International Journal of Marine Engineering Innovation and Research, Vol. 11(3), Sept. 2026. 957-965
(pISSN: 2541-5972, eISSN: 2548-1479)

Implementation of International Safety Management (ISM) Code For Enhancing Maritime Safety: Evidence From Merchant Vessel at Tanjung Perak Port Surabaya

Teguh Pribadi[1*], Trisnowati Rahayu[2], Sutoyo[3], Agus Dwi Santoso[4], Maulidiah Rahmawati[5], Prima Yudha Yudianto[6]

(Received: 25 June 2026 / Revised: 28 June 2026 / Accepted: 4 July 2026 / Available Online: 1 September 2026)

***Abstract*—** Maritime accidents remain a persistent threat largely due to the complexities of operating a ship and our inherent dependence on human performance. Even with the International Safety Management (ISM) Code implemented since 1998 as a mandatory requirement, there is a significant gap between the actual practice and theoretical principles. Lack of clear procedures, supervision, and a weak on-board safety culture impede effective implementation. This research examines the implementation of the ISM Code on merchant ships passing through Tanjung Perak Port in Surabaya, Indonesia, as well as human and organizational factors influencing its implementation. Through a step-by-step mixed-methods approach, a total of 186 certified seafarers (masters, deck officers, chief engineers, and engineers) participated in the study, utilizing in-depth interviews, onboard observations, safety document checks, and a five-point Likert scale questionnaire for data collection. 90% of respondents agree on the increased level of on-board safety awareness; positive factors contributing to enhanced awareness include strong leadership, efficient communication, and common daily safety activities such as Job Safety Analysis and hazard reporting. Negative factors impacting ISM Code implementation, on the other hand, are mainly fatigue, heavy work loads, lack of time, and insufficient crew involvement. Based on these findings, the study proposes a Participatory Safety Governance framework in which the aspects of leadership, communication, culture, and participation are integrated for effective implementation of maritime safety, which emphasizes the importance of anticipating risks prior to actual occurrence, rather than just filling up safety checklists.

Keywords—ISM Code, Maritime Safety, Human Error, Merchant Vessel.

[*]*Corresponding Author: jeftaseptiano@gmail.com*

I. INTRODUCTION

As a globally traded commodity transported almost entirely over sea, Shipping holds an exceptionally vital place in global commerce and global connectivity. Shipping remains the most effective and efficient method of goods transportation, accounting for over 80 percent of the total world trade according to the International Maritime Organization (IMO) [1], [2], [3]. While shipping technology has greatly evolved through the years with navigation equipment and regulations becoming increasingly advanced and stringent, Maritime accidents have continued to pose significant challenges and threats to national governments, ship operators and various stakeholders.

As a maritime country and one with the largest archipelago, maritime transportation plays a significant role in the economic and physical connectivity of Indonesia. With its significant number of maritime activities and its geographical location, Indonesia, unfortunately has faced its share of maritime accidents. Various reports from the Directorate General of Sea Transportation (DGST) point out that maritime accidents occurred as a result of combinations of different factors, including human error, technological malfunction, environmental problems and failures in the implementation of the safety management system. The international literature clearly identifies human error as the leading factor in marine accidents. Reason [4] indicates that few accidents can be attributed to the failure of an individual operator alone.

Rather, they tend to occur due to a chain of circumstances involving latent system defects and individual slips. Similarly, Hetherington et al. [5] stated that more than 80 percent of all maritime accidents are related to human and organizational factors. Thus, maritime safety can no longer be achieved by technological improvement alone; it also relies on effective management systems and a strong organizational safety culture [6], [7], [8]. To manage safety more systematically on ships, the International

Teguh Pribadi with Department of Ship electrical Engineering Technology, Politeknik Pelayaran, Surabaya, 60155, Indonesia, E-mail: jeftaseptiano@gmail.com
Trisnowati Rahayu with Department of sea transportation, Politeknik Pelayaran, Surabaya, 60155, Indonesia, E-mail: trisnowati.rahayu@poltekpel-sby.ac.id
Sutoyo with Department of Nautical Engineering, Politeknik Pelayaran, Surabaya, 60155, Indonesia, E-mail: sutoyo@poltekpel-sby.ac.id
Agus Dwi Santoso with Department of Ship electrical Engineering Technology, Politeknik Pelayaran, Surabaya, 60155, Indonesia, E-mail: agusbp2ipsby@gmail.com
Maulidiah Rahmawati with Department of Sea Transportation, Politeknik Pelayaran, Surabaya, 60155, Indonesia, E-mail: maulidiah@poltekpel-sby.ac.id
Prima Yudha Yudianto with Department of Ship Engine Engineering Technology, Politeknik Pelayaran, Surabaya, 60155, Indonesia, E-mail: prima.yudha.17@gmail.com

Maritime Organization (IMO) created International Safety Management (ISM) Code.

The ISM Code is adopted as a new chapter (Chapter IX) of the International Convention for the Safety of Life at Sea (SOLAS). This International Code defines safety management system and establishes procedures for it. The International Maritime Organization (IMO) set forth standards for the operation and safety of ships with an intent to ensure safe ships and prevent pollution of the marine environment through the application of sound safety management principles [1], [2].

From its adoption in 1998, the ISM Code has become a standard for global maritime safety management. The ISM Code provides requirements for companies to develop documented procedures covering all aspects of ship operation and safety. According to International Maritime Organization [1], [2] implementation of the ISM code is successful only if both management and crew members are fully committed and comply strictly with the company procedures. Nonetheless, many studies indicate the existence of gap between actual practice of implementation and compliance. For example, Bhattacharya [6] found that the successful application of the ISM code to reduce the accident risk depends on management support, commitment of crew, integration into everyday operations, and development of safety culture in the organization.

If they do not follow with a good safety culture, ISM code may be an ineffective exercise and a pure bureaucracy. Similar to this research finding, Chauvin et al. [9] emphasized that some common organisational factors, lack of communication and poor leadership practices continue to be major contributing causes for Maritime accident even after the implementation of safety management systems on ships. A lot of previous empirical work on the implementation of the ISM Code has focused on the issues related to this matter. Lappalainen et al. [7] mentioned that generally companies welcomed the Code as an efficient safety tool though difficulties were faced with respect to the implementation of continuous improvement concept.

Karakasnaki and Pantouvakis [10] investigated key factors for the ISM code implementation in terms of company-related and crew-related categories and revealed that companies adhering to safety Code practices achieve accident reduction. Batalden and Sydnes [11] who analyzed investigate accidents provided clear evidence of many incident-driving factors that are consistent with human-factor provisions in the code including the one addressing human-centered accident causal factors which map onto command responsibility elements. Despite mandatory nature of the Code, the implementation effectiveness continues to remain a concern with a notable gap between formal compliance and operational practice in the shipping sector, and maritime accidents in Indonesian waters still often reported, predominantly related to human and organizational factors instead of technology or environmental ones.

A root problem lies in the common treat ISM code as documentation-based routine management, ignoring that human-organizational conditions which significantly impacts operational safety-fatigue, stress, work-load, quality of leadership, crew engagement, communication patterns – need more attention.

Also most research to date has addressed issues such as levels of compliance, documented procedure evaluation, and only few has attempted to explore the relationship among the ISM Code implementation, leadership, communication, safety culture, crew participation, and operational pressure which becomes increasingly challenging in busy ports such as Tanjung Perak with high operation intensity. The port of Tanjung Perak, Surabaya, represents a critical nexus for maritime activities, and as a strategically important and busy Indonesian port, it is an ideal location to investigate current practices of safety management on merchant vessels. Merchant vessels navigating the port of Tanjung Perak, especially under the intense scheduling and high cargo throughput pressures found in a busy operational context such as this one, must implement their safety management systems effectively. The following questions guide the current study:

1. How is the ISM Code implemented on merchant vessels operating through Tanjung Perak Port?
2. What factors influence the effectiveness of ISM Code implementation?

Furthermore, it aims to identify contributing factors influencing the effective ISM Code implementation and to suggest practical recommendations for improving maritime safety management systems in the sector. A key novel contribution of this study is the development of a Participatory Safety Governance framework for ISM Code implementation that explicitly integrates leadership, communication, safety culture, and crew engagement as dynamic, interrelated components, rather than separate compliance markers. Unlike previous studies focusing primarily on compliance and the procedural completeness of safety systems, this research frames the ISM Code as a socio-technical, participatory process where active operational crew involvement is paramount for safety. Supported by empirical evidence from merchant vessels in a highly active Indonesian port, the study advances the body of knowledge in maritime safety and offers actionable guidance for companies, regulators, and maritime educators.

II. LITERATURE REVIEW

This section discusses theoretical background of the use of the ISM Code and related previous empirical research for safety management practices in the maritime sector. The review is structured according to four key interrelated concepts - the ISM Code and Safety Management System, Human Error and Organizational Factors, Safety Culture and Leadership, and Communication and Crew Participation - to set the theoretical base for the development of the Participatory Safety Governance framework proposed herein. The ISM Code and Safety Management System The ISM Code was adopted by the International Maritime Organization and the requirements of the Code were adopted into chapter IX of the SOLAS Convention.

The ISM Code and Safety Management Systems

The code established international standards for Safety Management System (SMS) to manage safe operations, emergency preparedness and response, safety assessment of risk, maintenance of ship and equipment and continued improvement [1]. Following its mandatory date in 1998, the Code required shipping companies to create and implement policies and procedures relating to all aspects of shipboard safety. Numerous research studies, however, have concluded that existence of safety procedure did not automatically result in safe behaviour. A qualitative study conducted by Bhattacharya [6], among sea farers, suggested that effectiveness of ISM code largely depends upon organizational support, participation of the sailors, incorporation of safety behaviours into work life, and if they are not reinforced by a solid safety culture, the safety management systems will often be converted to a superficial, perfunctory administrative undertaking. The empirical studies in the broader context supported the above argument, that overall most of shipping companies felt the ISM Code is effective tool in promoting maritime safety, although to integrate the spirit of continuous improvement seems to be the biggest challenge for them [7].

The finding Pantouvakis and Karakasnaki [12] showed that ISM Code effectiveness is strengthened when the safety management system is reinforced by ISO-based quality management, while Karakasnaki and Pantouvakis [10] identified crew-related and company-related factors as the critical dimensions that determine whether the Code fulfils its intended purpose and contributes to accident reduction. Modern implementation strategies for the ISM Code demand continuous improvement and innovative development approaches to overcome bureaucratic barriers [10], [12], [13]. To optimize operational safety, shipping companies are also encouraged to implement integrated quality and safety management systems [14], [15].

Human Error and Organizational Factors in Maritime Safety

A substantial body of literature identifies human error as the leading contributor to maritime accidents. Reason [4] argued that accidents rarely result from a single individual mistake; rather, they emerge from the alignment of latent organizational conditions, unsafe acts, and systemic weaknesses, an idea later extended in his analysis of organizational accidents [16]. Empirical maritime studies support this view: Hetherington, Flin, and Mearns [5] concluded that more than 80 percent of maritime accidents are attributable to human and organizational factors, and Chauvin et al. [9], applying the Human Factors Analysis and Classification System (HFACS) to collisions at sea, found that organizational influences, communication failures, and ineffective supervision remain decisive even where formal safety systems exist. Wagenaar and Groeneweg [17] further emphasized that accidents at sea are shaped by the interaction of human limitations and organizational decisions rather than by isolated operator error. To mitigate these risks, recent methodologies emphasize cognitive mapping and proactive error modeling in accident prevention [9], [18]. Among these human factors, fatigue is consistently identified as a critical hazard; Allen et al. [19] highlighted fatigue as a persistent and under-managed risk in the maritime sector, linking it to extended working hours and irregular schedules [19], [20].

Safety Culture and Leadership

Safety culture and leadership are widely regarded as decisive determinants of safety performance in the maritime industry. Cooper [21] proposed a reciprocal model of safety culture in which organizational commitment, management behaviour, and employee participation interact dynamically to shape overall safety outcomes, positioning leadership commitment as a foundational element. Implementing a resilient safety culture requires a deliberate shift from mere formal compliance to active, everyday participation by the operational crew [21], [22]. This transformation heavily relies on the role modeling behavior of shipboard leaders, such as masters and chief engineers, who must bridge the gap between abstract corporate policies and daily shipboard realities.

Flin et al. [23], reviewing safety-climate research, identified management commitment and the priority given to safety relative to production as common features distinguishing safe organizations. The relationship between organizational safety climate and individual safety behaviors has been empirically validated across various maritime sectors, including container terminals and passenger ferries [23], [24], [25], [26]. These studies collectively emphasize that when seafarers perceive that their leaders genuinely prioritize safety over commercial pressure, their compliance and proactive hazard reporting behaviors increase significantly. Therefore, safety leadership acts as the primary catalyst that converts a passive safety management system into an active, resilient safety culture.

Communication, Crew Participation, and Continuous Improvement

Effective communication and active crew participation are increasingly recognized as essential pillars for safe ship operations, especially during high-risk maneuvers and intensive port activities. Hetherington et al. (2006) identified communication failures, whether rooted in hierarchical barriers, language differences, or poor interpersonal dynamics, as one of the most significant contributors to catastrophic maritime accidents. Contemporary safety-management thinking stresses that organizational learning, transparent hazard reporting, and continuous improvement are critical mechanisms that keep safety systems dynamic and responsive.

However, despite these theoretical frameworks, actual crew participation in safety governance, particularly in revising Standard Operating Procedures (SOPs) and contributing to operational decision-making, nevertheless remains severely limited. In practice, vital safety documents and checklists are often developed in isolation, mainly by senior officers or shore-based management. When operational crews are systematically

excluded from these developmental processes, the resulting procedures risk being perceived merely as administrative burdens and a "paperwork exercise" rather than practical, lifesaver tools. This alienation severely weakens their field effectiveness, creating a dangerous operational gap where crews bypass procedures to meet strict commercial timelines.

Research Gap and Conceptual Position

Although these prior studies provide valuable insights into maritime safety, a critical conceptual gap persists in the existing literature. Most prior research predominantly evaluates the ISM Code through a rigid lens of strict compliance levels and procedural completeness, while treating leadership, communication, safety culture, and crew participation as isolated, independent variables. Consequently, few studies integrate these dimensions into a single, cohesive governance framework or examine how they jointly determine the real-world effectiveness of ISM Code implementation within a high-pressure, high-traffic port environment.

This study explicitly addresses that gap by investigating the complex socio-technical interactions of these variables on merchant vessels operating at Tanjung Perak Port, Surabaya. By proposing a comprehensive Participatory Safety Governance framework, this research repositions the operational crew as co-authors and active governors of shipboard safety rather than mere passive implementers. This approach aligns directly with the objective of evaluating ISM Code implementation beyond surface-level documentation, thereby identifying the underlying organizational and human factors that fundamentally shape genuine maritime safety performance.

III. METHOD

This research study utilized a mixed methods approach, dominant in qualitative analysis, with a sequential explanatory design. As such, the primary data source was collected qualitatively and quantitatively used to validate and substantiate the data acquired during interviews and observation. A mixed method approach was determined by the desire to provide an in-depth study on implementation of the ISM Code as well as maritime safety practices in merchant vessels.

A. Data Collection Techniques

In order to conduct qualitative research, interviews with captains, officers, chief engineers, engine room crew as well as safety document review, and onsite observation with respective captains and deck officers were conducted. Safety documents reviewed for their contents were; Standard Operating Procedures, Safety Management Systems, Job Safety Analysis records and incident reports.

Structured questionnaire using five point Likert's Scale were used for quantitative data collection method to supplement and confirm the qualitative information obtained during Interviews and observation not for the purpose of testing causal relationship between the variables.

B. Sampling Technique

Purposive sampling technique were utilized for the selecting respondents, where each respondents had direct knowledge and experiences with the work environment and operations in regards to safety management implementation. In addition, participants had to hold valid STCW certification, and at least one year of onboard working experience in merchant vessels.

The study involved a total of 186 respondents, comprise of:

TABLE 1
DISTRIBUTION OF RESPONDENTS

Position	Number of Respondents
Captains	22
Deck Officers	53
Chief Engineers	45
Engine Crew	66
Total	186

Source: Authors (2025)

C. Variables Studied

The study was designed in a sequential explanatory mixed-methods paradigm. The analytical framework provided an integrated, rigorous, and comprehensive analysis of qualitative and quantitative data. Qualitative data, the main and most prominent source of empirical evidence, were analysed using thematic analysis systematically adapted from the established methodological framework of Braun and Clarke. This qualitative analytical process was conducted via five progressive and iterative stages:litative data was analyzed using the theme analysis, adapted from Braun and Clarke's methods [27]. This qualitative analytical process was conducted via five progressive and iterative stages:

1) Familiarization with the data, which entailed an extensive process of transcribing, repeated reading of the interview transcripts, and immersive review of field notes, to understand the nuanced experiences of shipboard personnel.
2) Initial coding development: Selected portions of text describing operational pressures, safety behaviours, leadership styles and procedural deviations were systematically coded with descriptive labels.
3) Themes identification: the generated codes were conceptually clustered and organized into larger

coherent over-arching themes representing the core socio-technical dynamics of safety management.

4) Interpretation and contextualisation: entails a critical evaluation of the identified themes against existing theories of maritime safety and organizational accident models.
5) Triangulation of results: Qualitative insights from the seafarer interviews were cross-checked with direct observations onboard and structural reviews of the corporate safety documents.

The quantitative phase was intended only to support and validate the qualitative themes, not to examine causal relationships or test hypotheses. As the questionnaire was only used for triangulation and not for measuring the model, no reliability and validation test is carried out. Descriptive analysis was deemed sufficient to justify the qualitative findings and to give a holistic view of the seafarers' perceptions towards the implementation of ISM Code.

IV. RESULT AND DISCUSSION

The implementation of International Safety Management (ISM) code at Tanjung Perak Port for all merchant vessel sailing across this Port have generally succeed to assist and to support in its operation for its safe condition. Many interviews with the captain deck officers chief engineer and engineer room officers are taken on this project. Based on interviews on the respective vessel that the general implementing on SMS safety is quite fulfill and having their respective written procedure meeting plan to execute their SMS program. Their procedure consist on regular meeting on safety on board their respective emergency plan to ensure if something went wrong it have plan to respond on this situation , maintenance plan for all machine and also hazard report form to make their voyage safe.

Almost all of the respondents indicated that the ISM Code has already integrated into routine shipboard practices and operations, not just simply seen as regulatory mandate. Dissemination of safety procedures is part of our company's safety culture and these procedures are shared through, amongst others, toolbox meetings, pre-job meetings, and onboard safety trainings. It also emphasized the importance of the adherence to the ISM Code that in doing so, it would increase the overall occupational safety awareness and inculcate the sense of operation discipline.

These findings provide support for the contention by Bhattacharya [6] that an organization that incorporates the ISM Code into daily operational context has enhanced its safety culture.

Communication and Coordination as Essential Safety Factors

Communication and Coordination as Important Safety Issues Another important aspect identified during analysis of interview responses as well as survey responses that Communication and Coordination play significant role in ensuring safe vessel operation. Survey results indicate that more than a significant number of respondents perceived that the level of their working relationship with captain, officer and other crew was highly positive. This good communication flow was particularly noticeable during various shipboard activities like navigation operations, cargo operations, engine room work and emergency exercises.

According to their opinion, regular meetings have helped to promote the communication process between individuals and among departments regarding various safety issues and problems faced during operations (as seen in Table 2):

TABLE 2.
PERCEPTIONS OF COMMUNICATION AND COORDINATION EFFECTIVENESS

Assessment Category	Percentage (%)
Strongly Agree	48
Agree	44
Neutral	6
Disagree	2
Strongly Disagree	0

The result shows that almost 92% of respondent perceived that their communication was good. It is in agreement with Hetherington et al. [5], research, in which communication failures was one of significant contributor for any maritime accidents, thus, effective communication enhances situation awareness and supports for effective decision making process for all high-risk activities and during emergency situation. As result of interviews indicated a strong relationship between effectiveness of communication and leadership behavior, those who had been interview suggested that Captain and chief engineer actively communicate and discuss with their crew leads to strong rapport between leader and followers, cooperation and adherence to company's safety policy.

Safety Culture and Compliance with the ISM Code

The findings of the study indicate that safety culture has become increasingly embedded within the operational practices of merchant vessels. The respondents indicated a comprehensive understanding of their safety responsibilities and acknowledged the significance of adhering to established procedures.

The respondents indicated a comprehensive understanding of their safety responsibilities and acknowledged the significance of adhering to established procedures. The implementation of Job Safety Analysis

(JSA), Permit to Work systems, safety drills, and hazard reporting mechanisms has contributed significantly to strengthening safety awareness among crew members (as seen in Table 3):

TABLE 3.
SAFETY CULTURE INDICATORS

Indicator	Positive Responses (%)
Understanding of Safety Responsibilities	97
Compliance with Safety Procedures	95
Participation in Safety Meetings	93
Hazard Reporting Awareness	94
Emergency Preparedness Awareness	92

Source: Authors (2025)

The findings indicate that the ISM Code has effectively promoted safety awareness across various organizational levels on board ships.

This finding aligns with the conclusions of Karakasnaki and Pantouvakis [10], who found that effective ISM Code implementation enhances safety awareness among ship personnel. Concurrently, Lappalainen et al. [7] determined that the consistent application of safety management procedures strengthens overall maritime safety performance.

However, the results of the interviews indicated that safety culture remains vulnerable to operational pressures. It was acknowledged by several respondents that safety compliance occasionally competes with commercial and operational demands, particularly during periods of intensive cargo operations.

Human Error and Operational Pressure

While the results on the implementation of safety management are generally positive, human error remains a great challenge. The respondents indicated that the main contributors to unsafe behavior and non-compliance with procedures were fatigue, pressure of work, tight schedules and long hours. The survey found that 21-27 respondents indicated that operational pressures had at times led to the taking of procedural shortcuts to meet commercial aims.

TABLE 4.
FACTORS CONTRIBUTING TO HUMAN ERROR

Contributing Factor	Frequency Mentioned
Fatigue	High
Excessive Workload	High
Time Pressure	Moderate
Communication Breakdown	Moderate
Inadequate Rest Periods	Moderate

Source: Authors (2025)

The finding also correlates to Reason's Human Error Theory [4] that presents a vital perspective to analyzing complex accidents. Accidents don't result from isolated failures by operational level workers; on the contrary, systemic failures and underlying organizational conditions play a significant role. Excessive fatigue, commercial pressure to run continuously to satisfy customer needs, lead even highly skilled and experienced professionals to disregard safety, procedures and, most important, create openings for accidents.

During the review of the qualitative interview comments, the workers from the engine room appears to have higher rate of error prone, caused by the lack of sleep. Two major issues contributed to the problem are long period of maintenance tasks, particularly when conducted under extremely hostile environmental condition, as well as haphazard work schedule based on the variable port operations and machinery requirements. This corroborates what Allen et al. [19] had found: Fatigue is pervasive, and chronically poorly managed, problem in global shipping and it significantly degrades cognition and situational awareness.

Even when the safety management systems and associated documentation become institutionalized and documented through official procedures, human errors persist as a leading threat. Such problems will not necessarily be remedied by simple bureaucratic control; it emphasizes that adherence to procedures needs to be supplemented by sound work load management and provision of regular rest to ensure a safe operation.

Leadership and Safety Performance

Safety Performance of Leadership It was apparent from the present study that leadership has a strong influence on the daily implementation of the ISM Code. Most of the interviewees reported that ship's captains and chief engineers are able to demonstrate the desired level of commitment toward safety, influencing positively on the crew perception on risks, the way in which they incorporate safety into their tasks, and their behavior during stressful operations. When leaders demonstrate proactive commitment to safety through clear actions, and encourage honest reporting, without blame, crew members will feel encouraged to comply with all the procedures and will promote a robust safety culture. The

findings derived from leadership's variables in Table 5 further support this claim:

TABLE 5.
LEADERSHIP INFLUENCE ON SAFETY MANAGEMENT

Leadership Indicator	Positive Response (%)
Commitment to Safety	95
Open Communication	93
Safety Decision Making	94
Support for Safety Reporting	92
Encouragement of Crew Participation	89

The data indicate leadership influenced safety both through formal authority and the day-to-day interactions, language, and example. Cooper [21] found the same-his conclusion was leadership commitment to safety should form the basis of a corporate safety culture and be the driver of organizational compliance. Similar arguments were made by Flin et al. [23] when they found that effective safety leadership, evident commitment from management, and the placing of safety ahead of production in business decision-making had major impacts on accident prevention and crew confidence.

Active and obvious, safety-first, role modeling by masters and chief engineers cascading throughout the ship's organization reduced unsafe acts and contributed to greater reliability in shipboard operations.

Crew Participation and Safety Governance

To return briefly to crew participation and safety governance, whilst overall, for all the participants, the study showed their belief that procedures overall were good, there were considerable discrepancies in terms of involving the operational crew more widely in the overall concept of safety oversight, risk governance and operational improvement. It was clear from responses that when SOPs had to be amended, for example, this tended to be undertaken by senior officers or shore based personnel without much input from those on the operational decks, and resulted in some perceiving procedures as solely administrative requirements in order to meet the needs of the auditor rather than a useful and lifesaving guide to undertaking their daily duties effectively and safely.

It is the intention of the model, herein, that in order for the ISM Code to be successful all people working onboard must engage in it, particularly those on the operational decks. The model here argues that to make the ISM Code work well, everyone, especially the crew, needs to get involved. Crew members should take an active role in spotting hazards, reporting safety concerns, suggesting improvements, and making operational decisions. This way of thinking fits today's safety management principles, which focus on learning as an organization and never stopping the push to improve.

Discussion

That, in the study, all of the crew actively participate in identifying risks, reporting their safety concerns, offering advice on improving procedures and participate in decision-making on operational matters; this will form the backbone of the modern safety management concept which has the emphasis on learning organizations, socio-technical resilience and continuous improvement.

Figure 1. Proposed Participatory Safety Governance Framework

However, ISM Code effectiveness appears to rely on three interdependent domains:

1. Organizational Commitment;
2. Human Factors Management; and
3. Participatory Safety Culture.

First, organization commitment strongly contributes to the consistency of safety application. High positive values related to leadership commitment (95 per cent) and support of safety reporting (92 per cent) mean that when the leadership openly supports safety by demonstrating interest, and commitment through consistent training and monitoring of safety standards, crews will be likely to Internalized Safe Behaviors. Similar findings were reported by Cooper [21] and Flin et al. [23] that management commitment provided the foundation for any successful Safety Culture, and it supports the previous notion of Bhattacharya [6] where the ISM code effectiveness depends on the ownership of safety which will shared between management of ship management office and shipb.

Second, human factors remain as critical element in preventing accidents. While the procedures were perceived as readily available, interview data demonstrated repeatedly fatigue, excessive workload, time pressure and lack of adequate rests were perceived as conditions undermining safe behaviour, with a minority of participants admitting to deliberately bypassing safety procedures due to the pressure of time under commercial constraints. This evidence empirically supports Reason's [4], [16] theory regarding the latent conditions of organizations: procedure are available, but it is pressure to bypass the procedures which creates cracks for the safe behavior to take place. The existence of fatigue especially among engine department crews, due to extensive maintenance activity and unpredictable working schedules, is reminiscent of Allen et al. [19]'s concern, thereby showing that formal documentation of the procedures cannot nullify systematic human error which generated by the latent conditions in organization. oard people.

Third, participative Safety Culture fosters safety performance as it provides distribution of risks over all level of organization. Although many crews claimed to be aware of their safety responsibilities (97%) and complying with safety procedure (95%), the interviews pointed out limited opportunities for crews to be directly involved in safety procedure review or safety decision making. This means the awareness alone did not bring the crew participate fully into safety, in other words if they merely perceived as actors who just implemented procedures not as creators then the safety procedure will become just document. Embedding the participation of the operational crews to identify hazard, report unsafe acts, and modify safety procedures helps turn the ISM Code into an effective dynamic and self-correcting safety management system rather than static documented standard.

In conjunction, the research supports Bhattacharya's [6] and Karakasnaki & Pantouvakis' [10] claim for the necessity of integration within the organization as well as crew participation rather than documentation alone to assure the ISM Code's effectiveness, and enhances Reason's [16] call for organizations to eliminate latent conditions which underlies human errors. Our study offers novel contribution by developing a Participatory Safety Governance framework for ISM Code implementation that incorporates leadership commitment, communication, Safety Culture and crew participation in an integrated manner that each aspect reinforces the others. We move beyond viewing these as separate components to consider them as a dynamic and synergistic system, whereby a deficiency in any part of the framework will influence and undermine the others, leading to an overall decline in the safety performance regardless of apparent adherence to procedures.

From this, we can hypothesize that future maritime safety interventions should evolve beyond focusing solely on procedural compliance towards adopting a more comprehensive strategy integrating leadership engagement, open communication, safety culture development and active crew participation. This holistic paradigm shift will offer profound theoretical and practical implications, challenging the traditional compliance versus implementation framework within maritime safety discourse by conceptualizing ISM Code implementation as a socio-technical governance process. The implications for shipping companies include a paradigm shift in performance monitoring beyond documentation to encompass the quality of leadership, communications, workload, rest management and operational crew involvement in shaping safety practices. Maritime training institutions should emphasize developing the leadership, communication, and participative safety skills along with the technical skills required for seafarers to become effective members of the safety system.

V. CONCLUSION

This study investigated the implementation of the ISM Code and its influence on the safety performance of merchant vessels sailing through Tanjung Perak Port in Surabaya, as well as explored relevant organizational and human factors impacting its effectiveness. We found that the ISM Code has successfully enhanced operational safety. Our analysis indicated that effective leadership, communication, safety culture embedded into practices, a well-developed hazard reporting system, and routine Job Safety Analysis procedures all contribute to higher levels of safety compliance and improved operational performance. Despite these encouraging results, we encountered considerable challenges hindering the effective implementation of the Code. A range of factors contributing to an elevated likelihood of human errors and operational incidents were identified. These include operational workload, fatigue, time pressures, adherence to procedures under the guise of commercial demands and lack of genuine crew participation in safety governance.

Based on our findings responding to the second objective, The authors propose that organizational commitment, effective leadership, quality of communication and crew participation, coupled with

proactive fatigue and workload management, are critical determinants of ISM Code implementation's effectiveness. It suggests that safety should be viewed as a socio-technical system involving the continuous interaction of human, organizational, and operational factors, transcending mere regulatory compliance and documentation.

The innovation of this research is its contribution to the literature by developing a Participatory Safety Governance perspective for the ISM Code implementation framework that combines leadership, communication, safety culture and crew participation as interconnected components that reinforce safety performance in the maritime industry. The proposed framework offers a unique perspective with practical relevance to shipping companies, regulators, and training institutions in crafting sustainable, human centered safety management systems.

ACKNOWLEDGEMENTS

The authors express our deep gratitude to Politeknik Pelayaran Surabaya for providing facilities, institutional support and financial assistance that supported the conduction of this study. The authors also convey our special thanks to the Directorate General of Sea Transportation, port authorities at Tanjung Perak Port Surabaya and the management of participant shipping companies for giving us permission and assistance in data collection process. Finally, we would like to acknowledge all captains, chief engineers and crews who willingly involved in this research giving insightful contributions.

REFERENCES

[1] IMO, "Guidelines On Implementation Of The International Safety Management (Ism) Code By Administrations," vol. 1188, no. 33, 2024.

[2] International Maritime Organization, *ISM code*. 2018.

[3] J.-U. Schröder-Hinrichs, E. Hollnagel, M. Baldauf, S. Hofmann, and A. Kataria, "Maritime human factors and IMO policy," *Marit. Policy Manag.*, vol. 40, May 2013, doi: 10.1080/03088839.2013.782974.

[4] J. Reason, *Human Error*. Cambridge: Cambridge University Press, 1990. doi: DOI: 10.1017/CBO9781139062367.

[5] C. Hetherington, R. Flin, and K. Mearns, "Safety in shipping: The human element," *J. Safety Res.*, vol. 37, no. 4, pp. 401–411, 2006, doi: https://doi.org/10.1016/j.jsr.2006.04.007.

[6] S. Bhattacharya, "The effectiveness of the ISM Code: A qualitative enquiry," *Mar. Policy*, vol. 36, no. 2, pp. 528–535, 2012, doi: https://doi.org/10.1016/j.marpol.2011.09.004.

[7] J. Lappalainen, J. Kuronen, and U. Tapaninen, "Evaluation of the ISM Code in the Finnish Shipping Companies," *J. Marit. Res.*, vol. 9, pp. 23–32, Apr. 2012.

[8] V. Thai and D. Grewal, "The Maritime Safety Management System (MSMS): A Survey of the International Shipping Community," *Marit. Econ. Logist.*, vol. 8, pp. 287–310, Sep. 2006, doi: 10.1057/palgrave.mel.9100161.

[9] C. Chauvin, S. Lardjane, G. Morel, J.-P. Clostermann, and B. Langard, "Human and organisational factors in maritime accidents: Analysis of collisions at sea using the HFACS," *Accid. Anal. Prev.*, vol. 59, pp. 26–37, 2013, doi: https://doi.org/10.1016/j.aap.2013.05.006.

[10] M. Karakasnaki, P. Vlachopoulos, A. Pantouvakis, and N. Bouranta, "ISM Code implementation: an investigation of safety issues in the shipping industry," *WMU J. Marit. Aff.*, vol. 17, Sep. 2018, doi: 10.1007/s13437-018-0153-4.

[11] B.-M. Batalden and A. K. Sydnes, "Maritime safety and the ISM code: a study of investigated casualties and incidents," *WMU J. Marit. Aff.*, vol. 13, no. 1, pp. 3–25, 2014, doi: 10.1007/s13437-013-0051-8.

[12] A. Pantouvakis and M. Karakasnaki, "An empirical assessment of ISM Code effectiveness on performance: the role of ISO certification," *Marit. Policy Manag.*, vol. 43, no. 7, pp. 874–886, Oct. 2016, doi: 10.1080/03088839.2016.1169451.

[13] S. M Esad Demirci and Kadir Cicek, "Innovative Strategy Development Approach for Enhancing the Effective Implementation of the International Safety Management (ISM) Code," *Transp. Res. Rec.*, vol. 2677, no. 1, pp. 25–48, Jan. 2023, doi: 10.1177/03611981221098394.

[14] M. Celik, "Designing of integrated quality and safety management system (IQSMS) for shipping operations," *Saf. Sci.*, vol. 47, no. 5, pp. 569–577, 2009, doi: https://doi.org/10.1016/j.ssci.2008.07.002.

[15] K. Pun and W. G. Lewis, "Safety management system registration in the shipping industry," no. 1998, 2002, doi: 10.1108/02656710310482140.

[16] J. Reason, *Managing the Risks of Organizational Accidents*. 1997.

[17] W. A. Wagenaar and J. Groeneweg, "Accidents at sea: Multiple causes and impossible consequences," *Int. J. Man. Mach. Stud.*, vol. 27, no. 5, pp. 587–598, 1987, doi: https://doi.org/10.1016/S0020-7373(87)80017-2.

[18] E. Akyuz and M. Celik, "Utilisation of cognitive map in modelling human error in marine accident analysis and prevention," *Saf. Sci.*, vol. 70, pp. 19–28, 2014, doi: https://doi.org/10.1016/j.ssci.2014.05.004.

[19] P. Allen, E. Wadsworth, and A. Smith, "The prevention and management of seafarers' fatigue: a review," *Int. Marit. Health*, vol. 58, pp. 167–177, Feb. 2007.

[20] J. R. Jepsen, Z. Zhao, and W. M. A. van Leeuwen, "Seafarer fatigue: a review of risk factors, consequences for seafarers' health and safety and options for mitigation.," *Int. Marit. Health*, vol. 66, no. 2, pp. 106–117, 2015, doi: 10.5603/IMH.2015.0024.

[21] M. D. Cooper Ph.D., "Towards a model of safety culture," *Saf. Sci.*, vol. 36, no. 2, pp. 111–136, 2000, doi: https://doi.org/10.1016/S0925-7535(00)00035-7.

[22] J. I. Håvold, "Safety-culture in a Norwegian shipping company," *J. Safety Res.*, vol. 36, no. 5, pp. 441–458, 2005, doi: https://doi.org/10.1016/j.jsr.2005.08.005.

[23] R. Flin, K. Mearns, P. O'Connor, and R. Bryden, "Measuring safety climate: identifying the common features," *Saf. Sci.*, vol. 34, no. 1, pp. 177–192, 2000, doi: https://doi.org/10.1016/S0925-7535(00)00012-6.

[24] C.-S. Lu and K. Shang, "An empirical investigation of safety climate in container terminal operators," *J. Safety Res.*, vol. 36, no. 3, pp. 297–308, 2005, doi: https://doi.org/10.1016/j.jsr.2005.05.002.

[25] C.-S. Lu and C.-S. Yang, "Safety climate and safety behavior in the passenger ferry context," *Accid. Anal. Prev.*, vol. 43, no. 1, pp. 329–341, 2011, doi: https://doi.org/10.1016/j.aap.2010.09.001.

[26] C.-S. Lu and C.-L. Tsai, "The effect of safety climate on seafarers' safety behaviors in container shipping," *Accid. Anal. Prev.*, vol. 42, no. 6, pp. 1999–2006, 2010, doi: https://doi.org/10.1016/j.aap.2010.06.008.

[27] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qual. Res. Psychol.*, vol. 3, no. 2, pp. 77–101, Jan. 2006, doi: 10.1191/1478088706qp063oa.