JIPOWER JOURNAL OF INTELLECTUAL POWER
E-ISSN : 3048-3646

STRENGTHENING SMART PORT-BASED PORT GOVERNANCE IN INDONESIA

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ABSTRACT

Indonesia's archipelagic geography presents unique challenges in managing a maritime-based nation. The complexity and disparities are particularly challenging and require a greater budget and commitment from the government, stakeholders, and all Indonesian people. The 1957 Djuanda Declaration, ratified by the 1982 UN Convention on the Law of the Sea (UNCHLOS), marked international recognition of Indonesia's status as a large archipelagic nation. However, the utilization of marine resources has not been maximized, necessitating comprehensive, holistic, and integral efforts, including strengthening port governance through smart ports.Smart ports are expected to improve the performance of ports throughout Indonesia, meet international standards, and be highly competitive. Governance must be strengthened in such a way as to achieve good governance, while simultaneously strengthening the quality of human resources and utilizing digital technologies in the maritime sector, such as smart ports.Smart ports, as a port subsystem, have been implemented in various ports worldwide, such as the Port of Rotterdam Authority, Singapore's Maritime and Port Authority (MPA), and the Port of Hamburg, including ports in Indonesia managed by PELINDO.This study employed a qualitative descriptive design with a thematic narrative approach to identify and describe efforts to strengthen smart port-based port governance in Indonesia. Data were collected from various publications from credible official institutions for literature review. The data were then analyzed qualitatively and narrated based on similar themes and comprehensively compared.The data analysis concluded that strengthening smart port-based port governance in Indonesia is being implemented through various efforts, including: strengthening smart port-based port governance has significant potential to improve the efficiency, transparency, and competitiveness of Indonesian ports. Implementation includes strengthening: a) Operational Digitalization; b) Service Optimization: Use of Smart Vision 3D, Berth Monitoring, and Gate & Weighbridge (Weighbridge); c) Data Integration; c) Strengthening Digital Infrastructure; d) Talent Human Resource Development; e) Electrification and Equipment Digitalization; f) Eco-Friendly Terminals.

Keywords: Port Governance, Smart Port, Pelindo

A. INTRODUCTION

Advancing public welfare can be achieved, among other things, through leveraging Indonesia's geography. As the world's largest archipelagic nation, it enjoys a strategic position along international trade routes. With more than 17,000 islands spread across the archipelago, the existence of efficient and effective ports is crucial to support the smooth flow of goods and logistics. In this context, the 1957 Djuanda Declaration and the 1982 United Nations Convention on the Law of the Sea (UNCLOS) play a crucial role in defining the status and management of Indonesia's maritime territory. The 1957 Djuanda Declaration proclaimed to the world the concept and claim of Indonesia as an archipelagic state, where all waters between the islands constitute a single, unified national territory. This affirmed Indonesia's rights to the sea and its resources. This declaration serves as the foundation for the management of maritime and shipping resources within the context of national sovereignty. Thus, ports serve not only as transit points but also as centers of economic activity that can drive regional and national development.

UNCLOS 1982 strengthens Indonesia's role as a maritime nation, establishing the state's rights and obligations in the utilization of marine resources and environmental protection. This convention regulates territorial sea boundaries, exclusive economic zones (EEZs), and state responsibilities in marine resource management. As a signatory to UNCLOS, Indonesia has an obligation to maintain and sustainably utilize its waters and ports. This further emphasizes the importance of efficient and technology-based port management.

Indonesia's maritime potential is enormous, but it has not yet provided significant benefits for the progress of the nation and the Republic of Indonesia. According to Rokhmin Dahuri, this potential encompasses various sectors, including capture fisheries, aquaculture, marine energy, the maritime industry, and marine tourism. The potential reaches approximately IDR 1 trillion (approximately IDR 12,000 trillion) and can absorb a workforce of approximately 40 million people. This potential, if managed optimally and sustainably, can become a key pillar of national economic development and improve the welfare of the Indonesian people. Furthermore, Prof. Indroyono Susilo emphasized that Indonesia's maritime potential, as Rokhmin Dahuri stated, and the performance of the maritime sector still contributes minimally to the nation. The maritime sector's development performance remains small in contributing to state revenue, reaching only 20.6 percent of the national Gross Domestic Product (GDP), of which 4.5 percent comes from the fisheries sector and 16.1 percent from the oil and maritime mining sector. He believes that infrastructure improvements, human resource development, technological modernization, and capitalization are needed to manage marine resources to provide economic benefits to the community. Furthermore, improvements to the supply chain and a competitive logistics system are needed, and connectivity between maritime economic growth centers based on the "eco-marine" concept is built. This is coupled with the development of seaports, encouraging maritime

industrial activities, and utilizing the potential of new, renewable energy sources from the ocean, such as ocean currents, tidal energy, and biofuels.

Ports, as a sub-sector of maritime development, hold a strategic position as a means of realizing connectivity that enables the transportation of people and goods between islands and internationally. Port performance must be improved comprehensively and integratedly from the central to the regional levels to provide excellent, fast, and sustainable services. In the digital era, development towards a modern and sustainable smart port must be pursued to ensure optimal port function. These functions include serving as a loading and unloading facility and distribution of goods, passenger transportation, inter-island and international connectivity, supporting maritime industry logistics, national defense, and more.

Existing ports are still unable to reach all regions of Indonesia, necessitating efforts to strengthen port development. This includes building new ports tailored to community needs and utilizing cutting-edge technology for smart ports. Therefore, it is crucial to conduct research on smart port-based port strengthening in Indonesia to identify and describe the strengthening efforts undertaken, in this case those undertaken by Pelindo.

B. LITERATURE REVIEW

1. Management

According to Hadiningrat et al. (2025), management is an activity that encompasses planning, organizing, implementing, and controlling, forming a cycle as a system to achieve goals. This aligns with George Terry's opinion regarding management functions, which consist of POAC functions. In the digital era, these functions are increasingly efficient, effective, and fast thanks to the support of internet infrastructure and advances in digital technology.

2. Ports

In this case, the author limits the definition to maritime ports. According to Government Regulation No. 69 of 2001, Article 1, paragraph 1, concerning Ports, a port is a place consisting of land and surrounding waters with certain boundaries as a place for government and economic activities. It is used as a place for ships to dock, anchor, embark passengers, and/or load and unload goods, equipped with shipping safety facilities and port support activities, as well as a place for intra- and inter-modal transportation transfers. Their existence is crucial not only as connectivity between regions/islands but also as a means of connecting ships to docks/ports worldwide. Besides supporting international trade, ports play a strategic role in national economic development, creating jobs, supporting related industries, and providing connectivity between various regions of the world, population mobility, and national defense and security facilities.

3. Port Governance

Port governance refers to the processes, structures, and practices used to regulate and manage port activities. This governance encompasses decision-making, planning, monitoring, and evaluation, with the aim of ensuring the efficiency, security, and sustainability of port operations. The characteristics of Smart Port-Based Governance are transparency, participation, innovation, and sustainability.

4. Smart Port

A Smart Port is a modern port concept that integrates advanced digital technologies (such as AI, IoT, 5G) and automation to improve operational efficiency, security, and sustainability, as well as optimize overall logistics management, with the ultimate goal of reducing logistics costs and increasing economic competitiveness. It's not just about technology, but also about collaboration between stakeholders and environmental awareness based on green ports and sustainable ports. In this regard, key elements of a smart port include digitalization and automation, artificial intelligence, big data and its integration, physical and non-physical efficiency and security, sustainability (a sustainable or green port), and more.

C. METHODS

This research design is descriptive qualitative with a thematic narrative approach. The aim is to identify and describe efforts to strengthen smart port-based port governance in Indonesia, using a case study of PT. Pelabuhan Indonesia (Pelindo). This thematic narrative approach will be used to collect and analyze qualitative data. This thematic narrative approach allows researchers to explore individual stories and experiences and create themes relevant to the context of port governance strengthening. These themes are then analyzed qualitatively based on similar themes to identify patterns relevant to the context of governance strengthening. Narrative analysis is used to process the data and analyze the relationships between themes, referring to the research variables.

This aligns with the understanding that research is necessary when a gap is identified between current and desired conditions. Qualitative research uses a descriptive or thematic narrative research approach that aims to understand social phenomena through the collection and analysis of non-numerical data (Hadiningrat et al. 2025a).

D. RESULTS AND DISCUSSION

As a maritime nation, Indonesia has the largest sea area, reaching 13,466 islands, covering 5.8 million km2 of sea, including the Indonesian Exclusive Economic Zone (EEZ), and is surrounded by 95,181 km of coastline. It possesses potential marine natural resources, such as fisheries, coral reefs, mangrove forests, seaweed, and biotechnology products; as well as oil and gas reserves, tin, iron ore, bauxite, and other minerals. It also offers marine energy resources such as tidal,

wave, wind, and Ocean Thermal Energy Conversion (OTEC); and marine environmental services such as marine tourism and sea transportation. Indonesia's sustainable marine fish production potential, which can be utilized through capture fisheries, is 6.5 million tons/year, approximately 8 percent of the world's total sustainable marine fish production potential (90 million tons/year). Approximately 24 million hectares (ha) of Indonesia's shallow marine waters are suitable for the mariculture of grouper, snapper, rabbitfish, pearl oysters, sea cucumbers, seaweed, and other marine biota of high economic value, with a potential production of approximately 42 million tons/year. However, according to 2012 data from the Ministry of Maritime Affairs and Fisheries (KKP), Indonesia has only utilized 4.6 million tons (10.95 percent) of this marine aquaculture potential. The coastal land area suitable for the cultivation of shrimp, milkfish, grouper, tilapia, crab, blue swimming crab, seaweed, and other aquatic biota is estimated to exceed 1.2 million ha, with a potential production of approximately 10 million tons/year, and there are still many other potential natural resources. Furthermore, supporting infrastructure in the form of ports is a crucial pillar in the maritime industry ecosystem. More than 75% of goods are transported by sea, particularly through the Straits of Malacca, Lombok Strait, Makassar Strait, and other Indonesian seas, with a value of approximately US$1,300 trillion annually. More than 75 percent of traded goods are transported through these ports. Therefore, to maximize the benefits for the prosperity of the people, the nation and state must fully implement Law No. 32 of 2014 concerning Maritime Affairs, which regulates maritime areas, maritime development, maritime management, marine space management, and marine environmental protection, defense, security, law enforcement, safety at sea, governance and institutions, community participation, and their derivative regulations.

Strengthening smart ports is a challenge that must be faced with focus and seriousness, utilizing advances in digital technology, AI, IoT, big data, and other technologies to optimize and competitive port operations. For example, through the development of real-time monitoring systems, ship traffic management, and increased security. However, ports in Indonesia still face various challenges, including: a) the vastness and geographical disparity of the archipelago; b) limited infrastructure, electricity, and internet; c) bureaucracy and regulations that have not yet moved on, hindering innovation and investment, and innovation. Indonesia is moving towards the Smart Port concept, for example, implemented by Tanjung Priok Port, Patimban Port, Kuala Tanjung Port, and others.

PT Pelindo, as a state-owned enterprise (BUMN), has a vision of "Becoming a world-class, integrated maritime ecosystem leader" with a mission to realize a national maritime ecosystem network through improved network connectivity and service integration to support Indonesia's economic growth. One of the policies adopted to realize a smart port is the transformation from a conventional port to a smart port based on technological innovation to improve operational efficiency and reduce logistics costs.

PT Pelabihan Indonesia (Pelindo) has implemented the smart port concept through initiatives such as the "Pelindo Terminal Operating System" (TOS) and other digitalization systems to unify operations across all managed ports, thereby improving connectivity and reducing national logistics costs. This is accompanied by strengthening: a) Operational Digitalization: Implementation of integrated systems such as the Nusantara Terminal Operating System (TOS) and Phinisi for ship services; b) Service Optimization: Use of Smart Vision 3D, Berth Monitoring, and Gate & WB (Weighbridge) to accelerate the movement of goods; c) Data Integration: Connecting the entire port system with the National Logistics Ecosystem (NLE) for transparency and speedy document and goods flow; c) Strengthening digital infrastructure; d) developing talented human resources; e) electrification and equipment digitalization; f) environmentally friendly terminals. The Pelindo Smart Port transformation aims to: a) reduce Port Stay and Cargo Dwell Time: Accelerate ship berthing times and cargo stacking; b) Logistics Cost Efficiency: Reduce national logistics costs to be more competitive; c) increase port competitiveness.

In parallel, port strengthening must be carried out, including through: a) Regulatory Reform: Simplifying the permit process and facilitating access to information for stakeholders; b) Investment in Infrastructure: Raising investment from both the public and private sectors to build technology-friendly ports; c) Increasing Human Resource Capacity: Training the workforce in information technology and port management to support the implementation of new technologies; d) Multi-stakeholder Collaboration: Encourage cooperation between the government, private sector, and academia to strengthen innovation and share relevant information; and prepare adequate budgets and digital technology support to reach all regions of Indonesia.

E. CONCLUSION

From the data analysis above, it can be concluded that strengthening Smart Port-based port governance has significant potential to increase the efficiency, transparency, and competitiveness of ports in Indonesia. Its implementation includes strengthening: a) Operational Digitalization: Implementing integrated systems such as the Nusantara and Phinisi Terminal Operating Systems (TOS) for ship services; b) Service Optimization: Using Smart Vision 3D, Berth Monitoring, and Gate & Weighbridge (Weighbridge) to accelerate the movement of goods; c) Data Integration: Connecting the entire port system with the National Logistics Ecosystem (NLE) for transparency and speedy document and goods flow; c) Strengthening digital infrastructure; d) Developing human resource talent; e) Electrification and equipment digitalization; f) Environmentally friendly terminals. The Pelindo Smart Port transformation aims to: a) reduce Port Stay and Cargo Dwell Time; b) Logistics Cost Efficiency; c) increase port competitiveness; d) Regulatory Reform; e) Investment in Infrastructure; f) Increase Human Resource Capacity; and g) Multi-stakeholder Collaboration.

REFERENCES

1. Ali, S. 2021. **Green technology in ports: Challenges and opportunities for sustainable development.** *Journal of Maritime Research*, 18(2), 45-59. https://doi.org/10.21463/jmr.2021.18.2.02
2. **Arnita, D. 2014.** *Peranan Pelabuhan Tanjung Priok dalam Perekonomian Indonesia*. Jurnal Ekonomi Maritim, 10(2), 120-135.
3. Arshad, M., Zhang, J., & Liu, H. 2020. **Smart ports: A comprehensive framework for implementation and sustainability.** *Maritime Economics & Logistics*, 22(4), 507-523. https://doi.org/10.1057/s41278-020-00136-2
4. Badjuri, Abdulkahar dan Yuwono, Teguh. (2002) *Kebijakan Publik Konsep dan Strategi.* Universitas Diponegoro. Semarang.
5. Bappenas. (2021). *Rencana Pembangunan Jangka Menengah Nasional 2020-2024*. Jakarta: Bappenas.
6. **Consultrans, S.A.** (Tahun tidak tersedia). *Smart ports: towards a high performance, increased productivity, and a better*.
7. **ESPO (European Sea Ports Organisation).** 2022. *Smart Port Strategy*. Brussels.
8. Hadiningrat, KP. Suharyono S. Dkk. 2025. *Manajemen SDM Kontemporer : Transformasi ketenagakerjaan Indonesia menuju Revolusi Industri 4.0 Perspektif Ketahanan Nasional*. Deepublish. Yogyakarta.
9. Hadiningrat, K.P.Suharyono S., dkk. 2025a. *Riset Kualitataif Suatu Pendekatan Practikal Jilid 1.* Feniks Muda Sejahtera. Palu.
10. Kementerian Perhubungan Republik Indonesia. (2020). **Roadmap pengembangan pelabuhan cerdas di Indonesia.** Jakarta: Kementerian Perhubungan.
11. **Kementerian Perhubungan Republik Indonesia.** (Tahun tidak tersedia). *Peraturan terkait kepelabuhanan dan transportasi laut*. Diakses dari situs web resmi Kementerian Perhubungan: https://jdih.dephub.go.id/
12. Lee, S. K., & Song, D. J. (2019). **Human resources in smart port implementation.** *International Journal of Logistics Research and Applications*, 22(3), 291-310. https://doi.org/10.1080/13675567.2018.1472362
13. Mazumdar, M. (2019). **Governance issues in Indonesia's port management**. *Asian Journal of Shipping and Logistics*, 35(3), 196-205. https://doi.org/10.1016/j.ajsl.2019.07.001
14. Miao, J., Wang, W., & Liu, Y. (2021). **The role of IoT in enhancing port efficiency**. *Journal of Transport Geography*, 91, 102863. https://doi.org/10.1016/j.jtrangeo.2020.102863
15. Notteboom, T., & Rodrigue, J. P. (2020). **Port regionalization: A global perspective**. In *The Geography of Transport Systems* (pp. 183-204). New York: Routledge.
16. **Peraturan Pemerintah Republik Indonesia Nomor 61 Tahun 2009 tentang Kepelabuhanan.** (2009). *Lembaran Negara RI Tahun 2009 Nomor 162*. Jakarta: Sekretariat Negara.
17. **Suhendra, I. (2015).** *Smart Port sebagai Solusi untuk Tantangan Globalisasi*. Jurnal Transportasi Maritim, 12(1), 45-60.
18. Yuan, X., Chen, C., & Zhu, J. (2021). **Big data analytics and its impact on port performance**. *Ports and Maritime Logistics*, 3(1), 56-71. https://doi.org/10.1016/j.pml.2020.06.003
19. https://www.undp.org/sustainable-development-goals
20. https://lemhannas.go.id.
21. www.impinews.com
22. https://sultra.antaranews.com/berita/274815/potensi-ekonomi-maritim-indonesia-sangat-besar