ANALYSIS OF NEAR-MISS EVENTS ONBOARD SHIPS

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Summary

Despite increasingly stringent regulations and rules, the use of modern equipment on ships, and the implementation of additional training and education for seafarers, accidents in the shipping industry continue to happen. The consequences of accidents vary from minor injuries and material damage to severe casualties, complete loss of ships and cargo. It is in the interest of all stakeholders in the shipping industry to reduce risks and improve safety, but still, only after severe accidents corrective measures are taken, i.e. new ways to improve safety are sought. In contrast to such an approach, a proactive approach is proposed, which would try to prevent the occurrence of accidents. One way that could make this possible is a near-miss management system. Such a system must be as simple as possible and adapted to the shipping industry to be effective. The authors used a survey questionnaire to investigate the opinion of officers and masters about the near-miss management systems implemented on their ships. An analysis of the responses showed that they are relatively satisfied with the current near-miss management system on their ships but still believe that a large proportion of seafarers still do not report all near-misses due to specific barriers. Furthermore, officers and masters believe that most near-misses are related to operation on deck, followed by the engine room activities.

Keywords: near-miss management, accident, personal protective equipment, maritime safety

1. INTRODUCTION

Marine accidents of various proportions are continuously occurring despite increasingly advanced modern technologies introduced on merchant ships and the education and training of seafarers. The question is how to reduce their number and reduce risks. First of all, a marine accident needs to be defined. It is an unexpected unintentional sequence of events that caused harmful outcomes that put human lives, property, and the marine environment in direct danger [1-3]. Reducing the number of marine accidents and increasing safety at sea is one of the goals of all stakeholders in the shipping industry. There are several ways to achieve it: investigating accidents and implementing safety measures originated from accident investigations results

and safety recommendations or investigating near-miss events and implementing lessons learned into onboard policies and procedures [3,4]. The first one presents a corrective approach to safety improvements, while the second is a proactive approach. A proactive approach means that safety improvements are implemented before any damage, injury, fatality or environmental pollution was done, based on analysis of an event that is the precursor of an accident – a near-miss [3-5]. It is an unwanted event that could have caused adverse consequences for human lives, property, and the marine environment, but it did not. The harmful outcome was avoided by a fortuitous break in the chain of events [3,4,6]. It is an excellent possibility and opportunity to reduce unwanted events since there is no harm done and no additional costs, like after some catastrophic accidents [4].

A near-miss management system needs to be introduced onboard a ship to investigate near-misses and find their immediate and root causes, identifying corrective measures that need to be implemented. The system must be as effective, as simple as possible and applicable to be an adequate tool for safety improvements. According to the available literature review, the near-miss management system is comprised of eight elements or phases:

1. Identification is a first phase where the seafarer identifies possible near-miss events [3, 7-12];
2. Reporting is a phase where the seafarer decides to report observed near-miss event (either to his superior officer or he reports it by himself) [3,7-14];
3. Prioritisation includes rating the importance of hazard that near-miss event could have caused and assessment of the proportion of the causation analysis [3,7-10,12-14];
4. Distribution of near-miss data to the person in charge of corrective actions [3,8-11,14];
5. Cause analysis where immediate and root causes are identified [3,7-13];
6. Solution identification includes corrective actions aiming to prevent recurrence or mitigate possible near-miss consequences [3,7-12,14];
7. Dissemination of near-miss data and implemented corrective measures [3,7-11,13,14];
8. Resolution is a final phase where corrective actions are implemented and evaluated [3,8-14].

The first two phases are crucial for a practical and usable near-miss management system. If seafarers cannot identify near-miss events or are unwilling to report them, such a system could be considered inadequate. The seafarer needs to be trained and familiar with the definition of the near-miss to identify it [3,4].

Even though near-miss reporting and analysis might lead to valuable conclusions and implementation of corrective measures, studies showed that seafarers are not reporting all observed near-misses. There are several barriers to reporting identified in literature dealing with near-miss reporting. Besides near-miss identification, the literature review revealed several significant reporting barriers, like blame culture, inadequate leadership, the complexity of near-miss reporting form, seafarer's national culture and crewmember's turnaround on a specific ship [1,3,4].

2. METHODOLOGY

This paper aims to gain insight into seafarers' opinions on the near-miss management systems implemented on their ships and reveal the most hazardous areas onboard ships. Furthermore, the paper tries to identify the most common types of near-misses and propose proactive measures. The research tool was a survey developed by the authors. The first part of the survey were seven demographics questions, followed by 12 questions on the near-miss management system in the second part. Demographics questions dealt with respondents nationality, age, rank, education, ship type, service time in rank and sea service time. Questions on near-miss management systems were predominantly closed type questions. There were four simple yes/no/I don't know questions (Q1-Q3, Q11), four five-point Likert scale questions (Q5-Q8), two checklist type multiple-choice questions (Q4 and Q12) and one rank order multiple choice question (Q10). One question was open-ended where respondents had to type their answers (Q9).

The survey questions were neutral to avoid biased participation. The prepared survey was available online, and a web link was sent to several crew recruitment agencies. They shared it with seafarers, who shared it with their colleagues (virtual snowball sampling). Each seafarer could freely choose whether to participate in the survey or not, and the participation was confidential and anonymous. A total of 112 seafarers participated in the survey.

3. RESULTS AND DISCUSSION

Eight nationalities were represented in the survey, 90% of participating seafarers being from Croatia (Figure 1).

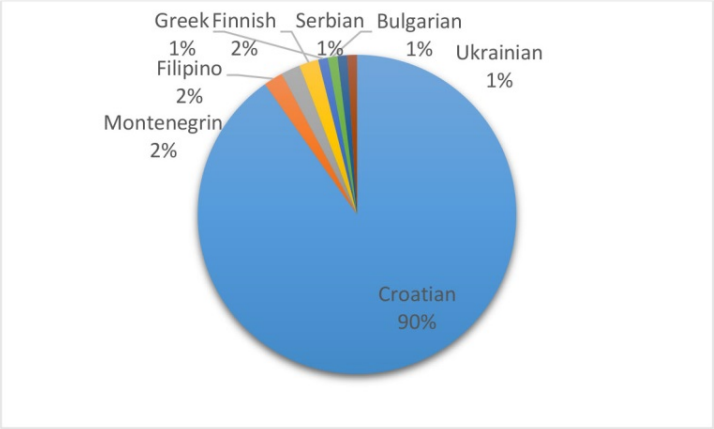

Figure 1 Nationalities of participating seafarers

The age of the respondents is presented in Figure 2. Most of the respondents were aged 42 and under (70%).

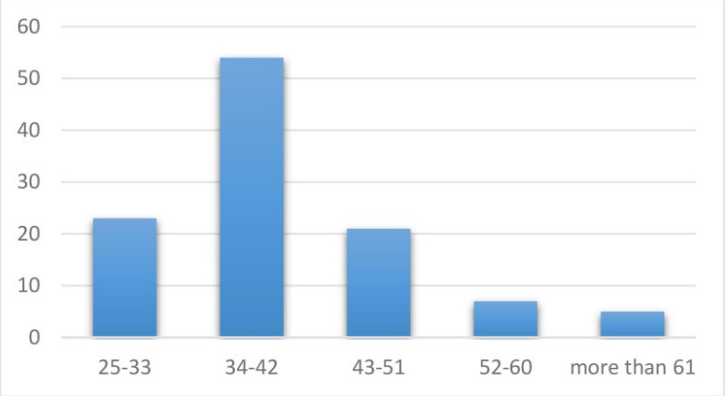

Figure 2 Age distribution of the participating seafarers

Just over half of the respondents (51%) were ranked as Masters and Chief Officers (Figure 3).

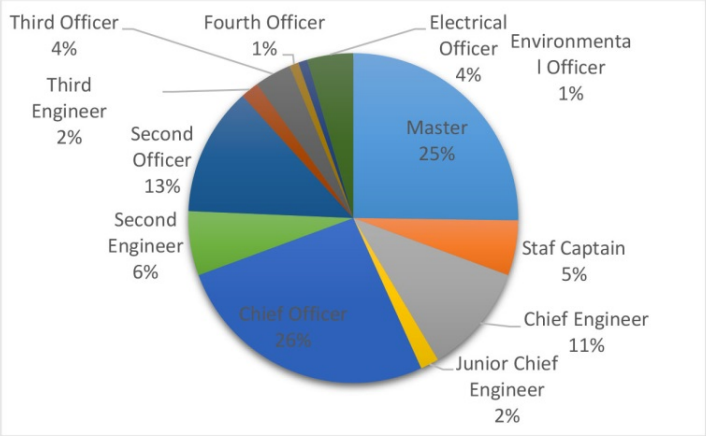

Figure 3 Reported ranks of participating seafarers

Most of the participants reported being educated at a maritime college (Figure 4).

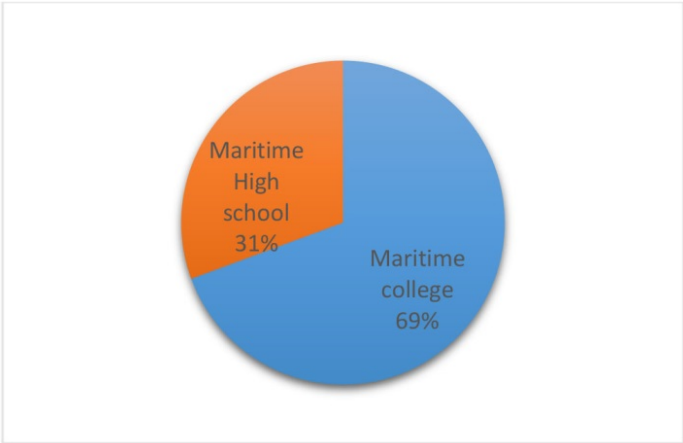

Figure 4 Type of education of participating seafarers

Participating seafarers sailed on different ship types, where oil tankers, LNG tankers and cruise ships were the most represented ship types (77%). Figure 5 presents participants' ship types.

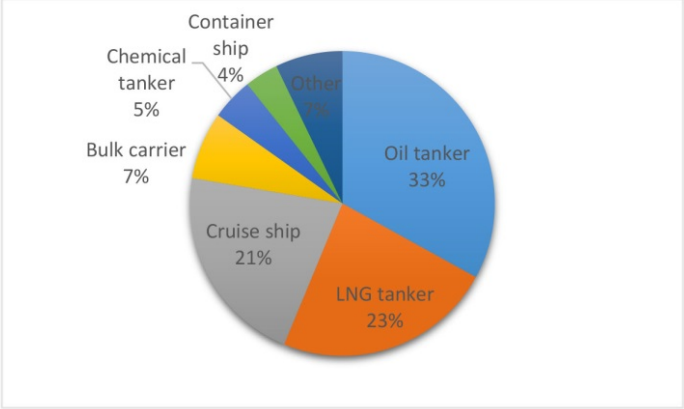

Figure 5 Ship types of participating seafarers

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) ship.

Most of the surveyed seafarers reported serving in the present rank for six years and less (Figure 6).

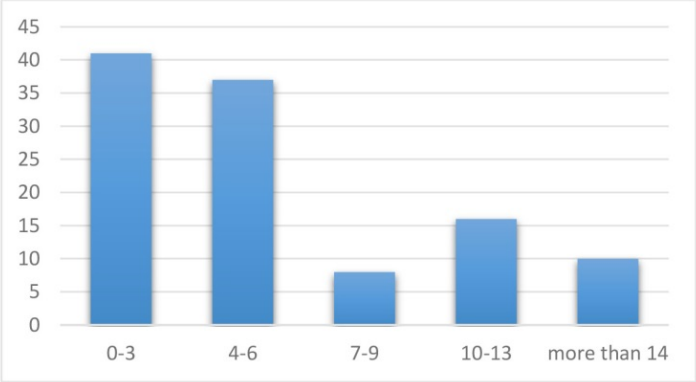

Figure 6 Surveyed seafarers reported service time in the rank

Most participants reported between 6 and 17 years of sea service (61%). Figure 7 presents respondents sea service time.

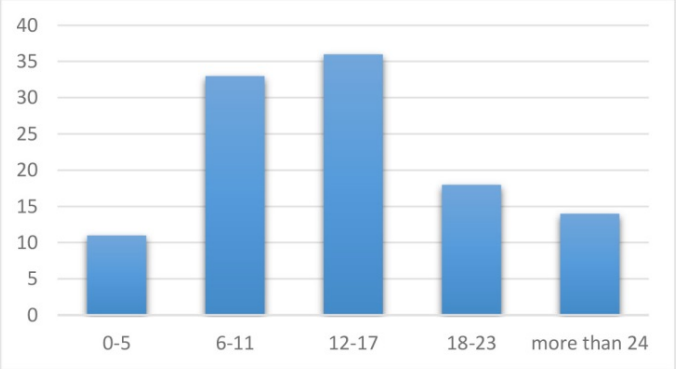

Figure 7 Surveyed seafarers reported sea service time

Analysis of demographics questions showed that surveyed seafarers are well experienced and educated professionals. In the following section, the results of the survey are presented and discussed.

IMO Model Course 3.11 "Safety investigation into marine casualties and marine incidents (2014 Ed.)" deals with reporting and investigation of accidents, incidents and near-misses. Also, several tailor-made courses are developed by training centres or shipping companies, based on IMO Model Course 3.11. These courses incorporate topics of accident, incident and near-miss reporting and investigation. However, they are not mandatory, and some companies are unwilling to invest money in non-mandatory courses.

The first near-miss management question in the survey was: have you received formal training for accident/incident/near-miss investigations (Q1). More than half of the participants answered affirmatively (Figure 8). Formal training is considered training provided in a shore-based training centre and not onboard training. That kind of training is implemented to improve safety awareness onboard ships, facilitate accidents/incidents investigations, and enable safety culture maturing.

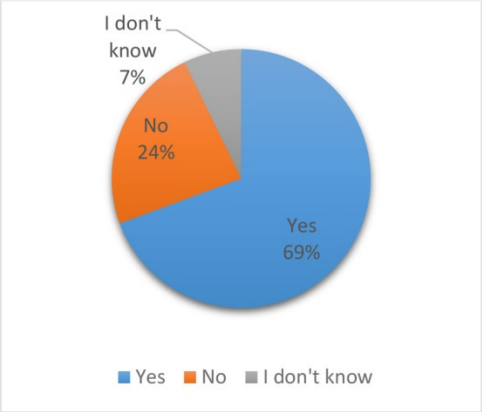

Figure 8 Answers to the question "Have you received formal training for accident/incident/near-miss investigations?"

It means that most of the respondents (primarily senior officers onboard ships) are trained to investigate incidents, find immediate and root causes and propose corrective actions. However, it is not the case with all respondents, and there is still many masters and safety officers who have not received adequate training for incident investigation.

Answers to the following question revealed that most surveyed seafarers believe that such training should be mandatory (Q2) (Figure 9).

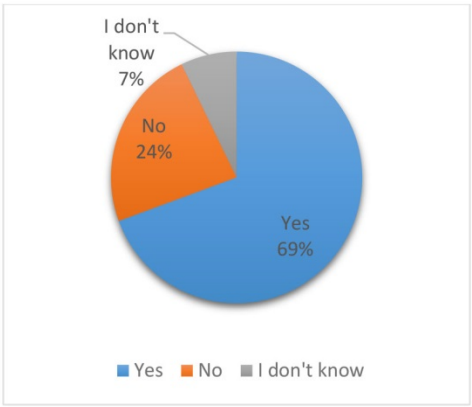

Figure 9 Answers to the question "Do you think that formal training regarding accident/incident/near-miss investigations should be mandatory?"

The introduction of mandatory incident investigation training would enable more efficient and thorough hazardous events investigations, and in return, it could identify unknown root causes and implement corrective measures that could improve safety at sea. Furthermore, safety culture in shipping could benefit from such training because seafarers are familiarised with no blame culture, safety culture and advantages of incident reporting.

Figure 10 presents the ranks of seafarers answering affirmatively to Q2. Analysis of the answers showed that more seafarers that belong to the deck department think that accident/incident/near-miss investigations training should be mandatory (75% of affirmative answers to Q2) than the seafarers that belong to the engine room department (25% of affirmative answers to Q2). Furthermore, analysis of affirmative answers revealed that 36% of respondents work on oil tankers, 25% on LNG carriers, 25% on cruise ships, 6% on bulk carriers and the remaining 8% on other types of ships (chemical tankers, container ships, FLNG and FSRU).

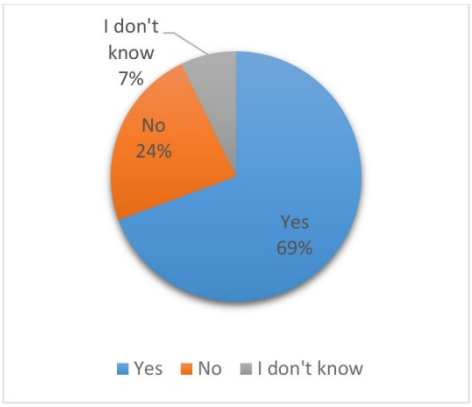

Figure 10 Ranks of seafarers thinking that accident/incident/near-miss investigation training should be mandatory

The participants were asked do they encourage their fellow crewmembers to report all observed near-misses (Q3). The vast majority of seafarers actively encourage their colleagues to report near-misses, but some officers are still reluctant to report hazardous events and reported that they do not encourage their crewmembers (Figure 11).

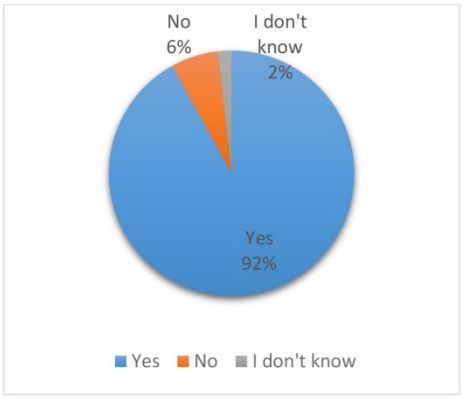

Figure 11 Answers to the question "Do you encourage your crewmembers to report all near-misses?"

Although a relatively small number of seafarers do not encourage reporting, the troubling fact is that they are all holding officers ranks, and they manage with people and assets onboard ships.

When asked which onboard location is the area where most of the near-misses occur (Q4), surveyed seafarers reported deck area (43%) and engine room (35%) as the most hazardous areas onboard a ship (Figure 12).

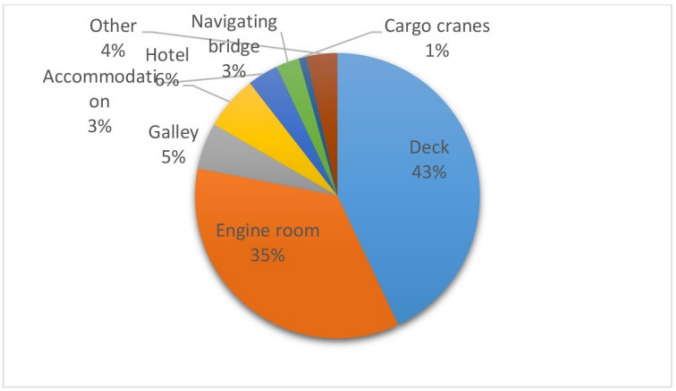

Figure 12 Answers to the question: "Which onboard location, as per your own experience, is a location where most near-misses occur?"

Answers to Q4 are in line with the American Bureau of Shipping (ABS) research [15]. They analysed the 45298 near-miss reports they collected in their database regarding near-miss causation, ship type, near-miss location onboard a ship and category (type) of near-miss event. Their analysis revealed that 37% of all near-misses collected in their database occurred on the deck. It can be concluded that the deck area is the most dangerous ship's area, and extra care should be taken accordingly.

Table 1 contains the following four questions given on the five-point Likert scale.

Table 1 Likert scale questions

No	Question	Mean	Standard deviation
Q5	Do you think that crewmembers onboard your vessel report all near-misses they observe?	2.52	1.09
Q6	Do you think that near-miss follow up measures received from the company are substantial and applicable to your vessel?	3.52	1.09
Q7	Do you agree that near-misses should be rated (given low or high priority) before sending them to the office (to the designated person ashore)?	3.40	1.18
Q8	Please rate satisfaction with Near-miss Management System in your company.	3.48	0.99

Q5 through Q7: 1=strongly disagree; 2=disagree; 3=nor disagree nor agree; 4=agree; 5=strongly agree; Q8: 1=poor; 2=average; 3=good; 4=very good; 5=excellent

The column Mean in Table 1 are sums of answers to particular questions measured on a Likert scale from 1 to 5 divided by the number of answers. The standard deviation in Table 1 indicates dispersion around mean (or average value). For example, the average value of answers for Q5 is 2.52, which is between Likert scale values 2 (disagree) and 3 (nor disagree nor agree) for that question, meaning that respondents generally don't believe that crewmembers onboard their ships report all near-misses they observe. There could be several reasons for not reporting all observed near-misses, including near-miss identification, blame culture, and the complexity of reporting forms. In [3], it was found that lower-ranking crewmembers are not adequately involved in near-miss reporting (less than 3% of the reports done by lower-ranking crewmembers). One way to improve near-miss reporting on ships and include lower-ranking crewmembers in the near-miss management system and safety improvements is to increase near-miss and incident awareness during the education and training of future and active seafarers.

Most of the participants perceive follow up measures received from the company as substantial and applicable (Q6). Studies have shown that not responding and not acting on reported near-misses or incident negatively affects near-miss reporting onboard a ship. However, shore management should continuously improve involvement in the near-miss management system with enhanced communication and instructions to ships and respond to each sent near-miss report.

When asked about their opinion on rating reported near-miss before sending them to the company (Q7), most participants consider it a good practice (Table 1). In that way, processing and investigating near-miss events would be facilitated, focusing on the most critical and high-risk events.

Participating seafarers are considering near-miss management systems on their ships as satisfactory and believe that they are well implemented and improve safety onboard (Q8).

Question (Q9) dealt with the most frequent type of near-miss event. Near-misses connected with Personal Protective Equipment (PPE) were first, with 68.8% of the answers. Other answers included blockage of emergency exits, faulty life-saving and fire-fighting equipment, near-misses during lifeboat drills and others.

In the following questions (Q10), seafarers were offered ten near-miss events types, and they were asked to rate them according to safety importance (from one to ten, where number one is most important to onboard safety, and number ten being least important). According to answers (subject opinion of each participant), near-miss types were rated as follows (Figure 13):

1. Not using/inadequate PPE;
2. Unsecured openings;
3. Oil spill/leak (bunker, cargo, hydraulic oil);
4. Damaged/faulty life-saving equipment;
5. Line handling during mooring/unmooring/tug operation;
6. Fire/explosion hazard;
7. Working without permission;
8. Damaged/faulty fire-fighting equipment;
9. Near collision/grounding/contact;
10. Emergency exit/passage blocked.

According to reported answers, near-misses including PPE are the most common, and seafarers rate them as events of high importance. The least rated near-miss event was blockage of emergency exit, but the surprising fact is that near-collision/grounding/contact is rated as ninth, and it constitutes a severe hazard to human lives, environment and property protection.

According to ABS data [15], the most common types of near-misses recorded in their database were struck by/against, cut, crushed, strain/sprain closely followed by PPE. In their report, out of 200 random records from PPE reports, 89% of PPE near-miss reports were because of PPE not being used, followed by PPE incorrectly used (6%). It seems that PPE usage is still a significant problem onboard ships, although shipping companies developed safety procedures, including the type of PPE to be used during specific job performance.

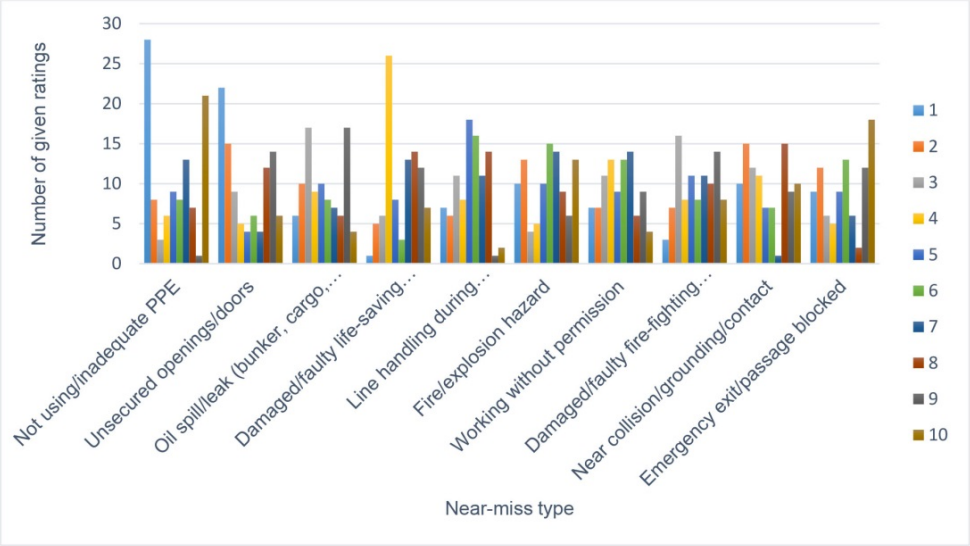

Figure 13 Rating of most important near-miss events

As some shipping companies insist on a specific number of near-miss reports per ship per month, participants were asked if they think there should be a fixed number of reported near-miss per ship per period as a minimum (Q11). Most respondents answered negatively (90%), while only 6% of respondents favoured such demand (Figure 14).

Figure 14 Answers to the question "Do you think that there should be a fixed number of reported Near-misses per vessel?"

In the following question (Q12), participating seafarers were offered four options:

1. One reported Near-miss per crewmember per year.
2. One reported Near-miss per week.
3. Ten reported Near-misses per month.
4. There should not be a fixed number of reported Near-misses per vessel per year as a minimum.

The most favoured option was that there should not be a fixed number of reported Near-misses per vessel per year (88% of respondents). However, a small number of participants (8%) believes that each ship should report one near-miss weekly (Figure 15).

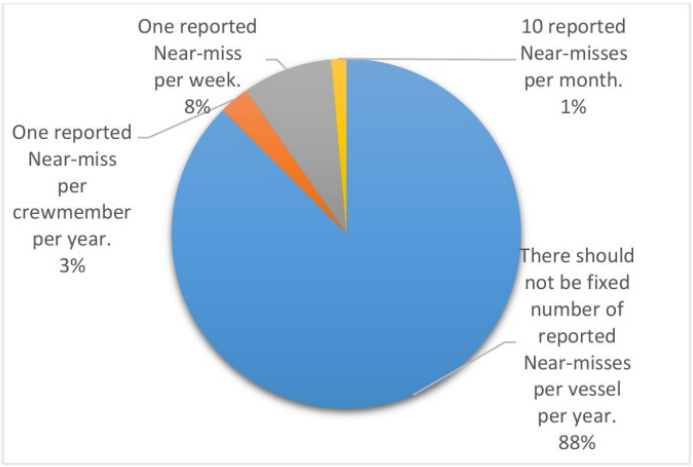

Figure 15 Seafarers' opinion on the number of reported near-misses

It can be argued that a fixed number as a minimum of near-miss reports could introduce false and imagined reports because if there is nothing to report, people could think up near-miss events to fulfil the form. That could be dangerous because false (imagined) reports would end up in databases, wrong conclusions would be drawn, and inadequate corrective measures were implemented. Instead of improving safety in shipping, that kind of report could seriously undermine it.

4. CONCLUSION

From the analysis of survey answers, it can be concluded that surveyed seafarers perceive near-miss management systems on their ships as substantial, and they are mostly satisfied with it. However, many respondents believe that their fellow crewmembers are not reporting all observed near-misses, which happens due to reporting barriers. These barriers need to be bridged to fully use the potential of learning from near-misses and improving safety at sea.

Deck area seems to be the most dangerous area onboard a ship, and near-misses involving PPE are the most frequent and rated as the most important ones. Nevertheless, it can be argued that this type of near-miss event cannot cause severe consequences in most cases, and for instance, near-collision could cause far more severe damage and consequences for human lives, property and environmental protection. Anyhow, seafarers perceive PPE near-misses as significant because of their large number. Safety training and adequate familiarisation of seafarer's onboard ships might reduce these unwanted events to some degree, but implementing adequate safety culture is the key to solving this problem.

Most of the seafarers believe that there should not be a fixed number of near-miss reports. A fixed number of near-miss reports might induce false (imaginary) near-miss reports and misguide researchers to wrong conclusions. If reports only serve to increase their number, conclusions derived from them will be wrong, and real problems will not be tackled.

REFERENCES

[1] Vepsalainen, A.; Lappalainen, J. Utilization of Incident Reporting in the Finnish Maritime Industry; Centre for Maritime Studies University of Turku. Turku, Finland, 2010.
[2] MSC-MEPC.7/Circ.7. Guidance on Near-miss Reporting; International Maritime Organization: London, UK, 2008.
[3] Hasanspahić, N.; Frančić, V.; Vujičić, S.; Maglić, L. Reporting as a Key Element of an Effective Near-Miss Management System in Shipping, Safety 2020, 6, 53; doi:10.3390/safety6040053.
[4] Hasanspahić, N.; Frančić, V.; Vujičić, S.; Maglić, L. Near-Miss Reporting as Seen from Seafarers' Perspective. TransNav, The International Journal on Marine Navigation and Safety of Sea Transportation, in press. DOI: 10.12716/1001.XX.XX.XX.
[5] Gnoni, M.G.; Saleh, J.H. Near-miss management systems and observability-in-depth: Handling safety incidents and accident precursors in light of safety principles. Saf. Sci. 2017, 91, 154–167.
[6] International Maritime Organization: ISM Code, International Safety Management Code and guidelines on implementation of the ISM Code. London, UK (2010).
[7] Craig, B.N.; Papillon, R.; Curry, J.; Zhu, W. Reporting Practices for Close Call (Near Miss) Reporting Systems. In Proceedings of the Offshore Technology Conference, Houston, TX, USA, 5–8 May 2014.
[8] Gnoni, M.; Andriulo, S.; Maggio, G.; Nardone, P. "Lean occupational" safety: An application for a Near-miss Management System design. Saf. Sci. 2013, 53, 96–104.
[9] Meel, A.; Seider, W.D.; Oktem, U. Analysis of Management Actions, Human Behavior, and Process Reliability in Chemical Plants, Part II: Near-Miss Management System Selection. Process Saf. Prog. 2008, 27, 139–144.
[10] Oktem, U.G.; Wong, R.; Oktem, C. Near-Miss Management: Managing the Bottom of the Risk Pyramid. Risk & Regulation. 2010. Available online: http://www.nearmissmgmt.com/Oktem%20Wong%20Oktem%20LSE%202010.pdf (Accessed on 07 May 2021)
[11] Phimister, J.R.; Oktem, U.; Kleindorfer, P.R.; Kunreuther, H. Near-Miss Incident Management in the Chemical Process Industry. Risk Anal. 2003, 23, 445–459.
[12] Rasmussen, H.B.; Drupsteen, L.; Dytreborg, J. Can we use near-miss reports for accident prevention? A study in the oil and gas industry in Denmark. Saf. Sci. Monit. 2013, 17, 1–12.
[13] Lindberg, A.-K.; Hansson, S.O.; Rollenhagen, C. Learning from accidents—What more do we need to know? Saf. Sci. 2010, 48, 714–721.
[14] Oktem, U.G. Near-Miss: A Tool for Integrated Safety, Health, Environmental and Security Management. Available online: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.386.9322&rep=rep1&type=pdf (Accessed on 25 April 2021)
[15] American Bureau of Shipping (ABS). Mariner Personal Safety (MPS) Near Miss Statistics. Available online: https://ww2.eagle.org/content/dam/eagle/rules-and-resources/Safety-and-Human-Factors-Design/mariner-personal-safety/mariner-safety-project-resources/MPS%20Near%20Miss%20Statistics.pdf (Accessed on 05 May 2021)