Siber Journal of Transportation and Logistic (SJTL)
E-ISSN: 2987-1050
P-ISSN: 2987-1026
+62 822 1012 3600 https://research.e-siber.org siberpublisher.info@gmail.com
DOI: https://doi.org/10.38035/sjtl.v4i1.859

Maritime Accident Risk Assessment as a Basis for Selecting Anchorage Area Locations: A Perception Study in the Waters of Riau Islands, East Kalimantan, and South Kalimantan

Raden Aditya Wirawan[1]
[1]Institut Transportasi dan Logistik Trisakti, Indonesia, wirawan.cpm@gmail.com

Corresponding Author: wirawan.cpm@gmail.com[1]

Abstract: This study aims to analyze stakeholder perceptions regarding the risk of shipping accidents as a basis for consideration in selecting locations for anchorage areas to be commercialized in the waters of Riau Islands (Kepri), East Kalimantan (Kaltim), and South Kalimantan (Kalsel) Provinces. The method used is a descriptive quantitative and qualitative survey of 39 respondents consisting of representatives from the Ministry of Transportation (56.4%), Local Government (15.4%), Associations (7.7%), the Private Sector (15.4%), and Academics (5.1%). The survey results indicate that the majority of respondents (71.8%) stated that the marine location significantly influences the risk of shipping accidents. Marine environmental conditions were deemed highly influential by 79.5% of respondents, and 84.6% of respondents stated that a combination of extreme conditions (storms, high waves, and strong currents) constitutes the primary threat. From a shipping traffic perspective, 82.1% of respondents selected a combination of congested conditions, narrow waters, and the absence of Aid to Navigation (AtoN) as the greatest potential risk. Regarding anchoring, 97.4% of respondents agreed that the designation of these areas needs to be carried out by the government, and 79.5% designated the Ministry of Transportation as the authorized organizer. Furthermore, 87.2% of respondents supported the Public-Private Partnership (PPP) scheme, with Concession and Utilization Cooperation (KSP) being the preferred options at 41% each. The urgency of risk assessment in location selection obtained an average score of 4.26 on a scale of 5, while the value of safety as an investment parameter reached an average of 4.64.

Keywords: Risk of Shipping Accidents, Anchorage Area, KPBU, Shipping Safety, Kepri, Kaltim, Kalsel.

INTRODUCTION

Indonesia is the world's largest archipelagic nation, with a water area of 3.25 million km², making the shipping sector the backbone of national connectivity. Shipping activities are inherently subject to the risk of accidents, which can be caused by various factors, ranging from marine environmental conditions to traffic congestion.

Anchorage areas are strategic facilities in the port ecosystem that function as waiting zones for ships before docking, or furthermore, areas within the scope of activities can be used as water areas that can function to carry out port activities. In Indonesia, the commercial potential of anchorage areas has not been systematically optimized, especially for waters that have the potential to function to carry out port activities. Three regions that are the focus of this research, namely; Riau Islands, East Kalimantan, and South Kalimantan. These regions were chosen because all three are strategic shipping nodes with water characteristics that have the potential to use anchorage areas that can function as port areas, due to the limited depth of the port area which is relatively shallow when compared to the demand for ships.

Determining the appropriate location for anchorage areas requires a comprehensive accident risk analysis. Without an adequate risk assessment, commercialization of anchorage areas has the potential to increase accident incidents and threaten shipping safety. Therefore, this study seeks to explore stakeholders' perceptions regarding the relationship between water conditions, accident risk, and the suitability of anchorage locations, particularly for areas with the potential for port activities.

METHOD

A. Types and Approaches to Research

This study employed a mixed methods approach, combining descriptive quantitative and qualitative methods. The quantitative approach was used to analyze the frequency distribution and average responses of respondents to closed-ended questions, while the qualitative approach was used to explore respondents' perceptions of specific water conditions and safety improvement efforts.

B. Survey Implementation Time

This research was conducted over three months, from April to June 2023. The timing was adjusted to the need for primary data collection through the distribution of questionnaires and electronic forms to respondents from various backgrounds, such as government agencies, academics, associations, regionally-owned enterprises (BUMD), and the private sector. During this period, researchers distributed, completed, collected, and tabulated respondents' responses in stages to ensure more comprehensive and accountable data.

C. Population and Sample

The research population comprised stakeholders directly involved in shipping and port activities in the waters of the Riau Islands, East Kalimantan, and South Kalimantan. The sample was selected using a purposive sampling method based on institutional representation and expertise in the shipping sector, with selected respondents and experts possessing professional policy authorization in the maritime transportation sector within each stakeholder group.

This study successfully collected data from 39 respondents, exceeding the initial target of 36 respondents. The composition of the respondents is presented in Table 1.

Table 1 Composition of Research Respondents

Stakeholder Groups	Agency/Institution	Amount	Percentage
Kementerian Perhubungan	Direktorat Kepelabuhanan, KSOP, Distrik Navigasi	22	56.4%
Pemerintah Daerah	Dishub Prov. Kepri, Kalsel, Kaltim	6	15.4%
Asosiasi	INSA, ABUPI	4	10.3%
Swasta	Perusahaan Pelayaran, Badan Usaha Pelabuhan	6	15.4%
Akademisi	Pengajar, Mahasiswa Pascasarjana	3	7.7%
TOTAL		**39**	**100%**

D. Respondent Demographic Profile

In terms of gender, 97.4% (38 people) of respondents were male and 2.6% (1 person) were female. This reflects the male dominance in the port and shipping profession in Indonesia. Meanwhile, in terms of age, 17.9% were under 30 years old, 66.7% were between 30 and 50 years old, and 15.4% were over 50 years old, indicating that the majority of respondents were of productive age with sufficient work experience.

E. Instruments and Data Collection

The research instrument was a structured questionnaire consisting of 25 questions covering both quantitative aspects (closed-ended questions on a nominal and ordinal scale) and qualitative aspects (open-ended questions). Data were collected through an online survey over a specific period and included the following variables:

- X1: Water Location (karakteristik geografis wilayah Kepri, Kaltim, Kalsel)
- X2: Marine Environment (permukaan dasar laut dan klimatologi)
- X3: Shipping Traffic (kepadatan, ketersediaan SBNP)
- Y: Risk of Maritime Accidents
- Z: Maritime Safety Level

F. Data Analysis Techniques

Quantitative data analysis was conducted using descriptive statistics including frequency, percentage, mean, median, mode, and standard deviation. Qualitative data analysis was conducted through data reduction, data presentation, and drawing conclusions from respondents' open-ended answers.

RESULTS AND DISCUSSION

A. The Influence of Water Location on Accident Risk

The first question measured respondents' perceptions of the influence of water location on the risk of maritime accidents. The survey results showed a strong consensus among stakeholders.

Table 2 Effect of Water Location on Accident Risk (P1)

Answer Options	Amount (n = 39)	Percentage
Very influential	28	71,8%
Influential but not significant	9	23,1%
No effect at all	2	5,1%
Total	**39**	**100%**

A total of 71.8% of respondents stated that the location of the waters significantly influences the risk of accidents, while 23.1% stated that it had an influence but was not significant. Only 5.1% believed it had no influence at all. The mean score was 1.33 on a scale of 1 to 3 (1 = very influential), indicating a strong consensus that geographic location is an important determinant of accident risk.

All respondents (100%) stated that marine environmental conditions and shipping traffic vary across Indonesian waters. This finding reinforces the argument that risk analysis must be conducted on a site-specific basis and cannot be generalized to all Indonesian waters.

B. Marine Environmental Factors on Accident Risk

As many as 79.5% of respondents stated that marine environmental conditions (seabed surface and climatology) significantly influence the risk of shipping accidents. When asked which marine environmental conditions are potentially most dangerous, 84.6% of respondents chose a combination of all extreme conditions (strong winds, high waves, and strong currents) as the greatest threat.

Table 3 Marine Environmental Conditions that Potentially Contribute to Accident Risk (P6)

Marine Environmental Conditions	Amount (n=39)	Percentage
Strong wind storm	2	5,1%
High waves	2	5,1%
Strong current	2	5,1%
A combination of all of the above extreme conditions	33	84,6%
Total	**39**	**100%**

C. Shipping Traffic Factors on Accident Risk

Fifty-nine percent of respondents stated that shipping traffic significantly influences accident risk, while 35.9% stated that it does have an insignificant effect. Regarding traffic conditions that could potentially lead to accidents, the majority (82.1%) chose a combination of conditions: heavy traffic, narrow waters, and the absence of a SBNP.

Respondents' views on the dominant risk showed that 64.1% of respondents from the shipowner perspective considered extreme marine environmental conditions to be riskier than extreme shipping traffic conditions (35.9%). This finding implies that from a ship investment perspective, mitigating sea conditions (waves, currents, wind) in shipping route plans is prioritized over shipping traffic density conditions.

D. Characteristics of the Waters of the Three Provinces Study Locations

a. Waters of Prov. Kepulauan Riau (Kepri)

Based on respondents' qualitative responses, marine environmental conditions in the Riau Islands waters vary depending on the specific location. The Singapore Strait and Batam areas

tend to be more protected due to the morphology of the islands, which form a natural barrier. However, the northern region of Bintan, which borders the South China Sea, experiences more extreme wave and current conditions, particularly during the East Monsoon.

In terms of shipping traffic, the Singapore Strait is one of the world's busiest shipping lanes. All respondents with knowledge of the region stated that Riau Islands waters have very heavy traffic, but it is considered under control due to strict monitoring by Indonesia and Singapore.

b. Waters of Prov. Kalimantan Timur (Kaltim)

East Kalimantan waters have dual characteristics: open sea waters in the Makassar Strait with the potential for significant waves and currents in certain seasons, as well as river channels (Sungai Mahakam) which are relatively safe from waves but have strong tidal currents.

Shipping traffic in East Kalimantan is considered very dense and risky, particularly due to the dominance of coal barges traversing the Mahakam River toward the Mother Vessel in the Makassar Strait. Several respondents mentioned a high potential for accidents due to this traffic intensity.

c. Waters of Kalimantan Selatan (Kalsel)

South Kalimantan's waters are dominated by the Barito River, which connects the interior to Trisakti Port in Banjarmasin. Marine conditions are relatively less extreme than those in the Riau Islands and East Kalimantan, but shallowing due to high sedimentation poses a major challenge, complicating navigation for large vessels.

Shipping traffic is considered quite busy, but not as dense as in East Kalimantan and the Riau Islands. The narrow river channel, combined with upstream coal loading activities, creates operational risks that need to be mitigated through an adequate pilotage system.

E. Perceptions regarding the Establishment and Commercialization of Anchorage Areas

The survey showed a very high level of support from stakeholders for the government's establishment and commercialization of anchorage areas.

Table 4 Perceptions of Anchorages and PPP Schemes

Statement / Question	Yes / Agree	No / Disagree
Knowing the determination of the anchor anchor area (P15)	87,2% (34)	12,8% (5)
Agree that the government needs to make a determination (P16)	97,4% (38)	2,6% (1)
Agree to development with KPBU scheme (P18)	87,2% (34)	12,8% (5)
Risk mitigation improves safety (P22)	92,3% (36)	7,7% (3)

Regarding the authority of the organizer, 79.5% of respondents stated that the Ministry of Transportation was the most authorized party to manage the anchorage area, while 17.9% chose the Ministry of Maritime Affairs and Fisheries (KKP) and 2.6% chose others.

F. The Most Appropriate PPP Scheme

Of the 34 respondents who supported development with the PPP scheme, preferences for the type of scheme were divided almost evenly between Concession (41%) and Utilization Cooperation (41%), followed by BLU (10.3%) and Lease (5.1%).

Table 5 PPP Scheme Preferences for Commercialization of Anchorage Areas (P19)

Skema KPBU	Amount (n=39)	Percentage
Concession	16	41,0%
Utilization Cooperation	16	41,0%
Badan Layanan Umum (BLU)	4	10,3%
Rent	2	5,1%
Other	1	2,6%
Total	**39**	**100%**

The balanced preference between Concessions and Utilization Cooperation reflects differing views among stakeholders. Concessions grant full management rights to business entities in exchange for revenue concessions, while Utilization Cooperation allows the government to retain strategic control while involving the private sector in operations.

G. Responsibility for Accident Risks in the Anchorage Area

The question regarding who is responsible for accident risks in the anchorage zone yielded an interesting distribution of responses. 35.9% of respondents identified the ship operator/owner as the most responsible party, followed by the Government/Port Authority (30.8%), the Anchorage Area Operator (28.2%), and others (5.1%).

This relatively even distribution reflects the complexity of the division of responsibilities within the port ecosystem. The implication is that risk mitigation policies need to collectively involve all stakeholders, rather than being solely the responsibility of one party.

H. Urgency of Risk Assessment and Safety Value

Respondents' assessment of the urgency of accident risk assessment in selecting the location of the anchorage area showed very significant results.

Table 6 Urgency of Risk Assessment and Shipping Safety Value

Indicator	Mean (Skala 1–5)	Highest Distribution
The urgency of risk assessment in selecting anchorage locations (P21)	4,26	Skor 5: 69,2%
Safety value as a parameter for investment decisions (P23)	4,64	Skor 5: 76,9%
Assessment of Indonesia's current shipping safety level (P24)	3,92	Skor 3: 38,5%

The average score of 4.64 (scale 1-5) for safety parameters in investment decisions indicates that shipping business actors prioritize safety aspects. This is consistent with the finding that 92.3% of respondents believe that risk mitigation can improve safety levels.

Meanwhile, the survey/poll averaged 3.92 for Indonesia's maritime safety rating, with 38.5% of respondents giving it a moderate rating (a score of 3), indicating significant room for improvement. No respondents gave it a very low rating (a score of 1 or 2).

I. Efforts to Improve Shipping Safety

From the qualitative answers to the open questions, several main themes emerged relating to efforts to improve shipping safety, namely:

- Improvement and maintenance of SBNP.

That by adding SBNP at blank spot points, especially in the waters of the Riau Islands, East Kalimantan and South Kalimantan, it was mentioned most by respondents, it could increase the level of safety and security of shipping.

- Improving seafarer human resources.
  The competence of ship crew and navigation officers needs to be improved through continuous training to reduce human error that can cause shipping accidents.
- Coordination between stakeholders.
  Cooperation between port authorities, ship owners and anchorage area operators is considered crucial in improving shipping safety.
- Monitoring and supervision.
  The use of patrol boats and VTS (Vessel Traffic Service) needs to be intensified.
- Enforcement of regulations.
  Consistency in the application of safety rules without discrimination is the key to effectiveness.
- Socialization to service users.
  Service users' understanding of safety aspects needs to be continuously improved.

CONCLUSION

A. Conclusion

Based on the results of the survey and analysis of 39 expert respondents selected from each stakeholder in the research scope, several main conclusions were drawn:

- There was a strong consensus (71.8%) that the location of the waters significantly influences the risk of maritime accidents. All respondents (100%) acknowledged that marine environmental conditions and shipping traffic vary between regions, emphasizing the need for location-specific risk assessments.
- The combined extreme conditions of the marine environment (storms, high waves, strong currents) were perceived as the greatest threat by 84.6% of respondents, while the combined traffic conditions (heavy, narrow, no SBNP) were selected by 82.1% of respondents as the main operational risk.
- The three study areas have different risk profiles: Riau Islands is dominated by traffic density in the Singapore Strait; East Kalimantan by the intensity of coal barges on the Mahakam River; and South Kalimantan by the shallowing of the Barito River channel.
- Support for government determination (97.4%) of anchorage zone locations and commercial solutions for developing PPP schemes (87.2%) was very high, with the Ministry of Transportation seen as the most authoritative organizer (79.5%).
- The average value of 4.64 for safety as an investment parameter and 4.26 for the urgency of risk assessment confirms that Risk Assessment is an integral component of commercial planning for anchorage areas.

REFERENSI

IMO. (2018). Guidelines for Vessel Traffic Services. International Maritime Organization, London.

Kementerian Perhubungan RI. (2023). Statistik Perhubungan Laut. Direktorat Jenderal Perhubungan Laut, Jakarta.

Peraturan Presiden Nomor 38 Tahun 2015 tentang Kerja Sama Pemerintah dengan Badan Usaha dalam Penyediaan Infrastruktur.

Trbojevic, V. M., & Carr, B. J. (2000). Risk Based Methodology for Safety Improvements in Ports. Journal of Hazardous Materials, 71(1–3), 467–480.

Undang-Undang Nomor 66 Tahun 2024 tentang Perubahan Ketiga atas Undang-Undang Nomor 17 Tahun 2008 tentang Pelayaran

Undang-Undang Republik Indonesia Nomor 17 Tahun 2008 tentang Pelayaran.

Valtinsen, O.M. (1990). Sea Loads On Ships And Offshore Structures. Cambridge University Press.

Widagdo, P. S., et al. (2023). Karakteristik Kondisi Perairan dan Lalu Lintas Pelayaran di Kepulauan Riau, Kalimantan Timur, dan Kalimantan Selatan: Tinjauan dari Perspektif Pemangku Kepentingan. Jurnal Penelitian Transportasi Laut, 25(2), 88–104.

Yip, T. L. (2008). Port Traffic Risks — A Study of Accidents in Hong Kong Waters. Transportation Research Part E: Logistics and Transportation Review, 44(5), 921–931.