Reporting Culture – A Prerequisite for Safety in Shipping

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Abstract: As the human factor is considered a leading cause of maritime accidents, reducing its effect and making shipping safer, more sustainable and reliable concept is necessary. Therefore, IMO introduced the ISM Code as a tool for creating and developing a safety culture in shipping. However, barriers prevent the development of an effective safety culture on ships. One of the safety culture elements is reporting culture, where seafarers are expected to freely and unbiasedly report observed accidents and near-misses. Reporting such undesired events should enable organisational learning through investigation, analysis, and dissemination of complete reports. In addition, it needs to be mentioned that reporting and, in the end, learning from near-miss reports is more desirable than learning from accidents since no harm was done. This paper gives a brief overview of safety culture in shipping, emphasising reporting culture, especially near-misses. Developing a just culture onboard a ship is a pivotal factor in implementing and developing an effective safety culture. Shipboard leadership and company management should create an adequate climate that enables reporting and thus improves safety in shipping.

Keywords: Accident, Near-miss, Reporting, Leadership, Maritime safety.

1. Introduction

Many high-risk industries (nuclear, air, rail, chemical, medicine, and shipping) have realised that a combination of human, organisational, and technological factors is the cause of many catastrophic accidents. Analysis of catastrophic accidents throughout history has proven that these events cannot be explained only by accidental equipment failures but are a combination of human, organisational, and technological factors [1]. The notion of safety culture first appears in the International Atomic Energy Agency (IAEA) report following the 1986 Chernobyl accident. The first accident report emphasised the plant's shortcomings; however, more thorough analyses showed organisational, cultural, and managerial

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shortcomings and a lack of an effective safety culture. According to the International Atomic Energy Organization, a safety culture should be based on safety attitudes and a management policy that reflects all individuals' proper common attitudes within the organisation toward safety [2].

Before defining the concept of safety culture, it is necessary to clarify the concept of culture itself. According to Hofstede et al. [3], culture is "the collective programming of the mind which distinguishes the members of one group or category of people from another." Continuing with Hofstede's thoughts on culture, Garcia-Herrero et al. conclude that it is acquired and not inherited, and therefore, it can be evaluated and acted upon, which means that it is changeable and can be improved [1]. Thomas et al. [4] define culture as "systems of values, attitudes, beliefs, and behavioural meanings shared by members of a social group (society) and learned from previous generations. Culture, a group level construct, is neither genetic nor about individual behaviour. However, it exists within the knowledge systems of individuals, which are formed during childhood and reinforced throughout life" [4]. Since the Chernobyl accident, organisational culture research has increasingly been applied to organisations' safety characteristics in high-risk activities, that is, to their safety culture. As every organisation has a culture, it can be expected to affect organisational safety. Understanding how it affects safety can provide insights into how it can be adapted to prioritise safety [5, 6]. There are several definitions of safety culture, and in plain words, safety culture could be described as the understanding that safety is one of the organisational priorities and how employees feel about safety within an organisation. Hence, it needs to be given the necessary attention. However, how much an organisation cares about safety, that is, about safely performing specific actions, will only be revealed in the way those specific actions are performed, safety communication between managers and employees (vertical communication) and employees among themselves (horizontal communication), and the very organisation of safety within. All organisation members' basic assumptions and values (managers, leaders, and employees) will be expressed in their attitudes, norms, and practices [7].

Another essential term closely related to safety culture and needs to be mentioned is safety climate. According to Zohar [8], safety climate is "a summary of molar perceptions that employees share about their work environments." Bhattacharya [9] refers to it as a "temporal phenomenon, a snapshot of safety culture, relatively unstable and subject to change."

Safety culture was a topic of numerous research. Guldenmund, in his paper [10], reviewed existing literature on safety culture and safety climate from a social psychological aspect. One of the conclusions was that the studies should not be done to develop "new" safety climate measurement

instruments and should investigate whether safety climate could be used to indicate the organisation's safety performance. Clarke reviewed the safety culture concept and proposed a theoretical model of the safety culture's influence on work behaviour [7]. In his paper [5], Strauch suggested that safety culture assessment could be made by examining companies' post-accident actions and lessons learned. Ek et al. [11] proposed a new questionnaire for measuring safety culture in shipping and presented the test results. They used nine safety culture aspects: Reporting culture, Flexible culture, Just culture, and Learning culture (these four were previously proposed by Reason [22, 25]) and added Working conditions, Safety-related behaviour, Attitudes towards safety, Communication, and Risk perception. Using questionnaire data, Ek et al. [12] analysed the relationship between safety culture aspects. Safety culture data were collected from six Swedish ships engaged in international voyages. Their work confirmed that safety culture aspects and their relationships could be used to design measures for organisational safety improvements. Berg elaborated on human factors affecting maritime safety. According to his research, maritime safety could be improved by safety culture improvement, training schemes, and formal competence assessment programs [13]. Bhattacharya studied the alignment between safety culture and safety climate onboard ships among Indian officers. He found that seafarers' safety level perception was low, indicating the existence of misalignments between the company's set safety culture and safety climate among seafarers. One of the conclusions was that Blame culture, where it exists, must be replaced with Just culture since it prevents reporting of accidents and near-misses, thus preventing learning from adverse events. Management must enable a blame-free atmosphere onboard ships to remove reporting barriers and potentiate reporting of unsafe events [14]. Lappalainen [15] concluded that a safety culture emerged in shipping and is still developing. Potential barriers recognised for further development of safety culture were underreporting of near-misses and non-conformities and high turnover of seafarers in some companies. Underreporting prevents learning from unwanted events, and the high turnover of the labour force prevents the establishment of a stable and influential safety culture on ships. For his study, Håvold [16] used a safety culture questionnaire data that was distributed to seafarers on 20 vessels. He found that national culture plays a vital role in creating a safety culture in shipping, i.e., seafarers of different nationalities perceive safety differently. Another critical finding was the existence of safety subcultures onboard ships.

Safety culture is still being developed in shipping, and there is a need to recognise factors affecting its' creation and act on them to improve it. One of

the essential aspects is reporting accidents, incidents and near-misses. Creating and maintaining a just culture onboard ships is a prerequisite for open and honest reporting. One of the factors that could attenuate the development of reporting culture on ships is a lack of safety leadership practices, which could be considered a key element of successful implementation and development of safety culture in shipping. Consequently, this paper aims to elaborate on safety culture in shipping, describing its components (especially reporting culture) and suggesting safety improvements onboard ships.

2. Safety culture and its components

According to Clarke, aspects of an organisational safety culture can be divided into three layers (Figure 1) [7]:

- The surface layer (standards and creations),
- The intermediate layer (beliefs and values),
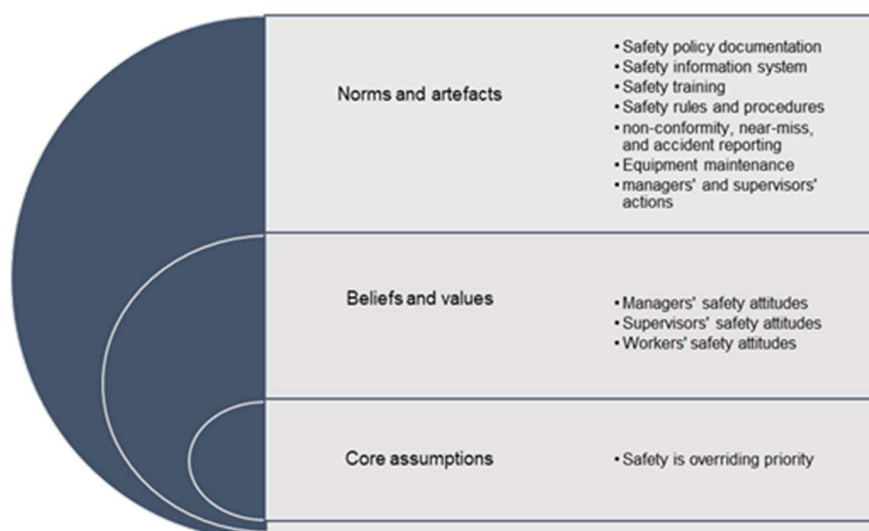- The deepest layer (the core assumptions).

Fig. 1 – *Layers of organisational safety culture.*

Source: Authors as per [7].

Onboard ships, senior officers must influence the layers to change and improve the organisational safety culture [17].

Organisations typically go through three stages during the development and improvement of a safety culture, namely [18]:

- control of safety,

- guarantee of safety, and

- total safety.

The first stage is driven by compliance and is primarily based on rules and regulations. Safety is understood as a technical matter at this stage, where compliance with the rules and procedures imposed by a third party is considered adequate for safety. In the second stage, adequate safety performance becomes the organisation's goal and is tried to be achieved by setting safety goals. In the third stage, safety is recognised as a continuous improvement process to which all organisation members can contribute [19, 20]. For an organisation's safety culture to be as developed as possible and continuously progressing, it must be assessed periodically. Assessment can be performed in several ways [5, 21]:

- Safety attitude questionnaires to employees.

- Safety management audits.

- Workshops on safety culture.

- Safety performance indicators.

- Accident, incident or near-miss investigation and root-cause analysis.

Safety culture assessment can help an organisation better understand employees' attitudes toward safety and find ways to increase safety performance. However, when assessing the safety culture, there are several peculiarities, and the most interesting is that safety is determined and measured more by its non-existence than by its existence [22]. Therefore, the safety level onboard ships is usually measured in the number of accidents, incidents, near-misses, and unsafe conditions.

A safety culture's progression can be shown by a stairway, with each step representing maturing towards the ultimate goal [23]. For example, the International Association of Oil and Gas Producers uses a five-tier model accepted by many large oil companies (Figure 2).
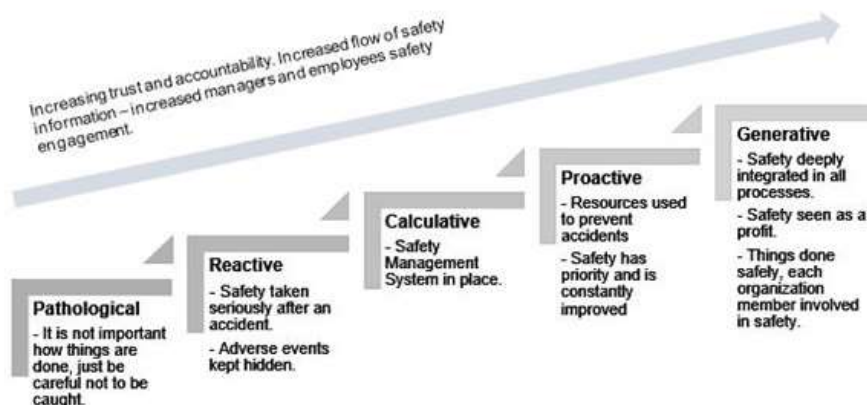
Fig. 2 – *Safety culture stairway.*

Source: Authors as per [23].

As presented in Figure 2, the evolution of a safety culture starts with a pathological safety culture, where safety is not a priority, and it is not important how things are done; the only that is important is not to be caught if an incident occurs. The next step is a reactive safety culture where only the occurrence of an accident puts safety as a priority. A reactive safety culture usually develops into a calculative one since, after accidents, numerous safety procedures are in place. One example of a calculative safety culture could be an organisation where a system for reporting near-misses is in place, and reporting is mandatory. However, nothing is done from the management side when the report arrives. If the organisation further evolves, it will develop a proactive safety culture where safety systems and procedures, including near-miss reporting, are in place and, more importantly, effective. It means that possible safety issues are anticipated before they occur, and corrective measures for occurred near-misses are identified, implemented and evaluated. Evolution ends with a generative safety culture where safety is deeply embedded in all aspects of work, and nothing is done without considering the safety aspect first. The organisation needs to strive to evolve to a generative stage, where safety is a way of doing things, but quite often, it is a complex and long path that needs to be overcome by all organisation members, from managers to workers.

It is important to emphasise that safety culture can be changed, i.e., the influence of leadership on employees and their example can significantly improve the organisation's safety culture. Improving the safety culture is possible by acting from the outer layer towards the core and increasing the value of its parts. Another vital factor enabling improvements is how long

employees work together within the organisation and their mutual connections. Safety culture improvement involves assessments that can be carried out in many ways, usually through audits and questionnaires [9]. Assessment analysis enables the detection of "weak links" in the safety system which need improvement and special attention. Improving an organisation's safety culture achieves greater efficiency in accident prevention and environmental protection [24]. The safety culture can be viewed as a whole consisting of elements. Therefore, it can be broken down into elements that can be observed, assessed, and improved separately. Consequently, one way to enhance an overall safety culture is to improve one or more elements. According to Reason [22, 25], the safety culture could be broken into five elements (Figure 3) [24, 25]:

- Reporting culture.
- Just culture.
- Learning culture.
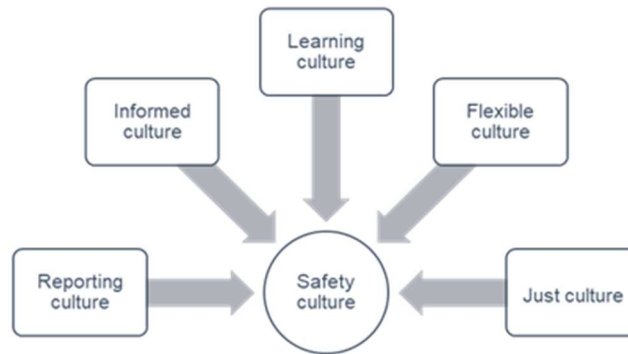- Flexible culture.
- Informed culture.

Fig. 3 – *Safety culture components.*

Source: Authors as per [25].

A reporting culture is a safety culture's element where employees are sincerely and openly willing to report accidents and near-misses [11, 12, 24, 25]. There are many accidents and near-miss reporting barriers, the most significant being fear of punishment, shame, and guilt [24, 26, 27]. Furthermore, it has been observed that cultural differences among employees also affect reporting and the difficulties in identifying the near-miss and means of accident or near-miss reporting (paper or electronic reporting form and its complexity) [28, 29]. Another barrier is the frequent change of company or place of employment [15, 27, 30]. Removing the

barriers that prevent them from doing so is necessary to report openly and without fear. The organisation's management must visibly and clearly emphasise that employees will not be held liable for accidents or near-misses they report, which they did not cause through their fault, negligence or gross negligence. Reported accidents and near-misses are essential for improving an organisation's safety because lessons learned can help to prevent unwanted events. Thus, the reporting culture is linked to just culture.

A just culture implies reporting without fear of punishment, blame, and prosecution if they did not intentionally or grossly negligently cause the accident or the near-miss [11, 24, 25, 27, 31]. A just culture is an element of a safety culture, opposite to blame culture, without which it is impossible to overcome reporting barriers. Every shipping company should avoid a blame culture and strive for a just culture to increase reporting and create an atmosphere of trust among seafarers and managers [11]. A safety culture cannot be effective without a just culture, and according to Bhattacharya, safety is worth a little more than filling out paperwork if there is no just culture [9].

A learning culture involves drawing conclusions and learning from all available safety data collected within an organisation. Accident and near-miss reports, for example, provide the immediate and root causes identified, enable learning and thus prevent the same and similar events in the future [11, 12, 24, 25, 29, 32].

A flexible culture implies changes related to safety procedures and processes within the organisation to raise safety to a higher level. The safety changes should be as simple as possible and follow safety trends [24, 25].

An informed culture is a system that encompasses all the elements of a safety culture. In addition, accident and near-miss reports are collected, and corrective measures and implementation methods in already existing systems. With such safety data, the entire organisation's safety is raised to a higher level, changes are made to the quality management system, new equipment is introduced, and information is disseminated throughout the organisation [24, 25].

Improving some components of the safety culture individually or as a whole increases safety and can reduce the number of accidents. Because shipping is a high-risk industry, and about 90% of the world's traded goods are transported by sea [33], a safety culture must be implemented in shipping.

3. Implementing a safety culture in shipping

The International Maritime Organization (IMO) defines a safety culture in shipping as a culture that makes significant efforts to reduce risks to persons, ships, and the marine environment to a minimum [34]. Maritime transport is a hazardous branch of transport where an accident can cause catastrophic consequences such as personal injury or fatality of passengers and/or crew, loss or damage to cargo, damage or loss of a ship, and environmental disasters. According to some estimates, human error is the cause of 75% to 96% of maritime accidents [35]. As organisational and human factors make up the leading share in maritime safety, they must be guided towards safety [13].

To reduce the number of accidents in shipping, it is necessary to identify root causes and eliminate them or reduce their impact to prevent a recurrence [36]. The first step towards reducing the number of accidents is to report all observed accidents and near-misses and assess the risk of accidents [37]. Unfortunately, according to some research, accidents and near-misses in shipping are not reported to the extent they should, being underreported [27, 29, 38]. Therefore, there is a need to raise seafarers' awareness of safety culture [39]. To this end, engaging the company's top management is necessary. The top management must continuously and purposefully raise safety awareness within the company through written regulations and actual action [13, 40] and approach it with a just culture, not a blame culture. Seafarers must be assured that reported accidents or near-misses will not get them into trouble; they will not be blamed and prosecuted for reporting. The company's management and management onboard a ship have a vital role because, with their example and written regulations, they must act on seafarers and convince them that reporting is the foundation of a healthy organisation. It is also necessary to overcome all reporting barriers, which requires a special effort from top management and the shipboard leadership [41]. Company management should accept the occurrence of near-misses as warning signals and not consider them successes because no damage has occurred [42]. Near-misses can also affect the understanding of risk, so it should be understood that they are not a sign of resistance to accidents and lull into a sense of complacency, but on the contrary, analyse them and implement corrective actions to prevent recurrence [43].

According to Hänninen, the shipping industry has many shortcomings within the safety culture [44]:

- There is greater tolerance in shipping towards accepting accidents and near-misses.

- Companies are more profit-oriented than safety-oriented, and safety issues are neglected.
- There is no systematic procedure for accident management.
- Seafarers are not proactive in addressing safety issues.
- Non-conformity data are not collected in the shipping industry and are not reported accurately to maritime authorities.

It is essential to mention the creation of safety subcultures in shipping. Assuming that every company has a safety culture, it can be said that every ship within the company has a safety subculture. Therefore, it can be concluded that each department within a ship (for example, a merchant ship has a deck, engine, and galley department) has a subculture of the safety subculture (Figure 4) [16, 27].
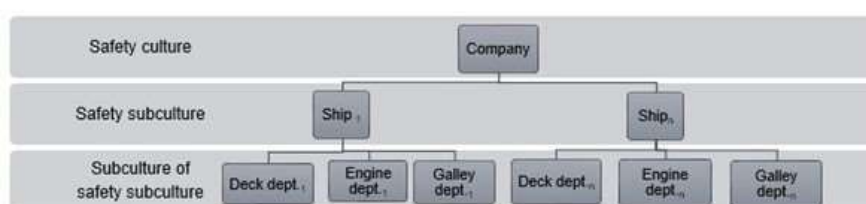

Fig. 4 – *Safety culture and subcultures.*

Source: Authors own construction.

As the ship's crews change, so do safety subcultures. Crews that sail together for a long time have created a sense of trust and friendship between themselves. If they have permanent contracts, they return to the same ship, take safety more seriously, and are more willing to report and participate in safety activities. Conversely, crews who are briefly together and know that they will not return to the same ship and plan to change company due to instability take safety issues less seriously and participate in reporting to a smaller extent [27].

Another critical factor of safety culture in shipping is cultural diversity. As crews today are usually composed of two or more nationalities, the company's management must consider that national culture influences the perception and understanding of safety culture and thus the reporting of accidents and near-misses [9, 27, 45].

The relatively large number of accidents in shipping and the underreporting of accidents and near-misses from which the root causes would be identified are major problems that prevent the safety culture in shipping from maturing to a higher level. The IMO has, therefore, obliged

companies to implement a Safety Management System (SMS) in shipping. Its goal is to reduce the number of accidents, make shipping a safer industry, and improve the safety culture.

4. Safety Management System in shipping

An analysis of the Herald of Free Enterprise (1987) and Estonia (1994) accidents revealed shortcomings within the safety culture in shipping [26]. To address this problem, the IMO has developed a new safety management system. The result was the International Safety Management (ISM) Code, which in 1994 was included in the International Convention for the Safety of Life at Sea (SOLAS) in Chapter IX. According to Chapter IX, each company must establish a ship safety management system to comply with ISM regulations. The requirement of the ISM regulations is adopting the Safety Management Manual (SMM), which is in writing and deals in detail with the company's Safety Management System [46]. The ways in which the IMO, through SMS, seeks to achieve and enhance safety culture in shipping are [15]:

- "recognising that accidents are preventable through following correct procedures and established practices";
- "constantly thinking about safety", and
- "seeking continuous improvement."

The IMO has set the ISM Code's fundamental goal to create a new safety-oriented culture in shipping over time. It was expected to reduce the number of accidents, injuries, and lost time in ship operations. The safety culture promoted by the ISM Code enhances ship safety and marine protection [15]. However, according to [47], implementing the ISM Code in shipping failed. The study found that company managers' and seafarers' perspectives on it were different, and seafarers filled logbooks and checklists according to SMS requirements even though it meant falsifying records [47]. When such a condition occurs on the ship, besides contravening regulations, it is very dangerous, undermines safety efforts, and hampers the development of a safety culture. From that perspective, the SMS is only a bureaucratic need to fill out many needless papers, and it does not serve its purpose – accident prevention and safety improvement. Therefore, seafarers must be included in the development of shipboard SMS since their knowledge and expertise could valuably contribute to creating shipboard-specific and usable procedures and operations together with practical checklists. As found in [48], one of the ISM's major problems is the "development of plans for shipboard operations" since ship-specific, practical, usable instructions, procedures, and checklists are scarce. As pointed out, including experienced

seafarers could effectively solve this problem and improve shipboard safety. In addition, deviation from existing procedures was found to be a common issue [48]. However, suppose the written procedure is too complex or even not applicable to a specific ship. In that case, seafarers will make routine violations and do it on their way (cutting corners and similar).

IMO described the ultimate purpose of the ISM Code in Section 1.2.1 [15]: "The objectives of the Code are to ensure safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment, in particular to the marine environment and property."

The functional requirements of the SMS include the following [15]:

- regulations on safety and environmental protection,
- instructions and procedures to ensure the ship's operations and environment are safe and following relevant international and national legislation,
- clearly defined levels of authority and levels of communication between shipboard and shore personnel,
- procedures for reporting accidents and non-conformities following the provisions of the Code,
- procedures for preparation and response to emergencies,
- procedures for internal audits and reviews.

Therefore, it is necessary to monitor its current safety performance and identify areas where safety can be improved to achieve an effective safety culture within an organisation [49]. Research has shown that out of approximately 300 incidents or near-misses, 30 will likely result in an injury, one being major. Thus, acting to prevent near-miss will likely reduce injuries and accidents in shipping [40]. The safety pyramid designed by Heinrich shows the relationship between near-misses, minor injuries, and major injuries (Figure 5) [50]. According to him, accidents and near-misses have the same root causes, and investigating, analysing and learning from the conclusions can improve maritime safety [50].

Fig. 5 – *Heinrich's safety pyramid.*

Source: Authors according to [50].

The safety pyramid has changed over time to show the number of events that precede serious accidents and major injuries as accurately as possible. Thus, in his study in 1969, Bird came to new knowledge and made a new pyramid [51, 52] (Figure 6a). In 2003, ConocoPhillips conducted a study to show even more precisely the relationship between near-misses and accidents (Figure 6b) [50, 51, 52]. The ConocoPhillips pyramid has extensively displayed ratios of actions that can lead to serious injury or fatality [50, 51, 52]. It is important to emphasise that the pyramid ratio is based only on reported adverse events, not all. Suppose blame culture and other reporting barriers exist within an organisation. In that case, there will be fewer reported risky behaviours, incidents, and near-misses in one serious accident, and the safety pyramid will be reshaped.
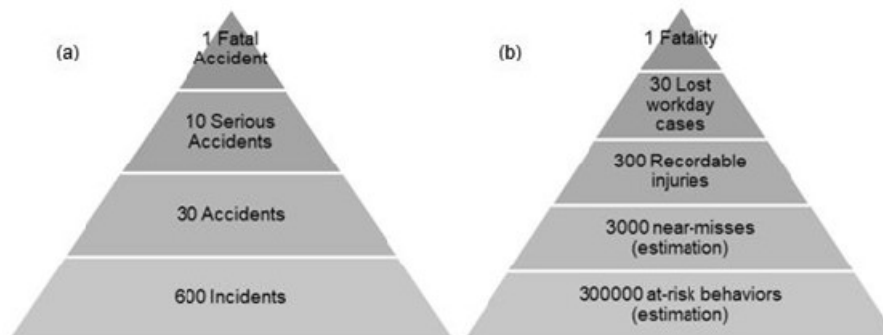

Fig. 6 – *Safety pyramid proposed by Bird (a) and one based on ConocoPhillips study (b).*

Source: Authors according to [50, 51, 52].

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When a serious accident occurs, time, effort, and money are usually spent investigating why it happened. Often, such investigations reveal that the root causes of such an accident were visible long before it occurred. Reporting such factors and implementing corrective actions early can prevent accidents leading to environmental pollution, damage, injury, or loss of life [40]. Thus, the reporting and recording serious accidents are generally accepted and known. The same thing should be done with reporting and recording non-conformities and near-misses. Learning from near-misses can contribute to the prevention of events that cause fatality, severe injury, or significant material damage [53, 54]. The company's safety management system should clarify that non-conformity, near-miss, and accident reporting are not intended to find someone to blame and punish. Reporting such adverse events provides an opportunity to investigate them and discover their root causes not to recur. It is possible to introduce corrective actions by understanding why such events occur. When corrective action is implemented in the system, the likelihood of an accident resulting in loss of life, injury, damage, or environmental pollution will be significantly reduced [40, 54]. For the part of the company's SMS that deals with reporting non-conformities, near-misses, and accidents to be effective, it is necessary to report such events, share reports, read and act on them, and take corrective actions to prevent them from happening again.

However, the underreporting of accidents [55] and near-misses [56] in shipping is a major issue that needs to be dealt with. As found in [56], seafarers believe that not all near-misses, only major ones should be reported to the company. The existence of reporting barriers, such as blame culture onboard ships, prevents reporting and negatively affects the development of safety culture.

Another serious problem besides the underreporting of near-misses in shipping is reporting fictional near-misses due to the fixed number of reports that many companies insist on. However, if the required number of near-misses does not occur in a given month, seafarers tend to fabricate certain events to comply with reporting requirements. Consequently, to avoid possible problems, seafarers report fictional events, which misleads researchers and creates a false image of the state of safety on ships [56].

Continuous monitoring, measurement, and control are required for the company's SMS to continually mature and lead to an effective safety culture [57]. It is performed by SMS audits and inspections, which can be internal - the ship's captain or company's safety inspector, and external – Flag State, Recognised Organization (RO), Port State Control (PSC) Inspection, or vetting inspection. In addition, SMS audits are performed periodically and, if

adequately performed, are useful tools to indicate the system's shortcomings and suggest improvement [47].

The ISM Code has introduced an SMS in shipping, one part of which deals with near-miss reporting. For the ISM to justify its introduction and improve the safety culture in shipping, seafarers must report near-misses and accidents to be investigated and their root causes detected and recorded. Dissemination of such complete investigation reports, together with needed corrective actions to eliminate the root causes of such events and prevent recurrence, will enable learning from such events and facilitate positive change in the safety culture onboard ships. Only when corrective actions are applicable onboard a specific ship, understood by all crewmembers, and finally implemented in the SMS does it guarantee improved maritime safety.

5. Safety improvement methods

As maritime transport is a branch of transport in which there is an increased level of danger, and human error is one of the biggest causes of accidents, there is a need to improve safety. Some of the ways to improve safety according to the shipping SMS are:

- a written list of critical shipboard operations and instructions on how to perform each of them,
- planning shipboard operations and carefully following existing checklists before, during and after work,
- permit to work system,
- risk assessment before performing shipboard operations,
- risk assessment reviews after completion of shipboard operations,
- analysis of non-conformities, near-misses and accidents, and implementation of corrective actions.

According to the SMS, all shipboard operations must be defined, and guidance for performing each operation should be given. In addition to guidance, various manuals help seafarers safely perform the necessary tasks. All equipment onboard a ship must have a valid manual written in the official language of the ship. Replacing manuals from unused equipment and removing them from the ship with those onboard is essential. The Shipboard Safety Management Manual lists all the jobs and crew members in charge of a particular job. Seafarers should follow written instructions to ensure that operations are carried out safely.

Before performing any shipboard operation, careful planning is required, including the planned start and end, the persons involved in the execution, and the equipment necessary for the work's safe execution.

Increasingly essential and complex ship operations have checklists that those in charge of their execution and safety must follow. Checklists such as work permits contain necessary information about the specific task to be performed, such as the procedures, the equipment to be used, and the persons involved.

Making a risk assessment before performing a particular task involves evaluating the likelihood of an adverse event and its consequences [58]. Some companies within their SMS have already developed risk assessments for most of the work performed on ships. However, risk assessments include the probabilities of events that have usually occurred before, and seafarers should go beyond that, so the notion of safety imagination emerges, where all possible scenarios should be imagined to go wrong steps and what to do. By properly conducting a risk assessment, seafarers can safely perform ship operations, reducing the number of damages, injuries, and loss of life.

A risk assessment review is used to determine whether a particular operation has been performed safely and the effectiveness of the risk assessment itself. If the operation was completed safely and there were no deviations, the risk assessment performed before the work can be considered adequate and does not need to be changed. However, if there was a change in the plan during the job, and there were some unexpected and unaccounted risks, it is necessary to change the risk assessment following new developments, share data with other company ships, and propose including changes in the SMS.

The analysis of near-misses and accidents reveals the root causes that need to be eliminated so that these adverse events do not recur. Reporting such occurrences is a prerequisite for analysis to identify the causes. As mentioned, barriers prevent reporting, and blame culture is the most common [24, 25, 31, 32, 59]. The company's and ship's management must implement a just culture and thus facilitate reporting. Therefore, the role of the ship's master is crucial for developing just culture onboard a ship [60]. Reported adverse events must be analysed to determine the root and immediate causes. It is then necessary to identify/propose corrective actions that will prevent such events in the future, implement them in the safety management system, and disseminate them to the company fleet or, preferably, publicly.

6. Conclusion

Implementation and growth of a safety culture onboard ships are needed to make shipping safe and sustainable. However, although the ISM Code with the aim to reduce accidents was introduced in shipping, accidents

still happen. The human factor is found to be the most frequent cause of maritime accidents, and therefore, it needs to be dealt with. One of the possible solutions was the introduction of a safety culture, respectively the ISM Code, aiming to reduce the effect of human factors in accidents.

The efficacy of safety culture in shipping primarily depends on company management, but another important factor is shipboard leadership. The existence of blame culture onboard ships inhibits reporting and thus prevents learning from unwanted events. Companies should invest in their employees, and adequate training should be provided to shipboard supervisors and team leaders to improve their skills to manage their subordinates successfully. In addition, companies should ensure that crewmembers are adequately trained and familiarised with shipboard operations, procedures and equipment. As mentioned, free and unbiased reporting is a prerequisite for creating and developing a strong safety culture where each individual understands that reporting adverse events will enable learning and prevent such events from reoccurring, not finding someone to blame.

Furthermore, the results of investigated and reported near-misses should be used to improve shipboard SMS and overall safety at sea. Ship procedures, manuals, and equipment should be changed if unsafe conditions or unsafe acts arise due to them. Monthly safety meetings should be used to discuss all safety issues (or preferably lack of safety) and propose adequate and acceptable solutions. Dissemination of accident and near-miss reports, including analysis and conclusions, is crucial for learning and improving safety culture in shipping. However, just disseminating data will not enable learning by itself; sharing disseminated reports during safety meetings where all crewmembers are included and discuss them is necessary.

References

[1] S. Garcia-Herrero, M.A. Mariscal, J.M. Gutiérrez and A. Toca-Otero, "Bayesian network analysis of safety culture and organisational culture in a nuclear power plant". Safety Science, Vol. 53, pp. 82-95, 2013.
[2] International Atomic Energy Agency 2009. "The Management System for Nuclear Installations". Safety Guide No. GS-G-3.5., IAEA, Vienna, Austria.
[3] G. Hofstede, G.J. Hofstede, M. Minkov, "Cultures and Organisations, Software of Mind, Intercultural Cooperation and Its Importance for Survival". The McGraw-Hill Companies, ISBN 9780071770156, 2010.
[4] D.C. Thomas, K. Au and E.C. Ravlin, "Cultural variation and the psychological contract". Journal of Organizational Behavior, 2003, Vol. 24, No. 5, pp. 451-471. DOI: 10.1002/job.209.
[5] B. Strauch, "Can we examine safety culture in accident investigations, or should we?". Safety Science 77, pp. 102-111, 2015.

[6] A. Hopkins, "Studying organisational cultures and their effects on safety". Safety Science, 2006, 44(10), pp. 875-889. https://doi.org/10.1016/j.ssci.2006.05.005.

[7] S.G. Clarke, "Safety culture: under-specified and overrated?". International Journal of Management Reviews, 2000, Vol. 2, no. 1, pp. 65-90.

[8] D. Zohar, "Safety Climate in Industrial Organizations: Theoretical and Applied Implications". Journal of Applied Psychology, 1980, Vol. 65, No. 1, 96-102, DOI: 10.1037/0021-9010.65.1.96.

[9] Y. Bhattacharya, "Measuring Safety Culture on Ships Using Safety Climate: A Study among Indian Officers". International Journal of e-Navigation and Maritime Economy, 2015, no. 3, pp. 51-70, http://dx.doi.org/10.1016/j.enavi.2015.12.006.

[10] F.W. Guldenmund, "The nature of safety culture: a review of theory and research". Safety Science, 2000, Vol. 34, pp. 215-257. https://doi.org/10.1016/S0925-7535(00)00014-X.

[11] Å. Ek, U. Ollson and K.R. Akselsson, "Safety culture onboard ships". In Proceedings of the IEA 2000/HFES 2000 Congress, 2000, pp. 320-322.

[12] Å. Ek, M. Runefors and J. Borell, "Relationships between safety culture aspects - A work process to enable interpretation". Marine Policy, 2014, Vol. 44, pp. 179-186, http://dx.doi.org/10.1016/j.marpol.2013.08.024.

[13] H.P. Berg, "Human Factors and Safety Culture in Maritime Safety (revised)". The International Journal on Marine Navigation and Safety of Sea Transportation (TRANSNAV), 2013, Vol. 7, No. 3, pp. 343-352. DOI: 10.12716/1001.07.03.04.

[14] Y. Bhattacharya, "Measuring Safety Culture on Ships Using Safety Climate: A Study among Indian Officers". International Journal of e-Navigation and Maritime Economy, 2015, Vol. 3, pp. 51-70. http://dx.doi.org/10.1016/j.enavi.2015.12.006.

[15] J. Lappalainen, "Transforming maritime safety culture, Evaluation of the impacts of the ISM Code on maritime safety culture in Finland", Centre for Maritime Studies University of Turku, Turku, A46, 2008.

[16] J.I. Håvold, "Safety Culture in a Norwegian shipping company", Journal of Safety Research, 2005, Vol. 36, pp. 441-458.

[17] A. Bain, "Do we truly understand Safety Culture?". in Achieving Systems Safety: Proceedings of the Twentieth Safety-Critical Systems Symposium, Bristol, UK, 2012.

[18] S. Garcia-Herrero, M.A. Mariscal Saldana, M.Á. Manzanedo del Campo and D.O. Ritzel, "From the traditional concept of safety management to safety integrated with quality". Journal of Safety Research, 2002, Vol. 33, pp. 1-20.

[19] International Atomic Energy Agency. Key practical issues in strengthening safety culture, INSAG-15. Available online: https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1137_scr.pdf.

[20] Institute of Medicine (US). Committee on the Work Environment for Nurses and Patient Safety; A. Page, editor. Keeping Patients Safe: Transforming the Work Environment of Nurses. Washington (DC): National Academies Press

(US); 2004. Available online: https://www.ncbi.nlm.nih.gov/books/NBK216190/ doi: 10.17226/10851.

[21] M. Grabowski, P. Ayyalasomayajula, J. Merrick and D. Mccafferty, "Accident precursors and safety nets: leading indicators of tanker operations safety". Maritime Policy & Management, 2007, Vol. 34, No. 5, pp. 405-425, https://doi.org/10.1080/03088830701585084.

[22] J. Reason, "Safety paradoxes and safety culture", Injury Control & Safety Promotion, 2000, Vol. 7, No. 1, pp. 3-14.

[23] J. Adamson, "Best Management Practices For Implementing An Effective Safety Culture". Allmode Ltd. 2015. Available online: https://www.onboardonline.com/assets/PDFs/best-management-practices-for-implementing-an-effective-safety-culture-copyright-2015v3.2.pdf.

[24] E. Douglas, S. Cromie, M.C. Leva and N. Balfe, "Modelling the Reporting Culture within a Modern Organisation". Chemical Engineering Transactions, Vol. 36, pp. 589-594, 2014. DOI: 10.3303/CET1436099.

[25] J. Reason, "Managing the risks of organisational accidents". Routledge, Taylor & Francis Group, 1997.

[26] J. Lappalainen, A. Vepsäläinen, K. Salmi and U. Tapaninen, "Incident reporting in Finnish shipping companies". WMU Journal of Maritime Affairs, 2011, Vol. 10, pp. 167-181.

[27] H.A. Oltedal, "Safety culture and safety management within the Norwegian - controlled shipping industry, State of art, interrelationships, and influencing factors". University of Stavanger, Faculty of Social Sciences, Stavanger, PhD Thesis, 2011.

[28] J. Storgård, I. Erdogan and U. Tapaninen, "Incident Reporting in Shipping, Experiences and best practices for the Baltic Sea". Centre for Maritime Studies University of Turku, Turku, A59, 2012.

[29] N. Hasanspahić, V. Frančić, S. Vujičić and L. Maglić, "Reporting as a Key Element of an Effective Near-Miss Management System in Shipping", Safety, 2020, 6(4), 53, https://doi.org/10.3390/safety6040053.

[30] H.A. Oltedal and D.P. McArthur, "Reporting practices in merchant shipping and the identification of influencing factors", Safety Science, 2011, 49, pp. 331-338.

[31] B.J. Weiner, C. Hobgood and M.A. Lewis, "The meaning of justice in safety incident reporting", Social Science & Medicine, 2008, no. 66, pp. 403-413.

[32] N. Hasanspahić, S. Vujičić and M. Mandušić, "Ship Safety Officers'Perceptions and Attitudes Toward Near-Miss Management Systems", Transactions on Maritime Science, 2023, 12(1), DOI:10.7225/toms.v12.n01.w07.

[33] J. Castonguay, "International Shipping: Globalisation in Crisis" Available online: https://www.visionproject.org/images/img_magazine/pdfs/international_shipping.pdf.

[34] IMO MSC 77/17 2003, "Role of the Human Element, Definition of safety culture", International Maritime Organization, Maritime Safety Committee, 2003.

[35] A. Rothblum, "Human Error and Marine Safety", Maritime Human Factors Conference, Linthicum, MD, March 13-14, 2000.

[36] M.L. Barnett, "Searching for the Root Causes of Maritime Casualties - Individual Competence or Organisational Culture?", WMU Journal of Maritime Affairs, 2005, Vol. 4, no. 2, pp. 131-145.

[37] A.J. Ringstad and S. Szameitat, "A comparative study of accident and near miss reporting systems in the German nuclear industry and the Norwegian offshore industry". In Proceedings of the Human Factors and Ergonomics Society Annual Meeting, Vol. 44, Issue 27, 2000, pp. 380-383.

[38] G. Psarros, R. Skjong and M.S. Eide, "Under-reporting of maritime accidents". Accident Analysis and Prevention, 2010, 42(2), pp. 619-625.

[39] J.I. Håvold and E. Nesset, "From safety culture to safety orientation: Validation and simplification of a safety orientation scale using a sample of seafarers working for Norwegian ship owners". Safety Science, 2009, 47, pp. 305-326.

[40] ICS, "Implementing an Effective Safety Culture, Basic Advice for Shipping Companies and Seafarers". International Chamber of Shipping, 2013, Available online: https://www.ics-shipping.org/publication/implementing-an-effective-safety-culture-basic-advice-for-shipping-companies-and-seafarers/.

[41] N. Hasanspahić, S. Vujičić, M. Kristić, and M. Mandušić, "Improving Safety Management through Analysis of Near-Miss Reports - A Tanker Ship Case Study". Sustainability, 2022, 14(3), 1094. https://doi.org/10.3390/su14031094.

[42] R.L. Dillon and C.H. Tinsley, "Organizational Correctives for Improving Recognition of Near-Miss Events". Journal of Management, 2016, Vol. 42, no. 3, pp. 671-697.

[43] C.H. Tinsley, R.L. Dillon and M.A. Cronin, "How Near-Miss Events Amplify or Attenuate Risky Decision Making". Management Science, 2012, Vol. 58, No. 9, pp. 1596-1613.

[44] H. Hänninen, "Negotiated risks: the Estonia accident and the stream of bow visor failures in the Baltic ferry traffic". Aalto University 2007, doctoral dissertation, ISBN: 978-952-488-127-2.

[45] C.-S. Lu, C.-N. Hsu and C.-H. Lee, "The Impact of Seafarers' Perception of National Culture and Leadership on Safety Attitude and Safety Behaviour in Dry Bulk Shipping". International Journal of e-Navigation and Maritime Economy, 2014, Vol. 4, pp. 075-087.

[46] International Maritime Organization. SOLAS Consolidated Edition 2020. ISBN: 9789280116908.

[47] S. Bhattacharya, "The effectiveness of the ISM Code: A qualitative enquiry". Marine Policy, 2012, no. 36, pp. 528-535.

[48] B.-M. Batalden, and A.K. Sydnes, "Maritime safety and the ISM code: a study of investigated casualties and incidents". WMU Journal of Maritime Affairs, 2014, 13, pp. 3-25, doi: 10.1007/s13437-013-0051-8.

[49] B. Basso, C. Carpegna, C. Dibitonto, G. Gaido, A. Robotto and C. Zonato, "Reviewing the safety management system by incident investigation and

performance indicators". Journal of Loss Prevention in the Process Industries, 2004, 17(3), pp. 225-231.

[50] M.G. Gnoni, S. Andriulo, G. Maggio and P. Nardone, "Lean occupational' safety: An application for a Near-miss Management System design". Safety Science, 2013, 53, pp. 96-104.

[51] A. Radvanska, "Accident losses elimination by means of safety pyramid analysis". Annals of Faculty Engineering Hunedoara - International Journal of Engineering, 2010, Vol. VIII, pp. 73-76, ISSN 1584-2665.

[52] B. Freibott, "Sustainable safety management: incident management as a cornerstone for a successful safety culture". WIT Transactions on The Built Environment, Vol. 134. Safety and Security Engineering V. doi:10.2495/SAFE130241.

[53] N. Carter and E. Menckel, "Near-Accident Reporting: A Review of Swedish Research". Journal of Occupational Accidents, 1985, Vol. 7, pp. 41-64.

[54] Drägerwerk AG &Co. "Near misses – a learning opportunity for working towards zero accidents. Available online: https://www.draeger.com/Content/Documents/Content/near-miss-wp-pdf-9110376-en-master.pdf.

[55] G. Psarros, R. Skjong, M.S. Eide, "Under-reporting of maritime accidents". Accident Analysis and Prevention, 2010, 42, pp. 619-625.

[56] N. Hasanspahić, V. Frančić, S. Vujičić and L. Maglić, "Near-miss Reporting as Seen from Seafarers' Perspective". The International Journal on Marine Navigation and Safety of Sea Transportation, 2021, Vol. 15, No. 4. Doi:10.12716/1001.15.04.15.

[57] J.S. Withington, "ISM - What has been learned from marine accident investigation?". Available online: http://www.he-alert.org/filemanager/root/site_assets/ standalone_pdfs_0355-/HE00475.pdf.

[58] M. Hess, S. Kos and M. Njegovan, "Assessment and control of operational risks on board ships in accordance with the ISM Code". Scientific Journal of Maritime Research, 2011, 25/2, pp. 405-416.

[59] J. Storgård, I. Erdogan, J. Lappalainen and U. Tapaninen, "Developing incident and near miss reporting in the maritime industry - a case study on the Baltic Sea". Procedia - Social and Behavioral Sciences,m 2012, Vol. 48, pp. 1010-1021.

[60] T. Bielić, D. Predovan and J. Čulin, "The role of the master in improving safety culture onboard ships", The International Journal on Marine Navigation and Safety of Sea Transportation, 2017. Vol. 11, No. 1. doi:10.12716/1001.11.01.14.

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