

ANALYSIS OF THE ROLE OF RISK ASSESSMENT, COMPLIANCE WITH THE ISM CODE, ISPS CODE ON RISK AND SAFETY OF SHIPPING

Mhd. Taris Hasibuan^{1*}, Edi Abdurachman², Sandriana Marina³, Sudjanadi Tjipto⁴

¹⁻⁴ Doctoral Program, Institute of Transportation and Logistics Trisakti, Indonesia

*Email corresponding author: tarisnkri7@gmail.com

Abstract

This study analyzes the influence of risk assessment and compliance with the ISM and ISPS Codes on maritime risk and safety. Motivated by the persistent occurrence of maritime accidents and security incidents despite the adoption of international safety regulations, the study applies a quantitative approach using a survey design targeting shipping companies across western, central, and eastern Indonesia. Hypotheses are developed based on the theoretical framework of maritime safety management and IMO regulatory standards. The study aims to contribute to the development of a digital transformation system based on electronic audits to support sustainable maritime safety and security. By integrating risk assessment, regulatory compliance, and the mediating role of safety risk, this study provides empirical evidence on how procedural and behavioral factors jointly influence maritime safety outcomes. The research employs Partial Least Squares Structural Equation Modeling (PLS-SEM) to test the direct and indirect effects of each construct. The findings are expected to support the implementation of data-driven maritime safety strategies, promote proactive risk mitigation, and enhance organizational accountability through digital monitoring systems. Ultimately, the study offers insights into bridging the gap between international safety frameworks and local operational practices in Indonesia's maritime sector.

Keywords: Risk Assessment; ISM Code; ISPS Code; Safety Risk; Maritime Safety

INTRODUCTION

As maritime operations grow increasingly complex, the need for safety management systems that are not only compliant with international standards but also adaptive to local operational realities becomes more urgent. In the Indonesian context, implementation of the ISM and ISPS Codes remains largely administrative and has yet to reflect the practical challenges encountered in the field. One of the main concerns is the limited utilization of digital technologies in safety audits and reporting mechanisms, resulting in weak early detection of operational risks (Rajaram et al., 2022; Uflaz et al., 2022).

The integration of digital tools such as electronic audits, real-time monitoring systems, and data-driven reporting platforms holds significant potential for improving transparency, accountability, and responsiveness in maritime safety management. However, the adoption of such technologies remains limited among domestic shipping operators. Prior research has highlighted that digital transformation in risk management significantly enhances the effectiveness of safety protocols (Fireteanu, 2019; Zou et al., 2017).

As a member of the International Maritime Organization (IMO), Indonesia is obligated not only to adopt international maritime regulations but also to ensure their effective implementation. Discrepancies between international standards and national policies often result in inconsistent compliance across regions and operators (Batalden & Sydnes, 2014). Furthermore, the lack of

continuous training and weak organizational safety culture exacerbate the issue (Chuasanga & Victoria, 2021; Taequi & Basuki, 2020).

Recent studies also emphasize the importance of psychosocial factors, leadership style, and organizational communication in strengthening the implementation of maritime safety standards (Hadziahmetovic & Salihovic, 2022; Lu et al., 2023). Without competent and risk-aware human resources, the implementation of technical standards such as the ISM and ISPS Codes is unlikely to yield significant safety improvements.

Therefore, this study aims to evaluate the relationship between risk assessment, compliance with the ISM and ISPS Codes, and their impact on safety risks and overall maritime safety. By offering empirical insights, this research seeks not only to assess the effectiveness of these regulatory frameworks but also to propose a digital transformation approach through an electronic audit system to enhance sustainable and integrated maritime safety governance.

LITERATURE REVIEW AND HYPOTHESIS FORMULATION

Risk assessment is a systematic process of identifying, analyzing, and evaluating risks that may cause accidents or losses in maritime operations. Fireteanu (2019) and ISO (2009) emphasize that this process is essential in modern safety management systems. The ISM Code regulates ship operational safety management to prevent accidents and marine pollution (Uflaz et al., 2022), while the ISPS Code aims to protect ships and port facilities from security threats such as terrorism and sabotage. Taequi & Basuki (2020) stated that ISPS Code effectiveness largely depends on the quality of implementation and monitoring.

According to a study by Lu et al. (2023), it was revealed that high work stress can reduce workers' psychosocial safety behavior. However, an individual's psychological resilience can mediate such negative impacts, increasing compliance with safety and participation in a safe work environment. These findings highlight the importance of psychological factors in occupational safety management. Authentic leadership and transparent communication significantly increase employee engagement. Open leadership and clear communication create a supportive work environment, which in turn improves performance and safety (Hadziahmetovic & Salihovic, 2022).

Additionally, risk assessment and maritime safety are closely linked through the broader lens of organizational behavior and safety culture. Studies in maritime psychology have noted that crew attitudes, leadership styles, and organizational communication channels significantly affect the perception and mitigation of safety risks. Therefore, any technical standard such as ISM or ISPS is only as effective as the safety culture cultivated within maritime organizations (Batalden & Sydnes, 2014).

Batalden & Sydnes (2014) found that implementing safety standards significantly reduces maritime accidents. Similarly, Zhang et al. (2016) argue that strong operational standards enhance control over operational risks. However, the effectiveness depends on internal compliance, human resource readiness, and audit integrity. Emerging research also points to the critical role of continuous training, the use of simulation technology, and proactive engagement in safety drills as mediating factors in achieving effective implementation.

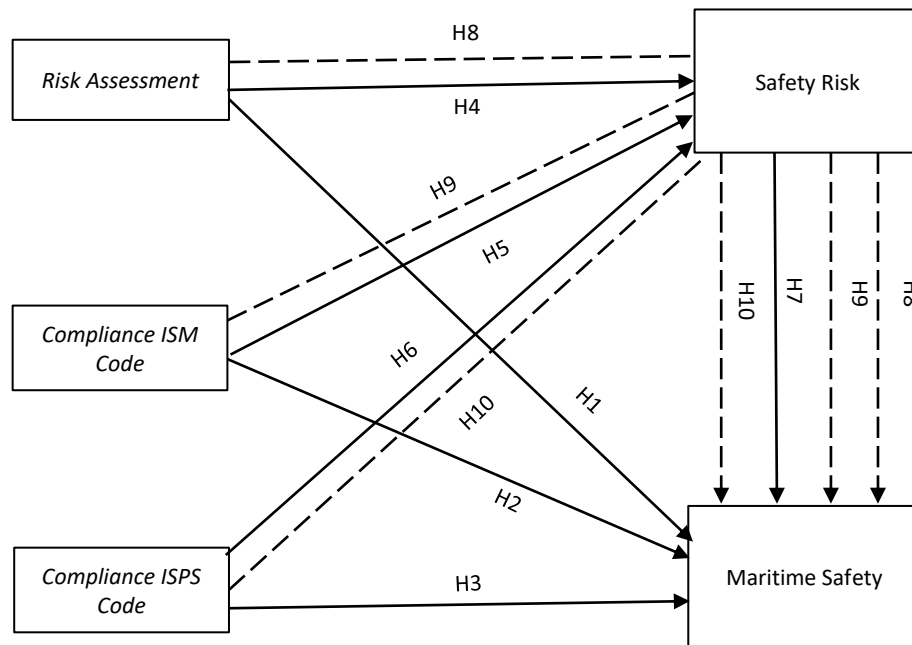


Figure 1. Conceptual Framework

The hypotheses proposed in this study are:

- H1: Risk assessment significantly influences maritime safety.**
- H2: ISM Code compliance significantly influences maritime safety.**
- H3: ISPS Code compliance significantly influences maritime safety.**
- H4: Risk assessment significantly influences safety risk.**
- H5: ISM Code compliance significantly influences safety risk.**
- H6: ISPS Code compliance significantly influences safety risk.**
- H7: Safety risk significantly influences maritime safety.**
- H8: Risk assessment, mediated by safety risk, significantly influences maritime safety.**
- H9: ISM Code compliance, mediated by safety risk, significantly influences maritime safety.**
- H10: ISPS Code compliance, mediated by safety risk, significantly influences maritime safety.**

RESEARCH METHODS

This study uses a quantitative approach with an explanatory survey design. The population includes shipping companies in five regions: Aceh, Batam, Tanjung Priok, Kendari, and Ambon. The sampling technique is purposive sampling. Data is collected through a Likert-scale questionnaire and analyzed using the SEM-PLS method to examine relationships among variables.

The research instrument was developed from literature and international standards such as ISO 31000, IMO ISM Code, and ISPS Code. Instrument validity and reliability were tested before conducting the survey.

Furthermore, to enhance accuracy and reliability, the study will integrate triangulation through expert validation of indicators. Pre-testing the questionnaire will also ensure clarity and remove potential ambiguity before full deployment. Survey data will be supported by descriptive statistics and cross-regional comparisons to identify any geographical variance in safety compliance.

Table 1. Research Variables and Indicators

Variable/Definition	Indicators
Penilaian Risiko (Risk Assessment) : The process of identifying hazards and analyzing possible risks, then deciding on appropriate measures to eliminate those hazards. Fithri et al. (2020)	a. Risk Elimination Identification and Analysis b. Risk Substitution Identification and Analysis c. Risk Engineering Identification and Analysis

Variable/Definition	Indicators
	d. Risk Administration Control Identification and Analysis e. Identification and Analysis of Risk Personal Protection Equipment (Fithri et al., 2020)
Compliance to ISM Code : Compliance with the ISM Code standards on the safety of ship operations which is responsible by the captain in the safety and prevention of marine pollution, aims to ensure maritime safety, prevent accidents and fatalities, and prevent damage to the environment and ships Chuasanga & Victoria (2021)	a. Compliance with Vessel Operating Safety standards b. Compliance with Marine Pollution Prevention standards c. Compliance with Maritime Safety standards d. Compliance with Accident Prevention standards e. Compliance with Fatality Prevention standards f. Compliance with Environmental Damage standards g. Compliance with Vessel Breakdown standards (Chuasanga & Victoria, 2021)
Compliance to ISPS Code : Compliance with the ISPS code regarding regulating port area security, and there must be an appointment of a Port Area Security Officer. The officer will be responsible for facilitating the development, implementation, review, and maintenance of the Port Area Security Plan and will be responsible for coordinating with the Port Facility Security Officer in facilitating administration and improving communication (Razali & Ghani, 2017).	a. Compliance with Ship Safety Plan standards b. Compliance with Port Facility Security Plan standards c. Compliance with Ship Safety Officer standards d. Compliance with the standards of the Corporate Security Officer e. Compliance with Port Facility Security Officer standards (Razali & Ghani, 2017)
Safety Risk : potensi ancaman atau bahaya yang dapat memengaruhi operasional kapal, melibatkan aspek keselamatan fisik serta keamanan dari tindakan ilegal atau berbahaya (Chowdhury et al., 2024; Taequi & Basuki, 2020; X. Zhang et al., 2019).	a. Ship Condition b. Human Factors c. Navigation Systems and Technology d. Cargo and Cargo e. Operational Factors f. Regulatory Compliance (X. Zhang et al., 2019)
Maritime Safety : a set of measures, policies, and procedures designed to protect ships, crews, passengers, and cargo from a wide range of threats and hazards, both from internal and external factors. This concept involves the prevention of risks related to the operational safety of ships as well as protection from security threats, such as piracy, terrorism, theft, and other illegal acts (Taequi & Basuki, 2020; Torres et al., 2020).	a. Transport Safety b. Occupational Health and Safety c. Environmental safety d. Maintenance safety e. Physical Security f. Cyber-security (Torres et al., 2020)

Basically, this section explains how the research was conducted. The important points of this section are: (1) research design; (2) population and sample (research target); (3) data collection and

instrument development techniques; (4) and data analysis techniques. For research that uses tools and materials, it is important to write down the specifications of the tools and materials. The tool specification describes the sophistication of the tool used while the material specification describes the type of material used. For qualitative research such as classroom action research, ethnography, phenomenology, case studies, etc., it is necessary to add the presence of researchers, research subjects, informants who help collect research data, the location and duration of the research and a description of the validity check of the research results.

(Calibri Light 11, spasi 1, spacing before 0 pt, after 0 pt)

RESULTS AND DISCUSSION

As this research is still in the data collection phase, this section presents the expected findings based on theory and prior studies. The analysis is expected to reveal:

1. A systematic risk assessment improves operational awareness and reduces accident rates (Zou et al., 2017).
2. ISM Code compliance contributes positively to ship operational safety standards (Karakasnaki et al., 2018).
3. Radonja & Glujić (2020) found that ISPS Code compliance enhances the mitigation of ship and port security threats.
4. Safety risk is likely to serve as a crucial mediating variable bridging the effects of risk assessment and compliance on maritime safety outcomes.

These anticipated findings align with existing literature and are expected to reinforce the notion that regulatory compliance alone is not sufficient unless embedded within a framework of performance monitoring and behavioral accountability. It is also expected that companies with established internal auditing mechanisms and dedicated safety officers will report significantly lower incident frequencies.

The discussion will also evaluate the role of technology adoption, such as integrated maritime safety dashboards, digital audit trails, and mobile-based alert systems, in enhancing risk visibility and response efficiency. The transition toward a digital audit framework will be assessed in terms of scalability, user adoption, cost-efficiency, and potential policy support needed from government regulators. To visually represent the theoretical structure of this study, Figure 2 presents a conceptual model for Partial Least Squares Structural Equation Modeling (PLS-SEM). The model includes three exogenous constructs Risk Assessment, Compliance with the ISM Code, and Compliance with the ISPS Code which influence Maritime Safety both directly and indirectly through the mediating variable Safety Risk. Arrows indicate hypothesized causal paths, labeled H1 through H10, which reflect both direct and mediating effects. This model forms the basis for the empirical testing in this research.

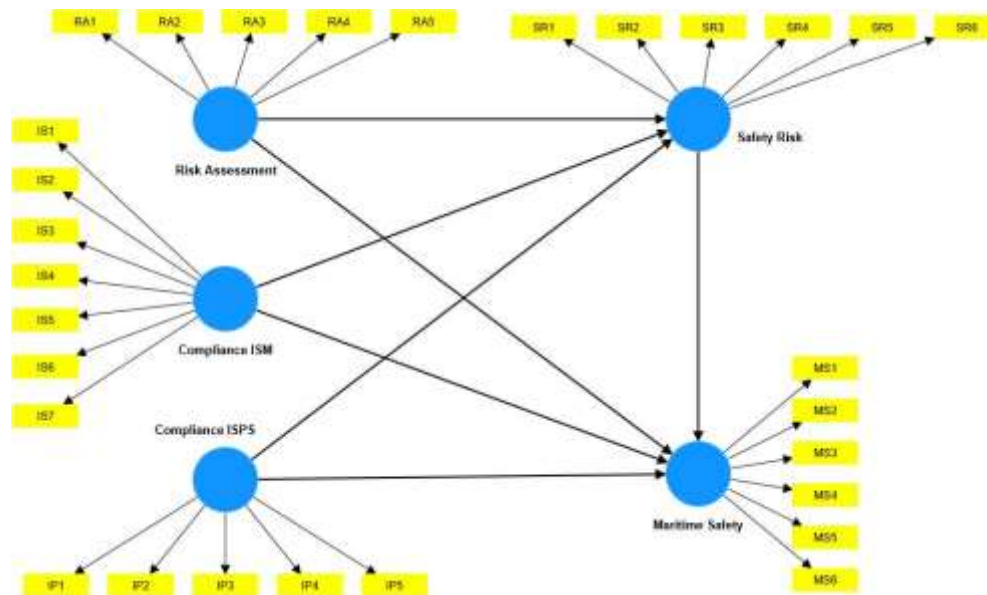


Figure 2. Conceptual Model for PLS-SEM

The results of this study are expected to validate the hypothesized relationships depicted in the conceptual model. Based on theoretical and empirical precedent, it is anticipated that risk assessment and compliance with the ISM and ISPS Codes will have both direct and indirect effects on maritime safety. The mediating role of safety risk is projected to be significant, reflecting the mechanism through which operational risk management influences broader safety outcomes.

This finding aligns with previous research which emphasized that technical compliance alone is insufficient without a robust risk culture and active monitoring systems (Zhang et al., 2016). Safety risk acts as a critical filter in translating procedural compliance into tangible safety performance indicators. For example, a high level of ISPS Code compliance may not translate to reduced incident rates if safety risks such as human error or technological failure—are not effectively managed.

Moreover, the model supports the notion that a well-structured risk assessment system enhances proactive hazard identification and response strategies. In organizations with strong audit mechanisms and well-trained personnel, the flow of influence from compliance to safety outcomes is expected to be more efficient and impactful.

These anticipated findings contribute to answering the central research question: How do compliance and risk assessment practices influence maritime safety performance? The results suggest that improvements in maritime safety can be achieved not only through adherence to international standards but also through integrated risk management systems supported by digital monitoring tools. This reflects a growing consensus in the literature that future maritime safety governance must move beyond documentation toward data-driven, real-time assurance.

Furthermore, the discussion of results introduces implications for theory and practice. Theoretically, the study may reinforce or refine existing frameworks of safety management by highlighting the mediating role of safety risk. Practically, the findings advocate for the development of digital audit platforms that enhance transparency, responsiveness, and accountability in maritime safety practices.

CONCLUSION

This study is expected to contribute to strengthening national maritime safety and security management through an evaluative approach to the implementation of the ISM and ISPS Codes and risk assessment. The novelty lies in proposing a digital transformation in audit and reporting processes to enhance regulatory effectiveness. The study also provides a foundation for developing data-based management systems integrated with digital technologies such as blockchain and AI in the maritime transport context.

In future studies, empirical data from maritime companies will allow further refinement of the digital framework and verification of mediation effects proposed in the conceptual model. This research can be extended into comparative analyses between domestic and international compliance practices to identify best practices in safety governance.

BIBLIOGRAPHY

- Batalden, B. M., & Sydnese, A. K. (2014). Maritime safety and the ISM code: A study of investigated casualties and incidents. *WMU Journal of Maritime Affairs*, 13(1). <https://doi.org/10.1007/s13437-013-0051-8>
- Chowdhury, M. N., Shafi, S., Mohd Arzaman, A. F., Teoh, B. A., Kadhim, K. A., Salamun, H., Abdul Kadir, F. K., Said, S., Kadir, K. A., Embong, A. M., Abdul Aziz, N. A., Jusoh, M. H., Phuoc Pham, L. H. H., & Si Xuan, A. N. (2024). Navigating Human Factors in Maritime Safety: A Review of Risks and Improvements in Engine Rooms of Ocean-Going Vessels. *International Journal of Safety and Security Engineering*, 14(1), 1–14. <https://doi.org/10.18280/ijssse.140101>
- Chuasanga, A., & Victoria, O. A. (2021). ISM-Code as a Legal Protection of Use Ships Are Not Confort With Marine Standard in Indonesia. *Jurnal Pembaharuan Hukum*, 8(1), 95-104.
- Fireteanu, V. V. (2019). Risk assesment parameters for internet of things projects. *2019 15th International Conference on Engineering of Modern Electric Systems, EMES 2019*, 41–44. <https://doi.org/10.1109/EMES.2019.8795180>
- Fithri, P., Wirdianto, E., & Asri, Y. O. (2020). Risk assesment in confined space of the ship repair at PT bandar abadi ship builders and dry-docks. *AIP Conference Proceedings*, 2227. <https://doi.org/10.1063/5.0001026>
- Hadziahmetovic, N., & Salihovic, N. (2022). The Role of Transparent Communication and Leadership in Employee Engagement. *International Journal of Academic Research in Economics and Management Sciences*, 11(2). <https://doi.org/10.6007/ijarems/v11-i2/14067>
- Hermawan, A. (2019). Analisis indikator keselamatan pelayaran pada kapal niaga. *Jurnal Saintara*, 5(January), 53–59.
- Karakasnaki, M., Vlachopoulos, P., Pantouvakis, A., & Bouranta, N. (2018). ISM Code implementation: an investigation of safety issues in the shipping industry. *WMU Journal of Maritime Affairs*, 17(3), 461–474. <https://doi.org/10.1007/s13437-018-0153-4>
- Lu, C., Yu, D., Luo, Q., & Xu, C. (2023). A Study of the Effects of Job Stress on the Psychosocial Safety Behavior of Construction Workers: The Mediating Role of Psychological Resilience. *Buildings*, 13(8). <https://doi.org/10.3390/buildings13081930>
- Radonja, R., & Glujić, D. (2020). Safety aspects of isps code onboard practice. *Nase More*, 67(2), 178–180. <https://doi.org/10.17818/NM/2020/2.11>
- Rajaram, P., Goh, M., & Zhou, J. (2022). Guidelines for cyber risk management in shipboard operational technology systems. *Journal of Physics: Conference Series*, 2311(1). <https://doi.org/10.1088/1742-6596/2311/1/012002>
- Razali, N. A., & Ghani, F. A. (2017). An Overview of ISPS Code Implementation in Malaysia. *Journal of Information System and Technology Management*, 2(5), 1–7. www.jistm.com
- Taequi, A., & Basuki, M. (2020). Study Implementasi Isps Code Pada Pelabuhan Dili Timor-Leste. *Prosiding Seminar Teknologi Kebumihan ...*, August, 23–27. <https://ejournal.itats.ac.id/semitan/article/view/979>
- Torres, F. S., Kulev, N., Skobie, B., Meyer, M., Eichhorn, O., & Schafer-Frey, J. (2020). Indicator-based safety and security assessment of offshore wind farms. *2020 Resilience Week, RWS 2020, November*, 26–33. <https://doi.org/10.1109/RWS50334.2020.9241287>
- Uflaz, E., Akyuz, E., Arslan, O., & Celik, E. (2022). A quantitative effectiveness analysis to improve the safety management system (SMS) implementation on-board ship. *Safety Science*, 156. <https://doi.org/10.1016/j.ssci.2022.105913>
- Zhang, J., Teixeira, A. P., Guedes Soares, C., Yan, X., & Liu, K. (2016). Maritime Transportation Risk

- Assessment of Tianjin Port with Bayesian Belief Networks. *Risk Analysis*, 36(6), 1171–1187. <https://doi.org/10.1111/risa.12519>
- Zhang, X., Zhang, Q., Yang, J., Cong, Z., Luo, J., & Chen, H. (2019). Safety Risk Analysis of Unmanned Ships in Inland Rivers Based on a Fuzzy Bayesian Network. *Journal of Advanced Transportation*, 2019. <https://doi.org/10.1155/2019/4057195>
- Zou, Y., Kiviniemi, A., & Jones, S. W. (2017). A review of risk management through BIM and BIM-related technologies. *Safety Science*, 97, 88–98. <https://doi.org/10.1016/j.ssci.2015.12.027>