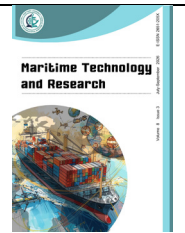




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Research Article

Cruise/Passenger ship evacuation: A human-centered evaluation for improvement

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Article information	Abstract
Received: January 1, 2026 Revision: March 26, 2026 Accepted: April 14, 2026	This paper investigates the complex and multidimensional challenges affecting the efficiency of emergency evacuations onboard cruise/passenger ships. Despite the existence of a comprehensive regulatory framework established by the International Convention for the Safety of Life at Sea (SOLAS) and the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), which prescribes mandatory training activities, time-bound evacuation requirements, and strict technical safety standards, real-life experiences and a number of maritime incidents continue to expose critical deficiencies. Based on the comparison of literature review results with qualitative data gathered from surveys, semi-structured interviews among seafarers, and an onboard observation study, this research effort explores the human, organizational, and design-related attributes that inhibit timely and efficient evacuations. Analytical results have uncovered profound skepticism among seafarers around the feasibility of evacuating large cruise/passenger vessels within the established 30-minute regulatory timeframe, citing shortcomings in training, lack of psychological preparedness, and coordination/communication difficulties, particularly under stressful situations. The human element emerges as a very influential actor, with cognitive denial and poor safety culture frequently delaying effective responses during emergency situations. Recommendations deriving from seafarers themselves support (among others) the adoption of enhanced psychological training and better utilization of crews' working language, as well as increased manning levels; future integration of evacuation technologies based on ethical standards also stands out. Improvements in emergency evacuation safety aboard cruise/passenger ships depend on the integration of seafarers' practical experiences into both policy development and operational activities, opening the way towards fostering a proactive, human-centered safety culture throughout the concerned shipping sectors.
Keywords Emergency evacuation; Human element; Passenger behavior; Safety culture; Ship design; Training and drills	

1. Introduction

The evacuation of cruise/passenger vessels constitutes a fundamental component of maritime safety, utilized (commonly, as a last resort) in cases where the lives of crew and passengers are placed in imminent danger (Andreidakis & Dalaklis, 2025). This procedure necessitates the rapid, organized, and coordinated movement of individuals from their current locations to the designated muster stations, and subsequently to the life-saving boats and other equipment with a similar purpose (SOLAS Reg. II-2/13.3). Despite the seemingly straightforward nature of this process, empirical evidence from real-world maritime incidents has revealed a wide range of challenges, both anticipated

and emergent, that can compromise the efficiency and effectiveness of the abandonment procedure. Factors such as delays in decision-making and communication and cooperation errors or breakdowns, as well as the unpredictable nature of human behavior, are just a few indicative issues contributing to escalating an initially manageable emergency into a large-scale disaster. Taking into consideration the critical nature of these situations, in which every moment is vital, a failure to execute the abandonment swiftly and within the timeframes as established by SOLAS Regulation III/21.1.3. (4)-30 minutes for cruise/passenger ships- can lead to considerable casualties. The aforementioned became evident with the sinking of the Costa Concordia, where the evacuation lasted more than six (6) hours, and thirty-two (32) people lost their lives. This happened while the vessel was located around 500 meters from the Italian shores and the weather conditions were good (Bartolucci et al., 2021; Italian Ministry of Infrastructures and Transports, 2012); it is not hard to speculate about an increased number of life-losses if the same vessel sank in the open sea.

Modern cruise/passenger ships are constructed, equipped, and certified in accordance with rigorous safety regulations that aim to ensure the safety and survival of people onboard, across a wide range of emergency scenarios that could potentially require evacuation. Furthermore, the International Maritime Organization (IMO), in response to the continuous growth of ships of this size, complexity, and capacity, has developed and implemented comprehensive design and operational requirements aimed at improving evacuation outcomes. Among these regulatory measures is the incorporation of evacuation simulation models during the vessel design phase, which are utilized to assess the vessel's theoretical performance by evaluating parameters such as the adequacy of escape routes, congestion patterns, and overall evacuation time (IMO, 2016). These simulations serve as important tools for naval architects, enabling them to verify compliance with the regulatory standards and to identify potential discrepancies that may affect the safe egress of all people onboard. Additionally, through their utilization, ship-designers can evaluate if the proposed layout of a vessel ensures the timely and safe evacuation of all people onboard within the prescribed regulatory timeframes. However, despite the remarkable progress in naval architecture, maritime safety technologies, and simulation-based evacuation planning, major maritime disasters with long evacuation times and casualties, such as the Costa Concordia (2012), Norman Atlantic (2014), and KM Barcelona 5 (2025), continue to occur. This underscores the continuous presence of critical shortcomings in the area of ship abandonment during real-life emergencies. These deficiencies, in the majority of cases, cannot be solely connected to design flaws, mechanical failures, or unpredictable factors (e.g., weather conditions, nature of emergency); rather, they are largely influenced by the level of crew training both ashore and onboard (drills), insufficient passenger management skills and preparedness, behavioral and psychological responses of crew and passengers, and other anthropogenic influential factors (e.g., inability to make prompt decisions, communication errors) (Andreadakis & Dalaklis, 2022). Having recognized these challenges, over the years, the concerned regulatory bodies have progressively expanded their focus beyond purely technical aspects, in order to investigate, address, and incorporate the influence and importance of ^athe human element within the safety management frameworks. Instruments such as the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), in conjunction with the International Convention for the Safety of Life at Sea (SOLAS), have been introduced and further enhanced over the years. Furthermore, mandatory training protocols, designed to boost seafarer evacuation competence for emergency situations onboard cruise/passenger ships, have been extensively utilized (Andreadakis et al., 2024). Key examples of this regulatory approach include specialized training in crowd management, crisis communication, and effective passenger assistance during emergencies (STCW Code Section A-V/2, paragraph 1 - 8).

^a The human element refers to the complex interaction of human capabilities, limitations, behaviors, and decisions within socio-technical systems, particularly in safety-critical domains. It encompasses factors, such as training, cognition, communication, organizational culture, and situational awareness, which influence performance and risk outcomes (IMO, 2018; Reason, 1997).

Nevertheless, the overall effectiveness of these important safety developments, in pragmatic conditions, is often met with criticism and concerns. Ongoing debates persist regarding the extent to which the existing training regimes, routine drills, procedural briefings, and preparations genuinely equip both crew and passengers to respond effectively to the demands of high stress and unpredictable actual emergency evacuation scenarios (Szcześniak, 2013; Pospolicki, 2017; Tac et al., 2020). Emerging issues regarding the existing safety culture aboard cruise/passenger vessels and within shipping organizations, the consistency and quality of drills, and disparities in shore-based training and preparedness standards among flag states, further exacerbate these concerns. The diversity of the psychological and behavioral responses between individuals during emergencies, particularly within a context of large, heterogeneous passenger populations, further complicate the processes of evacuation planning, preparedness, and execution (Keating, 1982; Ockerby, 2001; Leach, 2004; Leach, 2005; Casareale et al., 2017). Additionally, research supports that cognitive and emotional responses such as panic, confusion, and deviation from official instructions are frequently observed during high-stress scenarios (mainly in passengers, but also in crew), especially when instructions are perceived as ambiguous, or where they contradict instinctive human responses (Robinson, 2012; Ockerby, 2001; Casareale et al. 2017; Lu et al., 2017; Zhang et al., 2023). Indicatively, these responses may manifest through a range of behavioral patterns, strongly depending on the concerned individual, and they can often appear contradictory. Such reactions may vary from individuals becoming “frozen”, and unable to respond, to exhibiting excessive emotional reactions or inappropriate behavior; in certain other cases, maintaining calmness and acting rationally in the face of danger is achieved (Leach, 1994). The so-called “irrational behavioral responses” may be further intensified in confined environments, where exit routes are limited or restricted. Under such conditions, individual behaviors may become self-destructive or even pose (additional) risks to others (Leach, 2004; Leach, 1994). Furthermore, according to Leach (2005), these unpredictable behaviors, particularly among passengers, can be attributed to the reliance on pre-determined patterns of action developed through everyday experiences. Consequently, when individuals are confronted with sudden, unfamiliar, and rapidly evolving situations, they may struggle to respond effectively. It should also be highlighted that these emotional reactions are likely to spread rapidly, as individuals are inherently social beings and are significantly affected by the responses of others, particularly under adverse conditions (Nilsson & Johansson, 2009). The aforementioned issues, when compounded by unregulated and often unpredictable variables occurring during the aftermath of an accident such as vessel list, reduced visibility, time of day, and the specific nature of the emergency, further exacerbate the challenges related to effective evacuation.

Given the intricate interplay between ship design, regulatory adequacy and compliance, and the mental, psychological, and behavioral dimensions of human nature, a comprehensive analysis of the issue necessitates a multidisciplinary/integrative approach. This paper is based on a comparative methodology. Existing academic literature findings are matched against empirical insights collected through the application of three qualitative research instruments: surveys, interviews, and (personal) observation. The utilized qualitative data is obtained mainly from seafarers employed in the cruise/passenger ship industry. As the primary stakeholders in shipboard emergencies, both crew members and passengers are directly impacted by the success (or failure) of evacuation procedures. Consequently, the survey and interviews aim to capture, validate, and present first-hand insights from the experiences, opinions, and practical challenges as perceived by the seafarers in relation to the topic of emergency evacuation. It must be highlighted that seafarers from both the cruise and passenger ship sectors were intentionally selected during the interviews in order to examine potential discrepancies in procedural efficacy, safety culture, and the overall approach to evacuation preparedness across these two domains. Furthermore, an in-situ observation was conducted in order to directly capture and evaluate the crew’s knowledge and understanding of, and preparedness for, their responsibilities and duties during an evacuation drill setting. Through the acquisition and analysis of empirical data and their comparison with already established knowledge in the field, this

study seeks to identify existing knowledge gaps in the domain of cruise/passenger ship evacuation, with particular emphasis on the anthropocentric dimensions of emergency evacuation processes. It examines how cognitive, behavioral, and organizational factors, such as decision-making, communication, stress response, and training, affect evacuation outcomes. Moreover, it aims to uncover discrepancies between theoretical planning and practical execution, identify disparities and inefficiencies in training protocols, and contribute to a deeper understanding of human nature within the maritime emergency context. Finally, drawing upon the responses and insights obtained through the employed qualitative instruments, and grounded in the perspectives of seafarers, this effort will put forward recommendations for enhancing the effectiveness and efficiency of evacuation procedures.

2. Methodology

2.1 Research design

A comparative research design was adopted to examine evacuation inefficiencies in the cruise/passenger ship sector. The study integrated multiple data sources, including academic literature, an onboard observational study, a mixed-method questionnaire, and semi-structured interviews with seafarers and a clinical psychologist. This triangulated approach enabled a comprehensive and critical assessment of the research topic. The primary literature insights which provided the basis of comparison were grounded in three previous comprehensive review papers of the authors (Andreadakis & Dalaklis, 2024; Andreadakis et al., 2024; Andreadakis & Dalaklis, 2022). All of these papers examined holistically the various aspects of the evacuation inefficiencies topic. The thematic areas included the established legislation around cruise/passenger ships, the adequacy of seafarer training regarding ship evacuation (encompassing both shore-based instruction and onboard preparedness through emergency drills), the behavioral patterns exhibited by individuals (crew and passengers) during emergency evacuation, and the influence of unregulated external factors (e.g., weather conditions).

Furthermore, the literature review findings included the influence/significance of the human element, human psychology, group behavior, and ship design in shaping evacuation effectiveness and efficiency during emergencies. Additionally, the literature investigation extended to the identification and evaluation of existing or emergent technological or procedural innovative solutions, both from within the maritime domain and other industries, that have the potential to enhance the safety and efficiency of emergency ship evacuations at sea. The outputs of the identified literature were compared with the results of the empirical studies to either validate or challenge the existing academic perspectives and to offer a better understanding of the current state of affairs about the topic from the standpoint of seafarers, which is the group of people mostly affected during emergencies (together with passengers). Finally, the analysis aspired to present actionable recommendations, rooted in the perspective of seafarers, for upgrading related procedures in the cruise/passenger ship sector.

2.2 Participants

The survey study sample consisted primarily of seafarers employed on cruise/passenger vessels operating internationally. The responses were obtained from seafarers employed on a range of cruise and passenger vessels of different flags, operating across different voyages. Participants represented diverse nationalities and onboard ranks, enabling the study to capture a more comprehensive and holistic understanding of conditions and practices around the research topic within the cruise/passenger shipping sector. The total number of responses varied between 90 and 100, depending on the specific question, with a total completion rate of 61.9 %.

In regard to the semi-structured interviews, six individuals participated: five seafarers of different ranks (1 Master, 2 Staff Captains, 1 Chief Officer, 1 Second Engineer), with at least 5 years of sea service each, currently or previously employed as crew in different cruise/ passenger shipping companies, and one clinical psychologist providing expert insights into human behavior and

psychological responses during emergencies. The observational study focused on crew members aboard a RO-PAX ferry operating between the United Kingdom and France. The vessel had a carrying capacity of approximately 1,000 passengers, 250 cars, and 120 freight vehicles. The identities of both the vessel and participants were anonymized to ensure confidentiality and protect employment.

2.3 Instruments

Three (3) empirical research instruments were employed to collect data across different methodological dimensions. The utilized survey tool was a mixed-method questionnaire, consisting of fifty-five (55) questions. The questionnaire followed an “Embedded Design,” comprising forty-seven (47) closed-ended quantitative questions and eight (8) open-ended qualitative questions. The qualitative questions were designed to provide the participants with an optional exploratory opportunity to elaborate on some of their quantitative responses, thus deepening understanding of their experiences and perceptions.

Semi-structured interviews were utilized as a qualitative instrument to further explore and validate the results obtained from the survey and literature review. The semi-structured interviews were identified as the most suitable interview type, as seafarers were expected to have variant experiences and opinions around the topics under discussion. Consequently, it was evident that questions which required strict adherence (without any freedom of adjusting to the individual answers and experiences of each participant) would fall short. Furthermore, given that the interviews involved the participation of a psychologist, who provided expert insights on seafarers’ topics, and by considering that the direction of the discussion would not be predetermined or confined to narrowly focused questions, the selection of semi-structured interviews was deemed the most appropriate and effective methodological approach. This format allowed for flexibility in the dialogue, enabling the exploration of complex themes while still maintaining a coherent structure.

Additionally, an observational protocol was employed during the onboard study. The selected observation role adopted was the “partially participating observer”. With that modality, it was made possible to moderately interact with the ship’s crew and gain insights and information about their safety related behaviors, practices, and decisions, not only during drills, but also during daily interactions and conversations (Fangen, 2001; Hammersley & Atkinson, 2007). Nevertheless, that role helped the authoring team to maintain enough distance to critically assess situations and individuals without becoming overly emotionally or personally involved. Similarly, the “direct non-participant” observation technique was adopted to facilitate approaching the seafarers and the research field, while maintaining the position of an outsider. In that way, the observer was able to engage with participants within the research setting without the need to become embedded within the group, thereby minimizing the risk of influencing group dynamics, and reducing the potential for observer-induced bias in the data collection process (Hawthorne effect) (Kostera, 2007; Ciesielska et al., 2018).

2.4 Procedure

Having priorly identified the relevant literature, the empirical research was conducted in three phases. The mixed-method questionnaire was distributed electronically to seafarers across various cruise and passenger vessels. The design of the questionnaire considered the demanding nature of seafarers’ schedules, aiming to balance comprehensiveness with practicality in order to minimize respondent fatigue and dropout rates. The electronic survey platform employed for questionnaire distribution incorporated control mechanisms to ensure that each participant could submit only a single response, thereby enhancing the reliability and validity of the collected data.

Following the analysis of the survey data, semi-structured interviews were conducted to validate, challenge, and expand upon the results of the mixed-method survey, thus enhancing the quality and validity of the research effort. Furthermore, the interviews were employed to gain further understanding about the seafarers’ perceptions, experiences, and insights around the topic of the

emergency evacuation practices onboard cruise and passenger ships and to potentially receive opinions and suggestions that could help in forming a framework that could enhance the execution of abandonment procedures. Although the previously administered survey was a valuable instrument for the identification of patterns and challenges around the research topic, the complimentary use of interviews was deemed essential. This decision was linked to the authoring team's observation that certain inconsistencies emerged between literature review findings and survey responses; further qualitative clarification and investigation was needed.

Finally, an onboard observational study was conducted over a 12-day period. The primary elements examined during the onboard observations were informed by prior identified literature (Pospolicki, 2017), which suggested potential deficiencies in safety training and safety awareness among crew members of lower hierarchical ranks. In particular, the authors focused on assessing whether disparities exist between lower and higher-ranking crew in terms of knowledge, operational efficiency, and overall preparedness. More specifically, during the course of the observed drill, the leading researcher evaluated the extent to which crew members demonstrated a comprehensive understanding of their assigned duties, their ability to respond appropriately to different types of emergencies, and their capacity to effectively assist others under emergency conditions. By observing their attitude, behaviors, actions and safety awareness during the conduct of an evacuation drill (but also during their everyday lives), a clear understanding about the level of training throughout the ranks onboard the targeted type of ship would be made feasible. Limited interaction with participants took place to clarify observations, while maintaining analytical distance and minimizing observer bias.

2.5 Tools for data analysis

Data analysis was conducted through a comparative and integrative approach. Findings from the literature review were systematically compared with survey results, interview data, and observational insights to identify consistencies, discrepancies, and emerging patterns. Quantitative survey data were analyzed to identify trends, distributions, and correlations related to training adequacy, behavioral responses, and operational challenges. Qualitative data from open-ended survey questions and interviews were analyzed thematically to extract key insights, perceptions, and experiential knowledge from participants.

The integration of multiple data sources enabled methodological triangulation, enhancing the validity and reliability of the results. Particular attention was given to discrepancies between literature and empirical data, which were further investigated through qualitative methods. Ultimately, the analysis aimed to generate actionable recommendations grounded in both academic evidence and seafarers' lived experiences, contributing to the improvement of evacuation procedures and safety practices within the cruise and passenger shipping sector.

3. Results

Before proceeding to the analysis of the gathered empirical data around the aforementioned areas of interest, it is worth mentioning a quite interesting discovery in regard to evacuation times. As previously mentioned, crew and passenger are required to evacuate cruise/passenger ships in under 30 minutes from the moment the "abandon-ship" signal is given. This requirement was researched in all three empirical studies. The questionnaire results reveal that around 43% of the participants believe that a cruise/passenger ship evacuation is not possible to be accomplished in the timeframe of 30 minutes or are unsure of its feasibility. In regard to the interview responses, unanimously, all participants with a seafaring background claim that it might be achievable to evacuate smaller cruise or passenger ships in that timeframe, but in larger (size and capacity) cruise/passenger vessels, the abandonment cannot be accomplished in under 30 minutes. During the observation study, the researcher adopted the role of a "partially participating observer" and was able to engage in moderate interaction with the crew. In a discussion with several crew members on this topic, the majority of

responses were positive, with the qualification that such an approach would be attainable primarily because the vessel in question had limited deck and common areas and could accommodate only a relatively small number of crew and passengers. However, the crew expressed uncertainty regarding the feasibility of achieving abandonment within 30 minutes on a larger ship, which would feature more expansive and complex deck configurations and interior spaces.

3.1 Training

In regard to the ashore training around emergency ship evacuation, the questionnaire results indicate that 40 % percent of the respondents claim that the delivered training is insufficient for equipping the crewmembers with the necessary preparation and knowledge in order to face real-life emergencies, or that they are unsure of its effectiveness. Respondents claim that, in many cases, the offered knowledge is largely theoretical, lacking familiarization through practice; thus, resulting in gaps of familiarity and expertise when they arrive onboard for the first time. The interview participants' responses around this topic differ between them, offering interesting insights. Overall, an interesting point which emerges is that, despite the existence of international standards mandating and promoting uniform practices and training requirements across all signatory member states, in practice, there are substantial differences observed among various countries. One interviewee stated that, while in the state training center of their country there is a willingness from the instructors to provide the necessary knowledge and training, the available equipment is either outdated or malfunctioning; thus, rendering it impossible to provide adequate and effective training for present-day cruise/passenger ships. Another interviewee, who serves as a staff captain on a cruise ship, asserted that there are countries (primarily, developing nations) where shore-based training is notably inadequate. In these contexts, seafarers can often obtain certificates with relative ease, and in certain cases, examiners may even be susceptible to bribery, thereby compromising the integrity and reliability of the certification process. Consequently, a gap between the knowledge and skills among crew members is created onboard a ship, whereby some individuals are adequately trained, while others lack essential knowledge and practice. These inconsistencies can delay significantly the abandonment process and potentially have fatal impacts during a real-life emergency. These empirical results confirm the information provided in the identified literature (Pospolicki, 2017) and provide further insights from the seafarers' perspectives.

Furthermore, with respect to the onboard crew drills, the survey outcomes indicate that around 40 % of the respondents, based on their current or previous experience on ships, are fully satisfied with the evacuation knowledge and preparedness that is offered onboard. The remaining percentage claim medium or medium-to-high satisfaction in regard to the offered drill quality. The interview respondents overall draw a similar picture. The main difference is located between the respondents of cruise/passenger ships. Seafarers coming from cruise ships claim that the drill quality and level of knowledge that they can offer is relatively high, since they perform longer voyages and, consequently, have more time that they can invest in the onboard training, while the respondents working on passenger ships support that, due to the shorter voyage spans and the very frequent "standbys", the onboard training cannot be in depth and thorough. The interview participants holding both cruise/passenger ship experience hold the same opinion, underlining the difficulty of performing a quality drill while having limited time at hand. Another important issue arising through this, is the connection of high work demands and drill inefficiency. Around half of the survey participants claim that their workload negatively impacts their ability to fully achieve the objectives of an evacuation drill (**Figure 1**). The participants further elaborated on their responses, supporting that the work demands onboard are, in some cases, so demanding that they feel both physically and mentally exhausted, and are thereby unable to focus on the tasks and duties sufficiently and perform accordingly. The interview participants seemed to agree with the survey results, as they claimed that the number of crew is, in most cases, insufficient to cover all the work needs and also remain fully focused during the course of the drills without thinking that they need to finish some work tasks. The

principal area of dissatisfaction among respondents concerns the already considerable amount of paperwork, which has grown markedly over time, further exacerbating administrative burdens. These outcomes are particularly alarming, as they suggest that an exhausted crew is unable to fully assimilate the learning objectives of a drill. Consequently, it can be inferred that, in the event of an actual emergency, the performance of the personnel may be significantly compromised and, thus, remains highly questionable.

Do you believe that the crew's workload negatively impacts their ability to fully achieve the learning objectives of an evacuation drill? (N=91)

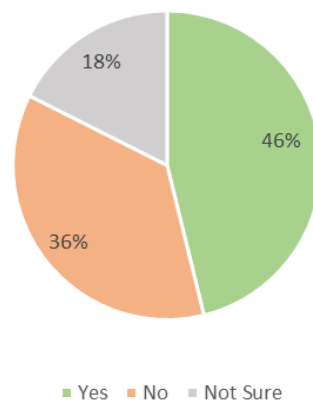


Figure 1 Effect on crew workload on evacuation drills.

Moreover, the questionnaire results indicate that 34 % of the respondents claim that fellow crew members have stated that drills are a waste of time and should be performed in less frequent intervals. Three out of five interviewed seafarers responded that they have never encountered such a statement, while the remaining two have encountered such claims. This data partially confirms the literature findings, which suggest that there are instances in which crew members treat drills as monotonous tasks, rather than vital safety exercises (Szcześniak, 2013). It is worth noting, as well, that around 32 % of the survey participants note they have experienced colleagues abstaining from drills, usually attributing this behavior to lack of professionalism, interest, or high work demands. During the interview, when participants were asked a related question, the majority indicated that all crew members routinely participated in the drills. However, one participant reported having observed instances where high-ranking officers (e.g., the Master, Chief Engineer) repeatedly avoided participation, often offering various excuses to justify their absences. It is evident that such behavior may seriously undermine the cohesion that crew members need to develop during emergency training, while also impeding the promotion of a genuine and robust safety culture onboard. Additionally, further survey answers indicate that only around 40 % percent of the participants feel fully confident in understanding and performing their duties during evacuation drills. In the observation study conducted, the researcher monitored an evacuation drill. During the course of the drill, it was observed that not all crew members were adequately familiar with their assigned duties. A number of individuals (mainly from the hotel department) were engaged in discussions among themselves regarding the specific tasks they should perform and the appropriate methods for doing so. Remarkably, one crew member demonstrated a lack of basic competence by being unaware of how to correctly don and secure a lifejacket. The interview results around this topic can be characterized as occupying a middle ground, reflecting perspectives that are neither entirely positive nor wholly negative in regard to the crew familiarity with their emergency evacuation duties. Nevertheless, the combination of results was rather alarming when considering that the people who are responsible for

the safety of a very large number of individuals are not confident or fully aware of their emergency abandonment duties. Furthermore, one overall common and expected element noted in the literature (Pospolicki, 2017; Wahl et al., 2018), survey, and interviews is the inability of ashore training and drills to replicate, in an optimal manner, real-life emergency evacuation scenarios. Apart from the fact that the training cannot replicate analogous surrounding conditions (e.g., inclination, water intake, illumination conditions), the participants are generally in proper mental and physical health and are focused on facilitating the survival and well-being of the passengers, and not their own; a fact that does not correspond to the reality of an emergency abandonment.

Another alarming result that was raised through the survey was the topic of false drill reporting. Around 30 % of the questionnaire respondents claimed instances in which drills were reported as performed, while in reality, they did not take place. A further 9 % of the participants expressed uncertainty regarding the legitimacy of drill reporting onboard their current or previous vessels. Four out of five interviewees, when asked if they had experienced similar instances, responded that all the drills onboard the ship they sailed were legitimate. However, one of the participants, employed on passenger ships, reported that the majority of the drills on one particular vessel they had sailed were not truthfully reported. The interviewee claimed that, due to very high workloads, the drills were conducted legitimately only when the ship was at shipyard facilities. Although it is observed that the phenomenon of drill reporting falsification is not generalized, the results are still quite serious and rather concerning. The catastrophic and, potentially, fatal consequences of an emergency evacuation conducted by untrained crewmembers cannot be overstated; thus, highlighting the vital necessity of rigorous and continuous training.

Moreover, the topic of muster drills was examined with the utilization of the surveys and interviews. The questionnaire results showcase that (participating) seafarers believe that around half of the passengers are truly engaged during the course of muster drills, while the remainder are moderately or less interested in them. Additionally, 58 % of the survey respondents support that muster drills in the currently performed manner are sufficient to prepare passengers for a real-life emergency evacuation, while the remaining 22 % support that they are insufficient, and the remaining 20% are unsure about their effectiveness. The answers to the interviews present a similar picture. According to the interview participants, only about half of the passengers demonstrate full attention and active engagement during the course of the drill. The remainder are not engaged due to reasons like language barriers or lack of interest. According to the interviewees, passengers onboard, especially those on cruise ships, are predominantly in a vacation mindset. As a result, they generally show minimal interest in safety demonstrations and related activities, perceiving them as monotonous or unnecessary interruptions to their leisure experience. The psychologist interviewed expanded on this observation, explaining that such behavior aligns with a well-documented psychological tendency in which individuals consciously or subconsciously distance themselves from contemplating potential risks. Consequently, they often fail to adequately attend to or internalize emergency procedures, thereby compromising their readiness in critical situations. One interview participant further reported that they had served on a cruise ship conducting voyages of more than 24 hours registered under a flag of convenience, which allowed for the replacement of physical muster drills with virtual ones. Under this system, each cabin was provided with an electronic tablet, and passengers were instructed to watch an informational video covering fundamental safety procedures such as lifejacket donning, identification of muster stations, emergency signals, and prescribed evacuation steps. This virtual approach raises significant safety concerns, as it does not ensure that passengers are capable of physically locating muster stations or performing simple but vital survival actions under real emergency conditions. Such practices may critically compromise passenger awareness and readiness and could have severe consequences during an actual evacuation scenario. These discoveries confirm and further elaborate on the existing academic literature findings around passenger behavior during and awareness of muster drills (Harbst & Madsen, 1993).

On a different note, some highly interesting discoveries and opinions emerged during the interviews. Two seafarers, as well as the clinical psychologist who was interviewed, emphasized that, on large-capacity cruise ships, the evacuation process is almost impossible to be completed in under 30 minutes, not only because of the large number of individuals onboard who need to be guided and controlled, but also because of the lack of familiarity and cohesion among crew members. In vessels with a very large number of crew members, frequent crew changes, and departmental structures that limit interaction between departments, it is inherently difficult to establish cohesion and mutual trust among personnel from different areas. Consequently, crew members often struggle to fully trust and effectively cooperate with one another, as they remain uncertain about their colleagues' levels of competence and operational reliability. Furthermore, the topic of insufficient safety culture and climate was prominently raised during the interviews. The seafarers interviewed clearly emphasized that fostering a robust safety culture and climate, both at the company level and onboard the vessel, was crucial for ensuring effective training and, by extension, for achieving successful outcomes during a possible emergency situation requiring abandonment.

How much do you think that your capabilities to perform your duties can be affected by panic, fear, "freezing behavior" or despair in case of a real-life abandonment ? Rate from no psychological affect (1) to very severe psychological affect (5).
(N=84)

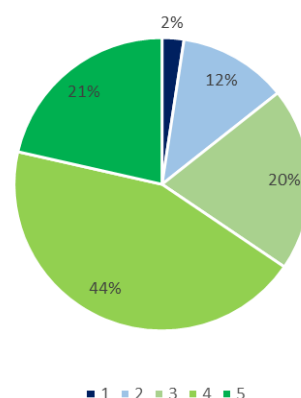


Figure 2 Effects of psychological and mental impact in real-life abandonment.

3.2 Human element

The human element is a highly complex and multifaceted factor in any operational context, and it becomes particularly critical during the process of an emergency ship evacuation; therefore, it was extensively researched with the utilization of the aforementioned empirical tools. Human psychology in regard to both passengers and crew can significantly influence the emergency evacuation of a passenger cruise ship. 65 % of the survey respondents believe that their capabilities to perform their emergency evacuation duties can be highly or very highly affected by panic, fear, or "freezing behavior" in the face of a real-life emergency (**Figure 2**). It is worth highlighting that these results come from professional seafarers with years of training and experience. It is, therefore, conceivable to assume that the passengers, who are largely inexperienced and untrained in any type of emergency and evacuation scenario, are prone to experience more prevalent and long-lasting signs of denial, "freezing", and other responses that inflict evacuation delays. These empirical results confirm the evaluated literature data (Leach, 2004; Leach, 2005), which indicated the serious effects of denial and freezing behavior on the evacuation outcome. Furthermore, the clinical psychologist interviewed elaborated further on this topic, emphasizing that these moments can be regarded as the most critical, challenging, and dangerous of the entire evacuation process. People tend to be

unpredictable in the presence of such unprecedented life-threatening situations. Their reactions can escalate from total inaction to aggression and delirium in seconds. Therefore, a precise and straightforward approach is required from the crew's side. Although training in people and passenger management are currently provided to seafarers working in the cruise/passenger ship industry, both the survey and interview results indicate that this training would benefit from significant enhancement. The participating psychologist asserted that it would be highly beneficial for both crew and passengers and, by extension, for the overall evacuation outcome to learn specific techniques and orders designed to help seafarers alleviate stress and streamline the abandonment process.

Moreover, the questionnaire results suggest that ineffective communication both among crew members, and between crew and passengers, constitutes the number one cause leading to evacuation delays and uncertain evacuation outcomes, together with the ability or inability of the crew to make informed and timely decisions. The interview results agree with the survey responses, further supporting that the language barrier mainly between crew and passengers, but also at times between crewmembers themselves, is a decisive element of an abandonment success or failure. Additionally, the element of familiarity and trust among crew members was prominently highlighted during the interviews. It was emphasized that crew members working in different departments have minimal interaction in their daily lives; consequently, during emergency situations, they may struggle to trust one another, as they lack awareness of each other's experience, strengths, and weaknesses. This phenomenon is further exacerbated due to frequent crew changes and new crewmembers, which make the establishment of social relationships even harder. This evidence is also confirmed through the questionnaire responses, as the participating seafarers believe that the second most commonly identified shortcoming during a potential emergency abandonment is linked with the inadequacy of the crew to coordinate and lead the passengers onboard to a safe place. Nevertheless, interviewed seafarers employed in smaller cruise companies with limited fleet sizes and rotations of the same personnel over time indicated that, because crew members remained largely consistent over the years, they developed a deeper familiarity with one another, as well as with the company's procedures. As a result, evacuation drills and overall preparedness were reported to be more efficient and streamlined. The aforementioned empirical data consequently confirm the literature evidence linking communication and leadership gaps to delayed and problematic evacuation procedures (Casareale et al., 2017).

One interesting, and at the same time alarming, discovery that emerged from one interview was related to the lifestyle that passengers followed while onboard cruise vessels. The interviewed seafarer highlighted that certain passengers, to a large extent, consume substantial quantities of alcohol, and there were cases where they even smuggle forbidden substances (e.g., drugs) onboard. Consequently, in the event of a real-life emergency requiring ship abandonment, these individuals were more likely to become incapacitated, and unable to respond in a cohesive and timely manner. This, in turn, introduces an additional obstacle to an evacuation process that is already compromised by various other undermining factors. Additionally, passengers with mobility limitations or special needs were recognized, through the course of interviews and the survey, as critical factors, potentially contributing to delays and complications during emergency abandonment procedures. Given that elevators are inoperative during shipboard emergencies, facilitating the movement of passengers with mobility issues from their cabins or common spaces to muster stations and life-saving appliances becomes substantially more complex and time-consuming for the crew. This challenge is compounded by other uncontrolled variables, including the vessel's list and trim, potential water ingress, and situational factors such as time-of-day conditions and reduced visibility.

3.3 Ship design

With respect to the importance and impact of ship design on evacuation times and outcomes, notable contradictions, but also interesting outcomes, emerged between the interview data and the questionnaire results. This divergence is particularly striking, as the academic literature consistently

underscores the pivotal influence of ship design on the overall success and timeliness of evacuation operations. In more detail, questionnaire results indicate that approximately 40 % of the participants strongly or moderately classify the structure and the interior design of a ship (e.g., placement of stairs and exits, width of doors and corridors) as a factor that can have a significant impact on an abandonment outcome. At the same time, it is noteworthy that the remaining 60 % did not classify ship design as a significant contributing factor in an evacuation outcome; thus, raising concerns and questions around the crew's comprehension around crucial contributing factors during shipboard emergencies (**Figure 3**). Nevertheless, all the interviewed seafarers repeatedly highlighted the importance and influence of ship design during shipboard emergencies requiring evacuation, especially in the case of cruise ships or large passenger vessels. Notably, as previously mentioned, all the interviewees and the majority of survey respondents claimed that, on large or very large cruise ships, the emergency evacuation of the ship in under 30 minutes is virtually impossible, particularly when considering all other contributing factors (e.g., potential inefficiencies in crew organization and preparedness, mental and psychological state of individuals, unregulated factors). Moreover, based on the interviewed seafarers' opinions, this situation is exacerbated when complex interior layouts occur. Based on the interview results it is supported that large open spaces significantly enhance individuals' spatial orientation onboard, allowing them to become acquainted with the ship's layout more quickly and effectively. Furthermore, based on the seafarers' experience, it is suggested that the location of muster stations, as well as the number and placement of stairways and exits, can play a critical role in the overall progress of the evacuation process, in either preventing or exacerbating bottlenecks and confusion. These observations, thus, corroborate the assertions found in the existing literature regarding the significant impact of ship design features on evacuation efficiency (Liu et al., 2022; Yue et al., 2022).

Do you believe that the interior design and structure of a ship (placement of stairs, emergency exits, width of corridors, width of doors) can affect the outcome of an evacuation? (N=79)

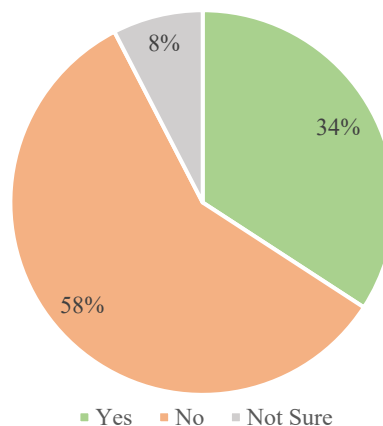


Figure 3 Influence of ship design on evacuation outcome.

As technological advancements continue to emerge and are introduced across various sectors, the maritime industry has increasingly embraced new technologies, including, for example, the implementation of Electronic Chart Display and Information Systems (ECDIS), and the adoption of electronic payment bracelets on cruise ships. Interestingly, based on the questionnaire results, 40 % of the respondents strongly believe that the expansion and incorporation of innovative technologies can enhance the effectiveness of evacuation practices, while 27 % of them are unsure in regard to the extent that contemporary technological solutions can assist during an evacuation emergency. The interviews further elaborate on this insight, indicating that technologies capable of streamlining the mustering of passengers and expediting the evacuation process through electronic verification or

registration could significantly enhance the overall effectiveness and efficiency of evacuation procedures. When asked about their opinion on the integration of AI technologies in locating passengers through sensors that could be placed throughout the decks of the ship, a mixed reaction was received. Although everyone recognized the convenience and the benefits during an emergency evacuation that this potential technological engagement could bring, there were voices claiming potential emergent issues for the shipping companies could appear. Seafarers raised concerns regarding the collection and use of passengers' personal information and data, noting that some passengers may prefer not to be locatable onboard by their travel companions. Additionally, they highlighted that such systems could create operational challenges for the crew, as passengers might continuously request assistance in locating their companions, thereby complicating crew duties and potentially detracting from overall service efficiency.

4. Discussion

The present study triangulated evidence from three empirical studies- a mixed-method questionnaire, semi-structured interviews, and an onboard observation- to examine the reasons that emergency evacuations on cruise and passenger ships, to a large extent, remain vulnerable to delays and shortcomings, despite the depth and maturity provided by the SOLAS and STCW framework. Overall, when interpreted together, the evidence indicates that evacuation performance is shaped less by the existence of procedures, and more by the operational conditions under which those procedures are executed, such as heterogeneous competence across crews, fatigue and competing work demands, uneven safety culture, communication constraints, and psychologically mediated human responses under stress. The results, therefore, reinforce the notion that a persistent disparity remains between nominal compliance (e.g., documented training, drills, and design verification) and functional preparedness (e.g., the capacity to implement evacuation tasks reliably under time pressure and uncertainty).

4.1 Regulatory adequacy vs practical feasibility: the 30-minute benchmark

A crucial point arising from the research results concerns the perceived feasibility of complying with the SOLAS-mandated requirement for the evacuation of all persons onboard within 30 minutes. Across all empirical instruments, seafarers expressed substantial skepticism regarding the achievability of this timeframe, particularly on large and very large cruise vessels. This result aligns with the findings of previous studies, found in literature, questioning the realism and feasibility of time-based evacuation criteria when applied to contemporary high-capacity passenger ships characterized by complex layouts and large, heterogeneous populations (Guarin et al., 2014; Liu et al., 2022). Nevertheless, the interviews supported that the 30-minute standard may remain attainable for smaller passenger ships or simpler RO-PAX configurations, with smaller population density and simpler spatial designs.

Furthermore, while evacuation simulations are routinely used during the design stage to demonstrate regulatory compliance (IMO, 2016), the present results suggest that these models may insufficiently capture the cumulative effects of human behavior, communication breakdowns, fatigue, and psychological responses under stress from both seafarers and passengers. The empirical evidence, therefore, supports earlier critiques that evacuation performance verified under idealized assumptions may not translate into real-world effectiveness (Ha et al., 2012; Park et al., 2015). This discrepancy raises broader questions regarding the adequacy of existing verification methodologies and the extent to which regulatory benchmarks reflect operational complexity rather than theoretical capability.

4.2 Training effectiveness and organizational safety culture

The discussion of training effectiveness reveals a notable divergence between formal compliance and meaningful preparedness. Although SOLAS and STCW establish extensive training and drill requirements, the empirical studies' results demonstrate that both shore-based and onboard

training are frequently perceived as insufficient, inconsistent, or inadequately contextualized. Variations in training quality across flag states, particularly under flags of convenience, were identified as a source of uneven competency levels among crew members that could potentially prove catastrophic during emergencies requiring ship evacuation, thus confirming concerns raised in the identified literature (Pospolicki, 2017; Wahl et al., 2018). Additionally, the results indicate that high workload, fatigue, and administrative burden substantially undermine the pedagogical value of drills. When drills are conducted under conditions of physical and mental exhaustion, learning outcomes can be compromised, and procedural familiarity remains superficial. These results are also confirmed by Tac et al. (2020), who emphasize that emergency preparedness is inseparable from organizational conditions and resource allocation.

Furthermore, the uncovered instances of drill falsification, although not universal, are particularly concerning. Even isolated occurrences showcase systemic weaknesses in safety oversight and accountability, potentially eroding trust in onboard safety practices and performance during times of emergency. From a safety culture perspective, such practices undermine the very foundations of preparedness, reinforcing the argument that safety culture must be actively cultivated and reinforced rather than assumed through procedural compliance (Bielić et al., 2017). The interviews also emphasized that safety culture is not an abstract ideal but a functional prerequisite for effective evacuation. Where crews feel unable to raise concerns, question unclear duties, or challenge unsafe shortcuts, preparedness becomes fragile.

4.3 Human element and psychological constraints

The human element emerges as the most influential, while least predictable, determinant of evacuation effectiveness. The results of the empirical studies confirm that even trained professionals anticipate significant degradation of performance under real emergency stress, due to panic, fear, cognitive overload, and freezing behavior. This result strongly corroborates the psychological literature on emergency response, particularly the work of Leach (2004, 2005), which demonstrates that cognitive paralysis can affect individuals regardless of training or experience. Importantly, the conducted studies enhance this understanding by highlighting that crew members themselves are not immune to these effects, thereby amplifying risks when responsible for guiding large passenger populations that can exhibit a wide range of behaviors and emotions- particularly given that the vast majority of passengers are untrained individuals. The clinical psychologist's interview and contributions underline the need of integrating applied psychological techniques into evacuation training- specifically, the incorporation into seafarers' training programs of short, directive communication strategies designed to interrupt freezing responses and restore action-oriented behavior. This is not simply "more training"; it is different training: psychologically informed, stress-exposure oriented, and designed to function under degraded cognitive capacity. The aforementioned aligns with recent calls for more human-centered, behaviorally informed safety training models (Casareale et al., 2017; Stefanidis et al., 2023).

Passenger behavior further exacerbates these challenges. Consistent with earlier studies (Harbst & Madsen, 1993; Nilsson & Johansson, 2009), the study results indicate widespread passenger disengagement during muster drills, driven by denial, language barriers, and a leisure-oriented mindset. The replacement of physical muster drills on cruise ships with virtual alternatives, as reported in one case, raises serious concerns regarding situational awareness and embodied learning, which are critical during time-sensitive emergencies.

4.4 Communication, coordination, and crew familiarity

Across the dataset, communication emerged as a primary driver of delay and uncertainty, both among crew members and between crew and passengers. Language barriers, hierarchical distance, and limited interdepartmental interaction were repeatedly cited as obstacles to coordinated action in times of emergency. These results are supported by prior research demonstrating that leadership

clarity and trusted authority figures are decisive during crisis situations (Brown, 2016; Turgut & Bozdog, 2022). Furthermore, the lack of familiarity among crew members, which is exacerbated by frequent crew turnover and compartmentalized departmental structures, emerged through the studies as a social structural weakness, particularly on large cruise ships. In contrast, vessels with more stable crew compositions reported higher levels of trust, cohesion, and drill effectiveness. This observation underscores the importance of organizational continuity as a safety-enhancing factor and challenges prevailing crewing models driven primarily by cost efficiency.

4.5 Ship design and evacuation complexity

Although a significant proportion of survey respondents underestimated the role of ship design, interview results reaffirm its critical influence on evacuation outcomes. Complex interior layouts, centralized staircases, and poorly distributed muster stations were identified as sources of congestion and confusion, particularly under conditions of list or trim. These insights are consistent with simulation-based studies demonstrating dramatic increases in evacuation times as vessel inclination increases (Fang et al., 2024; Wang et al., 2024). The discrepancy between seafarers' perceptions and the established literature suggests a knowledge gap that warrants attention within training curricula. Enhancing crew understanding of design-related evacuation constraints may improve situational awareness and adaptive decision-making during emergencies.

4.6 Technology as an enabler and ethical challenge

The study participants, in regard to the topic of integration of technological solutions in emergency evacuation practices, expressed cautious optimism, tempered by ethical and operational concerns. Electronic mustering and passenger-tracking technologies were widely perceived as potentially beneficial for expediting evacuation processes. However, concerns regarding data privacy, misuse of personal information, and increased workload for crew members highlight the need for ethically grounded implementation frameworks. These concerns suggest that technological interventions should be evaluated not only for technical feasibility but also for socio-technical fit; in other words, whether they reduce workload and decision complexity during emergencies, or if new sources of friction are introduced.

5. Suggestions

The seafarers who participated in the mixed-method survey and the semi-structured interviews provided a range of opinions and suggestions aimed at improving evacuation procedures, reducing evacuation times and, ultimately, minimizing the risk of casualties. All the interview participants advocated in favor of reducing the size of cruise ships, as they all believed that an effective evacuation in the given timeframe of 30 minutes, as provided by SOLAS Regulation III/21.1.3. (4), is only possible on smaller sized ships which have fewer people onboard and where the deck spaces are more compact and less complex. Additionally, both survey and interview participants expressed support for an increase in the number of crew members onboard, arguing that such a measure would help reduce seafarer fatigue and workload, thereby enhancing their performance during drills and, by extension, in actual emergency situations requiring ship abandonment. Furthermore, a specific mention was made towards elevating the safety culture standards both on the company side, but also onboard. The recommendations propose that company personnel should adopt a more safety-oriented mindset, prioritizing the adherence to safety procedures, as well as the mental, psychological, and physical well-being of individuals, rather than focusing solely on profit. Also, it is suggested that individuals who consistently fail to comply with a safety culture and mindset should be subject to removal from duty. The implementation of enhanced company standards is likely to foster greater appreciation and loyalty among seafarers, increasing the likelihood that they will remain with the company over the long term. This continuity can lead to improved familiarity with the vessels' layout, the company's safety policies, operational procedures, equipment and, possibly, fellow crew

members. As a result, such sustained engagement is expected to positively influence crew performance during evacuation drills and, by extension, in actual emergency situations. With regard to the safety culture onboard, it is suggested that existing safety meetings be conducted with greater rigor and be subject to closer supervision by the company. This would help ensure the active participation of all crew members and foster an environment in which individuals feel safe to express their opinions, questions, and concerns without fear of intimidation, ridicule, or dismissal. By promoting open communication and mutual respect, safety-related inefficiencies could be more effectively identified and addressed, thereby contributing to the elevation of overall safety perceptions and the strengthening of the understanding of emergency evacuation procedures.

Moreover, the survey participants and the majority of the interviewees strongly recommend upgrading the level of ashore and onboard training. More specifically, the need of adopting throughout all flag states a higher level, stricter, and more homogenous ashore training through all crew ranks is underlined. It is highlighted that all flag states should implement ashore training as compulsory, without the alternative of conducting that training onboard. Thereby, the level of seafarers' competency around evacuation procedures could become gradually more cohesive between individuals of all nationalities and ranks; thus, achieving a higher overall procedural understanding, proficiency, and a fertile ground for drills to be performed more effectively. Additionally, with respect to the seafarers' call for enhanced shore-based training in passenger psychology and management, the interviewed clinical psychologist proposed that practical measures could be implemented to address this need. The psychologist recommends that crew members be trained in the use of specific key phrases designed to "unlock" passenger responses during moments of psychological freezing or disorientation. Such short and straightforward verbal cues (e.g., move, go, do that, etc.) can help mitigate unarticulated or delayed reactions which often contribute to confusion and may adversely impact the overall efficiency and timing of the evacuation process. It is also suggested that crew members be taught techniques that help themselves calm down and not become affected by the surrounding emergency; hence, they would be able to focus more efficiently on their job, instruct or direct the passengers, and eventually expedite the abandonment effort. In regard to the conduct of drills, a large number of survey and interview participants underlined the importance of conducting evacuation drills in more frequent intervals (2 times per week), aiming to better familiarize the crew members with all possible emergencies requiring evacuation. Nevertheless, there were voices claiming that such an approach would further increase the workload of the personnel, thus elevating their stress level and adding to their fatigue. It is, therefore, conceivable that the employment of extra personnel, as previously mentioned, is essential for increasing the onboard safety training levels, which would ultimately reduce overall fatigue and stress levels.

Muster drills were also identified as an area of improvement. Taking into account that passengers are typically in a "vacation mode", and generally disengaged from learning experiences, crew members involved in the conduct of drills observed that passenger interest tends to increase when the importance of active participation and attention during muster drills is clearly communicated to them. In the study, participants emphasized that framing adherence to these procedures as a matter of life and death during a shipboard emergency substantially increases passenger attentiveness and compliance. Additionally, the interviewees highlighted that involving passengers in a more interactive manner, for example, by incorporating questions, renders the drill both more engaging and more memorable, thereby enhancing overall safety preparedness. Furthermore, with regard to passenger behavior during cruises, it would be beneficial to establish a maximum limit for alcohol consumption to ensure that passengers are not rendered incapacitated and remain capable of responding appropriately in the event of an emergency; also, in the case of muster drills, they should have the ability to focus and participate efficiently.

Moreover, the survey and interview results pointed to the need for stricter language-proficiency requirements for crew members employed by cruise/ passenger ship companies operating vessels where the designated working language differs from their native language. Specifically, the

seafarers supported that the crew should be required to undergo assessment in the vessel's designated working language prior to joining. If their language proficiency is deemed insufficient, they should be enrolled in targeted language training program to ensure adequate communication skills, particularly in operational and emergency contexts. Consequently, communication problems, which are identified as one of the primary causes of evacuation delays, can be effectively addressed through such measures. Furthermore, the empirical studies supported that it would be highly beneficial if cruise/passenger ship personnel be sent from the company to ships with similar layout (e.g., sister ships if possible), in order to have a continuous familiarity both with the ship and the other crew members. Thereby, newly joining crew members would, from their first day onboard, already possess a degree of familiarity not only with the vessel's physical layout, but also with their fellow seafarers. Such familiarity with both the operational environment and co-workers is recognized by the data-driven analysis results as a factor that can significantly enhance crew performance during emergency situations, ultimately contributing to more streamlined evacuation procedures, reduced evacuation times, and improved overall evacuation outcomes. Moreover, it is supported that passengers with mobility issues shall be placed in cabins on the same floor and in the vicinity of muster stations; thus, expediting the evacuation process for both crew and passengers during a possible emergency requiring evacuation. Finally, it is supported through the seafarers' questionnaires and interviews that the integration of modern technologies, such as electronic mustering of passengers, could streamline the evacuation process.

6. Limitations

Although the proposed recommendations for improving evacuation procedures aboard cruise and passenger ships are comprehensive and well-supported by seafarer experiences and psychological insights, there are certain limitations that their implementation may encounter. Firstly, the suggestion of reducing the size of cruise ships could directly challenge the current economic model of expansion of a significant number of cruise shipping companies or operators, which rely heavily on large and very large capacity vessels for profitability. Consequently, an effort to push for smaller cruise ships could be met with strong resistance from stakeholders prioritizing financial returns. Secondly, the proposal of increasing the number of crew members onboard, aiming to reduce fatigue and enhance performance, may lead to higher operational costs, such as wages, training, accommodation, and insurance, which companies may be reluctant to absorb without regulatory mandates. Thirdly, the proposal for stricter, more standardized shore-based training across all flag states might face issues in enforceability due to varying national regulations, infrastructure, and economic disparities, especially among flags of convenience.

7. Conclusions

This research effort extensively examined the multidimensional nature of emergency evacuation aboard cruise/passenger ships, uncovering a persistent gap between regulatory expectations and practical outcomes. Despite the existence of a comprehensive international regulatory framework, primarily structured and implemented through the provisions of SOLAS and STCW, which mandates time-based protocols and capabilities, rigorous training standards, and safety-centered procedures, the empirical and observational data collected in the current study suggest that significant inefficiencies remain. Through the examination and integration of literature findings and qualitative data obtained from surveys, interviews, and an onboard observation, it was showcased that the effectiveness of emergency evacuation is affected by a variety of factors, such as ship design and regulatory compliance, but also by the deeply embedded human, cultural, and organizational factors.

A significant observation from the empirical results is the widespread reservation between seafarers around the feasibility of evacuating large and very large of cruise vessels within the prescribed 30-minute timeframe. This concern is further exacerbated by the continuous increase in

vessel size, which may introduce additional challenges and complexities during emergency evacuations. These perceptions are rooted in their practical experiences and are further supported by observed limitations related to training, interdepartmental coordination, and passenger unpredictability. To mitigate these inefficiencies, seafarers propose, through the current study, several pragmatic solutions, including increased manning levels to mitigate fatigue and boost drill performance and the prioritization of safety culture, trust, and familiarity among crew through consistent deployment strategies. Nevertheless, such proposals are subject to economic and operational constraints underlining the friction between safety imperatives and commercial viability. Furthermore, the research reveals concerning disparities in shore-based training quality and effectiveness among flag states and, particularly, flags of convenience. These inconsistencies undermine the intended standardization of safety related competencies and contribute to operational asymmetries onboard that can prove fatal during a shipboard emergency requiring evacuation. Moreover, equally important are the psychological dimensions of evacuation: the prevalence of cognitive denial, “freezing” behavior, and impaired decision-making during crises, which illustrate the need of further inclusion of evidence-based psychological interventions in the crew training curricula and practices. The interviewed clinical psychologist emphasizes the necessity of incorporating tailored verbal and behavioral communication strategies into current passenger management training programs, specifically designed to elicit immediate and effective passenger responses during emergency situations. Additionally, the increasingly expanding technological solutions, such as electronic mustering systems, if ethically and operationally directed, could provide significant assistance during emergency evacuation. However, the potential misuse of personal data, and the increased burden on crew, raise serious questions about privacy and operational feasibility. These tensions exemplify the broader difficulty of finding a balance between innovation, ethics, and practical application.

Overall, the study findings underline that achieving substantial improvements in evacuation procedures, and in extension evacuation outcomes, requires holistic and systemic changes, including improved training, stronger safety culture at the company and ship level, efficient and intelligent ship design, and targeted human-centric policies. Although the regulatory compliance remains foundational and essential, it is the integration of seafarers’ lived experiences and the adoption of their practical recommendations that hold the greatest potential to generate meaningful improvements in evacuation procedures during emergencies and, ultimately, to reduce casualties.

Ethics Approval Declaration

The Research Ethics Committee (REC) of the World Maritime University (WMU) reviewed and approved the survey and interview instruments that were used in the current study. Ethical clearance for the observational study was obtained from the Master of the vessel on which the research was conducted. The researcher explicitly assured the Master that neither the name of the vessel, nor that of the shipping company, would be disclosed, and that the identities of the participating seafarers would remain strictly confidential, in order to safeguard their privacy and professional integrity. Furthermore, prior to the commencement of the observations, informed consent was sought from the crew members involved. The researcher clarified that no personal identifiers, including names or any information that could enable their identification, would be recorded or made publicly available.

Acknowledgement

This research effort is part of the leading author’s PhD effort. The author wishes to express sincere gratitude to all the seafarers who generously participated in this research through observation studies, interviews, and surveys. Their openness, trust, and willingness to share their experiences were invaluable to the depth and quality of this study. Special thanks are also extended to those individuals who facilitated contact with the seafaring community. Their assistance was crucial in enabling access to participants and ensuring the smooth conduct of data collection at sea and ashore.

Finally, sincere gratitude is given to Maria Carrera Arce, the clinical psychologist who participated in this study and who generously contributed valuable insights and perspectives on human behavior, particularly regarding seafarers' reactions and psychosynthesis during emergencies.

The views herein are solely of the authors, and do not represent the views of the Department of Homeland Security/U.S. Coast Guard, or any other organization with a similar scope.

Declaration of generative AI in scientific writing

The authors used ChatGPT (OpenAI) and Grammarly for assistance in conceptualization and grammar refinement of the manuscript. With or without AI applications, the authors are fully accountable for every process of the work and manuscript writing. All final edits, interpretations, and conclusions are the sole responsibility of the authors. The authors academically and ethically confirmed that the stated AI statements are true, and the authors are ultimately responsible and accountable for the contents of the published work, including the correctness of the references in the reference list.

CRediT author statement

Antonios Andreadakis: Conceptualization; Methodology; Validation; Writing - Original Draft; Writing - Review & Editing; Visualization; Data Curation; Resources; Investigation; Project administration. **Dimitrios Dalaklis:** Supervision; Project administration; Writing - Review & Editing; Visualization; Validation. **Al Blaisdell:** Supervision; Writing - Review & Editing; Visualization.

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