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Feasibility Evaluation in Port Development: A Systematic Literature Review of Global Trends, Methodologies, and Risks

Wawan Rudi Berlianto[1*], Dedi Purwana[2], Agus Wibowo[3]
[1-3] Department of Management, Universitas Negeri Jakarta, Indonesia

**Corresponding Author: wawan.rudi@mhs.unj.ac.id*

Abstract. *Feasibility evaluation is a crucial step in port development as it ensures that the project to be implemented provides optimal technical, economic, social, and environmental benefits. This study aims to provide a comprehensive overview of global research trends related to port feasibility evaluation, approaches applied in previous studies, and risks that arise when feasibility aspects are neglected in port development. Using a systematic literature review (SLR) approach, the study analyzes articles published between 2020 and 2025 indexed in Scopus. The results show that there has been increasing global attention to the importance of sustainable ports focused on green technologies and terminal automation. However, many studies still overlook social and environmental risks in feasibility evaluations. The study also found that neglecting feasibility aspects can lead to economic losses, environmental damage, and social dissatisfaction, resulting in project failure. Therefore, this research emphasizes the need for a more integrated feasibility evaluation that includes all technical, economic, social, and environmental dimensions. This study is expected to contribute to the development of a more holistic feasibility evaluation model, especially for developing countries like Indonesia, which still face significant challenges in port modernization and the adoption of green technologies.*

Keywords: *Feasibility Evaluation; Green Technologies; Port Development; Social Risks; Sustainability.*

1. INTRODUCTION

Ports play a crucial role in the global logistics system, significantly contributing to national economic growth and reducing logistics costs (Notteboom et al., 2022). The role of ports extends beyond cargo handling, evolving into value-added logistics hubs that connect hinterlands to international markets efficiently (Martinho & Adams, 2023). As this transformation progresses, port feasibility evaluations have expanded to include not only technical and financial aspects but also environmental, social, and governance considerations (Lin & Liu, 2023). These evaluations ensure that port projects are implemented effectively, sustainably, and economically in the long term (Lv & Shao, 2022).

Feasibility evaluation in port development involves assessing technical, economic, environmental, social, and risk aspects, which are critical for the success of the investment project (Le & Nguyen, 2023). These factors are necessary to reduce financial and operational risks that can arise due to poor planning, such as idle capacity, cost overruns, and unmet market demands (Nguyen & Tsai, 2025; Sun et al., 2021). For example, inadequate capacity planning or inefficient infrastructure can lead to wasted resources and missed opportunities. Thus, comprehensive feasibility evaluation is essential, particularly during the early planning stages, to enhance project implementation and minimize the risks of failure.

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In the context of modern and sustainable ports, feasibility evaluations must go beyond technical and economic dimensions to also include environmental and social considerations, which are gaining increasing importance in today's sustainable development era (Gabbar & Esteves, 2023). The transition to green and smart ports demands deeper assessments of renewable energy adoption, energy efficiency, and the social impacts of port development (Olivari et al., 2024; Retamero & Orive, 2025). Failure to account for these aspects can lead to severe environmental degradation and social resistance, which may delay or even halt port projects (Simmons et al., 2022).

Previous studies indicate that both developed and developing countries face challenges in conducting comprehensive port feasibility evaluations. In developing countries, such as Indonesia, feasibility evaluations often remain fragmented, focusing mainly on operational, regulatory, and maritime economic issues rather than the comprehensive planning needed for future port developments (Syafiq & Purwoko, 2022). This contributes to the low competitiveness of Indonesian ports, compared to neighboring countries such as Singapore and Malaysia, which have already adopted green technologies and automated terminal systems (Sánchez & Wilmsmeier, 2010; Xiao & Lam, 2020).

To improve the competitiveness of national ports, Indonesia needs to adopt a more integrated feasibility evaluation model. This model should encompass technical, financial, social, environmental, and digital readiness dimensions to address global energy transition challenges and sustainability concerns (T. Notteboom, 2016). One approach could involve implementing a feasibility assessment framework that integrates green technologies, strict environmental policies, and social considerations to minimize the adverse impacts of port projects on local communities (Martinho & Adams, 2023).

This systematic literature review aims to provide a comprehensive understanding of global research trends in port feasibility evaluation over the past five years, how feasibility evaluations have been applied in previous studies, and the risks that emerge when feasibility aspects are neglected in port development. Additionally, the study seeks to develop a more holistic port feasibility evaluation model, which can enhance the sustainability and competitiveness of ports in Indonesia.

2. LITERATURE REVIEW

Feasibility evaluation in port development involves various disciplines, including economics, engineering, environmental science, social factors, and risk analysis. Several

theories and models are used to understand, measure, and assess the feasibility of port projects holistically.

Project feasibility theory is an approach used to assess the viability of a project based on technical, economic, social, and environmental aspects. In port development, this theory is applied to evaluate whether a project can be implemented with the available resources, whether it generates financial returns, and whether the social and environmental impacts are acceptable to the community (Lv & Shao, 2022). According to Lin & Liu (2023), project feasibility in port development depends heavily on early identification of potential risks and an assessment of achievable operational capacity.

Risk management theory also plays a significant role in feasibility evaluation in port development, focusing on the identification, analysis, and mitigation of potential risks that may affect the project. This theory involves analyzing uncertainties that could impact the project's success and establishing strategies to reduce potential losses (Shen et al., 2023). In the port context, risks could include environmental damage, changes in government policies, or market uncertainties that affect the demand for port services (Simmons et al., 2022).

Sustainability theory plays a crucial role in port feasibility evaluation. Feasibility evaluations in port development go beyond technical and economic dimensions to integrate social and environmental factors, which are central to the concept of sustainable development. This theory focuses on achieving a balance between economic, environmental, and social needs and ensuring that port development can sustain long-term benefits without damaging ecological balance or neglecting local community needs (Gabbar & Esteves, 2023). Several studies (Olivari et al., 2024) suggest that sustainability aspects should be integrated into every stage of port project planning, from design to implementation.

Infrastructure project management theory is particularly relevant to port feasibility evaluations, given the large and complex nature of port projects. This theory focuses on managing resources, time, cost, and risks to ensure that the project proceeds according to plan and delivers the desired outcomes (Notteboom et al., 2022). In port contexts, this theory helps design efficient systems and manage the various stakeholders involved in the project, ranging from governments and port operators to local communities affected by the development.

In port development, infrastructure economics theory helps analyze the economic aspects of a project, such as cost-benefit analysis, Net Present Value (NPV), and Internal Rate of Return (IRR). This theory emphasizes the importance of economic evaluation to

ensure that port projects are not only technically feasible but also deliver optimal economic value for the country and society (Kuznetsov et al., 2020). According to research by Le & Nguyen (2023), port development projects that are not based on accurate economic evaluations may lead to cost overruns and investment failures.

3. RESEARCH METHODS

This study adopts a systematic literature review (SLR) approach to evaluate and analyze the literature on port development feasibility published in the past five years. This approach was selected due to its ability to provide a comprehensive overview of research trends, applied approaches, and the risks associated with neglecting feasibility evaluations in port development projects. The methodology follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure transparency and reproducibility throughout the selection and synthesis process.

Literature was sourced by accessing Scopus for relevant articles on port feasibility. The selected articles must meet certain criteria, including being published between 2020 and 2025, written in English, and indexed in Scopus.

Articles included in the review must explicitly discuss "port feasibility" in the context of port management, maritime policy, and port infrastructure. Conference papers, letters, and non-Scopus indexed articles were excluded from the analysis.

Screening was conducted based on article titles, abstracts, and keywords. After screening, the remaining articles were further analyzed to understand research trends, methodologies applied, and the associated risks.

A bibliometric analysis was conducted to identify research trends, author connections, country collaborations, and keyword occurrences. This data was analyzed using VOSviewer software.

After bibliometric analysis, a qualitative synthesis was conducted to dive deeper into the key findings from the selected articles. This synthesis includes identifying gaps in the literature and explaining how feasibility evaluation is applied in port development.

Table 1. Research Methodology

Step	Description	Data Source
Article Search	Searching for articles through the Scopus database that are relevant to "port feasibility"	Scopus Database
Screening	Applying inclusion and exclusion criteria to select relevant articles	PRISMA Screening Process
Bibliometric Analysis	Using VOSviewer to map author relationships, country collaborations, and keyword occurrences	Scopus, VOSviewer
Qualitative Synthesis	Compiling findings from selected articles to produce a theoretical and practical synthesis	Selected Articles

4. FINDINGS AND DUSCUSSION

From the literature search conducted, 718 articles were selected based on the inclusion criteria. After further analysis of the 30 most relevant articles, key findings emerged regarding research trends, applied approaches, and the risks associated with neglecting feasibility evaluation in port development projects. The following are the results of the analysis:

Research on port feasibility has shown an increasing global focus on sustainability and modernization of ports. From 2020 to 2025, publications related to this topic have risen significantly, indicating that ports are increasingly seen as key factors in developing sustainable maritime infrastructure (Yu et al., 2025).

The approaches used in port feasibility evaluations vary, with most studies employing cost-benefit analysis, sensitivity analysis, and discrete-event simulation to assess the technical and economic aspects of projects. These approaches help identify the potential success or failure of proposed port projects (Shen et al., 2023).

Risks frequently identified as a result of neglecting feasibility evaluation include environmental degradation, social harm, and economic losses. Some studies show that neglecting to assess environmental risks, such as marine pollution and mangrove ecosystem loss, can result in significant long-term damage (Simmons et al., 2022).

It is essential to emphasize that comprehensive feasibility evaluation is critical to enhancing the competitiveness of ports, especially in developing countries such as Indonesia. Based on the findings, several implications for port development in Indonesia can be drawn:

Indonesian ports still face challenges in adopting green technologies and automated terminal systems that could improve operational efficiency (T. Notteboom, 2016). Research conducted in developed countries like Singapore and Malaysia shows that the adoption of green technologies can reduce energy costs and environmental impact

(Olivari et al., 2024). Therefore, Indonesia needs to accelerate this transformation to remain competitive globally.

Most port projects in Indonesia face challenges related to social risk management. Resistance from local communities and social conflicts often arise due to a lack of participation in the planning process and an inability to manage the social impacts of the project (Simmons et al., 2022). Therefore, developing a more integrated feasibility evaluation model, including in-depth social analysis, is vital to achieve more sustainable port projects.

Feasibility evaluation also needs to involve more stakeholders, including the government, port operators, and the community. A more inclusive approach to decision-making can reduce the risk of project failure and improve long-term success (Yu et al., 2025).

Table 2. Results and Discussion

Finding	Description	Source
Global Research Trends	An increase in publications on port feasibility, with a focus on sustainability and modernization of ports since 2020.	Yu et al., 2025
Feasibility Evaluation Approaches	Cost-benefit analysis, sensitivity analysis, and discrete-event simulation are used to assess the technical and economic feasibility of port projects.	Shen et al., 2023
Risks of Neglecting Feasibility	Environmental degradation, social harm, and economic losses are major risks faced by port projects that fail to evaluate feasibility adequately.	Simmons et al., 2022
Green Technology Adoption in Indonesia	The need to accelerate the adoption of green technologies and automated terminals to enhance operational efficiency in ports.	Olivari et al., 2024
Social Risk Management in Indonesia	Social conflict and community resistance often occur, indicating the need for more comprehensive social risk management strategies.	Simmons et al., 2022

5. CONCLUSION AND RECOMMENDATION

Feasibility evaluation in port development is a crucial step to ensure the success and sustainability of projects. Based on the findings of this study, it can be concluded that global research trends indicate increasing attention to the aspects of sustainability and modernization of ports, with a focus on green technologies, terminal automation, and the integration of renewable energy. However, many studies still focus primarily on technical and economic aspects, while social and environmental risks are often overlooked.

Therefore, there is a need for a more integrated feasibility evaluation, one that not only covers technical and economic dimensions but also considers social and environmental sustainability to create competitive and sustainable ports.

Specifically in Indonesia, port development still faces significant challenges, such as the slow adoption of green technologies, lack of social risk management, and infrastructure capacity imbalances. It is therefore important for Indonesia to accelerate port transformation by integrating a more holistic and inclusive feasibility evaluation model, involving all stakeholders from the government to the local community. This approach is expected to enhance the competitiveness of Indonesian ports at the regional and global levels, while ensuring that port projects deliver long-term benefits for the economy and society.

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