Ship Safety Officers' Perceptions and Attitudes Toward Near-Miss Management Systems

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Unlike learning from accidents, learning from near misses is based on events that caused no injuries or damage. Therefore, reporting and investigating near-miss events in shipping could be considered a more convenient means of reducing accidents and safety improvements than accident investigations. However, to facilitate learning from near misses, an adequate and efficient Near-Miss Management System must be implemented on board ship. Since ship Masters and Safety Officers are responsible for the efficiency of the Near-Miss Management System (NMMS) on the shipboard side, their attitudes and opinions on implemented systems might be considered indicators of its quality. Therefore, the questionnaire was developed and distributed among Masters and Safety Officers to collect their perceptions of and attitudes toward Near-Miss Management Systems. Furthermore, the paper aims to examine the relationship between the respondents' ranks (Masters and Safety Officers), the type of ship they are serving on, and their attitudes toward Near-Miss Management. The data analysis showed that most respondents are satisfied with the Near-Miss Management Systems implemented on their ships but consider near-misses underreported. Moreover, analysis results showed that there are no significant differences in attitudes towards NMMS between ranks and types of ships.

1. INTRODUCTION

A marine accident is an undeliberate and unexpected event or a sequence of events resulting in injury or death of people or damage to property and environment, which occurred directly with the operations of a ship (IMO, 2008a). It is necessary to report, investigate and analyze marine accidents, and disseminate lessons learned publicly to improve safety at sea. Although systems and equipment comprised of new technologies aiming to prevent accidents and improve safety at sea are introduced on ships, accidents still happen. The reason for it might be the human-technology interaction, whereas relatively new causes of marine accidents emerge, like inadequate knowledge of own ship systems, overreliance on technology, and complacency (Bielić et al., 2017a; Bielić et al., 2020). According to Baker and McCafferty (2005) and Ugurlu et al. (2015), human error is accounted for about 80-90 % of marine accidents. It must also be noted that the organizational climate, which can be simply explained as the way things are done on board ship, is one of the leading causes of human error, besides the already-mentioned technology-related human error (Hasanspahić et al., 2021a). Reporting adverse events that did not cause injuries or material damage is crucial for safety improvements on board ships.

Therefore, near-miss events could be a valuable tool for preventing accidents in various shipboard operations. For example, mooring and unmooring operations could be

considered among the highest-risk ship operations. According to the UK P&I club report, mooring incidents are among the top seven types of insurance claims (DNV). Consequently, there is a need to implement updated mooring standards and practices in the shipping industry. As ships are getting larger, new materials and mechanical systems are introduced, and the number of crewmembers is being reduced, so mooring safety is seriously impaired (DNV). To develop new standards and procedures, it is necessary to receive feedback from seafarers and harbor workers who deal with mooring operations. Another input is accident reports, where something went wrong and there were serious consequences. For instance, one of the recently published accident reports was the fatality of a Chief Officer (C/O) on one general cargo ship during a mooring operation. The ship was moored alongside another ship and had a ship-to-ship (STS) cargo operation. The ship needed to move forward to continue with the cargo operation and during the warping operation, C/O got struck in the head by the mooring line that broke under tension and deceased from the consequences of the injury. Among other factors affecting the accident, the investigation revealed an insufficient number of crewmembers assigned to carry out the warping operation and insufficient planning for the mooring and warping operation. Furthermore, crewmembers were inexperienced in STS bulk cargo operations and lacked time available for planning and preparation (MAIB, 2022). The unavailability of adequate risk assessment seriously impaired the safety of shipboard operation and "routine" warping operation turned fatal. However, the risk of such accidents could be mitigated if mooring operation near-miss events were reported, investigated, analyzed, and disseminated to all stakeholders. Then, lessons learned could be implemented in existing procedures and risks could be mitigated. For example, International Marine Contractors Association (IMCA), through Safety Flashes, disseminate important data about incidents, potential hazards, and the lessons learnt from them that can help prevent similar events in shipping (IMCA). There were several reports of near misses during mooring operations on ships with a high potential for serious injury (IMCA, 2014; IMCA, 2018; IMCA, 2022). They disseminate information about the potentially hazardous event, together with analysis (causation finding), recommendations for corrective measures, and lessons learned. In that way, stakeholders can learn from near-miss examples that did not cause harm and shipboard safety can be improved (e.g., amending risk assessments for mooring operations for data disseminated in Safety Flashes). Serious accidents could be avoided in this way and collective learning could be achieved without severe consequences.

However, quite often, there is a tendency to take a near miss as a positive signal and ignore its importance for possible safety improvements. Seafarers and all maritime stakeholders should understand that a near-miss event is not a success since no harm was done; it is a warning signal calling for a quick reaction (Dillon et al., 2016). It reveals weak spots in safety systems and allows the patching of holes in safety barriers before harm is done. Therefore, events like this should be recorded and reported since they constitute a near miss and share the same root causes as accidents. According to the International Maritime Organization (IMO), a near miss is "a sequence of events and/or conditions that could have resulted in a loss. This loss was prevented only by a fortuitous break in the chain of events and/or conditions. The potential loss could be a human injury, environmental damage, or negative business impact" (IMO, 2008b).

Correspondingly, serious marine accidents could be prevented by reporting, investigating, and analyzing near-miss events and, equally important, disseminating conclusions to all interested maritime stakeholders. Near-miss investigation and analysis is an excellent chance to improve safety because there is no need to wait for an accident causing harm and economic loss to happen. It might be said that the near-miss analysis is a "cheap" way of improving safety and reducing the number of accidents at sea. To encourage and improve near-miss reporting, the IMO issued Guidance on near-miss reporting (IMO, 2008b). Moreover, near-miss reporting needs to be implemented on board ships under the International Safety Management (ISM) Code Section 9 (reporting of hazardous occurrences) (IMO, 2010). However, despite the ISM Code and mandatory reporting, several studies found that seafarers do not report all observed near-misses (Jones et al., 1999; Vepsäläinen et al., 2010; Hasanspahić et al., 2020). As Hasanspahić et al. (2020) found in their study, 95.5 % of seafarers consider that near misses should be reported, but only 38.5 % report each observed near miss. There could be several reasons for that, but the most significant ones identified in the literature are: blame culture (Phimister et al., 2003; Cooke and Rohleder, 2006; Wang, 2006; Erdogan, 2011; Lappalainen et al., 2011; Bhattacharya, 2012; Adamson, 2015), being ashamed (Vepsäläinen et al., 2010, Storgård et al., 2012b, Lappalainen et al., 2011), knowledge on near misses (Hasanspahić et al., 2020), inadequate leadership (Oltedal and McArthur, 2011; Bielić et al., 2017b; Hasanspahić et al., 2021b), near-miss reporting form complexity (Cooke and Rohleder, 2006; Wang, 2006; Erdogan, 2011; Lappalainen et al., 2011; Williamsen, 2013; Adamson, 2015; Hasanspahić et al., 2020), commitment from top management (Sanne, 2008; Oltedal and McArthur, 2011), seafarers' cultural differences (Sanne, 2008; Erdogan, 2011), turnaround on a particular ship (Oltedal and McArthur, 2011; Kongsvik et al., 2012), and "Nothing is wrong in my ship" approach (Safety4Sea, 2022). These barriers need to be overcome to efficiently use a Near-Miss Management System, improve safety at sea and develop a safety culture on board ship.

A Company needs to implement a Near-Miss Management System to efficiently and adequately deal with the near misses on board ship (Hasanspahić et al., 2020). As stated, near miss must be reported, investigated, and analyzed to find immediate and root causes, which will help draw conclusions and make suggestions for preventing recurrence and improving safety. Furthermore, the system should deal with the reporting barriers and guide seafarers to overcome them.

In addition, in research by Hasanspahić et al. (2020), near-miss reporting inequality was found between shipboard departments (Deck and Engine). Out of the 467 collected near-miss reports with reporter's rank, 72 % were reported by Chief Officers, 14 % by Deck Officers, 9 % by chief engineers, 2 % by Masters and 3 % by other crewmembers. Therefore, in this study, we intend to detect if there is a difference in opinions on Near-Miss Management Systems among ranks and ship types. Accordingly, this paper aims to:

• Investigate satisfaction of shipboard Safety Officers and masters with the implemented Near-Miss Management Systems in shipping because they are the users on shipboard side. Also, an efficient system might improve safety on board, and it is in the best interest of the seafarers to use it adequately;

• Investigate relations between the seafarers' ranks (Master and Safety Officers) and attitudes toward Near-Miss Management Systems;

• Investigate relations between ship type and attitudes toward Near-Miss Management Systems.

2. NEAR-MISS MANAGEMENT SYSTEMS IN SHIPPING – LITERATURE REVIEW

The efficiency of Near-Miss Management Systems implemented on board depends on the seafarers using it and Company management commitment from the shoreside. Previous studies on Near-Miss Management Systems identified five to eight phases (or steps).

Most studies consider identification the first phase in a Near-Miss Management System (Phimister et al., 2000; Oktem, 2002; Cooke and Rohleder, 2006; Meel et al., 2007; Gnoni et al., 2013; WSH, 2016; Hasanspahić et al., 2020). However, Rasmussen et al. (2013) recognized observation as the first phase, although it might be argued that to observe a near-miss event, one needs to identify it. Therefore, in their study, Craig et al. (2014) named the first phase awareness since their opinion is that seafarers need to be trained to identify hazards and near misses. Consequently, complete Near-Miss Management System efficiency and safety improvement depend on the seafarers' knowledge of near misses and hazards. If seafarers do not know what constitutes a near miss, the whole system is deficient, and it cannot be expected that safety will improve.

The system's second phase is reporting or disclosure (Phimister et al., 2000; Oktem, 2002; Cooke and Rohleder, 2006; Meel et al., 2007; Gnoni et al., 2013; Rasmussen et al., 2013; Craig et al., 2014; WSH, 2016). In the study by Lindberg et al. (2010), reporting is the first phase of a system, which could be considered adequate if all seafarers are proficient in recognizing near-miss events. Unfortunately, it was found that especially low-ranking seafarers have difficulties identifying near misses (Hasanspahić et al., 2020), and it can be considered that near misses cannot be reported without proper identification or processed further. Near-miss reporting could be done in two ways: 1) the seafarer observing the near-miss event reports it verbally to the Safety Officer or 2) the seafarer observing the near-miss event fills out the near-miss report form. In the first case Safety Officer fills out the report, while in the second case, he receives a filled-in report. In this phase, the Safety Officer's attitude will affect the reporting crewmember, and if it is negative, it could act as a reporting barrier and prevent near misses from being reported, thus downgrading shipboard safety. Along with identification, reporting could be considered a pillar of the whole Near-Miss Management System and, therefore, Hasanspahić et al. (2020) considered together with identification as the first phase.

The third phase of the system is prioritization or selection (Oktem, 2002; Meel et al., 2007; Gnoni et al., 2013; Rasmussen et al., 2013; Hasanspahić et al., 2020). Although some studies did not include prioritization in a Near-Miss Management System (Phimister et al., 2000; Cooke and Rohleder, 2006; Craig et al., 2014; WSH, 2016), it is a vital link within. For instance, companies with numerous ships employing hundreds or even thousands of seafarers could receive large numbers of near-miss reports in their offices. It would be impossible to investigate all of them; therefore, "minor" near misses (low-risk ones) should be resolved without performing an investigation and "wasting" resources. However, high-risk near misses must be investigated and analyzed to find root causes and learn from them. Therefore, rating near-misses (hazards that could have been caused) is critical to assess whether reported near-miss events should be investigated and analyzed.

Distribution could be considered the fourth phase of an effective Near-Miss Management System (Oktem, 2002; Meel et al., 2007; Gnoni et al., 2013; Hasanspahić et al., 2020), while Phimister et al. (2000) considered it the third phase. Some studies do not consider distribution (Cooke and Rohleder, 2006; Lindberg et al., 2010; Rasmussen et al., 2013; Craig et al., 2014; WSH, 2016), but without it, there could be no external investigation and analysis of the causes. If a near-miss report is prioritized and not distributed to the person in charge of safety within the Company, valuable knowledge could be lost and corrective actions not disseminated to a broader audience (if applicable).

The fifth phase of the system could be cause analysis or investigation (Oktem, 2002; Meel et al., 2007; Gnoni et al., 2013; Rasmussen et al., 2013; Hasanspahić et al., 2020). However, in the studies conducted by Cooke and Rohleder (2006), Lindberg et al. (2010), Craig et al. (2014), and WSH (2016), it is the third phase, and in Phimister et al. (2000) and Rasmussen et al. (2013), it is the fourth phase. All studies reviewed include cause analysis or investigation in the Near-Miss Management System. Its purpose is to identify immediate and root causes of a near miss that could trigger an accident in the future if no action is taken.

Solution identification is the sixth phase of the system (Oktem, 2002; Meel et al., 2007; Gnoni et al., 2013; Craig et al., 2014; Hasanspahić et al., 2020), while in Phimister et al. (2000), it is the fifth phase, and Cooke and Rohleder (2006) consider it the fourth phase. Studies by Lindberg et al. (2010), Rasmussen et al. (2013), and WSH (2016) do not incorporate this phase in their systems. This phase includes identifying adequate corrective actions that could improve onboard safety and prevent the recurrence of adverse events. It is important to stress that the solutions found should be practical and possible to implement on board ship. As seafarers will be the ones implementing corrective actions, it is suggested to discuss the implementation with crewmembers during a regular monthly safety meeting on board and ensure that the solution is adequate and efficient.

Corrective actions identified in the previous phase, together with the near-miss, should be disseminated in the seventh phase to the broader audience to increase safety awareness and prevent the occurrence of possible adverse events (Phimister et al., 2000; Oktem, 2002; Cooke and Rohleder, 2006; Meel et al., 2007; Gnoni et al., 2013; Craig et al., 2014; Hasanspahić et al., 2020). Lindberg et al. (2010) consider dissemination as the fourth phase of their system, while Rasmussen et al. (2013) and WSH (2016) do not include it in their systems. The value of dissemination in maritime safety improvement is immense. Without dissemination, the value of reporting, identifying and implementing corrective actions would be significantly reduced. Therefore, disseminating investigation results and findings, together with near-miss reports, is the basis of learning from incidents.

The final phase is resolution, during which the identified and implemented corrective actions are followed up, reviewed and evaluated to ensure their efficiency and applicability to the specific ship (Phimister et al., 2000; Oktem, 2002; Meel et al., 2007; Lindberg et al., 2010; Gnoni et al., 2013; WSH, 2016). Resolution should also include feedback to the initial near-miss reporter.

A Near-Miss Management System is important because it enables learning from someone else's experiences and, if adequately used, prevents accidents (Erdoğan, 2011). Identification and reporting are initial and the most critical phases of the system and any shortcomings during these phases will result in a flawed and inoperative system. Moreover, it must be noted that the other phases are also important, but dissemination is particularly important, especially for small shipping companies. It enables learning from near-miss events that occurred elsewhere and gives a chance for safety improvements based on solutions made by someone else. Near-Miss Management System literature overview provided an insight into the phases of the system.

3. METHODOLOGY

The main goal of this paper is to gain insight into the seafarers' satisfaction with the systems implemented on board their ships, together with the opinion on onboard locations where the most near-misses occur. Since Safety Officers and Masters are in charge of safety matters on board ships, this research aimed to collect and analyze their perceptions and opinions. In addition, the paper aimed to recognize the most common near-miss categories and suggest measures to improve the existing Near-Miss Management Systems in shipping. Another important goal of the study was to examine the relationship between the respondents' ranks, shipboard departments, and the type of ship with attitude toward Near-Miss Management Systems.

An online questionnaire was developed to collect data on Safety Officers' and Masters' attitudes toward the Near-Miss Management Systems implemented on their ships (Hasanspahić et al., 2021c). A web link to the questionnaire was sent to several crew recruitment agencies. They were asked to forward the link to the Masters and Safety Officers, who, in return, could agree to participate in the survey or not. However, confidentiality and anonymity were agreed upon if they chose to participate. Also, the seafarers could forward the link to their colleagues and expand the number of potential respondents (virtual snowball sampling). The questionnaire contained 20 questions, which were as neutral as possible to avoid biased responses, and it was available online during 2019 and 2020. Moreover, a pilot survey was conducted to test the questionnaire and ensure its completion would not be time-consuming and complicated. The study was ethically conducted, and the protocol was approved by the Ethics Committee of the University of Dubrovnik on 19 November 2020 (EA 1459/20).

After receiving positive feedback from the pilot survey respondents, it was decided to continue with the questionnaire, consisting of two parts. The first part was composed of questions dealing with the respondents' demographics including nationality, age, rank, type of education, type of ship, time served in the current rank and total sea service time. The second part was composed of 11 close-ended and two open-ended questions dealing with Near-Miss Management Systems.

Descriptive statistics were used to analyze the responses, and the Chi-Square Test of Independence was used to examine

the relationship between the responses. The programming language Python was used to examine the relationships between the variables. The first two variables were obtained by dividing the sample according to the rank (Master or Safety Officer) – V1, and the type of ship (tanker, cruise, dry cargo or other) – V2. The responses to the questions "Do you think that near-miss follow-up measures received from the Company are substantial and applicable to your vessel?" (Q3), "Do you agree that near-misses should be rated (given low or high priority) before sending them to the office (to the designated person)?" (Q10) and "Please, rate satisfaction with Near-Miss Management System in your Company" (Q5), were chosen as the following three variables. The following null hypotheses were tested:

H0,1) There is no statistically significant relationship between seafarers' ranks and opinion on near-miss follow-up measures received from the Company (V1 vs Q3).

H0,2) There is no statistically significant relationship between seafarers' ranks and opinion on rating near-misses before distributing them to the Company (V1 vs Q10).

H0,3) There is no statistically significant relationship between seafarers' ranks and perceived satisfaction with the ship's Near-Miss Management System (V1 vs Q5).

H0,4) There is no statistically significant relationship between the type of ship and the opinion on near-miss follow-up measures received from the Company (V2 vs Q3).

H0,5) There is no statistically significant relationship between the type of ship and the opinion on rating near-misses before distributing them to the Company (V2 vs Q10).

H0,6) There is no statistically significant relationship between the type of ship and the perceived satisfaction with the ship's Near-Miss Management System (V2 vs Q5).

A total of 112 seafarers participated in the survey. Eight nationalities were represented in the survey sample. The majority of the seafarers were from Croatia (90 %), followed by the Philippines (2 %), Finland (2 %), Montenegro (2 %), Bulgaria (1 %), Greece (1 %), Serbia (1 %) and Ukraine (1 %). The ranks of the seafarers are presented in Figure 1.
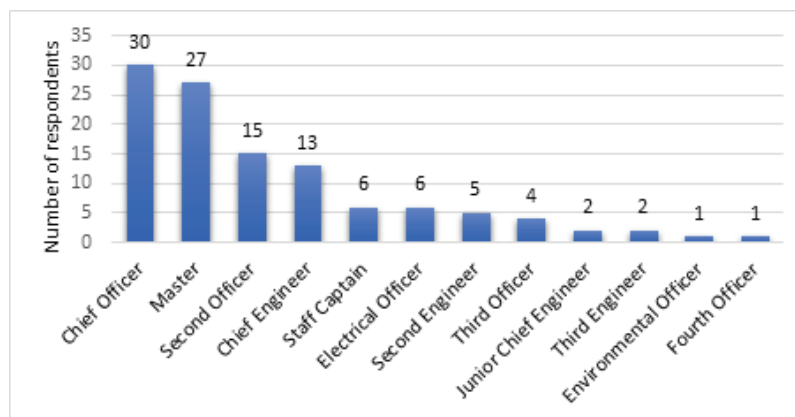

Figure 1.
Respondents' reported ranks.

Most respondents reported being Chief Officers and Masters (51 %). Moreover, 75 % of the respondents belonged to the Deck department, while 25 % belonged to the Engine department. Furthermore, in terms of age, 21 % of the respondents reported being younger than 33, 49 % reported being between 34 and 42, 19 % between 43 and 51, and 11 % were older than 52. The majority of respondents were maritime college graduates (69 %), and the remaining 31 % finished maritime high school. The participants reported sailing on different ship types, among which oil tankers (33 %), LNG tankers (23 %) and cruise ships (21 %) were the most highly represented ship types, followed by bulk carriers (7 %), chemical tankers (5 %), container ships (4 %) and other ship types (7 %). Other ship types included Ro-Ro passenger

ships, tug boats, AHTS (Anchor Handling Tug Supply ship), PSV (Platform Supply Vessel), FLNG (Floating Liquified Natural Gas) and FSRU (Floating Storage Regasification Unit) ships. In terms of years of service in the current rank, 70 % of respondents reported being in rank 6 years or less, while 30 % were in the rank for 7 years or more. Regarding their total sea service time, 39 % of the respondents spent 11 years or less at sea, 32 % between 12 and 17 years, and the remaining 29 % served for 18 years or more. According to the analysis of the seafarers' responses to the demographic questions, it can be concluded that the sample was composed of experienced and educated high-ranking officers in charge of safety on their ships.

4. RESULTS AND DISCUSSION

The second part of the survey was composed of the questions regarding Near-Miss Management Systems on the respondents' ships. The questions were grouped to facilitate the presentation of the results. The first two questions (Q1 and Q2) dealt with the respondents' attitudes towards the Marine Accident and Incident Investigation training. The questions and the descriptive statistics for the responses are presented in Table 1.

Table 1.
Seafarers' experiences and opinions on Marine Accident and Incident Investigation training.

Question	Yes (%)	No (%)	Don't know (%)
Q1: Have you received formal training on accident/incident/near-miss investigations?	69	31	N/A
Q2: Do you think formal training regarding accident/incident/near-miss investigations should be mandatory?	69	24	7

The IMO developed Model Course 3.11, *Safety investigation into marine casualties and marine incidents*, which deals with investigating accidents and incidents (including near misses). The investigation includes collecting and analyzing the incident data to draw conclusions that will determine immediate and root causes and the contributing factors and provide safety recommendations. In addition, some maritime training centers and shipping companies developed tailor-made courses based on the IMO Model Course 3.11. The subjects of the tailor-made courses include reporting, investigation, and learning from accidents and incidents. However, since they are not compulsory, some shipping companies are reluctant to invest money and train their employees even though this kind of training aims to improve safety awareness onboard ships, facilitate accidents/incidents investigations, and enable the development of the safety culture at sea.

The majority of the participating seafarers responded affirmatively to Q1 (Table 1), meaning that most of them are formally trained to investigate incidents, find their causes and suggest corrective actions. However, according to the responses, not all the participants are trained (31 %) and there are still Masters and ship Safety Officers who have not received formal training in incident investigation. In addition, according to the responses to Q2, most of the respondents (69 %) believe
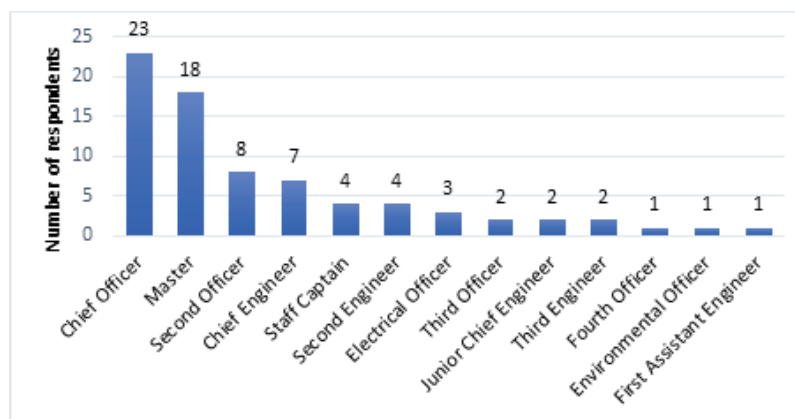
Figure 2.
Ranks of respondents answering affirmatively to Q2.

that incident investigation training should be mandatory for shipboard Safety Officers and Masters. There are several benefits of introducing incident investigation training as mandatory, such as more efficient unwanted events' (incidents, near-misses) investigations on board ships and improved safety culture in shipping.

The analysis of the responses to Q2 showed that more respondents belonging to the Deck department have a positive attitude towards introducing mandatory incident investigation training (75 % of positive responses to Q2) than the respondents belonging to the Engine department (25 % of positive responses to Q2). Also, most of the ship Masters and Chief Officers favored mandatory training (Figure 2).

Questions and descriptive statistics regarding respondents' attitudes toward Near-Miss Management Systems implemented on their ships are presented in Table 2.

Figures 3, 4 ad 5 present the respondents' attitudes toward Near-Miss Management Systems according to their ranks (Master or Safety Officer) and ship types.

Table 2.
Respondents' perceptions and attitudes toward Near-Miss Management Systems.

Question	1(%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. dev.
Q3: Do you think that near-miss follow-up measures received from the Company are substantial and applicable to your vessel?	5.3	12.4	21.2	44.3	16.8	3.52	1.09
Q4: Do you think that crewmembers on board your vessel report all near misses they observe?	20.7	25.8	32.8	14.7	6	2.52	1.09
Q5: Please, rate satisfaction with Near-Miss Management System in your Company.	4.4	10.5	28.9	43	13.2	3.48	0.99

Q3 and Q4: 1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree; Q5: 1=poor; 2=average; 3=good; 4=very good; 5=excellent
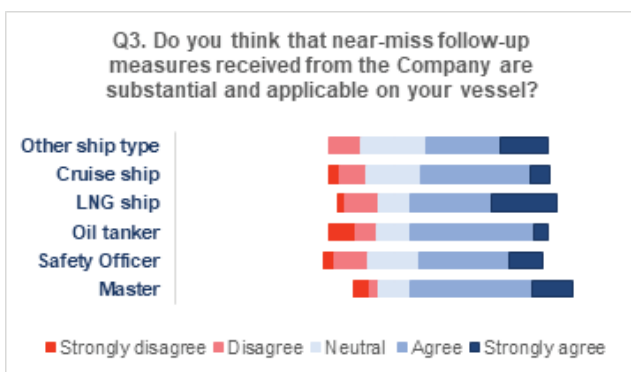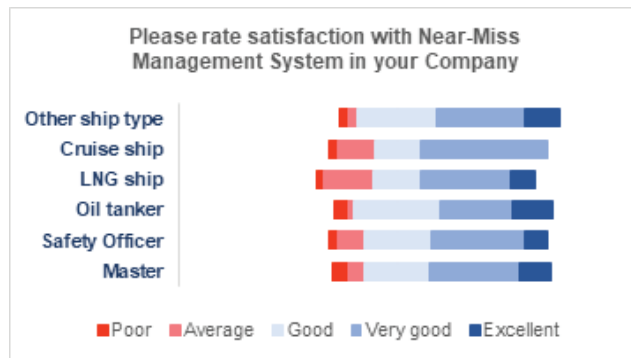

Figure 3.
Answers to Q3 according to respondents' ranks and ship types.
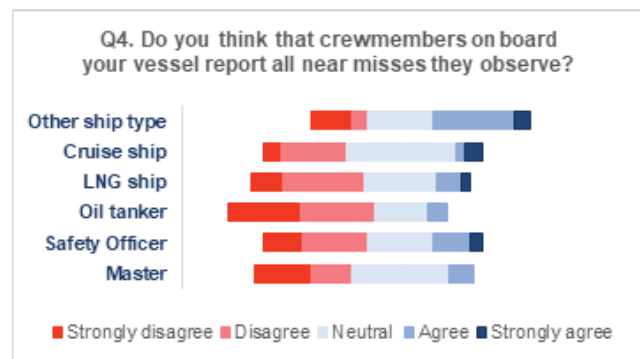
Figure 4.
Answers to Q4 according to respondents' ranks and ship types.

Figure 5.
Answers to Q5 according to respondents' ranks and ship types.

From the analysis of the responses, it can be concluded that most respondents have a positive attitude toward the implemented Near-Miss Management Systems (Figure 3 and Figure 5). Previous studies pointed out that shore-based management commitment plays a vital role in a Near-Miss Management System. If management is not involved in resolving the reported near-misses on board ship and there is no feedback from the shoreside, it might negatively affect near-miss reporting and act as a reporting barrier (Oltedal and McArthur, 2011; Kongsvik et al., 2012). Therefore, shore-based Management must be involved in the reporting process and actively support ship Masters, Safety Officers, and other crewmembers to improve safety and protect the environment. In addition, each reported near-miss should be commented on and responded to, which could raise safety awareness onboard a ship and create a safe working environment.

However, the opinions on reporting are different (Figure 4). Most respondents believe that their crewmembers do not report all the observed near-misses, which might be a serious defect within the Safety Management System. Reporting barriers are already mentioned in the Introduction to this paper. However, one interesting fact found in previous studies was that only a minor number of reported near-misses came from the ship rating side (Storgård et al., 2012a, 2012b; Hasanspahić et al. 2020). According to Hasanspahić et al. (2020), about 3 % of collected near-misses were reported by ship ratings (sample size: 580 near-miss reports). Therefore, near-miss education and training of the seafarers (active and future ones) could help improve safety awareness on board ships and help involve ratings in near-miss reporting. Also, the active involvement of Safety Officers and Masters is necessary to implement reporting culture on board ships and support ratings in their reporting efforts. In that way, ratings' active participation could prevent losing valuable near-miss data due to underreporting.

The following question (Q6) was: "Do you encourage your crewmembers to report all near-misses?" Analysis of the responses to Q6 has shown that most Masters and Safety Officers encourage reporting (92 %), while only 6 % do not encourage it. In addition, 2 % of the respondents have stated that they do not know if they encourage reporting. Encouraging crewmembers to report is an important step in creating reporting culture on board ship, and it should include promoting the 'no-blame' culture. The role of the Masters and Safety Officers in reporting is vital since, without their support, a near-miss will hardly be reported. Unfortunately, although few, a number of respondents stated they do not encourage reporting. It is an alarming fact and the reason behind this should be investigated as well as how it could be changed.

Question 7 (Q7) deals with near-miss types, rating according to perceived safety importance by the respondents: "Please, rate below types of near-misses according to safety importance as per your own opinion and experience. (Each type can be given a value from 1 to 10; the same value cannot be given to more than one near-miss type.)". Ten near-miss types were offered, and respondents could rate each type by assigning values from 1 to 10, where 1 is the highest importance and 10 is the lowest. Figure 6 presents the near-miss types by perceived importance.

According to the response analysis, "Not using/inadequate PPE" is perceived as having the highest safety importance, while "Emergency exit/passage blocked" is perceived as the least important near-miss type. The analysis showed that the "Near-collision/grounding/contact" type is perceived as having relatively low safety importance (rated as the ninth out of ten), which is an interesting fact. If the chain of events were broken, this near-miss type could develop into severe accidents resulting in property damage, environmental pollution, and injuries or fatalities. However, the respondents perceived it as relatively unimportant.

The following question (Q8) aimed to discover the most frequent near-miss types, as perceived by the respondents: "Please, write below the most frequent near miss that you have experienced." As this was an open-type question, the respondents were supposed to type down their answers; out of 112 respondents, 91 provided their answers. Again, near-misses involving PPE were perceived as the most frequent near-miss types by 68.1 % of the respondents, followed by slippery areas (wet/oily surface) by 3.3 %, and faulty life-saving and fire-fighting equipment by another 3.3 %. The study conducted by the American Bureau of Shipping (ABS) collected 45,298 near-miss reports. According to their analysis, the most common types of near misses found in the collected database were struck by/ against / cut / crushed / strain/sprain (12.2 % of all the collected reports), followed by PPE (11.7 %) and equipment (11.3 %)
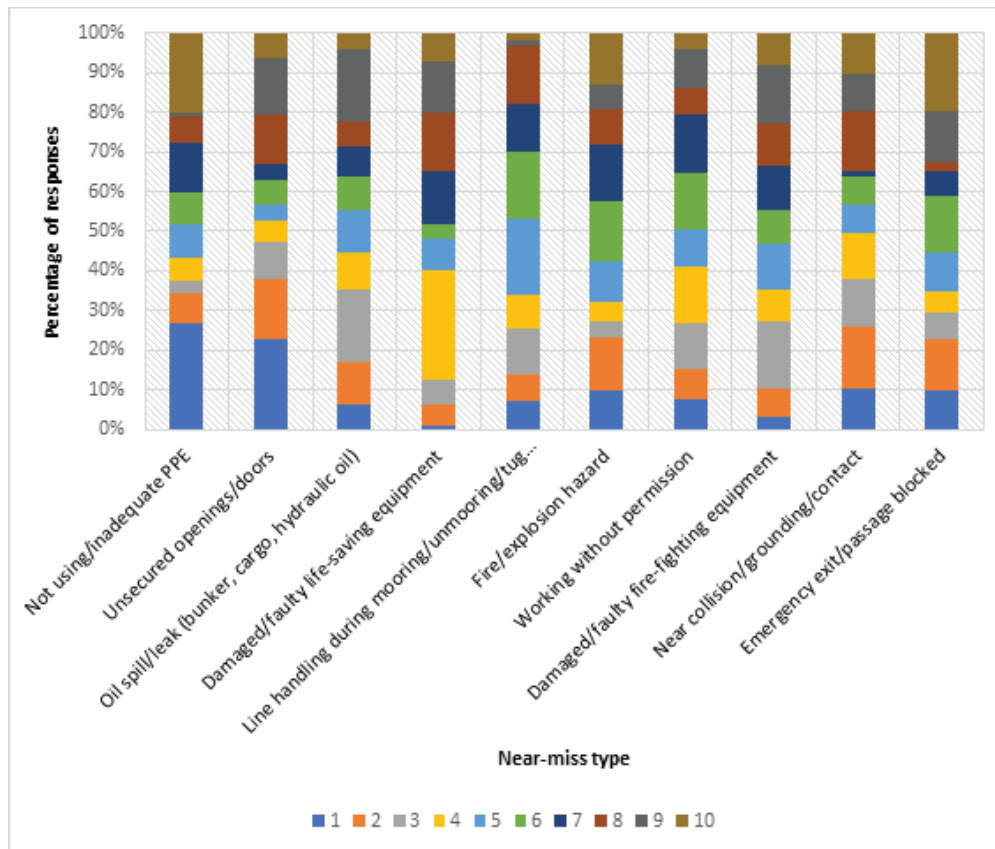
Figure 6.
Perceived importance of near-miss types.

(ABS). Therefore, perceived near-miss frequencies reported in this study could be considered accurate. Moreover, it could be concluded that adequate PPE usage, condition, or not using PPE at all present the major issue in shipping even though Safety Management Systems developed by shipping companies deal with PPE and identify each piece of PPE that is to be used during specific shipboard operation.

Question 9 (Q9) aimed to reveal the respondents' opinions on shipboard areas where most of the near-miss events happen: "Which onboard location, as per your own experience, is the location where most near-misses occur?" According to the analysis of the responses, the deck area is considered the area where most shipboard near misses occur (43 % of responses), closely followed by the engine room (35 %) (Figure 7).

The ABS study found that 37 % of all the near misses collected during their research in their database occurred in the deck area, followed by the engine room (20 %) and cargo area (14 %) [43] (ABS). However, this paper includes the cargo area in the deck area. Another study collected 309 near-miss reports

from an Aframax oil tanker and analyzed them by onboard locations where a near miss occurred. It was found that 64.1 % of the reported near misses occurred in the deck area, followed by accommodation (16.8 %), engine room (13.9 %), navigating bridge (3.2 %), and ballast tanks (2.0 %) (Hasanspahić et al., 2022). The conclusion is that the deck area and engine room are areas where most of the near-miss events occur on board ships, and during work, seafarers should always apply extra care and follow the procedures. In addition, it is important to stress that any unsafe condition should be immediately reported to the supervising Officer, and work in that specific area should be suspended until safe conditions are restored.

As mentioned in Section 2, the third phase of the Near-Miss Management System is prioritization or selection. In that phase, near-miss reports are rated, giving them a high or low priority, which would decide whether they need to be investigated or not. However, from the authors' experience and informal communication with several ship Captains, near-miss events are not rated on board ships. Usually, they are prioritized in the

office, which makes the system less effective since the near-miss rating is not an easy task, especially for persons not on board the ship where an event occurred. However, near-miss rating on board ships before distribution to the office makes near-miss management more difficult for shipboard personnel. Therefore, the authors asked the Masters and Safety Officers about their opinion on rating a reported near miss before sending it to the Company (Q10). According to the analysis of the responses, most respondents have a positive attitude toward near-miss rating (Table 3).
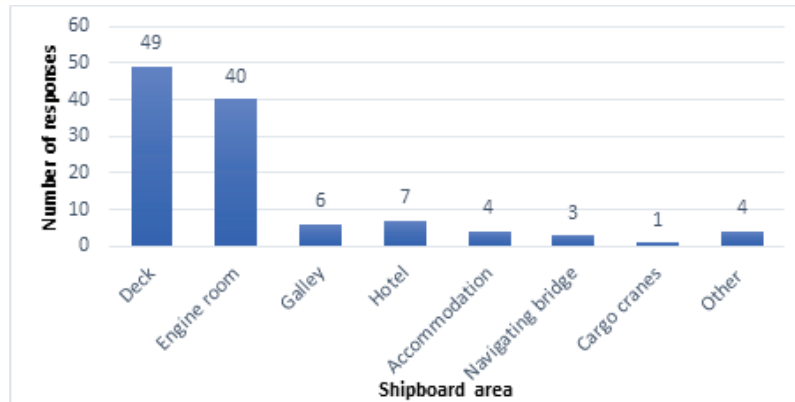
Figure 7.
Shipboard areas where most near-miss events occur as perceived by the respondents (Q9).

Table 3.
Question and descriptive statistics on near-miss rating onboard ship.

Question	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. dev.
Q10: Do you agree that near-misses should be rated (given low or high priority) before sending them to the office (to designated person)?	11.5	6.2	28.3	36.3	17.7	3.40	1.18
Q10: 1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree							

However, shipboard Masters and Safety Officers should have adequate knowledge of risk assessment and incident investigation for an efficient and adequate rating. Therefore, prioritizing on board ship is dependent on Safety Officers' training.

Although a number of near-miss events in a specific period are hard to predict, some shipping companies require a certain number of near-misses to be reported annually. Therefore, Masters and Safety Officers were asked: "Do you think there should be a fixed number of reported near misses per vessel?" (Q11). Although only 72 respondents answered this question, it can be concluded that the experienced seafarers negatively perceived a fixed number of reported near misses (88.9 % of respondents answered "No" while only 6.9 % of answers were "Yes" and 4.2 % were "I don't know"). Question 12 (Q12) also deals with a fixed number of reported near misses, and the respondents were asked: "As per your own opinion, how many near misses should be reported annually per one vessel?" where four answers

were offered. Again, there were 72 responses recorded, and most respondents (87.5 %) chose the answer "There should not be a fixed number of reported near misses per vessel per year." The answer "One reported near miss per week" was chosen by 8.3 % of respondents, while "One reported near miss per crewmember per year" gained 2.8 %, and "Ten reported near misses per month" gained 1.4 % of answers.

The respondent could comment on the questionnaire and the subject in Question 13 (Q13). Most of the comments referred to the fixed number of near-miss reports expected by the Company. For example, one LNG tanker Master stated: "If there is a fixed number of near misses to be reported, the whole point of promoting safety culture has failed." Another comment was: "Near miss is a random event. You cannot correctly predict a number of random events. There can be 100 near misses in one month, and none in the next month" (oil-tanker Third Officer). A cruise ship Staff Captain stated: "In case there is a dedicated annual number of reported near misses by ships, the quality of

near-miss reports will be downgraded, and near-miss reports will be just another checklist to be filled. Quality should not be supplemented by quantity". From the responses and comments, it can be concluded that the fixed number of near-miss reports in a specific period is not well accepted in shipping, and experienced seafarers believe that it could downgrade safety at sea. However, different ship inspections might insist on checking near-miss reports, and if nothing is reported, it could be considered a non-conformity. Therefore, some shipping companies insist on a fixed number of near-miss reports (minimum number) to stay on the 'safe side', but at the same time, this requirement might induce the fabrication of false reports (imagined ones). That could be dangerous, and analysis of such reports might be counterproductive for safety efforts.

One tugboat Master stated: "If this topic is overly regulated, it will just create paperwork and do nothing to help increase safety on board." As Bhattacharya (2020) found, a mandatory increase in reporting on one shipping Company did not decrease near misses and incidents, nor did it improve safety. He concluded that mandatory reporting might lead to reporting just to satisfy the requirements, not to improve safety and prevent future adverse events. Therefore, it could be concluded that the quantity might seriously endanger the quality of reports.

Furthermore, it needs to be emphasized that the number of reported near misses is usually relatively high while the system is being implemented, but if the suggested corrective actions are applied and if they are efficient, the number of reports should gradually decrease. That should be considered a sign of safety increment, not safety deficiency. Moreover, since safety is measured by its absence and not its presence, a reduction in the number of reports should be a sign of safety culture maturity and safety improvement. However, this should be corroborated by the absence of any recorded injuries and damages. Near-Miss Management Systems should be continuously monitored and evaluated to ensure purposefulness and efficiency.

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Some respondents suggested continuous use of near-miss reports as a tool for safety improvement. For example, one respondent (container-vessel Chief Engineer) commented: "Near miss should be reported as per appearance and should be discussed on board to familiarize all the crewmembers as well as explain how to avoid (prevent) it".

However, attitudes are different. Filling in report forms makes near-miss reporting a 'bureaucratic' burden for some seafarers, and in their opinion, safety is not improved, and near-miss management is inadequate to deal with safety improvement.

One LNG tanker Chief Engineer stated: "Near misses and most safety mechanisms have proved inadequate when considering that injuries and accidents are on the rise. Behavior-based safety, if implemented correctly (without additional paperwork or reducing current load) might be a step in the right direction".

The attitudes are different. While some Masters and Safety Officers consider near-miss reporting a step in the right direction, some consider it an unnecessary burden. However, most survey respondents believe that adequate and efficient near-miss management could improve onboard safety, and therefore systems should be continuously developed and upgraded with new knowledge. For example, one cruise ship Electrical Officer wrote: "I work for a Company where the near-miss system has been implemented for some time now, and it is working well although there is room for improvement, e.g., disseminating high-risk near-miss reports and corrective actions taken to prevent future similar situations throughout a fleet. False accident reports are topics to discuss since I have experience with false reports whose intentions were to cover wrong procedures and people's reactions. Those things can lead new and less-experienced people to wrong conclusions. I see why reports can be done that way, but accidents will continue to happen without honesty and open conversation. No matter what position on board we are, we all have a common goal: complete our contract fair and return safely. In my opinion, whatever is out there to help us be safe on the ship should be welcome and well-accepted among the crew. I believe this is one of the things (near-miss reports) that is good to help us at sea." The seafarers understand that data dissemination could solve numerous safety issues and therefore urge for communication and data sharing. Each shipping Company Management should act on this, improve existing incident/accident databases, disseminate data, and facilitate learning from incidents.

Finally, the Chi-square Test of Independence was done and the results are presented in Table 4.

Table 4.
Results of Chi-square Test of Independence onboard ship.

Null-hypothesis	Chi-square ($\chi 2$)	Degrees of freedom (df)	p-value
H0,1	2.407	4	0.661
H0,2	4.859	4	0.302
H0,3	1.401	4	0.844
H0,4	11.570	12	0.480
H0,5	9.351	12	0.672
H0,6	20.746	12	0.054

5. CONCLUSIONS

From the analysis of the survey answers, it can be concluded that most of the surveyed seafarers consider Near-Miss Management Systems well-implemented and adequate. However, most of them believe that near-misses are still underreported although they encourage reporting and promote safety culture. Underreporting near-misses in shipping is a serious barrier to improving safety culture, and valuable knowledge is irretrievably lost. Therefore, each Company should promote reporting and thus improve safety on their ships. However, as seen from the survey responses, mandatory reporting might be considered another obstacle and negatively affect learning from incidents. Therefore, most of the surveyed seafarers believe that reporting should not be mandated, but all observed near-misses should be reported to improve safety.

Respondents consider near-misses dealing with Personal Protective Equipment as the most frequent ones and at the same time the most important. However, one might wonder how come PPE near-miss events are recurrent. Does it mean that the corrective measures implemented are not adequate or do seafarers report PPE near-misses just to comply with the mandated number of reports and satisfy the requirements? However, this type of near-miss event should be acted upon, and safety measures regarding adequate usage of PPE should be re-evaluated. Shipboard leadership, especially Masters and Safety Officers, should play an important role and encourage and promote PPE usage. In addition, shipboard training for ratings regarding near-miss identification and reporting could benefit onboard safety since previous studies found that ratings seldom participate in reporting due to various barriers.

Furthermore, the respondents believe that most of the near-miss events occur on deck and in the engine room, which seems quite reasonable. Therefore, lessons learned from previous near misses should be incorporated in permits to work and risk assessments. In addition, monthly safety meetings should be used as an opportunity to discuss lessons learned and promote safety awareness.

A statistically significant relationship between the respondents' ranks and types of ships with attitudes on near-miss management was not found, suggesting the nonexistence of significant differences between seafarers. It is an important finding because it can be concluded that Masters and Safety Officers serving on different types of ships do not have significantly different attitudes toward Near-Miss Management Systems. Most of them consider attending training on incident investigation a positive detail that could improve their knowledge regarding near misses and help identify immediate and root causes.

The findings of this study could be used to help improve Near-Miss Management Systems in shipping and thus help improve maritime safety. Onboard safety is every seafarer's business, and all the crew should be actively involved in promoting safety.

CONFLICT OF INTEREST:

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