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Effectiveness Of Vessel Traffic Service Utilization By Commercial Vessels In Sorong Port

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ABSTRACT

This research aims to expolarate the utilisation of vessel traffic service (vts) in sorong waters by commercial vessels on the security and safety of shipping in sorong Port waters by knowing the effectiveness of the implementation of vts on its function and operation and knowing the suitability of services to applicable regulations. This research analyses the service procedures and reports of the implementation of VTS Sorong using qualitative descriptive methods, parsing data based on the results of observations, interviews and documentation. This research shows the data of commercial vessels using the vessel traffic service (VTS) in 2023, categorises the services into three services (incoming vessels, outgoing vessels and passing vessels), presents a graph and the percentage of services per month from the three service categories to the overall service. The results in this study explain that at the port of Sorong the use of ship traffic services has been effective, there are 9430 services at VTS Sorong in 2023, the most services are carried out in October with 924 services and the most used service category is by passing ships as much as 38%. There are several obstacles in the implementation of services at VTS Sorong, good coordination is needed between each related stakeholder in an effort to maintain shipping safety and security in these waters.

Keywords: *Vessel Traffic Service, Vts, Maritime, Ship Service*

Introduction

The growth of the global trade fleet over the past decades has increased rapidly, not only in the number of ships but also in tonnage, which affects maritime traffic, especially in nearby coastal areas, straits and inlets, thus causing traffic congestion and complexity. Ports are therefore a very important part of the maritime transport chain, and in turn, navigation in ports has become increasingly complex over the past decades due to the increase in maritime freight transport and vessel size leading to a greater flow of vessels in ports (Olba et al., 2019). Highlighting the importance of maritime safety, most maritime accident incidents are related to human error, so an understanding of human factors to mitigate this problem is very important. Human factors have been the object of study to improve the effectiveness and efficiency of maritime transport [1].

In this research, we focus on exploring the security and safety of shipping and the efficiency of ship operations in the water area around Sorong Port-Indonesia through the Vessel Traffic Services (VTS) function. In the VTS area, general reporting such as arrival, departure, and passage of vessels, as well as specific instructions on vessel traffic, are made by the VHF control channel. Therefore, it is possible to analyse VTSO communication patterns and vessel movements through the analysis of VTS area communications[2]. Using VTS as our intended system requires clarification on what VTS is. Firstly, 'VTS' is used to describe systems that provide services to assist mariners in the safe and efficient use of waterways through traffic regulation (passive means such as passage restrictions or predefined routes) or traffic control (active interaction with vessels) [3]. Secondly, 'VTS centres' refer to the actual locations where services are performed, and these centres are manned by VTS operators. Thirdly, 'VTS organisation' is the 'Competent Authority' which is the organisation responsible for the VTS [4]–[7].

The increasing complexity of global maritime traffic highlights the importance of advanced traffic management systems like VTS. While many ports worldwide have adopted similar systems to manage vessel congestion and improve safety, the specific challenges faced by Sorong Port make this research particularly relevant. Sorong serves as a strategic maritime hub in Indonesia, connecting domestic and international shipping routes. However, its rapid growth in vessel traffic has introduced unique challenges, including limited infrastructure, high vessel density, and coordination issues among stakeholders[8]–[11].

This research contributes to the global discourse on maritime safety by providing insights into the application of VTS in a developing port context. By addressing the operational challenges and examining the effectiveness of VTS in ensuring safe and efficient navigation, the study highlights the critical role of stakeholder collaboration. Furthermore, the findings underscore the broader implications of integrating human factors and advanced technology to adapt to evolving trends in maritime traffic management. This approach not only supports safer navigation but also ensures the sustainability and resilience of ports like Sorong in a competitive global maritime network

Literature Review

Vessel Traffic Service

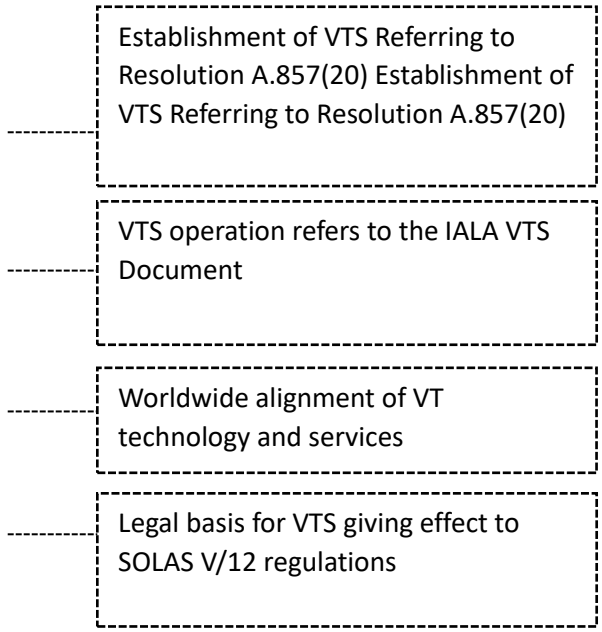
Vessel Traffic Services is one of the ways to fulfil the government's responsibility for the safety of navigation and the regulation of maritime traffic in maritime waters as stated in the United Nations Convention on the Law of the Sea [12]–[15]. VTS can simply be thought of as a system that collects environmental and traffic data to create a traffic picture that is continuously analysed by operators who assess whether there are emerging or existing risks that require interaction with traffic. If the VTS operator is aware of a vessel, the VTS can intervene by sending information, warnings, or instructions to all vessels or individual vessels using VHF voice communications [16]–[18].

The IMO is responsible for adopting international shipping regulations and standards, while individual countries have jurisdiction over their territorial waters and appoint Competent Authorities responsible for implementing VTS. International Non-Governmental Organisations (NGOs) are substantial contributors to the IMO and the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) is the NGO closest to the development of VTS [19]–[21].

VTS are services implemented by the Government that have the ability to interact with vessel traffic and respond to situations that develop within the VTS working area to improve the safety and efficiency of navigation, contribute to the safety of life at sea and the protection of the maritime environment [22], [23]. Each VTS centre is responsible for the day-to-day activities and is also responsible for adapting the centrally developed procedures to the elol procedures applicable to their area [24], [25].

In general, the benefits of VTS are divided into direct and indirect benefits or value-added and loss-reduction benefits. Many experts believe that VTS can provide water safety, efficiency and environmental protection benefits and have proposed quantitative methods to calculate these three aspects of benefits. However, these methods generally have the following problems: (1) It is difficult to collect data for the parameters in previous evaluation models and/or the parameters are illogically designed; (2) The models do not consider the following factors, e.g., reducing the frequency of coastal vessel patrols and saving human and material resources; (3) It is difficult to clearly distinguish the benefits from VTS and non-VTS. [26]

It provides an overview of the international regulatory and legal framework for establishing VTS. The main components of the international framework are as follows:



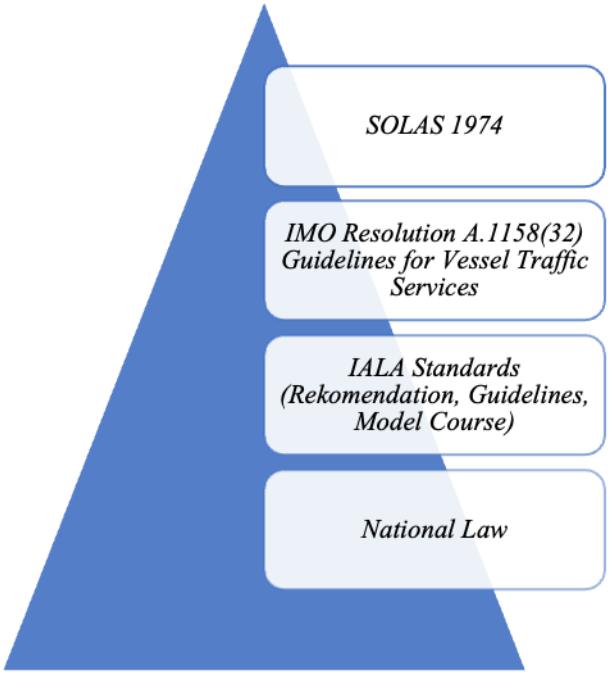


Figure 1. Establishing VTS

VTS Operator

VTS Operator means a person who performs duties associated with vessel traffic services, is trained in vessel traffic service operations and is qualified (IMO (International Maritime Organisation), 2022). VTS personnel are individuals who are appropriately trained and qualified in VTS operations according to the relevant modelled courses associated with their function. They actively contribute to the safe and efficient movement of vessel traffic together with the bridge team and associated services [27].

The VTSO) is essential to keep the VTS system operational in the face of various disturbances or irregularities suffered by the operators themselves: fatigue, workload, teamwork, communication, resilience, and so on, stemming from the daily operations between the shore system and the ship system [28].

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VTS operators work in shifts and have irregular working hours. VTS operators work in 24-hour shifts, which causes fatigue. In addition, the number of vessels in the VTS area varies daily. Therefore, VTS operators must adapt quickly to new situations every day. In addition, they have to maintain intense concentration and deal with critical situations and emergencies. As a result, VTS operators will undoubtedly experience fatigue. Moreover, it is well known that fatigue on the part of VTS operators can pose a catastrophic risk to human life and damage the environment and property [30]. Staffing levels that are only able to handle the expected workload will undoubtedly be overloaded when unexpected events, emergencies, or incidents occur (Yoo & Kim, 2021).

To carry out its tasks, the VTSO must rely on three main principles (IALA, 2022):

a. Traffic Overview and Maintaining the Traffic Image.
b. Interacting with traffic.
c. Responding to ongoing traffic situations.

Research Methods

This research employs a qualitative approach to explore the effectiveness of Vessel Traffic Service (VTS) utilization in Sorong waters, focusing on operational processes, stakeholder perceptions, and service outcomes. Data collection is conducted through three primary methods: direct observation, in-depth interviews, and document analysis. Direct observations at the VTS station involve monitoring operators' work processes, interactions with service users, and the overall operational environment. These observations are conducted over multiple sessions to capture variations in activity levels and operational dynamics under different conditions.

In-depth interviews are conducted with VTS operators to gather insights into their experiences, perceptions of service effectiveness, and the challenges they face. Similarly, captains of commercial vessels operating in Sorong waters are interviewed to explore their perspectives on the benefits and limitations of VTS services. Document analysis focuses on VTS activity reports, traffic statistics, and incident records to identify patterns, trends, and operational constraints. This multi-faceted methodology is justified as it allows for a comprehensive understanding of VTS operations, incorporating both qualitative and quantitative data to address the research objectives effectively.

Ethical considerations are a cornerstone of this study, particularly in interactions with human subjects and the handling of sensitive operational data. All participants, including VTS operators and vessel captains, are provided with detailed information about the study's purpose, methods, and their role in the research. Written informed consent is obtained, ensuring that participation is voluntary and that participants understand their rights, including the option to withdraw at any stage.

The study also ensures strict confidentiality by anonymizing participant identities and securely storing sensitive data. Permissions are sought from relevant authorities for access to the VTS station and internal documents, ensuring that the research complies with institutional and legal guidelines. Observational activities are conducted in a non-intrusive manner to avoid disrupting daily operations. By adhering to these ethical standards, the research upholds the integrity of its findings while fostering trust and transparency among all stakeholders involved.

Results and Discussion

Based on the results of observations and interviews at VTS Sorong, it can be explained that VTS Sorong in providing ship traffic services uses the two-way principle, which explains that the service process is not only one-way or only contacted by ships in the Sorong area but also contacts or provides broadcasts to ships in its coverage area, which require information and assistance for ship traffic services. VTS Sorong coordinates with related agencies/institutions in the process of service delivery such as BMKG Sorong, Navigation District, KSOP Sorong, BASARNAS and so on. This is in accordance with the function and operation of VTS.

There are 18 VTS Operators / Watchkeepers at VTS Sorong consisting of 12 civil servants and 6 non civil servants (PPNPN). VTSOs are required to fill out a VTS implementation report consisting of 8 forms consisting of Form A1 (VTS Log), Form A2 (Daily Vessel Traffic), Form A3 (Watchkeeping Hand Over), Form A4 (Pre Departure Report), Form A5 (Pre-Arrival Report), Form A6 (Ship Report / Incident or Accident), Form A7 (Special Operation) and Form A8 (Contravention report), this is in accordance with the Minister of Transportation regulation number PM 4 of 2023 concerning the implementation of telecommunications-voyage and ship traffic management services in Indonesian waters.

Based on the results of the VTS Log and Daily Vessel Traffic, the Vessel Data that uses the Sorong VTS service is as follows:

Table 1. Number of vessel traffic service

No.	Month	Incoming Vessels	Outgoing Vessels	Passing Vessels	Total
1	January	281	286	331	898
2	February	269	325	287	881
3	March	263	250	280	793
4	April	285	326	276	887
5	May	185	175	245	605
6	June	170	207	238	615
7	July	160	140	229	529
8	August	196	234	268	698
9	September	187	173	289	649
10	October	327	319	278	924
11	November	302	237	253	792
12	December	264	284	314	862
Total		2889	2956	3585	9430

The number of vessel traffic services by commercial vessels in sorong waters is divided into 3 categories, namely incoming vessels, outgoing vessels and vessels passing through sorong harbour. The graph of VTS services by ships in sorong waters is as follows:

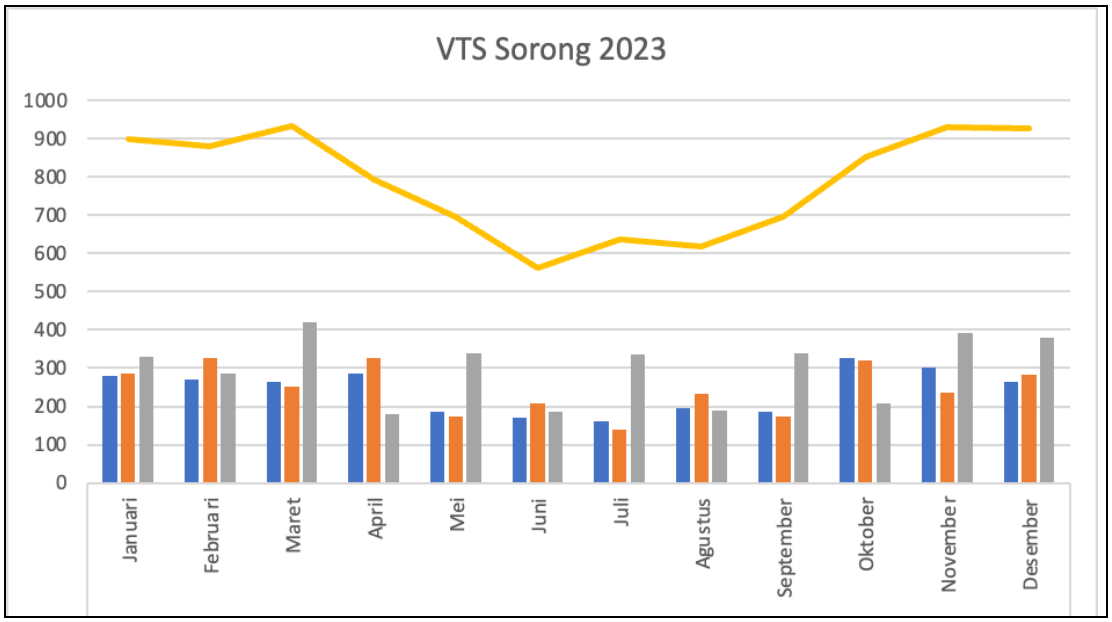

Figure 2. monthly vessel service traffic chart

VTS Sorong has an up and down graph from January to December in 2023, the increase or decrease occurs erratically every month. when calculated based on the total number of VTS services or calculated per category, the overall VTS service is the most in October with 924 services and the least in July with 529 services.

Vessel traffic service in the sorong water area for the category of ships entering the port of sorong most in October with a total of 327 services with a percentage of 38.3% of the overall service in that month, while the category of ships leaving the least in July with a total of 160 services with a percentage of 25.2% of the overall service in that month. The category of ships leaving the port of sorong is the most in April with a total of 326 services with a percentage of 41.2% of the total services in that month, while the category of ships leaving the port of sorong is the least in July with a total of 140 services with a percentage of 22.0% of the total services in that month. The category of ships passing through the waters of Sorong is the most in March with a total of 421 services with a percentage of 45.1% of the total services in that month, while the category of ships passing through the waters of Sorong is the least in April with a total of 181 services with a percentage of 22.9% of the total services in that month.

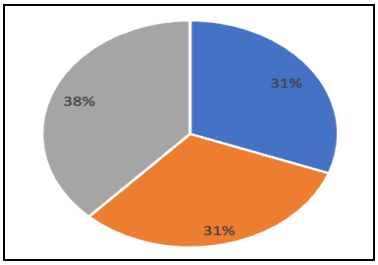

Figure 3. Services at VTS Sorong

The total number of services at VTS Sorong is 9430 services consisting of 2,889 incoming ship services, 2,956 outgoing ship services, 3,585 ships passing through the Port of Sorong.

Based on the data of the Sorong VTS organizing report in 2023, it is explained that the utilization of VTS Sorong in the waters of Sorong Port is most utilized by ships passing through Sorong waters with a percentage of 38%, while ships entering and leaving Sorong that use VTS Sorong services have the same percentage of 31%.

In carrying out its functions and duties VTS Sorong has implemented service procedures in accordance with applicable rules and regulations. The effectiveness of the use of VTS services by ships in the coverage area has been effectively proven by the various services provided such as information services, monitoring services and regulation of ship traffic and distress or emergency situation services. This is evidenced by documents form A1 to A8 in the VTS implementation report. This is also in accordance with the number and percentage of categories of incoming and outgoing ship services, passing as described above. In supporting the safety and security of shipping in the waters of Sorong, the obstacles faced in the implementation of the Sorong VTS

service are that there are still ships that are anchored not in the designated anchorage area, besides that there are still ships that turn off AIS and other violations. This has been recorded in the vessel traffic service report.

In carrying out its functions and duties, VTS Sorong must be supported by adequate equipment and human resources by rejuvenating equipment and providing technical training related to or supporting ship traffic services and other supporting training. In supporting the security and safety of shipping in its coverage area VTS Sorong must always contribute and maintain coordination with relevant stakeholders.

Conclusion

Based on observations and interviews, VTS Sorong has effectively implemented its functions and duties in ship traffic services by adhering to the two-way communication principle and coordinating with relevant agencies such as BMKG, KSOP, and BASARNAS. In 2023, the total number of VTS services reached 9,430, dominated by ships passing through Sorong waters (38%), with incoming and outgoing vessels each accounting for 31%. Despite monthly fluctuations, October recorded the highest service volume, while July had the lowest. Challenges such as non-compliance with designated anchorage areas and the deactivation of AIS were noted, emphasizing the need for enhanced equipment, human resources, and continuous collaboration with stakeholders to ensure safety and security in Sorong's maritime operations.

References

[1] Syafira Dyah Anggaraini and Lunariana Lubis, “Efektivitas Program Inaportnet dalam Pelayanan Penerbitan Surat Pemberitahuan Kedatangan Kapal di Kantor Otoritas Pelabuhan Utama Tanjung Perak Kota Surabaya,” *Apl. Adm. Media Anal. Masal. Adm.*, vol. 25, no. 1, pp. 25–30, 2022, doi: 10.30649/aamama.v25i1.138.

[2] R. Amri, D. Aromatica, and R. E. Putera, “Efektivitas Pelaksanaan Program Peningkatan Keselamatan Lalu Lintas Oleh Dinas Perhubungan Kota Padang,” *J. Adm. Publik dan Pembang.*, vol. 2, no. 1, p. 43, 2021, doi: 10.20527/jpp.v2i1.2769.

[3] A. Kurniawijaya, “Efektivitas Undang-Undang Nomor 22 Tahun 2009 Tentang Lalu Lintas dan Angkutan Jalan terhadap Pelanggaran Hak Pejalan Kaki di Kota Surakarta dalam Perspektif Sosiologi Hukum,” *J. Law, Soc. Islam. Civiliz.*, vol. 8, no. 2, p. 63, 2021, doi: 10.20961/jolsic.v8i2.49692.

[4] Aris Sarjito, “Peran Teknologi Dalam Pembangunan Kemaritiman Indonesia,” *J. Lemhannas RI*, vol. 11, no. 4, pp. 219–236, 2023, doi: 10.55960/jlri.v11i4.483.

[5] F. C. Moreno, J. R. Gonzalez, J. S. Muro, and J. A. G. Maza, “Relationship between human factors and a safe performance of vessel traffic service operators: A systematic qualitative-based review in maritime safety,” *Saf. Sci.*, vol. 155, p. 105892, 2022.

[6] S.-J. Chang, “Development and analysis of AIS applications as an efficient tool for vessel traffic service,” in *Oceans’ 04 MTS/IEEE Techno-Ocean’04 (IEEE Cat. No. 04CH37600)*, 2004, vol. 4, pp. 2249–2253.

[7] G. Praetorius, E. Hollnagel, and J. Dahlman, “Modelling Vessel Traffic Service to understand resilience in everyday operations,” *Reliab. Eng. Syst. Saf.*, vol. 141, pp. 10–21, 2015.

[8] G. Praetorius, “Vessel traffic service (VTS): A maritime information service or traffic control system?: Understanding everyday performance and resilience in a socio-technical system under change.” Chalmers tekniska högskola, 2014.

[9] S.-L. Kao, K.-T. Lee, K.-Y. Chang, and M.-D. Ko, “A fuzzy logic method for collision avoidance in vessel traffic service,” *J. Navig.*, vol. 60, no. 1, pp. 17–31, 2007.

[10] S.-L. Yoo and K.-I. Kim, “Optimal staffing for vessel traffic service operators: a case study of Yeosu VTS,” *Sensors*, vol. 21, no. 23, p. 8004, 2021.

[11] B. Siswoyo, “Evaluasi Pemanfaatan Vessel Traffic Service (VTS) Di Pelabuhan Utama Belawan,” *J. Penelit. Transp. Laut*, vol. 17, no. 4, pp. 143–154, 2020, doi: 10.25104/transla.v17i4.1401.

[12] H. Amir, S. Sudirman, and T. D. Saputra, “Evaluation of the Effectiveness of Ship Guiding Services at Tanjung Perak Port Surabaya,” *J. Apl. Pelayaran Dan Kepelabuhanan*, vol. 15, no. 1, pp. 45–54, 2024, doi: 10.30649/japk.v15i1.122.

[13] Z. Xiao *et al.*, “Next-generation vessel traffic services systems—From ‘passive’ to ‘proactive,’” *IEEE Intell. Transp. Syst. Mag.*, vol. 15, no. 1, pp. 363–377, 2022.

[14] W. Young, “What are vessel traffic services, and what can they really do?,” *Navigation*, vol. 41, no. 1, pp. 31–56, 1994.

[15] E. Wiersma and N. Mastenbroek, “Measurement of vessel traffic service operator performance,” *Ai Soc.*,

vol. 12, pp. 78–86, 1998.

[16] C. Nabila, P. W. Tresna, and R. Sukmadewi, "Penerapan Vessel Traffic Service Dalam Implementation of Vessel Traffic Service in Improving Security of Ship Trafficking in the," vol. 01, no. 01, pp. 38–63, 2023.

[17] L. Lee and J. Kim, "Development of priority index for intelligent vessel traffic monitoring system in vessel traffic service areas," *Appl. Sci.*, vol. 12, no. 8, p. 3807, 2022.

[18] T. Hughes, "Vessel traffic services (vts): Are we ready for the new millenium?," *J. Navig.*, vol. 51, no. 3, pp. 404–420, 1998.

[19] B. A. Syafaat, E. Sukmawati, I. Muh. Akib, A. Mayseptyana, and E. Sugiawiharja, "Efektivitas Penerapan Vessel Traffic Services (VTS) di Selat Sunda terhadap Keselamatan Pelayaran," *J. Manaj. Bisnis Transp. dan Logistik*, vol. 6, no. 3, pp. 257–264, 2021, doi: 10.54324/j.mbtl.v6i3.584.

[20] T. Stach, Y. Kinkel, M. Constapel, and H.-C. Burmeister, "Maritime anomaly detection for vessel traffic services: a survey," *J. Mar. Sci. Eng.*, vol. 11, no. 6, p. 1174, 2023.

[21] J. T. Mansson, M. Lutzhoft, and B. Brooks, "Joint activity in the maritime traffic system: perceptions of ship masters, maritime pilots, tug masters, and vessel traffic service operators," *J. Navig.*, vol. 70, no. 3, pp. 547–560, 2017.

[22] M. Nurhidayat, A. S. Chairunnisa, and W. Djafar, "Kinerja Pelayanan Kapal Pelabuhan Pare-pare," *J. Ris. Teknol. Perkapalan*, vol. 1, no. 1, pp. 1–7, 2023.

[23] F. Zhang, Y. Liu, L. Du, F. Goerlandt, Z. Sui, and Y. Wen, "A rule-based maritime traffic situation complex network approach for enhancing situation awareness of vessel traffic service operators," *Ocean Eng.*, vol. 284, p. 115203, 2023.

[24] A. Dwi Wahyu Wiranata, S. Sudirman, and B. Agus Setiono, "Analisis Berthing Time terhadap Kinerja Pelayanan Bongkar Muat Curah Kering," *J. Apl. Pelayaran Dan Kepelabuhanan*, vol. 12, no. 1, pp. 14–26, 2021, doi: 10.30649/japk.v12i1.75.

[25] F. X. Martínez de Osés and À. Uyà Juncadella, "Global maritime surveillance and oceanic vessel traffic services: towards the e-navigation," *WMU J. Marit. Aff.*, vol. 20, pp. 3–16, 2021.

[26] J.-M. Mou, C. Zhou, Y. Du, and W.-M. Tang, "Evaluate VTS benefits: A case study of Zhoushan Port," *Int. J. e-Navigation Marit. Econ.*, vol. 3, pp. 22–31, 2015.

[27] Y. Tira *et al.*, "Tata Kelola Pelayanan Kapal Ro-Ro Dumai-Tanjung Kapal Provinsi Riau," vol. 2, no. 2, pp. 880–893, 2024.

[28] P. Moreno *et al.*, "Expression Atlas update: gene and protein expression in multiple species," *Nucleic Acids Res.*, vol. 50, no. D1, pp. D129–D140, 2022.

[29] J. Letunaung, J. A. Timboeleng, and L. I. R. Lefrandt, "Analisis Tingkat Pelayanan Transportasi Laut Dengan Pengguna Jasa Pada Pelabuhan Manado (Studi Kasus: Manado-Tahuna)," *J. Ilm. Media Eng.*, vol. 11, no. 1, pp. 2087–9334, 2021.

[30] X. Bellsolà Olba, W. Daamen, T. Vellinga, and S. P. Hoogendoorn, "Risk assessment methodology for vessel traffic in ports by defining the nautical port risk index," *J. Mar. Sci. Eng.*, vol. 8, no. 1, p. 10, 2019.