



# Sustainable Technology and Innovation for Safe Ferry Transportation in Indonesia

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**Abstract :** Safety transportation Sea has a very important meaning in Indonesia, a vast archipelagic country that has more than 17,000 islands and is one of the countries with the longest coastline in the world. Ship A ferry is the ship used for crossing the sea that carries passengers along with the vehicle. The vehicle being transported can also be in the form of a private car, bus, truck, or semi-trailer. The thing that makes us boat This is a non-existent bridge crossing the sea. To analyse transformation safety Ferry transportation via technology and innovation sustainable. Method study qualitative using secondary data. Data collection involves identification and access to relevant secondary data sources. After obtaining secondary data, the researcher processes data to organize and compile information for analysis. From the results of research conducted with the use of study literature, the Internet of Things technology was found to be safe for ferries. Besides, related technologies with sustainable innovation for ferry safety were also found in Indonesia. A more holistic, integral, comprehensive, and applicable study related to safety on ferries in Indonesia is very much needed.

**Keywords:** Sustainable Technology and Innovation, Safe, Ferry Transportation

## 1. INTRODUCTION

Safety transportation by sea has a significant meaning in Indonesia, a vast archipelagic country that has more than 17,000 islands and is one of the countries with the longest coastline—the longest in the world. With its location's strategic geography that connects the Indian and Pacific Oceans, Indonesia is highly dependent on sea transportation. For connectivity domestic and trade international [1]. Dependence This show's important role in safety of sea transportation in ensuring the smoothness of current goods and supporting the national economy. The Indonesian maritime sector becomes the backbone of the national economy because 90% of the country's trade volume is carried out through the sea [2]. Every disturbance or nonexistence of safety in operation of sea transportation can cause high consequences that impact industry, business, and ultimately the livelihood of millions of Indonesian society. Therefore, making sure safety and security operations for sea transportation are very important. For guard welfare economy Indonesia.

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A. Yulianto et al. (eds.), *Proceedings of the International Conference of Inland Water and Ferries Transport Polytechnic of Palembang on Technology and Environment (IWPOSPA-TE 2025)*, Advances in Engineering Research 302,

[https://doi.org/10.2991/978-94-6239-731-6\\_17](https://doi.org/10.2991/978-94-6239-731-6_17)

Indonesia, as an archipelagic country, faces a big challenge in ensuring safety and security in the sea transportation sector, facing accidents, environmental risks, and security threats, although there is an effort to increase safety steps. Challenges: This is very important to overcome so that it can maintain economic growth, protect the sea environment, and guard the lives of millions of the public. Indonesia is dependent on sea transportation. Therefore, there is an urgent need to explore how technology and innovation can be utilized to increase safety in sea transportation in Indonesia. A ferry is the ship used for crossing the sea that carries passengers along with the vehicle. The vehicle being transported can also be in the form of a private car, bus, truck, or semi-trailer. The thing that makes us boat This is a non-existent bridge crossing the sea. Objective study This analyse the safety transformation of sustainable ferry transportation via technology and innovation.

## 2. METHODOLOGY

The study employs a qualitative method that utilizes secondary data. Data collection involves identification and access to relevant secondary data sources. After obtaining secondary data, the researcher processes data to organize and compile information for analysis.

## 3. DISCUSSION

### Increase Safety Transportation Sea Ferry through Technology Solutions Sustainable

One of the main efforts is the implementation of the Automatic Identification System (AIS). allows tracking the boat in a real-time way. According to a report from the Ministry of Transportation (2021), the use of AIS has helped monitor boat movement in a more effective way and prevent potential collisions, especially on congested cruise routes like the Strait of Malacca [3]. Besides that, development system warning early weather maritime become solution important in face challenge weather extreme. Widjaja and Utomo (2019) noted that the Meteorology, Climatology, and Geophysics Agency (BMKG) has introduced technology satellites that can give the latest weather information and wave height predictions so that boats can avoid high-risk areas [4]. e-Navigation technology was also introduced to increase safety. System This integrates various navigation and communication data into one easy platform accessed by the crew, ships, and port officers. Based on research conducted by Susilo and Wahyudi (2020), the implementation of e-Navigation in several harbour mainstays in Indonesia has helped reduce accident risk by giving guides better navigation that is accurate and up-to-date [5].

Besides that, using drones for inspecting ships and monitoring waters has started to be implemented in several areas. A study conducted by Rizal et al. (2022) showed that drones can be used to identify potential damage to boats or the existence of oil spills that can cause hazards and provide the necessary visual data for fast action [6]. In a number of year lastly, the solution technology like system GPS tracking system avoidance collision, and tools monitoring real-time has play a role important in increase safety transportation sea ferry in Indonesia. In Indonesia, the GPS tracking system has been implemented a lot to increase the ability to track and monitor ships. System This

utilise technology satellite For provide location data in a way real-time so that allows authority maritime track movement ship, detect activity illegal, and respond condition emergency with fast [7]. The Indonesian government has realized the importance of overcoming the problem of security-related maritime and cyber threats in its shipping area.

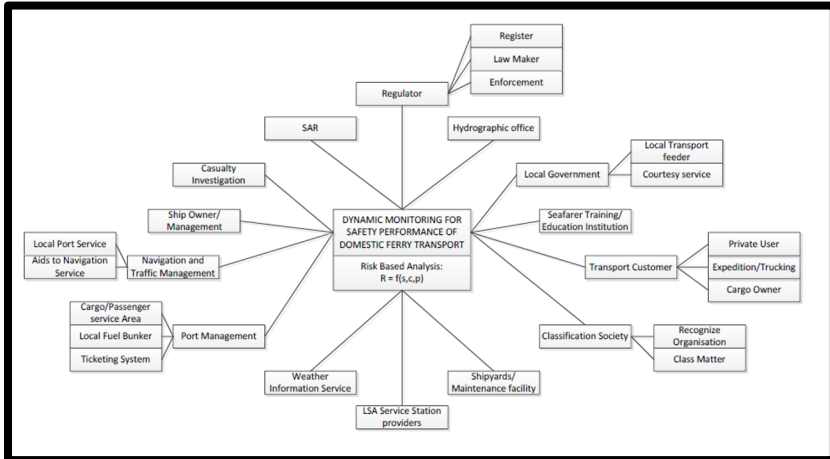


Figure 1. List of stakeholders responsible for maintaining safety in domestic ferry service (Source : Nurwahyudy, et al 2024)

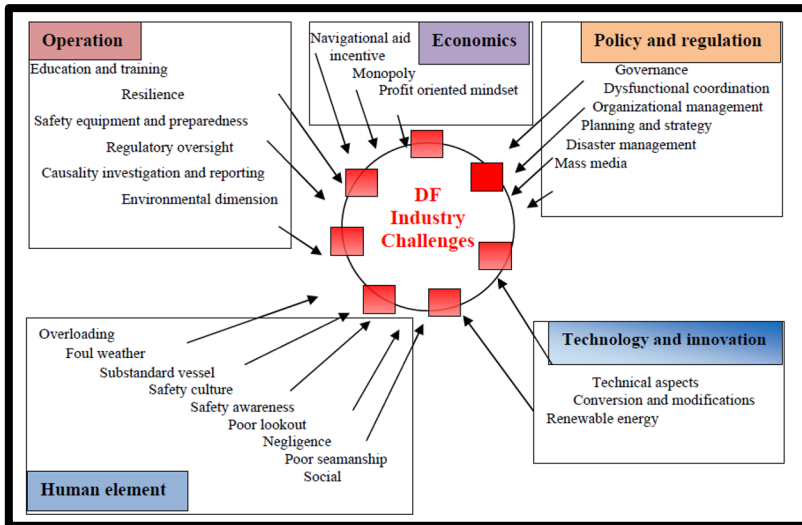


Figure 2. Classification of Domestic Ferry sector challenges in five categories (Source: Nurwahyudy, et al 2024)

There is a need to prioritize aspects of maritime security and form a responsible agency to answer for overcoming problems in cyberspace in Indonesia's maritime space. The existence of a rule or policy related to cyber security in space and at sea is very important for increasing safety and security in shipping in Indonesia [10].

Likewise, the system for avoiding collisions, such as the Automatic Identification System (AIS), has been implemented to increase situational awareness and reduce the risk of collisions at sea [8]. With sending information ships, including position, speed, and course, AIS improves ship visibility, allowing coordination and decision-making for more good decisions among stakeholders in the maritime interest [9]. The use of AIS has played an important role in tracking and monitoring the movement of boat fishermen in the waters around Indonesia. With analyzing AIS data, Global Fishing Watch (GFW) detects up to 6,800 hours of fishing activity by foreign fishermen every month in Indonesian waters.

AIS also allows management to efficiently traffic busy shipping routes, reducing congestion and minimizing the possibility of accidents or oil spills. AIS integration into in operation maritime has increase efficiency and effectiveness effort enforcement law in a way significant , possible more response appropriate more time and protection big to source Power maritime [11]. In addition to that, real-time tool monitoring, such as Electronic Chart Display and Information Systems (ECDIS), has been used to increase safety navigation and reduce risk foundation and error navigation [12]. ECDIS integrates electronic map navigation with real-time data, providing accurate and up-to-date information to the navigators to make the decision that is appropriate during the voyage [13].

Table 1 Research related to the Internet of Things on Ferries

No	Topic of research	Focus of research
1	IoT with transport service safety, effectiveness, and efficiency	Integration of IoT to improve the quality of transportation service. Some research proposes that IoT should be used to overview system health by allocating sensor modules to monitor the machinery system and other installed equipment.
2	IoT security system	The IoT security guard is the primary concern in preventing and mitigating any threat to the system
3	IoT with the transport safety system	Specific research focuses on utilizing the IoT to monitor safety systems such as tourism, vehicle health, and inland waterway transport.
4	IoT with machine learning and artificial intelligence development	The coming expansion of machine learning and artificial intelligence aims to enhance and expand the quality of service in transportation.

Source : Nurwahyudy, et al 2024

#### Innovation Strategy for the Ferry Industry: Increasing Safety Standards

According to a report from the Ministry of Industry (2021), the government is pushing to replace old ships with newer ships equipped with the latest safety technology, such as boat condition monitoring systems and fire detection systems. Initiative This aim is to reduce the risk of accident consequences and damage to ships and upgrade the safety of crew ships [14]. In addition to that, increasing standard

training and certification for maritime workers is also a major focus. Based on research conducted by Setyawan and Prasetyo (2020), the government and industry together have developed training programs based on technology, including simulation navigation and responsive emergency training, which are adjusted to standard international. This is done to ensure that the crew boat owns the required skills and knowledge to face emergency situations better [15].

Development center innovation in the maritime sector connecting academics, industry, and government is also carried out to push research and development in maritime technology safety. As an example, the Innovation Center Indonesian Maritime (PIMI) has collaborated with various universities and companies on technology to develop innovative safety solutions for the maritime sector. Research conducted by Supriyadi and Gunawan (2021) shows that collaboration This has produced a number of new technologies, like AI-based system monitoring that can detect operational anomalies on board and provide early warnings to the crew [16]. Besides that, the digitalization of maritime licensing and supervision processes has become part of the strategy to increase efficiency and transparency. According to a report from the Coordinating Body Investment Coordinating Board (BKPM) (2022), the government has introduced a digital platform for management permission, shipping, and inspection of the ship that helped ensure that all ships operating in Indonesian waters comply with established safety standards [17].

The concept of “open innovation” proposed by Chesbrough (2003) really emphasizes the importance of and exchanging knowledge with stakeholders outside of their interests to spur innovation. In context industry maritime, innovation strategy open involving partnership with institution government, institutions academic, provider technology, and actors industry other For develop and implement innovation safety. For example, a company maritime in Indonesia has collaborate with institution research and companies technology For develop technology safety new like system monitoring advanced ships and systems avoidance collision [18]. Collaboration This not only increases standard safety in the maritime industry but also encourages efficiency and sustainability overall. With the exchange of knowledge and skills with external stakeholders' interests, the company maritime can utilize the latest progress in technology and enter it into operation. This has an impact on reducing accidents and improving system navigation, which ultimately benefits industry and the environment [19].

Table 2. Opportunities of technology and innovation Sustainable For ferry

No	Areas	Opportunities
1	Technical Factors	<ul style="list-style-type: none"> <li data-bbox="515 1328 1005 1416">• The use of a combination of ashore supply and alternative fuels can reduce emissions by up to 23 % (NOx) and 17 % (CO<sub>2</sub>)</li> <li data-bbox="515 1425 1005 1513">• Necessary preparation for preparing relevant rules on the electrification of ferries may be instituted by maritime authorities</li> </ul>

2	Conversion and Modification	<ul style="list-style-type: none"> <li>•Strategies need to be developed for the strict implementation of established standards relating to vessel conversion and modification</li> </ul>
		<ul style="list-style-type: none"> <li>• In developing countries, the sites for ship modification or launch may be controlled</li> </ul>
		<ul style="list-style-type: none"> <li>• The use of electronic records can improve the certifications and permits for modification by regulators for effective tracking</li> </ul>
		<ul style="list-style-type: none"> <li>• All stakeholders concerned with construction, design, maintenance, classification societies, and regulatory authorities may adopt a transparent and strict liability regime</li> </ul>
3	Renewable Energy	<ul style="list-style-type: none"> <li>• The ferry sector needs to explore the use of alternative fuels for a sustainable green solution</li> </ul>

Source: Baig, et al 2024

Additionally, the Resource-Based View (RBV) provides insight into how companies leverage their internal strengths and capabilities to drive innovation in safety standards. According to Barney [20], the company owns a unique source of power and ability that can become a sustainable competitive source of superiority. In the Indonesian maritime industry, companies have invested in developing internal expertise, infrastructure, and capabilities technology to push innovation safety. For example, a company cruise has a special research and development department to do studies related to safety, develop new technology, and implement the best practices in safety management [21]. Department This Research and Development (R&D) collaborates with expert industry, government, and academic institutions to keep going, following development regulations, safety, the latest, and progress in technology. By investing in their internal expertise and infrastructure, Indonesian maritime companies can keep safety standards so that they can differentiate themselves from competitors and make sure their operations are safe. Focus on innovation safety. This not only increases their reputation but also helps them comply with international standard safety so that it is more interesting for candidate clients and partners in the global shipping industry. [22].

Besides that, innovation strategy in Indonesian maritime industry affairs often involves a combined effort of internal research and development and external collaboration. With the utilization of internal and external power sources, stakeholders' interests can access more knowledge, expertise, and technology to overcome safety challenges in an effective way [23]. For example, the port authorities in Indonesia have partnered with international organizations and technology providers to apply the latest system safety, such as automatic container scanning and tool evaluation risk [24]. Collaboration: This not only increases safety steps but also improves efficiency and power competition in the Indonesian maritime industry. Implementing container scanning in an automatic way has, in a way, significantly reduced the time required for inspection so that it speeds up time to completion and improves efficiency at the port.

In addition to that, using tool evaluation risk allows identification and mitigation of potential greater danger accurately so that it creates a better environment safe for workers and cargo. Overall, this innovative strategy has positioned the Indonesian maritime industry as a leader in safety practices and has garnered international recognition and partnerships.

### 3. CONCLUSION

Research conducted using study literature revealed that Internet of Things technology can enhance ferry safety. Besides, related technologies with sustainable innovation for ferry safety were also found in Indonesia. A more holistic, integral, comprehensive, and applicable study related to safety Ferries in Indonesia are very much needed.

### References

- [1] International Maritime Organization (IMO), "Maritime Safety." Accessed: Feb. 14, 2024. [Online]. Available: <https://www.imo.org/en/About/Pages/Default.aspx>
- [2] R. of Indonesia. Ministry of Transportation, "Indonesian Maritime Transport Statistics." Accessed: Feb. 14, 2024. [Online]. Available: <https://www.dephub.go.id/publikasi/buku-statistik-angkutan-laut>
- [3] Kementerian Perhubungan, "Laporan Tahunan Keselamatan Maritim di Indonesia," Jakarta, 2021.
- [4] P. Widjaja and D. Utomo, "Climate Change and Its Impact on Maritime Safety in Indonesia," *International Journal of Maritime Affairs and Fisheries*, vol. 11, no. 2, pp. 122–136, 2019.
- [5] A. Susilo and A. Wahyudi, "Enhancing Maritime Safety through e-Navigation in Indonesia," *Journal of Maritime Technology and Engineering*, vol. 50, no. 4, pp. 95–109, 2020
- [6] H. Rizal, R. Setiawan, and S. Andika, "Drone Technology for Maritime Safety: A Case Study in Indonesian Waters," *Marine Technology Journal*, vol. 50, no. 4, pp. 223–234, 2022.
- [7] FAO, "Advancing the digital transformation of agriculture and rural areas through national strategies, e-Government systems, and Digital Villages-update for Europe and Central Asia," 2023. [Online]. Available: <https://www.fao.org/3/cc2273en/cc2273en.pdf>.
- [8] J. Bradford and S. Edwards, "The Evolving Nature of Southeast Asia's Maritime Security Threats." Accessed: Feb. 14, 2024. [Online]. Available: <https://amti.csis.org/the-evolving-nature-of-southeast-asias-maritime-security-threats/>
- [9] L. J. Morris and G. Persi Paoli, *A Preliminary Assessment of Indonesia's Maritime Security Threats and Capabilities*. Santa Monica, CA: RAND Corporation, 2018. doi: 10.7249/RR2469.
- [10] R. Desiana and S. C. Prima, "Cyber security policy in Indonesian shipping safety," *Journal of Maritime Studies and National Integration*, vol. 5, no. 2, pp. 109–117, Jul. 2022, doi: 10.14710/jmsni.v5i2.13673.

- [11] GFW, “Sharp decline in foreign fishing boats in Indonesian waters – Global Fishing Watch analysis.” Accessed: Feb. 14, 2024. [Online]. Available: <https://globalfishingwatch.org/press-release/sharp-decline-foreign-fishing-boats-indonesian-analysis/>
- [12] J. Armstrong, “Indonesia’s Fishing Vessel Tracking Data Now Available to the Public.” Accessed: Feb. 14, 2024. [Online]. Available: <https://skytruth.org/2017/06/indonesias-vms-data-available-to-the-public/>
- [13] International Maritime Organization (IMO), “ECDIS - Guidance for Good Practice.” Accessed: Feb. 14, 2024. [Online]. Available: <https://www.imo.org/en/OurWork/Safety/Navigation/Pages/ECDIS.aspx>
- [14] Kementerian Perindustrian, “Laporan Tahunan Inovasi Industri Maritim Indonesia,” Jakarta, 2021.
- [15] B. Setyawan and H. Prasetyo, “Maritime Safety Training and Certification in Indonesia: Current Status and Future Directions,” *Journal of Maritime Education*, vol. 12, no. 4, pp. 178–191, 2020.
- [16] H. Supriyadi and I. Gunawan, “Maritime Innovation Hubs: Bridging Academia, Industry, and Government for Safer Seas,” *Indonesian Journal of Maritime Studies*, vol. 23, no. 2, pp. 145–160, 2021.
- [17] BPKM, “Digitalization in Maritime Licensing and Inspection: Enhancing Safety and Compliance,” Jakarta, 2022.
- [18] H. W. Chesbrough, *Open innovation: The new imperative for creating and profiting from technology*. Harvard Business Press, 2003.
- [19] UNCTAD, “Collaborative innovation within the maritime sector: the path to grow back better .” Accessed: Feb. 14, 2024. [Online]. Available: <https://unctad.org/news/collaborative-innovation-within-maritime-sector-path-grow-back-better>
- [20] W. Hesterly and J. Barney, *Strategic management and competitive advantage*. Pearson/Education, 2014.
- [21] J. B. Barney and W. S. Hesterly, *Strategic management and competitive advantage: Concepts and cases*. Pearson, 2019.
- [22] S. F. Muhibat, *Maritime safety in Indonesia: Mapping the challenges and opportunities*. Centre for Strategic and International Studies (CSIS), 2020.
- [23] Sari D. W., Windijarto W., & Novianti N. (2024, June). Operational efficiency and sustainability in smart ports: A comprehensive review. *Marine Systems & Ocean Technology*. Vol.19 (Page 145-167).

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