Journal of Infrastructure, Policy and Development 2024, 8(9), 7447.
https://doi.org/10.24294/jipd.v8i9.7447

Article

Future policies for managing ship traffic and safety in the access channel of a new nation's capital: A case study of Indonesia

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CITATION

Malisan J, Puriningsih FS, Marpaung E, et al. (2024). Future policies for managing ship traffic and safety in the access channel of a new nation's capital: A case study of Indonesia. Journal of Infrastructure, Policy and Development. 8(9): 7447. https://doi.org/10.24294/jipd.v8i9.7447

ARTICLE INFO

Received: 25 June 2024
Accepted: 23 July 2024
Available online: 5 September 2024

Abstract: Indonesia has a new capital, officially known as Nusantara (IKN). The nearest access to and from IKN is through Balikpapan Bay, a confined waterway that may eventually result in traffic congestion and interfere with shipping operations. This research aims to investigate ship traffic and safety governance policies, as few researchers have previously studied this issue in the IKN waters. We collected the empirical data in four steps. Firstly, we conducted in-depth interviews and focus group discussions attended by related stakeholders, such as the Harbormaster and Port Authority, the Indonesian Maritime Court, the Navigation District Officers, SOE Port Managers, Local Government, and Shipping Companies Association. Next, we distributed questionnaires to shipping operators. Furthermore, using triangulation techniques, this research suggests the need to harmonize regulations implemented by related agencies involved in shipping activities. The last step was determining ship routes to ensure maritime safety and ship traffic efficiency. The proposed harmonization would provide port and shipping operators with business certainty in accordance with applicable laws. The research also recommended sharing authority between the IKN Authority Agency, which is responsible for the exploitation of water areas, and the Transportation Ministry, which regulates maritime traffic and safety.

Keywords: sea traffic; ship safety; new capital; shipping routes; regulation harmonization

1. Introduction

Indonesia could be a global maritime fulcrum due to its strategic position between the Pacific and Indian Oceans and the Asian and Australian continents (Puriningsih, 2022). Accordingly, relocating the Indonesian capital to the island of Kalimantan, officially known as Nusantara (IKN), is a strategic step to develop an intelligent transportation system and efficient maritime governance (Gumzej, 2023). In general, a capital city is designed as a government center and symbol of a country. As a new capital, IKN will serve as a gathering place for national and international leaders, becoming the focal point of government and socio-economic activities (Ghalib et al., 2021). As a government center, IKN will also support Indonesia's goals as a global maritime hub and the nation's transformation towards the Sustainable Development Goals sustainable development (Fasoulis and Kurt, 2019; Haezendonck, 2020). The transportation system in IKN can be developed in an integrated and sustainable manner. According to the President's directives, transportation in IKN will be managed in a modern manner with an autonomous and electric vehicle system,

ensuring intermodal connectivity throughout the IKN area and its buffer zones. The mode of water transportation is an area of concern for ensuring connectivity. Because Kalimantan Island has many rivers and bay, water transportation plays a crucial role in supporting connectivity between port infrastructure; thus, efforts to increase connectivity are thought to be able to reduce logistics costs and make service patterns more efficient (Netirith and Ji, 2022).

Port infrastructure plays an essential role in boosting regional economic growth and is one of the efforts to improve inter-regional connectivity (Li et al., 2023; Netirith and Ji, 2022). One connectivity indicator is the transportation network that connects one region to another to serve the movement of goods and services. Moving IKN to a province with good connectivity to other provinces will encourage investment in the new capital city and neighboring provinces, and the new capital will become an economic driver for its surrounding regions. From the beginning, IKN was designed as a symbol of national identity and to become a new economic gravity center that is expected to provide a multiplier effect in realizing development that is evenly distributed throughout Indonesia to support Indonesia's development, which can become a magnet for new economic growth and a center for innovation in accelerating Indonesia Forward 2045 (Yusuf et al., 2023). President Joko Widodo directed the implementation of high-tech vehicles using autonomous systems and electric vehicles in IKN, with the aim of ensuring intelligent and modern transportation.

Balikpapan Bay is also referred to as the main gateway and important node in the development of the IKN and accommodates various national and international shipping interests. There are many ports in the waters of Balikpapan Bay including eight public ports, ten dedicated terminals, and 43 private interest terminals. Therefore, the safety and security of shipping routes must be a concern. One way to maintain and guarantee safety and security in Balikpapan Bay is to implement innovative shipping technology and govern shipping traffic and safety. Therefore, intelligent shipping technology and effective traffic management strategies are essential to maintaining the safety and security of shipping routes (Sepehri et al., 2022). Therefore, the safety and security of shipping lanes must be a concern. One way to maintain and guarantee safety and security in Balikpapan Bay is to implement smart shipping technology and govern shipping traffic and safety in the bay. This research aims to develop the concept of regulating the maritime traffic system in the IKN to support the development of safe and sustainable shipping.

2. Literature review

2.1. Sea traffic and ship safety

IKN was created by implementing a new concept in urban planning, intended to be a new city model that applies the concept of smart technology, which refers to environmental sustainability and protects local and national cultures. According to (Richter et al., 2022), the development of smart city technology and smart mobility is vital for sustainability, where the government plays an active role in investing all resources but still wisely considers its potential to realize sustainability goals. The relocation of Indonesia's capital will usher in a new era of advanced, just, and prosperous Indonesian civilization. The main goal of IKN's development is to create

a new smart city that is globally competitive as a part of the transition to a country based on innovative technology and a green economy. The concept of a smart city, smart mobility, has been developed to support the development of the IKN region. Transportation planning is critical to ensuring the smooth accessibility and mobility of people and goods in IKN. Environmentally friendly public transportation is the preferred mode for IKN connectivity and accessibility. The use of autonomous ships for passenger and cargo ships as well as the smart port concept and traffic separation scheme, will be developed.

According to Indonesian Law No. 17 of 2008, shipping safety regulates various aspects of ports, water transportation, and maritime environmental protection. The port is a vulnerable area for ship operations. Changing the status of a region to a new capital city will have an impact on increasing port activities in the region, increasing the number and type of ships, as well as the complexity of maritime traffic that may cause a higher risk of ship collisions or more unwanted incidents (Liu et al., 2023). The complexity of maritime traffic is a major factor that influences maritime safety. Therefore, better identification and understanding of maritime traffic complexity patterns and related risks can improve the standards of maritime safety management and safe operation (Li et al., 2023; van Westrenen and Baldauf, 2020). The complexity of the relationship between traffic characteristics, environmental conditions, and collision frequency is a significant source of concern for maritime authorities. Therefore, the existence of an Automatic Identification System (AIS) can ensure the high reliability of ship traffic information in port waters, and the use of AIS on ships can detect actual ship navigation activities and comprehend ship traffic in port waters (Shelmerdine, 2015; Tsou, 2010). AIS data is a valuable input parameter in ship traffic simulation models for risk analysis and the prevention of shipping accidents (Xiao et al., 2015). According to IMO regulations, ships must have an AIS system installed (IMO, 2003). Concerns about the environment are growing in tandem with the expansion of maritime traffic. CO2 emissions significantly contribute to global warming, whereas NOX, SOX, PM, and VOC emissions primarily affect human health in port cities (Toscano and Murena, 2019). Efforts are required to reduce pollution in the port environment. The use of electricity in the port environment as well as the use of electricity for ship operations while on board can help improve the port environment (Song et al., 2017).

2.2. Shipping management

Balikpapan Bay is the “home” of several marine animals or mammals, as well as a source of income for some of the population. Furthermore, it is also an area for the movement of commercial ships so that these waters become a meeting place for maritime trade and dynamic indigenous culture with extraordinary biological wealth, which, according to (Huntington et al., 2019), requires good governance so that all activities in these waters run harmoniously and can realize shipping safety, cultural preservation, and environmental sustainability. Based on the information of the Indonesian maritime court, improper shipping lane management may result in ship accidents such as sinking, aground, collision, and burning, or even pollution of the aquatic environment. It will, of course, disrupt ship traffic, mainly because the waters

of Balikpapan Bay are relatively narrow and tend to be crowded if the IKN administration's activities continue as planned. Some traditional shipping and harbors are near the IKN, such as Balikpapan City and Penajam Paser Utara Regency. Unfortunately, the safety management system for traditional shipping has not been implemented (Wahid et al., 2023). Furthermore, several accidents involving roro ships, pilot boats, tugboats, and people's ships that caught fire because of collisions, resulting in numerous casualties and property damage. Many studies have been conducted on the impacts of port and shipping activities on biodiversity (Grech et al., 2013; Sheikh and Alom, 2021), leading to the proposal of a set of government regulations to increase the capacity of decision-makers to minimize impacts and provide certainty and clarity for shipping operators. Like other types of transportation, sea transportation has risks that must be managed properly. The ability to manage shipping is essential to minimize the risks that may arise. Accidents that arise because of negligence have the potential to cause harm to all parties; therefore, good communication is needed between the parties involved in governing shipping safety. Shipping safety for transportation service users has become a general principle and is the responsibility of all parties.

3. Materials and methods

3.1. Research participants

The research participants or informants in this research are the Ministry of Transportation, the Head of Harbormaster and the Port Authority with deputies, the management of the navigation district, the Head of the Balikpapan Port, Local Government, SOE Port Managers, and Shipping Companies.

3.2. Procedure of data collection and analysis

The first phase of the data collection procedure to support this analysis is to conduct in-depth interviews with informants who have experience in the field of sea transportation, shipping safety and security, navigation, and port management, such as shipping entrepreneurs, Harbormaster and port authority, navigation officers, port SOE managers and local governments located around IKN. The author applies the triangulation method by crosschecking the interview results of each informant to find out if there are similarities and differences of opinion between the informants. If there is a significant difference of opinion, the author conducts a more in-depth interview to get a definite answer from the informants. Furthermore, the results of qualitative data processing were discussed again in the Focus Group Discussion.

The triangulation method for research is confronting data or information from several sources, such as interviews, observation, and secondary data. In applying this triangulation method, we use four information sources: in-depth interviews, FDG, surveys, and secondary documents. Triangulation aims to enhance the reliability and validity of collected data and research results. It can be applied in the operationalization phase to data sources, researchers, and research methods (van Thiel, 2021). For example, (Shin et al., 2018) applies it by confronting data or information from surveys, interviews, and social media. The authors also use the triangulation

method to crosscheck each informant's interview results to find their similarities and differences of opinion. A more in-depth interview then followed the difference of opinion from some very significant informants to get a definite answer from the informants. It is intended to consistently bind the understanding and interpretation of the findings (Morgan, 2017).

Furthermore, the results of qualitative data processing were discussed again in the focus group discussion. Qualitative analysis was carried out to identify patterns, understand stakeholder perspectives, and explain complex phenomena in maritime traffic management in Balikpapan Bay (Theotokatos et al., 2023). Data collected through interviews, FGDs, and direct observations is analyzed to find critical themes, identify problems, and develop evidence-based solutions. This approach ensures that policy findings and recommendations are based on a deep understanding and validation of the triangulation of various data sources. In this triangulation method. as mentioned by (Makarov et al., 2022), patterns of traffic management and shipping safety are evaluated considering human operational and managerial aspects using subjective and objective measurement tools that aim to obtain the governance mentioned above conceptually. After a comprehensive understanding by the stakeholders, data, and information were collected using interviews, focus group discussions, surveys, and several written documents to obtain reliable information and a complete picture of this research objective.

Figure 1 shows the roles of the government and shipping operators in implementing traffic management and shipping safety functions. Harbormaster represents the government. After receiving requests from shipping companies or their agents. the Harbormaster will physically verify or check ship documents and ships before they are declared fit for the sea.

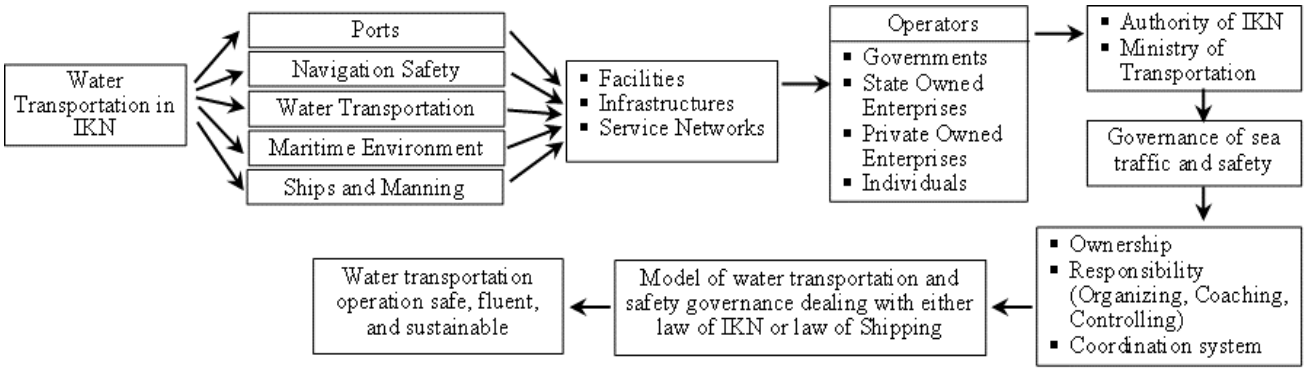

Figure 1. Research framework.

4. Result and discussion

4.1. Results of focus group discussion and in-depth interview

The result of the FGD forum agreed with the importance of shipping and safety governance considering the intensity of ship calls, which tend to increase and are not balanced with the width of Balikpapan's shipping lanes. The attendants of the forum revealed:

a) Since the establishment of IKN as the new capital, there has been an increase in

ship visits. This first phase is to support IKN development activities, especially nature transporting materials needed to build facilities and infrastructure for government and economic activities. Accidents arising due to the narrow channel will result in negative views of people towards the condition of the grooves in this bay. Therefore, this research effort is significant in helping the government improve safety aspects.

b) Both parties need to divide tasks according to their respective functions and authorities. The Ministry of Transportation carries out the function of shipping safety and security. In contrast, the IKN authority Agency carries out the business function even though both parties jointly carry out the function of organizing the port.

c) According to existing laws, the IKN Authority has the authority to manage land and water areas, including the planning of development in the area. At the same time, those related to route determination and underwater works, as well as salvage in order to establish the traffic system and effective and efficient safety of navigation, become the competence of the Transportation Ministry.

d) By conducting this study, there is a basis for the Indonesian government to ensure their respective authorities, which often overlap and make business actors unable to run their businesses properly.

Furthermore, the FGD forum suggested the importance of seeking direct views from shipping business actors as a unit of research analysis. This unit of analysis was needed to balance their views in ensuring important indicators for safe and secure navigation as well as considering rules of ship navigation in narrowing channels (Chen et al., 2023). As for instruments for collecting empirical data, the FGD forum suggested the use of questionnaires, in-depth interview instruments, and field observations to directly explore the views of shipping business actors in the Bay. Essential points included in questionnaires or interview instruments are concluded from the results of this forum to obtain opinions that strengthen the results of discussions in this forum. Finally, the FGD forum suggested the need for this study to assist the government in determining safe and secure ship trajectories because shipping lanes in this bay are relatively narrow. After the center of government moves to IKN, shipping activities will be very dense. Therefore, trajectory or route determination plays an essential role in ensuring navigation safety, preventing collision incidents, and improving ship traffic efficiency.

4.2. Ship movements

The transportation system for East Kalimantan's new state capital should be integrated and sustainable. Connectivity is critical because the new capital must be an economic driver for the surrounding region. As the East Kalimantan region has a relatively large water area and is used as a mode of sea transportation, sea transportation plays a vital role in supporting connectivity. In Balikpapan Bay, there are approximately eight public terminals, ten dedicated ports, and 43 dedicated terminals, and approximately 118 ships enter the bay each day. The changing status of the region to become a capital city has an impact on increasingly bustling shipping activities. Therefore, more efficient port governance is required, along with the

growing volume of ships and rapid service times (Liu et al., 2021). The number of ports or terminals along Balikpapan Bay demonstrates how busy ship traffic is, which has the effect of increasing ship operations to and from these ports and terminals. The term "infrastructure" refers to the physical structure of a building. There are various risks of accidents in narrow shipping routes, for example threatening the safety of ships; water depth also affects the ship's ability to navigate in the waters (Hu et al., 2023). Furthermore, the large number of marine structures in the bay's waters narrows the ship's maneuvering area, which can affect the ship traffic (Tong et al., 2019). The traffic-based model was developed using technical standards, environmental conditions, and traffic density (Kristiansen and Haugen, 2022). There are several ways to reduce ship collisions, such as maintaining the density of ships formulating or determining ships' routing and traffic separation schemes (Feng et al., 2022). Given the large number of ports surrounding Balikpapan Bay, resulting in a high level of ship traffic density, there is a potential for increased accidents if ship traffic flow is not separated by creating a Traffic Separation Scheme for ships, also known as the TSS. This TSS will assist in reducing and managing traffic in opposite traffic flows and assisting in the management of ships wishing to enter or leave the bay area, providing directives regarding safe distances between ships. and providing routes for deep-draft vessels. all of which are expected to create conditions of order and security-ship traffic systems. particularly in support of IKN. The trend of ship visits in Balikpapan Bay is expected to increase along with the implementation of IKN construction, as the large number of people visiting Balikpapan and North Penajam Paser increases the need for basic goods, triggering an increase in ship visits, reaching a peak in 2026/2027, then decreasing due to reduced construction activity, then increasing again in 2032 due to the growth of hinterland potential. **Figure 2** depicts the increasing number of ship visits to Balikpapan Bay.

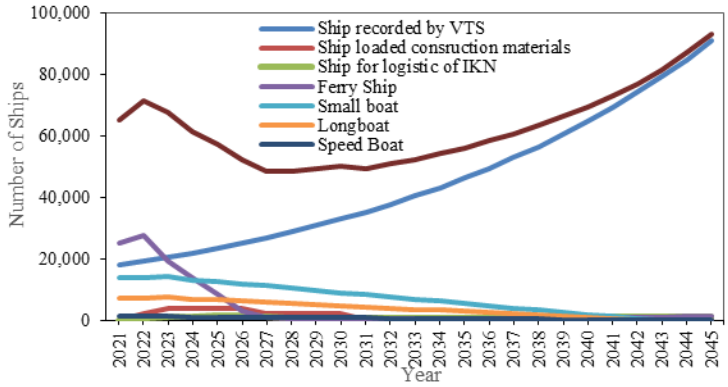

Figure 2. Projection of ship call before and after construction of IKN.

The number of ferry trips may decrease if the construction of the Balang Island Bridge is completed. As a result, the cargo and passengers of the ferry crossing Kariangau-Penajam will slowly decrease. It is estimated that the Kariangau-Penajam crossing will only increase until 2023, but in 2024–2028, the cargo and passengers will be estimated to decrease. Nonetheless, long-distance lines such as Kariangau-Mamuju and Kariangau-Taipa in Sulawesi Island are expected to increase because they become alternative entry points from Sulawesi to IKN. Speed boats, small boats

(local name "klotok"), and long boats are estimated to operate only until 2027, and starting from 2028 and beyond, those ships will significantly decrease. In addition, the distribution pattern of ships entering Balikpapan Bay was segmented to map the density level of each segment. The density of the access channel determined its width for separation. The distribution of ship calls per segment in Balikpapan Bay can be seen in **Figure 3**, which is based on the projected ship traffic density, where in 2023–2024, there are 198 ship calls per day to the bay.

The data had a positive impact on maritime economic activities for the IKN area. However, the growth of the merchant fleet, which tends to increase, has the potential to cause congestion and complexity of water traffic, especially in the strait and nearby channels, which was also explained by Crestelo Moreno et al. (2022) will cause congestion, so the government needs to overcome it and increase shipping safety in narrow waters such as Balikpapan Bay. Congestion is usually caused by traffic density. However, as concluded by Zhang et al. (2019), ship density is not significantly related to ship accidents. Even so. in narrow shipping lanes such as Balikpapan Bay, hotspot areas of speed that have the potential to be hotspot areas of ship accidents should be monitored to ensure that shipping safety can be realized. Thus, the government, through the harbor master and port authority, needs to govern or manage ship traffic in the waters.

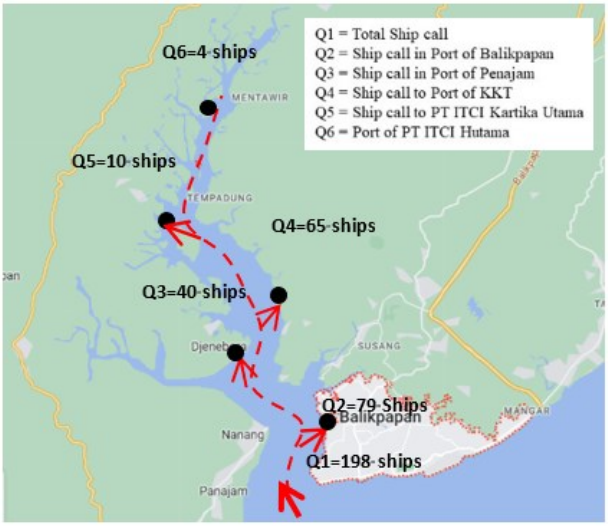

Figure 3. Ships call per day in Balikpapan Bay.

4.3. Shipping route and passage

Sea routes can be analogous to land roads that function like highways and can be used as a concentration point for ship movements (Pirotta et al., 2019). Each opening of a new sea road will undoubtedly have an impact on the growth of shipping activities; a new shipping route is currently more developed as a direct result of state capital removal, such as IKN to East Kalimantan. According to Li et al. (2024), ship passage determination is essential for maintaining navigational safety and improving the effectiveness of ship traffic. Therefore, shipping traffic must be governed, and navigation efficiency should be encouraged to reduce the risk of ship accidents and provide a sense of security for shipping service users. In addition, improving the safety

and efficiency of navigation and safety of life at sea is the purpose of the vessel traffic service, which is the authority of the maritime safety governance agency and should have uniform procedures and operations with other countries (IMO, 1997). The need for the separation of shipping lanes in Balikpapan Bay is based on the characteristics of ships that will call the waters and the depth and width of the bay. According to information, the bridge on Balang Island only has a 20 m clearance from the water surface, making it an obstacle for all ships. As a result, only ships with a specific height can sail under the bridge. Based on the width of existing ships entering Balikpapan Bay as determined by VTS data, the maximum width of ships entering is 25 m, allowing the minimum width of the shipping channel to be determined. This formulation calls for a straight shipping channel in Balikpapan Bay.

Straight channel width = 4 B + 30, where B is the width of the ship. Therefore, the minimum ship channel width is 130 m. If the width of the curved groove is 6 B + 30, the minimum width of the curved groove is 180 m. When compared to the results of the depth, channel width, and characteristic conditions of the planned ship, the width of the channel in Balikpapan Bay from the segment of A-H (before Balang Island) is 400 m, while the width from the segment of H-N (after Balang Island) is 200 m. Twenty-five meters allow the minimum width of the shipping channel to be determined. **Figure 4** depicts the channels and separation of shipping lanes in Balikpapan Bay and the plan of calculation of traffic separation by segmented route, as shown in **Table 1**.

Tabel 1. Segmentation and plan of shipping route in Balikpapan Bay.

Segment	Coordinate		Length (km)	Breadth (m)	Depth (m)
	Start	Finish			
A–B	116°56′8.803″ E–1°21′13.568″ S	116°54′7.287″ E–1°19′43.552″ S	4.66	400–380	7–23.5
B–C	116°54′7.287″ E–1°19′43.552″ S	116°49′43.716″ E–1°19′43.464″ S	8.14	370–380	7.5–12.5
C–D2	116°49′43.716″ E–1°19′43.464″ S	116°47′44.124″ E–1°17′18.960″ S	5.77	348–398	8.5–21
D1–E	116°47′53.700″ E–1°17′30.552″ S	116° 48′ 13.176″ E–1°16′1.488″ S	2.8	390–400	11–34
D3–D4	116°46′57.567″ E–1°13′46.469″ S	116°44′59.043″ E–1°12′54.845″ S	3.98	395–400	6–8
D4–D5	116°44′59.043″ E–1°12′54.845″ S	116°44′6.427″ E–1°12′49.756″ S	1.64	395–400	7–9
D2–F	116°47′44.124″ E–1°17′18960″ S	116°46′42.348″ E–1°12′37.008″ S	8.86	400	12.5–41
F–G	116°46′42.348″ E–1°12′37.008″ S	116°46′43.032″ E–1°11′26.196″ S	2.17	395–400	15–43
G H	116°46′43.032″ E–1°11′26.196″ S	116°46′50.556″ E–1°10′43.608″ S	1.33	360–400	12.5–23
I–J	116°45′49.500″ E–1°8′18.204″ S	116°43′29.069″ E–1°6′19.523″ S	5.67	200	7–42
J–K	116°43′29.069″ E–1°6′19.523″ S	116°43′19.820″ E–1°5′42.453″ S	1.17	200	-
J–L	116°43′29.069″ E–1°6′19.523″ S	116°43′50.331″ E–1°5′19.341″ S	1.96	200	-
L–M	116°43′50.331″ E–1°5′19.341″ S	116°43′43.996″ E–1°4′28.286″ S	1.58	200	-
M–N	116°43′43.996″ E–1°4′28.286″ S	116°44′18.904″ E–1°2′35.870″ S	3.62	200	-
AA–BB	116°46′36.337″ E–1°14′25.703″ S	116°48′6.507″ E–1°13′10.744″ S	3.61	50	2–23
BB–CC	116°48′6.507″ E–1°13′10.744″ S	116°48′17.922″ E–1°12′52.281″ S	0.67	50	2–3
CC–DD	116°48′17.922″ E–1°12′52.281″ S	116°48′19.480″ E–1°12′36.057″ S	0.5	50	2–4
DD–EE	116°48′19.480″ E–1°12′36.057″ S	116°48′28.719″ E–1°12′20.004″ S	0.57	50	2–4
EE–FF	116°48′28.719″ E–1°12′20.004″ S	116°48′36.030″ E–1°12′11.645″ S	0.34	50	2–4

Tabel 1. (*Continued*).

Segment	Coordinate		Length (km)	Breadth (m)	Depth (m)
	Start	Finish			
GG–GG	116°48′36.030″ E–1°12′11.645″ S	116°48′46.589″ E–1°12′5.263″ S	0.38	50	2–3
HH–HH	116°48′46.589″ E–1°12′5.263″ S	116°48′59.356″ E–1°12′2.496″ S	0.4	50	2–3

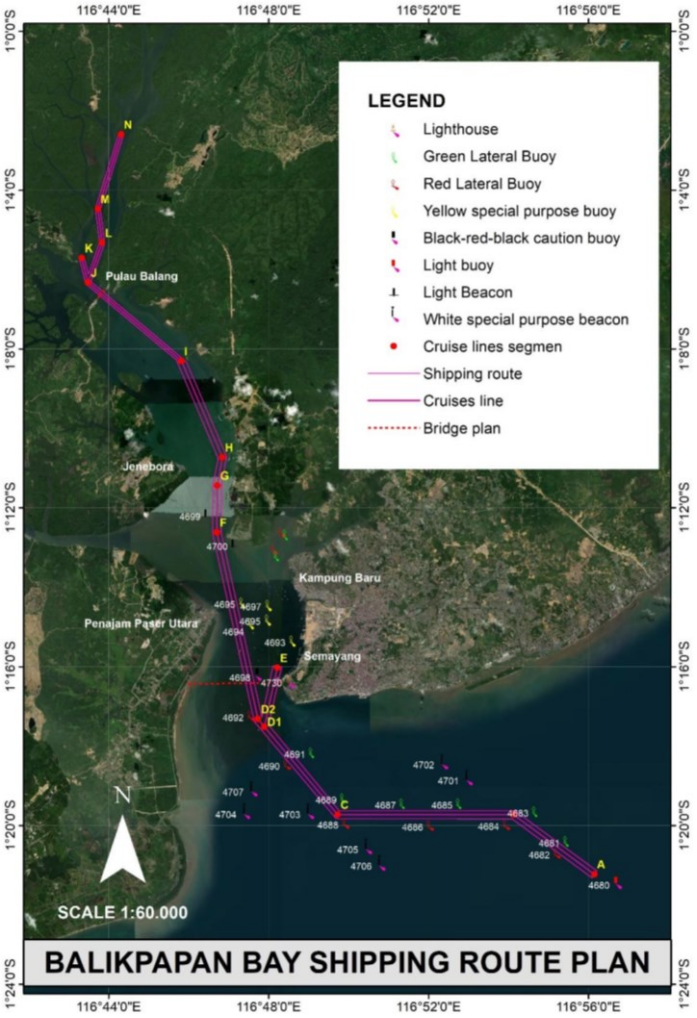

Figure 4. Plan of shipping routes in Balikpapan Bay.

4.4. Authority of shipping governance

4.4.1. Based on shipping law

Indonesia, being a maritime nation, adheres to national shipping regulations that aim to establish an efficient and effective transportation system and foster a robust and dynamic national distribution pattern. According to the Law, shipping is defined as an integrated system consisting of transportation in waters, ports, safety, and security, as well as the protection of the maritime environment. Currently, shipping safety and security functions in Balikpapan Bay are under the Harbor Master and Port Authority of Balikpapan. According to shipping law, the Ministry of Transportation holds the authority to regulate, guide, control, and supervise port activities. Its authority includes the provision and upkeep of shipping navigation aids, the supervision and controlling security and order at the port, the regulation and protection of the port's sustainable

environment, the establishment of a port master plan, a port work environment area, and a port interest environment area, the preparation and determination of tariffs based on mutual agreement with port service users, and the organization of systems and procedures to ensure the smooth flow of goods and passengers. Furthermore, the IKN Authority Agency holds the authority to establish and maintain port areas, both on land and in water, as well as to provide and maintain breakwaters, port basins, port access channels, and road networks. This authority also extends to ensuring security and order at ports and promoting the sustainability of the maritime environment. To support the implementation of government activities at the port dedicated to IKN, the Harbormaster and Port Authority of IKN coordinate with the IKN Authority Board in terms of exchanging data and information regarding the departure and arrival of ships to and from IKN waters. Through a land-use mechanism, the IKN Authority Board provides office space within the port area to carry out the Ministry of Transportation's duties. We need to clarify who owns the port work environment area from the Port of Balikpapan to Balang Island.

All ships arrive at IKN through the port working environment area of Balikpapan, and the authority of maritime safety is the responsibility of the Ministry of Transportation. Sailing Approval Letters were issued by the Harbormaster and Port Authority of Balikpapan by Transportation Minister Decree No. 28 of 2022 about procedures for issuing sailing approval letters and ship activity approval letters at the port. By Law No. 17 of 2008 about shipping, the provision of sailing approval letters is the duty of the Harbormaster to carry out the functions of shipping safety and security, including supervision and law enforcement in the field of water transportation, ports, and maritime environmental protection. Regarding activities in salvage and underwater works, each implementation of these activities in the IKN waters area should obtain permits for salvage activities and underwater works issued by the Directorate of Sea and Coast Guard Union represented by the Harbormaster and Port Authority dedicated to IKN. Hence, partnerships between maritime stakeholders and private sectors are critical factors in the development of effective, efficient, and sustainable trade shipping (Nyenno et al., 2019).

4.4.2. Based on IKN law

The IKN Authority occupies a unique position. IKN is a special region at the provincial level according to Law No. 3 of 2022, and the head of IKN Authority has a ministerial-level position. as stated in Article 5 of the Law. As a capital-specific region, IKN has the authority to regulate and manage its government affairs. In this regard, Article 12 of Law No. 3/2022 states that the IKN authority has the authority to issue investment permits, ease of doing business, and grant special facilities to parties who support financing in the context of preparing, developing, and moving National Capital, as well as the development of IKN and partner regions. Suppose there is no clear determination of appropriate authority limits between related agencies in the management of waters surrounding the IKN area. In that case, there is a risk of conflict of authority in the implementation of transportation affairs in the waters. According to Article 5 of Law No. 17/2008, shipping is governed by the state, with the (central) government in charge of regulation, control, and supervision. It was later strengthened by the sharing of government affairs as included in Law No. 23 of 2014 concerning

Regional Government. In terms of the sharing of transportation affairs in the shipping sub-affairs under the Law, it is stated that the implementation of shipping safety and security is the authority of the central government.

Furthermore, Article 27 of Law No. 23/2014 governs the provincial regions' authority to manage marine natural resources in their territory up to 12 miles from the coast. This authority includes the following responsibilities: (a) exploration, exploitation, conservation, and management of marine resources other than oil and natural gas; (b) administrative arrangements; (c) spatial arrangements; (d) participation in maintaining maritime security; and (e) participation in defending state sovereignty. According to the explanation, these administrative arrangements include, among other things, licensing, seaworthiness, and shipping safety. In these national laws, there is an intersection related to shipping governance authorities, especially if the implementation of this authority has the potential to generate financial income. Inter-agency conflicts can arise in the form of redundancy, that is, coordination problems, in which two or more agencies perform the same task. Therefore, inter-regional agency coordination is an essential issue in governance. Better coordination of policies will generate coherence across the government as a whole (Althaus et al., 2022), and our analysis, as also found by Rahayu et al. (2024) indicated that its practice in Indonesia's maritime transportation policy was generally a low level. For this reason, it is necessary to consider policy implementation through a whole-of-government approach, which means working across organization boundaries together, and therefore demands consistency and coherence policies (Althaus et al., 2022). It will assist stakeholders in knowing the gaps, challenges, and opportunities in the policy-making process, emphasizing the importance of coherence and coordination to provide certainty for businesses to operate effectively and efficiently (Skovgaard, 2018).

5. Conclusions

The designation of East Kalimantan as the new Capital Region of Indonesia (IKN) has a positive impact on the effectiveness of shipping as well as the distribution of port and shipping activities, ensuring an equitable distribution of inclusive and equitable economic development throughout Indonesia. In this regard, shipping lanes will become increasingly congested. making ship traffic management and shipping safety in Balikpapan Bay urgent matters to address. The large number of ferry and traditional ship trips in Balikpapan Bay allows for crossing collisions, high traffic density in the shipping channel, and the presence of short-crossing ferries and traditional ships. According to the Transportation Minister's Decree concerning the Organization and Work Procedure of the Ministry of Transportation, the Directorate General of Sea Transportation has the authority to implement shipping traffic safety management in Balikpapan Bay. Meanwhile, the IKN Authority, as designated and regulated by Law No. 3 of 2022 on the National Capital, is responsible for managing waters in the IKN region and surrounding areas. Therefore, it is necessary to regulate shipping traffic and safety management so that there is no overlap or conflict of interest in Balikpapan Bay. Law No. 3 of 2022 has established a special regional government. hereinafter referred to as the IKN Authority, which functions to carry out government affairs in the IKN and accelerate the country's economic transformation. Law No. 17 of 2008 on

shipping, which regulates various aspects of ports, maritime transportation, safety and security, as well as environmental protection, authorizes the Minister of Transportation to regulate maritime traffic and safety. This research highlights the necessity for maritime traffic and shipping safety management in the waters surrounding the IKN. It proposes the use of two relevant laws to facilitate the implementation of government activities and delineate the authority of the two institutions. Furthermore, it is necessary to harmonize the authorities of each relevant institution to ensure the effective and harmonious implementation of maritime operations in Balikpapan Bay, providing business certainty for port and shipping operators. Related stakeholders could coordinate and cooperate to monitor port activities in Balikpapan and IKN, thereby resolving overlapping authorities in port management. In addition, a clear division of tasks and authorities is essential for the effective and efficient implementation of port governance. The government can also consider implementing institutional reforms in port management to reduce the overlap of authority.

Author contributions: Conceptualization, JM, EM and FSP; methodology, JM, WPH and MYJ; software, WPH and AW; validation, AW, NI and HP; formal analysis, MYJ, WPH and DA; investigation, JM, FSP and NI; data curation, DA and M; writing-original draft, JM, EM and M; writing-review and editing, FSP, DA and HP; visualization, AW and M; supervision, MYJ; project administration, FSP and HP; funding acquisition, EM. All authors have read and agreed to the published version of the manuscript.

Acknowledgments: The authors would like to thank Balikpapan Port's Harbormaster and port authority, as well as all staff, for their coordination in conducting the field study and all of the expert stakeholder groups that answered the survey questions and participated in the focus group discussion. The authors also thank the anonymous reviewers, whose critical and constructive comments greatly helped in preparing an improved and clearer version of this paper. We kindly acknowledge all individuals and institutions who generously provided their data for this research.

Funding: This research was funded by the Research Organization for Governance, Economy, and Community Welfare of the National Research and Innovation Agency (BRIN), Indonesia, under the scheme of Riset Rumah Program RRP1 with the contract number: RRP1-15/2022.

Conflict of interest: The authors declare no conflict of interest.

References

Althaus, C., Ball, S., Bridgman, P., et al. (2022). The Australian Policy Handbook. Routledge. https://doi.org/10.4324/9781003351993

Chen, L., Qi, J., & Shi, J. (2023). A cellular automata ship traffic flow model considering navigation rules in narrowing channel. Alexandria Engineering Journal, 69, 715–726. https://doi.org/10.1016/j.aej.2023.01.062

Crestelo Moreno, F., Roca Gonzalez, J., Suardíaz Muro, J., et al. (2022). Relationship between human factors and a safe performance of vessel traffic service operators: A systematic qualitative-based review in maritime safety. Safety Science, 155, 105892. https://doi.org/10.1016/j.ssci.2022.105892

Fasoulis, I., & Kurt, R. E. (2019). Embracing sustainability in shipping: Assessing industry's adaptations incited by the, newly,

introduced “triple bottom line” approach to sustainable maritime development. Social Sciences, 8(7), 1–20. https://doi.org/10.3390/socsci8070208

Feng, H., Grifoll, M., Yang, Z., et al. (2022). Collision risk assessment for ships’ routeing waters: An information entropy approach with Automatic Identification System (AIS) data. Ocean & Coastal Management, 224, 106184. https://doi.org/10.1016/j.ocecoaman.2022.106184

Ghalib, H., El-Khorazaty, M. T., & Serag, Y. (2021). New capital cities as tools of development and nation-building: Review of Astana and Egypt’s new administrative capital city. Ain Shams Engineering Journal, 12(3), 3405–3409. https://doi.org/10.1016/j.asej.2020.11.014

Grech, A., Bos, M., Brodie, J., et al. (2013). Guiding principles for the improved governance of port and shipping impacts in the Great Barrier Reef. Marine Pollution Bulletin, 75(1–2), 8–20. https://doi.org/10.1016/j.marpolbul.2013.07.013

Gumzej, R. (2023). Intelligent logistics systems in E-commerce and transportation. Mathematical Biosciences and Engineering, 20(2), 2348–2363. https://doi.org/10.3934/mbe.2023110

Haezendonck, E. (2020). Port strategy for sustainable development: Circularization and value creation—introduction to a special issue. Sustainability (Switzerland), 12(23), 1–3. https://doi.org/10.3390/su12239914

Hu, Z., Liu, Y., & Sun, H. (2023). Safety Measures and Practice of Ship Navigation in Restricted Visibility Base on Collision Case Study. American Journal of Traffic and Transportation Engineering, 8(4), 82–87. https://doi.org/10.11648/j.ajtte.20230804.11

Huntington, H. P., Bobbe, S., Hartsig, A., et al. (2019). The role of areas to be avoided in the governance of shipping in the greater Bering Strait region. Marine Policy, 110, 103564. https://doi.org/10.1016/j.marpol.2019.103564

IMO. (1997). Resolution A.857(20) adopted on 27 November 1997 Guidelines for Vessel Traffic Services. 857(December), 1–26.

IMO. (2003). Guidelines for the installation of a shipborne automatic identification system (AIS). SN/Circ.227, 14.

Kristiansen, S., & Haugen, S. (2022). Maritime Transportation. Routledge. https://doi.org/10.4324/9781003055464

Li, M., Li, B., Qi, Z., et al. (2024). Enhancing Maritime Navigational Safety: Ship Trajectory Prediction Using ACoAtt–LSTM and AIS Data. ISPRS International Journal of Geo-Information, 13(3), 85. https://doi.org/10.3390/ijgi13030085

Li, W., Bai, X., Yang, D., et al. (2023). Maritime connectivity, transport infrastructure expansion and economic growth: A global perspective. Transportation Research Part A: Policy and Practice, 170, 103609. https://doi.org/10.1016/j.tra.2023.103609

Li, X., Oh, P., Zhou, Y., et al. (2023). Operational risk identification of maritime surface autonomous ship: A network analysis approach. Transport Policy, 130(July 2022), 1–14. https://doi.org/10.1016/j.tranpol.2022.10.012

Liu, J., Yu, B., Shan, W., et al. (2021). Optimizing the container truck paths with uncertain travel time in container ports. Transport, 36(6), 444–462. https://doi.org/10.3846/transport.2021.16169

Makarov, D., Makarova, O., Mayurov, N., et al. (2022). Development prospects and importance of the Northern Sea Route. Transportation Research Procedia, 63, 1114–1120. https://doi.org/10.1016/j.trpro.2022.06.114

Morgan, D. L. (2017). Commentary—After Triangulation, What Next? Journal of Mixed Methods Research, 13(1), 5. https://doi.org/https://doi.org/10.1177/1558689818780596

Netirith, N., & Ji, M. (2022). Analysis of the Efficiency of Transport Infrastructure Connectivity and Trade. Sustainability, 14(15), 9613. https://doi.org/10.3390/su14159613

Nyenno, I., Rekova, N., & Minakova, S. (2019). Joint Value as a Measure of Sea Trade Port Stakeholder Effect. Social Sciences, 8(4), 120. https://doi.org/10.3390/socsci8040120

Pirotta, V., Grech, A., Jonsen, I. D., et al. (2019). Consequences of global shipping traffic for marine giants. Frontiers in Ecology and the Environment, 17(1), 39–47. https://doi.org/10.1002/fee.1987

Puriningsih, F. S. (2022). Sorong Port Infrastructure Needs to Support the World Maritime Axis. Warta Penelitian Perhubungan, 34(1), 45–52. https://doi.org/http://dx.doi.org/10.25104/warlit.v34i1.1536

Rahayu, L., Busscher, T., Tillema, T., et al. (2024). Maritime transport governance challenges in the Global South. Marine Policy, 163, 106147. https://doi.org/10.1016/j.marpol.2024.106147

Richter, M. A., Hagenmaier, M., Bandte, O., et al. (2022). Smart cities, urban mobility and autonomous vehicles: How different cities needs different sustainable investment strategies. Technological Forecasting and Social Change, 184, 121857. https://doi.org/10.1016/j.techfore.2022.121857

Sepehri, A., Vandchali, H. R., Siddiqui, A. W., et al. (2022). The impact of shipping 4.0 on controlling shipping accidents: A systematic literature review. Ocean Engineering, 243(November), 110162. https://doi.org/10.1016/j.oceaneng.2021.110162

Sheikh, W., & Alom, K. (2021). Corporate governance, board practices and performance of shipping firms in Bangladesh. Asian

Journal of Shipping and Logistics, 37(3), 259–267. https://doi.org/10.1016/j.ajsl.2021.06.005

Shelmerdine, R. L. (2015). Teasing out the detail: How our understanding of marine AIS data can better inform industries, developments, and planning. Marine Policy, 54, 17–25. https://doi.org/10.1016/j.marpol.2014.12.010

Shin, S. H., Kwon, O. K., Ruan, X., et al. (2018). Analyzing sustainability literature in maritime studies with text mining. Sustainability, 10(10). https://doi.org/10.3390/su10103522

Skovgaard, J. (2018). Policy coherence and organizational cultures: Energy efficiency and greenhouse gas reduction targets. Environmental Policy and Governance, 28(5), 350–358. https://doi.org/10.1002/eet.1821

Song, T., Li, Y., & Hu, X. (2017). Cost-effective optimization analysis of shore-to-ship power system construction and operation. 2017 IEEE Conference on Energy Internet and Energy System Integration, EI2 2017 - Proceedings, 2018-Janua, 1–6. https://doi.org/10.1109/EI2.2017.8245586

Theotokatos, G., Dantas, J. L. D., Polychronidi, G., et al. (2023). Autonomous shipping—an analysis of the maritime stakeholder perspectives. In WMU Journal of Maritime Affairs. Springer Berlin Heidelberg. https://doi.org/10.1007/s13437-022-00290-2

Tong, S., Liu, J., Zhao, L., et al. (2019). Impact on water traffic environment based on ism model. ICTIS 2019 - 5th International Conference on Transportation Information and Safety, 2018, 1188–1191. https://doi.org/10.1109/ICTIS.2019.8883693

Toscano, D., & Murena, F. (2019). Atmospheric ship emissions in ports: A review. Correlation with data of ship traffic. Atmospheric Environment: X, 4, 100050. https://doi.org/10.1016/j.aeaoa.2019.100050

Tsou, M. C. (2010). Discovering knowledge from AIS database for application in VTS. Journal of Navigation, 63(3), 449–469. https://doi.org/10.1017/S0373463310000135

van Thiel, S. (2021). Research Methods in Public Administration and Public Management. Routledge. https://doi.org/10.4324/9781003196907

van Westrenen, F., & Baldauf, M. (2020). Improving conflicts detection in maritime traffic: Case studies on the effect of traffic complexity on ship collisions. Proceedings of the Institution of Mechanical Engineers Part M: Journal of Engineering for the Maritime Environment, 234(1), 209–222. https://doi.org/10.1177/1475090219845975

Wahid, A., Jinca, M. Y., Rachman, T., et al. (2023). Determination of Indicators of Implementation of Sea Transportation Safety Management System for Traditional Shipping Based on Delphi Approach. Sustainability, 15(13), 10080. https://doi.org/10.3390/su151310080

Xiao, F., Ligteringen, H., Van Gulijk, C., et al. (2015). Comparison study on AIS data of ship traffic behavior. Ocean Engineering, 95, 84–93. https://doi.org/10.1016/j.oceaneng.2014.11.020

Yusuf, A. A., Roos, E. L., Horridge, J. M., et al. (2023). Indonesian capital city relocation and regional economy's transition toward less carbon-intensive economy: An inter-regional CGE analysis. Japan and the World Economy, 68, 101212. https://doi.org/10.1016/j.japwor.2023.101212

Zhang, L., Meng, Q., & Fang Fwa, T. (2019). Big AIS data based spatial-temporal analyses of ship traffic in Singapore port waters. Transportation Research Part E: Logistics and Transportation Review, 129, 287–304. https://doi.org/10.1016/j.tre.2017.07.011

Appendix

Guide and scope of research questions for Focus Group Discussion and in-depth research interview.

1) Ownership status of IKN waters.
   a) Do you know the competent authority for water ownership in Balikpapan Bay and the river area, which is the shipping channel around the IKN?
   b) In your opinion, is the current ownership in accordance with law No. 17 of 2008 about shipping and Minister Decree No. 52 of 2012 about river and lake shipping lanes?
   c) With the existence of Law No. 3 of 2022 about the IKN, is the authority to govern or manage waters and shipping lanes in Balikpapan Bay and the river areas around the IKN also under the responsibility of the IKN Authority?
2) Provision and determination of shipping routes and crossings in the IKN waters.
   a) Do you know the institutions authorized to determine shipping lanes and crossings, route systems, traffic procedures, and ship anchoring areas in Balikpapan Bay and rivers around the IKN?
   b) Is the institution that provides and determines the shipping lanes mandated by Law No. 17 of 2018 on shipping?
   c) In your opinion, are the shipping lanes and crossings, route systems, traffic procedures, and designated ship anchoring areas subject to shipping safety criteria?
   d) Has the institution considered the aspects of shipping safety, maritime environmental sustainability, and water spatial planning when providing and determining shipping lanes and crossings?
   e) According to you, are there no accidents or collisions in the current lanes and crossings?
   f) If yes, please inform the cause of those accidents.
   g) In your opinion, with the existence of Law no. 3 of 2022 about IKN, is the authority to determine shipping lanes and crossings in Balikpapan Bay and the river areas around IKN also the responsibility of the IKN Authority?
      - If yes, please inform the extent of the authority of the IKN Authority.
      - If not, please inform how the model of provision and determination of a suitable flow.
3) Supervision and maintenance of shipping lanes and crossings
   a) In addition to the provision and determination of shipping lanes. are the shipping lane monitoring and maintenance systems also handled by the same or different institutions?
   b) How is the institution's authority related to Law no. 17 of 2018 about Shipping?
   c) Regarding law No. 3 of 2022 about IKN, can the IKN Authority also take part in the supervision and maintenance of shipping lanes and crossings?
      - If yes, please inform us how the system of supervision works.
      - If not, please inform us how suitable the supervision model is.
4) Determination of navigation system
   a) Do you know the competent authority in the navigation system in Balikpapan Bay and the river around the IKN?
   b) Is the navigation system governance institution by Law no. 17 of 2018 about shipping?
   c) In your opinion, is the established navigation system by shipping safety criteria?
   d) In your opinion, is the current navigation system well done or does it still need to be improved?

   If it still needs to be improved what should be done?
   e) In your opinion, with the existence of law No. 3 of 2022, is the authority of the navigation system in Balikpapan Bay and the river areas around the IKN also the responsibility of the IKN Authority?
      - If yes, please inform us the extent of the authority of the IKN Authority.
      - If not, please inform us how the model of governance authority of the navigation system is suitable.
   f) In your opinion, which institution is the most suitable to regulate the navigation system in IKN waters?

5) Control of navigation system and shipping safety.
   a) In addition to determining the shipping navigation system. please inform whether the navigation control system is also handled by the same institution or a different one.
   b) Please inform us how the institution's authority is related to Law no. 17 of 2018 on shipping?
   c) Regarding law No. 3 of 2022 on IKN, can the IKN Authority also take part in the navigation control system?
      - If yes, please inform us how the control system works.
      - If not, please inform us how the model of navigation control is suitable.
6) Authority of shipping development and business in the IKN waters
   a) In your opinion, what institutions or agencies have the authority to carry out shipping development and business in Balikpapan Bay and the river area around the IKN?
   b) Please inform us the authorities and roles of each institution or agency.
   c) Please inform us whether the agency's authority is by the mandate of Law no. 17 of 2018?
   d) Regarding law No. 3 of 2022, can the IKN Authority take part in the shipping development and business in IKN waters?
      - If yes, please inform how the establishment and business system is carried out.
      - If not, please inform how the model of shipping development and shipping business is suitable.
7) Authority of maritime environment protection and control in the IKN waters
   a) In your opinion, are there environmental protection and controlling systems in the IKN waters?
      - If not, please inform the cause.
   b) Do you know of any institutions that have the authority to protect and control the maritime environment in Balikpapan Bay and the river areas around IKN?
   c) Is the institution or agency by the mandate of Law no. 17 of 2018 about shipping?
   d) In the process of maritime environment protection has the agency paid attention to the prevention and control of both ship operations and port activities?
   e) In your opinion, with the existence of Law no. 3 of 2022. is the authority to control and protect the maritime environment in Balikpapan Bay and the river areas around the IKN also the responsibility of the IKN Authority?
      - If yes, please inform us the extent of the authority of the IKN government?
      - If not, please inform us what model of controlling and protecting the maritime environment is suitable in Balikpapan Bay.
8) Coordination between agencies in the implementation of a shipping traffic system and safety in the IKN waters.

   What is the ideal condition regarding the coordination system, roles, and responsibilities between agencies in the IKN waters governance. such as the Ministry of Transportation (i.e., harbor master, head of navigation district). IKN Authority, Navy Base, Regional Government, Indonesia Port Company, and the maritime private companies related to:
   a) Status of waters governance authority.
   b) Provision and determination of shipping lanes.
   c) Supervision and maintenance of shipping lanes and crossings.
   d) Determination of navigation system.
   e) Controlling of navigation system and shipping safety.
   f) Shipping development and business in Balikpapan Bay.
   g) Controlling and protecting the maritime environment.