ensure that all stakeholders are informed, participate, and have a role in decision-making. By building strong stakeholder relationships, ports can foster community and support for sustainability initiatives.

4.2.3. Provide Information

It is crucial to provide information on port planning, so that stakeholders can comprehend the present condition and plans of the port and its influence on the surrounding

community and the environment, for reasons of transparency and accountability, to improve decision-making, build trust, and for better coordination.

4.2.4. Address Conflicts

Conflicts among stakeholders in small port planning can arise due to divergent interests, goals, and priorities [57]. It is critical to take a collaborative approach that considers the interests and needs of all parties involved. Addressing conflicts constructively and transparently will help build trust and ensure that all stakeholders can be heard and managed effectively through a collaborative, participatory, and transparent approach.

4.2.5. Continual Engagement

This step entails ongoing monitoring, reviewing, and refinement of the plan, to ensure it remains aligned with stakeholders' changing needs and priorities [58]. Engagement with stakeholders should be a regular activity throughout a sustainable plan's design and implementation phases, rather than a one-time event. Ongoing involvement will help guarantee that the sustainable plan is frequently monitored, reviewed, and adjusted to ensure that it stays relevant and successful despite changing circumstances and that all stakeholders can have an input [59].

4.3. Phase 3: Goal Setting

Specific sustainability goals and objectives are identified based on the assessment and stakeholder engagement results. These objectives must be specific, measurable, attainable, relevant, and time-bound. Small port sustainability goals include lowering greenhouse gas emissions, increasing energy efficiency, and reducing waste. A well-defined goal-setting process provides a clear direction for the long-term plan, defining the desired outcomes and providing a framework for decision-making activities. Caliskan [60] formulated an all-encompassing framework for the implementation of sustainability measures in port operations, with the aim of facilitating the attainment of sustainable development goal (SDG) targets, specifically for European ports. The objective of their study was to address sustainability concerns pertaining to ports within the framework of the United Nations Sustainable Development Goals (UNSDG).

The steps, as well as the activities of the goal-setting phase, are described as follows:

4.3.1. Assess the Current State

The first step in goal-setting is to assess the SMSPs' current state. This evaluation should consider the port's environmental, social, and economic aspects and the surrounding community [61]. Both challenges and opportunities mark the current phase of small sustainable port planning, and stakeholders must collaborate to achieve better results for the overall image of the port. By identifying strengths and weaknesses, setting a plan baseline, anticipating future needs, measuring progress, and building trust, stakeholders can make informed decisions that benefit the port and the community [62].

4.3.2. Identify Challenges and Opportunities

The next step is to identify the challenges and opportunities faced by the small port and its surrounding community [63]. These issues can be addressed by implementing new technologies, forming partnerships, and focusing on environmental benefits. SMSPs can reap significant benefits by implementing innovative technologies, collaborating with other stakeholders, and demonstrating a commitment to environmental stewardship. Such benefits include lower operating costs, improved energy efficiency, and increased support for local economies. This will aid in identifying the most relevant and practical goals, while considering the needs and perspectives of all parties involved.

4.3.3. Involve Stakeholders

A large number of actors have interests in the port sector. As a result, port planning and development are usually performed in an environment where many interacting, and sometimes conflicting, interests are involved [64,65]. This complexity can create challenges in developing a mission statement, formulating the objectives and strategies for a port, and advancing port development projects. Involving stakeholders in the goal-setting process is critical to ensuring that the goals are relevant and practical, and to consider the appropriate parties' needs and perspectives.

4.3.4. Establish Clear and Measurable Goals

Developing sustainable ports requires the establishment of clear and quantifiable goals in port planning [66,67]. SMSPs can take concrete steps towards improving their environmental performance and becoming more sustainable by defining the port's purpose, identifying key performance indicators, setting realistic and measurable goals, and monitoring and evaluating progress. This will contribute to the ports' long-term viability and local communities' growth.

4.3.5. Prioritize Goals

Once goals have been set, they must be ranked according to relevance and realizability. Multiple objectives may compete for limited attention and resources, making this process easier. Prioritizing objectives is necessary to ensure that the limited resources available to SMSPs are used as efficiently as feasible. This will help allocate resources to the most essential and realizable objectives. In addition, decision-makers may choose which activities need urgent attention and which can be deferred [68]. This permits the development of a concise action plan and ensures that the most pressing needs are addressed first.

4.3.6. Communicate Objectives

Effective communication of goals and progress is critical for successful sustainable planning. Stakeholders can understand what the port is trying to achieve and why it is essential if the goals and objectives of the port's sustainability plan are communicated. This can increase support for the project and encourage stakeholders to play an active role in assisting the port in meeting its sustainability goals. Transparency and accountability can also be promoted through effective communication of sustainability goals. Stakeholders can check what the port is doing to improve its environmental performance and hold it accountable for its actions if it provides regular updates on progress towards its sustainability goals. This can contribute to developing trust and confidence in the port and its sustainability plan.

4.3.7. Monitor and Evaluate Progress

Monitoring and assessing progress towards the port's sustainability goals is critical to successful sustainable planning. The port can evaluate whether it is making the necessary progress toward its sustainability goals by regularly monitoring progress and identifying areas for improvement [69]. This enables the port to make informed resource allocation decisions and adjust its sustainability plan. Monitoring and evaluating progress can help build trust and confidence in the port and its sustainability plan and improve its environmental performance. The port can demonstrate its commitment to sustainability and transparency by regularly reporting on progress and making this information publicly available.

4.4. Phase 4: Strategy Development

The strategy development phase of small port sustainability planning is critical for translating the goals and objectives established during the goal-setting phase into concrete, actionable plans [70]. The strategies developed during this phase determine how the small port will work towards achieving its long-term goals and must be tailored to the port's

and the surrounding community's specific needs and circumstances [71]. In addition, it provides a road map for accomplishing the long-term objectives defined during the goal-setting phase, by detailing the particular activities to be undertaken and the required resources. The steps, as well as the actions of the strategy development phase, are described as follows:

4.4.1. Examine Goals and Objectives

Examining goals and objectives is crucial to port planning, because it forms the basis for the entire planning procedure. By clearly outlining the port's aims and objectives, decision-makers can guarantee that all efforts and resources are focused on attaining these objectives. This allows all stakeholders, including port authorities, shipping corporations, and government agencies, to develop a shared vision and a feeling of purpose [72]. Examining goals and objectives helps prioritize the port's growth [73]. By understanding what is most essential to the port and its stakeholders, decision-makers can allocate resources and prioritize initiatives with the highest likelihood of achieving these objectives. This may result in more efficient use of resources, less risk, and enhanced results.

4.4.2. Conduct a Gap Analysis

A gap analysis determines the difference between the small port's current state and the desired outcomes established during the goal-setting phase. This analysis provides valuable insights into a port's strengths and weaknesses and helps determine the required improvements to achieve the desired state. Port planners can ensure that the port is well-positioned to meet future demands and deliver the best possible outcomes for all stakeholders by conducting a thorough gap analysis. A performance gap analysis may also assist in identifying possibilities for innovation and expansion. By analyzing the port's strengths and limitations, decision-makers may find areas where new technology or novel techniques can enhance performance and boost competitiveness [74]. This may help the port remain ahead of the curve and serve its customers and stakeholders more effectively.

4.4.3. Involve Stakeholders

It is critical to include stakeholders in the strategy development process, to ensure that the strategies developed are practical and relevant, considering the needs and perspectives of all appropriate parties [75].

4.4.4. Identify and Prioritize Strategies

Various options for developing and improving the port are evaluated and prioritized during this phase based on feasibility, impact, and cost-effectiveness factors [76]. This step aims to identify the most viable and effective strategies for moving the port forward and ensuring its long-term success. Effective planning is critical here for the overall success of the port planning process. By analyzing various potential strategies and choosing the most effective and efficient alternatives, decision-makers may concentrate their resources on the plans with the greatest impact.

4.4.5. Develop Implementation Plans

Following the identification and prioritization of strategies, implementation plans must be developed, outlining the specific actions to be taken, the resources required, and the timeline for implementation [77]. The implementation plan must be comprehensive, while remaining flexible enough to accommodate unexpected obstacles. This phase ensures that all stakeholders understand the project objectives, scope, timeline, and each team member's roles and responsibilities. The project team can ensure that the proposed port project is completed on time, within budget, and to the desired quality standards by effectively planning and executing the implementation process.

4.4.6. Communicate Strategies

Effective communication strategies are required for small port planning, to implement plans and projects [78] successfully. Regular meetings with stakeholders, clear and transparent communication about goals and progress, and the use of visual aids, such as presentations and models, to convey information effectively are examples of these strategies. It is critical to actively seek stakeholder feedback and be open to incorporating their ideas and concerns into the planning process. Building trust and keeping lines of communication open can help small port planning initiatives succeed.

4.4.7. Monitor and Evaluate Progress

Ongoing monitoring and evaluation progress are critical to the success of the long-term plan. Monitoring and evaluating progress may assist in discovering areas for improvement and improving the overall quality of the port planning process. By regularly analyzing the port's performance, decision-makers may identify areas where procedures or systems need to be enhanced to boost efficiency and performance. This may improve the overall quality of the port planning process and guarantee that the port operates at its maximum capacity.

4.5. Phase 5: Implementation

This is the stage at which the strategies and action plans developed during the strategy development phase are implemented. The port's and the surrounding community's long-term goals and objectives established during the goal-setting phase are translated into tangible outcomes. The implementation phase increases accountability by ensuring that the strategies and action plans are implemented and the results are tracked and measured. The steps, as well as the activities of the strategy development phase, are described as follows:

4.5.1. Allocate Resources

Allocating resources is an essential step in planning for SMSPs seeking sustainability. It entails determining the resources required to implement a sustainable plan and how they will be distributed [79]. This includes allocating financial, human, and material resources effectively and efficiently, to ensure the plan's successful implementation. The resource allocation phase aims to ensure that the right resources are available at the right time, place, and quantities to support the SMSPs' long-term development.

4.5.2. Establish a Project Team

A project team is vital to achieving success, since this requires organizing and directing the work of a group of individuals to accomplish a common objective. Creating a project team entails identifying the right people, defining their roles and responsibilities, and establishing precise performance and communication expectations [80]. A well-organized project team can boost efficiency, productivity, and collaboration, thus resulting in better outcomes and project success [81].

4.5.3. Develop an Implementation Schedule

The implementation timeline is a crucial aspect of every project and acts as a road map for success. It is essential to have a clear and accurate plan in place for port planning, to guarantee that all activities run smoothly and efficiently [82]. The timetable must account for all facets of port operations, including people, equipment, resource deployment, maintenance, and repair tasks. By designing a clear and well-structured implementation schedule, we can meet project deadlines and ensure the timely accomplishment of all activities.

4.5.4. Communicate the Plan

Communication of the plan is an integral aspect of port planning, as it ensures that all stakeholders are aware of the port's goals and objectives and comprehend their role in supporting the plan. Effective communication can foster a feeling of ownership and responsibility among all stakeholders and guarantee that everyone is working towards the

shared goal of a prosperous and sustainable port. By clearly and effectively communicating the plan, decision-makers can ensure that all stakeholders understand the port's priorities and objectives and know the activities needed to accomplish these objectives.

4.5.5. Monitor Progress

Monitoring progress is an ongoing process that allows for adjustments and ensures that the sustainable plan remains relevant and practical (see Section 4.7).

4.5.6. Evaluate Outcomes

Evaluating port planning outcomes is essential for ensuring the effectiveness and efficiency of a port's operations. It entails evaluating the results of previous planning decisions and determining whether the desired goals and objectives have been met. This evaluation process identifies areas for improvement and directs future planning efforts in response to changing demands and challenges. It is a methodical approach to determining the impact of planning decisions on port performance and the return on investment for stakeholders.

4.6. Phase 6: Monitoring and Evaluation

The monitoring and evaluation phase of SMSPs is the stage in which the progress of the sustainable plan is monitored and evaluated to ensure that the desired outcomes have been achieved and that the plan remains relevant and practical [83]. The steps, as well as the activities of the strategy development phase, are described as follows:

4.6.1. Establish Monitoring and Evaluation Indicators

Establishing effective monitoring and evaluation (M&E) indicators during project planning is critical to ensuring success and sustainability [84]. M&E indicators are used to track progress, assess impacts, and identify areas for improvement [85]. A well-designed M&E system provides project managers with valuable feedback, allowing them to make well-informed decisions, adjust strategies, and allocate resources accordingly. When developing M&E indicators, it is essential to consider the project's goals and objectives, target population, and desired outcomes. A clear and concise M&E plan ensures project success and demonstrates accountability and transparency to stakeholders.

4.6.2. Develop a Monitoring and Evaluation Plan

An M&E plan is essential for a project's success and sustainability. A well-designed M&E plan can provide valuable insights into project progress and impacts, enabling project managers to make well-informed decisions, adjust strategies, and effectively allocate resources. Furthermore, it includes data collection and analysis frequency functions, to ensure that the project stays on track and progresses toward its goals and objectives.

4.6.3. Conduct Regular Monitoring

Regular monitoring is a crucial aspect of port planning, since it ensures that the plan is successfully implemented and that progress is made toward the desired outcomes. Regular monitoring enables decision-makers to evaluate the efficacy of their tactics and discover improvement opportunities, which may be vital to accomplishing the port's goals and objectives. Through frequent monitoring, decision-makers can evaluate the port's performance and identify potential concerns or obstacles. These data may then be utilized to make educated judgments and execute any required improvements to enhance the port's overall performance. Regular monitoring can guarantee that the port is running at its maximum capacity and that all stakeholders cooperate to achieve the shared objective of a successful and sustainable port.

4.6.4. Evaluate Outcomes

Evaluation of outcomes is an essential component of port planning, as it enables decision-makers to analyze the efficacy of their methods and quantify the port-wide impact

of their efforts. By analyzing results, decision-makers can identify areas for improvement and make well-informed choices, to guarantee that the port runs at its maximum capacity and that all stakeholders work towards the shared goal of a successful and sustainable port. By regularly evaluating results, decision-makers can review the port's performance and decide whether their initiatives have produced the intended results. These data may then be utilized to make the appropriate modifications to enhance the port's overall performance. By reviewing results, decision-makers can verify that their strategies are aligned with the port's aims and objectives and that they are advancing towards a prosperous and sustainable future.

4.6.5. Communicate Progress

Progress reporting is essential to port planning, as it keeps stakeholders informed and involved in the planning process. By discussing progress regularly, decision-makers can show their commitment to openness and accountability and develop stakeholder confidence [86]. This may ensure that the port has the support of the local community and the industry and that all stakeholders strive toward the common goal of a prosperous and sustainable port. Moreover, effective communication of progress may build a feeling of ownership and responsibility among all parties involved. By routinely reporting on the port's development, decision-makers can encourage stakeholders to take an active interest in the planning process and feel responsible for the port's future. This ensures that all stakeholders are aligned with the port's aims and objectives and work together towards a prosperous and sustainable future.

4.6.6. Make Adjustments

During this phase, changes and improvements to previously developed plans are made based on new information, stakeholder feedback, and emerging requirements. The goal is to ensure that the port development project corresponds with the evolving needs of stakeholders, adheres to the project's budget, and achieves the technical and operational standards set out. To make well-informed decisions and create a comprehensive, flexible, and practical plan, the project team, stakeholders, and relevant authorities must collaborate during this phase.

4.7. Phase 7: Continuous Improvement

This is the final step in the process of long-term planning. It is the stage at which the lessons learned from the monitoring and evaluation phase are applied, to improve the long-term plan and ensure that it remains relevant and practical. This contributes to progressing toward the goals and objectives established during the goal-setting phase, ensuring that the desired outcomes are realized. The continuous improvement phase is an ongoing process, and the sustainable planning process should be repeated regularly to keep the sustainable plan relevant and practical and progress toward the goals and objectives on track [87]. The steps, as well as the activities of the strategy development phase, are described as follows:

4.7.1. Lessons Learned

The lessons learned are a record of a project or initiative that highlights what worked well and what did not, and this is a necessary tool for effective port planning. Lessons learned throughout the port development process are crucial because they give significant insight into what went well and what could be improved. By reflecting on the lessons gained, decision-makers may identify best practices and make educated choices to safeguard the port's future viability. Learning from previous experiences is vital for the port planning process's constant development and innovation. By reflecting on the lessons learned, decision-makers can identify areas for improvement and modify the planning process as appropriate. This guarantees, in turn, that the port runs at its maximum capacity and that all stakeholders collaborate for a prosperous and sustainable future.

4.7.2. Identify New Challenges for the Next Plan

New difficulties arise daily in port planning, which is continuously evolving. In the upcoming years, port planners will encounter unique and distinctive challenges that will test their capacity to oversee and improve current port operations. Port planning is a dynamic and challenging area that demands adjusting to new and changing situations. As they try to make ports more sustainable, efficient, and safe, as well as handle the growing complexity of global commerce, port planners will encounter specific challenges in future years. These problems will require innovative solutions and a solid knowledge of the sector's recent trends and technology.

4.7.3. Update Port Planning Regularly

Port planning is a vital aspect of the shipping industry, and port planners must frequently analyze and change their plans to meet the industry's needs. Regularly updating the port planning procedure is necessary for several reasons [88]. First, the port industry is ever-evolving and changing, requiring periodic revisions to the port planning procedure. Second, revising the port planning process regularly ensures that the port runs at its maximum capacity and that all stakeholders work towards the shared objective of a successful and sustainable port. Third, periodically reviewing the port planning process can assist in identifying areas for improvement and making any required improvements. Lastly, updating the port planning process can assist in maintaining momentum and keep stakeholders motivated and involved in the planning process.

5. Conclusions

SMSPs are critical to coastal community development and marine environment preservation. Implementing sustainable planning strategies in SMSPs can ensure responsible resource use, promote economic growth, and improve residents' quality of life. This can be accomplished by combining various approaches, such as environmentally friendly infrastructure development, renewable energy adoption, and effective waste management practices. For instance, investing in environmentally friendly infrastructure and renewable energy might generate new employment prospects in industries, such as developing renewable energy and sustainable tourism. SMSPs can strike a balance that benefits everyone by considering the environmental and economic impact of sustainable planning initiatives. Moreover, effective collaboration among stakeholders, including government agencies, local communities, and private firms, is essential for the success of SMSP efforts. By addressing sustainability, SMSPs can ensure a bright and prosperous future for future generations.

The numerous case studies discussed in papers show how specific strategies and solutions to promote sustainability can produce unsustainable outcomes if their effects on various sectors or at various scales are not anticipated and adequately addressed. This survey's contribution is to provide a comprehensive understanding of the current state of research in the field, as well as valuable insights into best practices and methodologies, as well as to serve as a valuable resource for researchers, policymakers, and practitioners. This promotes the development of more sustainable ports and ensures that the port sector is better equipped to meet future challenges by contributing to a better understanding of sustainable port planning.

More analytically, this guide provides a thorough framework that identifies the critical elements affecting the sustainability of SMSPs and discusses the activities stakeholders may undertake to improve sustainability. It highlights the necessity for collaboration between port authorities, port users, and local communities, in order to ensure that the sustainability plan reflects the interests and concerns of all stakeholders. Environmental sustainability is emphasized heavily in this particular guide for SMSP sustainability planning, which is another crucial feature. Furthermore, it describes how SMSPs can reduce environmental effects by lowering emissions and managing waste. In addition, it emphasizes the signifi-

cance of economic sustainability, as SMSPs are frequently located in economically weak areas, and their economic viability is crucial to the local economy [89].

It is a valuable resource for researchers looking to advance the field of sustainable port planning. By comprehensively assessing the available literature on the issue, this survey intends to aid academics in identifying potential research gaps and directing their attention to areas that require additional examination. This can also contribute to future research on sustainable port planning being well-informed and relevant, which is critical for advancing the field and improving the port sector's sustainability.

Future work on SMSPs should center on initiatives that promote clean energy, waste management, water management, sustainable transportation, ecosystem protection, community building, sustainable tourism, alternative transportation infrastructure, sustainable development, and stakeholder engagement. SMSPs can build sustainable and resilient communities that support local economies and protect the environment for future generations by prioritizing these initiatives and collaborating closely with stakeholders. However, each port and community's unique circumstances and needs will determine the specific focus and priorities. They can play an essential role in creating a more sustainable and resilient future for their communities by taking a proactive approach to sustainable planning and development.

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Abbreviations

Monitoring and evaluation (M&E), small/medium-sized ports (SMSPs), sustainable port development plan (SPDP), sustainable development goals (SDGs).

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