Study over the increasing of situational awareness and the culture of safety among younger officers

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Abstract Two aspects count most on board of all ship today: safety and security. There are many rules and regulations stated on this issues containing requirements on managing different situations, on the way of approach a safety or security situation, and most important of all, on how to prevent these events. But, all these are coldly established for understanding and application when is necessary, without taking into consideration variant human behavior. Based on these observations, we can emphasize the importance of rules, regulations and procedures, but only after testing the situational feedback. Basically, all situations involving ship’s safety and security are treated as potential risks, before being recognized as a real threat. It’s important to increase the crew situational awareness into identifying and assessing the risks and to establish a culture of safety in order to prevent future dangerous situations. The question that arises is how are we capable to obtain the same average of understanding and response for a considered risk?

In the study we evaluated the understanding and addressing situations of risk for ship’s safety, by using simulations of different events to be faced at sea like stranding or collision situations, piracy attacks and terrorist threats. We included seafarers with different levels of training and experience on sea, from cadets and young officers – considered less experienced or in the beginning of their seafarer carrier, up to seafarers with considerable number of years on sea.

Present paper presents the methods used in the study and the results obtained on human response over different risky situations, on the way that situational awareness and culture of safety influence the assessment process for these conditions, the influence of experience and what are the optimal solutions to be considered in accordance with present evolution of maritime industry and procedural requirements for ship safety.

Keywords: Safety, awareness, culture, younger officers, study.

1. Introduction

Today, the maritime industry is focused on increasing the safety and security in all sectors and at all levels. This increase is based both on technical development and also on changing the human behaviour. The time when only the technical measures were taken into consideration is no longer available. Studies about the impact of technology on safety in different industries have shown that the improvement of equipment alone, without a proper increasing of human awareness, is not efficient. The technology can bring a lot of advantages on safety matters, but only if it is controlled by aware operators, able to understand the meaning of “safety”.

To define safety is important for every seafarer, because the understanding of this concept generates a secured working environment for all on board persons. A person able to perform activities in safe manners for him, will be able to offer safe environment for others. But, if you will not be able to define what is safe for yourself, there will be really difficult to offer a protected environment for the others. To be safety aware is not a characteristic of the “older” seafarers only, it must be seen as a basic concept for all seafarers. For a seafarer is important to be aware of possible dangers in most of the situations.
Any activity that has to be performed must begin with a risk evaluation, that aware the person involved about what can happen, which is the best way to approach the job and what is necessary to be done in order to avoid possible dangerous conditions. If these considerations will be taken into account for all activities performed on board, the number of dangerous situations, near misses and accidents will be very much reduced, and the maritime industry will no longer be considered as dangerous as it is today.

The relationship between situational awareness and the culture of safety is well known: is difficult to be aware about the risks without knowledge. A good safety knowledge will make the seafarers more aware about the risky situations for life, ship and environment.

For these reasons, the meaning of any maritime education and training institution is to guide the students to complete their training in ship safety and security, and to be able to bring their contribution to the ultimate concept of “safer ships, safer seas”.

2. Situational awareness and maritime safety

Like in many other industries, for the maritime, a good situational awareness means to have always a right and clear perception of your surroundings, to be able to understand what’s happening around you and how all of these will affect the ship [1]. Situational awareness refers to the capability to maintain a constant vigil over important information, to understand the relationships among the various pieces of information monitored, and to project this understanding into the near future for making critical decisions.

On board, regardless department affiliation, the seafarers must constantly maintain situational awareness in order to ensure safe operations. A healthy dose of situational awareness is essential to make informed decisions, act in a timely manner, and ultimately ensure operational safety, even on sea or in harbour. Studies over the maritime incidents have high lightened that the loss of situational awareness plays a significant role in incidents attributed to human factor. Different studies made by United States Coast Guard revealed that human factors accounted for 54% of the medium and high severity incidents and about 40% of the low severity incidents. Also, failures in situational awareness or task performance accounted for 69% of the medium and high severity human incidents. The same studies have shown that only 5% of the cases were attributed to mechanical problems [2].

To avoid inclusion in these statistics is important to know how to establish a good situational awareness, including the following considerations [3]:

- to be aware of your situational environment (ships in the transiting area, necessary communication with coastal stations or other ships, water depth, tide, current, weather, sea state),
- to be aware of the status of your ship’s systems,
- to have mode awareness (know the own ship configuration, including equipment and systems),
- to keep a time horizon (always allow time for unplanned events or emergencies),
- to maintain spatial orientation.

According to Endsley [4], the situational awareness can be organized in three levels of information processing. The first level, perception, is fundamental. Without basic perception of important information, the odds of forming an incorrect image of the situation will increase a lot. At this level, the seafarer perceives the status and the dynamics of the relevant elements in his environment and a typical error would be the missing of critical information [5].

At second level, the comprehension, situational awareness as unitary construct, goes beyond mere perception. It is surprising how people combine, interpret, store and retain information. At this level, there is an integration of multiple pieces of information and a determination of their relevance to the person’s goals. In this stage, the seafarer will evaluate and integrate the existing information. It is required for him to understand the information in relation to the relevant objectives and goals [5].
At the last level of situational awareness, projection, person is developing the ability to forecast future situational events and dynamics; this marks persons who have the highest level of understanding of the situation. In the final stage, the seafarer uses his perception and comprehension of the present situation to approximate what will be produced in the near future [5].

Regarding to the situational awareness levels, an analyse of the incidents occurred in offshore industry that included 135 cases, revealed that 67% of these were resulted from lack of perception of critical information (Level 1), 20% due to failure to comprehend the real situation (Level 2), and 13% were attributed to inability to project what will happen in the near future (Level 3) [6].

Regarding maritime safety, the situational awareness involves both a temporal and also a spatial component. Time is an important concept in situational awareness, being a dynamic construct, changing at a tempo dictated by the actions of seafarers, task characteristics, and the surrounding environment. As new inputs enter the system, the seafarer incorporates them into this mental representation, changing the plan and actions as necessary to reach the desired objectives. The situational awareness concept also includes the spatial knowledge about all the events and activities developed in locations of interest for seafarer. As example, the officer on the watch on the bridge has to be aware about the location and extent of the maintenance activities that take place on deck, in order to protect the seamen from any dangerous situation.

Presently, building of a firm situational awareness on maritime safety has faced an entire set of challenges, which must be considered in process designing [7]. The first challenge is to gather information on the situation around you and second one, to have the capability to identify the critical situations.

Thus, the concept of situational awareness includes perception, comprehension, and projection of situational information, as well as temporal and spatial components.

Important is not to forget that activities on board ship are made in most of the cases as a team work and situational awareness have to be treated as a whole for the entire team members. The team situational awareness is based and depends on the level of safety awareness for each member of the team and the level of safety awareness shared between team members. These aspects provide an accurate operating picture of those aspects of the situation common to the needs of each member of the team [8].

Regarding the team situational awareness, Endsley and Jones [1] describe a model intending to conceptualize how teams develop high levels of shared safety awareness across members, a model suitable to be used for those on board activities based on team activities. The factors considered to help into building a strong team and to share situational awareness are requirements, devices, mechanisms and processes.

The team situational awareness requirements represent the highest level of comprehension of information, of selecting the most important aspects that should be shared, including personal assessments and projections. There is also information on team member’s activities and capabilities. For situational awareness devices are considered the devices available in different working compartments for sharing information, including direct communication, visual or audio displays or a shared environment.

Team situational awareness mechanism represents the way of processing information by team members, like shared mental models, which support their ability to interpret information in the same way and make accurate projections regarding each other’s actions. To have capacity to use a shared mental model can help a lot to increase communication and coordination in team settings.

The situational awareness processes are the degrees of involvement of each team members into effective processes for sharing necessary information, like a group norm of questioning assumptions, checking
each other for conflicting information or perceptions, setting up coordination and prioritization of actions, and establishing contingency planning among others.

Related to this, in our study, we tried to recreate the situations possible to be met on the bridge during navigation and to find how different trained level seafarers manifest their situational awareness. We checked if practical experience and good knowledge about the events around offered the opportunity to take better decisions on ships control.

In the study, the team intended to identify the key factors characteristic for the evaluation of situational awareness level. We have been observing the way of using the perception, comprehension, and projection of relevant events.

3. Study on risk perception and reaction among younger officers

A good analysis of the maritime activities will reveal that many are characterized by a medium to high level of risk. It is well known that any risk can be assessed and managed in good conditions, if it is recognized. The real problem, when introducing humans in the work equation, is how they evaluate and recognize the risk value.

In risk evaluation and safety measures an important consideration is given to situational awareness and safety culture. Both have the meaning to create and improve the sense of good and safe work.

3.1. Aims of the study

The study was initiated to get explanation on how the situational awareness and the existence of a safety culture among the ship crew can contribute to increasing of ship safety and security. As research method was used simulation techniques combined with questioning technique and discussions, for a more complete explanation of decisions and results.

The study was realized using Constanta Maritime University’s simulation complex together with the support of our students and collaborators from maritime industry. Also, we received support from medicine faculty colleagues, to understand different psychological aspects of decision making process.

The main goal of the study was to understand the human response over different risky situations, and the influence of situational awareness and culture of safety on the assessment processes, considering the people involved experience in these situations. In the same time, was intended to found the optimal solutions to be considered according to the present evolution of maritime industry and procedural requirements for ship safety.

3.2. Methods

For analysis of situational awareness in different sailing conditions were included 30 students with variable periods of practice on sea or no practice, 10 students with more than 2 years of experience on sea as helmsmen or able seafarers and 4 Master licensed with more than 5 years of experience in this position. For the students were created simulation scenarios for some possible dangerous or difficult to be managed situations, and interviews, for the Masters were used professional discussions and opinions based on own experience in these kind of situations.

The situations considered for simulations were navigation in restricted visibility with risk of collisions, possible piracy attack in isolate ship condition, engine failure in bad weather conditions, loss of the steering system during a channel transit and fail of the electronic charts system during transiting of a heavy traffic area.
For a better analysis of the participant’s situational awareness, part of the simulations were performed by students alone, others in a bridge team format. When the simulations required a team format, members of the team were chosen with different levels of experience.

Procedure: Students were given no instructions other than as per normal procedures. Immediately after starting simulation, there were included heading changes in short succession. On re-commencing the simulation after the first freeze, students were instructed to continue with their simulation as planned. During this segment various radio calls were made, some of which were relevant, others incidental to the task. The relevant calls advised of traffic information, and of changing weather conditions. After different situations of system failure (engine failure, loss of steering system, failure of electronic charts, etc.), the second questionnaire was administered. On continuing the simulation, additional calls were made to advise of deteriorating weather conditions, restricted visibility, risk of collisions, piracy attack, etc.

The final questionnaire was instigated about 5 minutes prior to simulation termination.

This arrangement was agreed to allow to: analyse how are used perception, comprehension and projection according to the classification levels of situational awareness, which is the role of goals and goal directed processing attention and interpreting the significance of perceived information, the role of information in increasing of the situational awareness, the role of expectations in directing attention and interpreting information, the heavy demands on limited working memory restricting situational awareness for students without onboard experience or a short one, the use of mental models for providing a means for integrating different part of information and comprehending its meaning and pattern matching to schema, that provides rapid retrieval of comprehension and projection relevant to the recognized situation.

3.3. Results

The resulting error scores ranged from 1 (best answer score) to 10 (worst answer score). Categorical responses were scored as 1 (accurate) or 10 (inaccurate). The scores were then averaged across items for each of the three questionnaires to form three general scores (G1, G2, and G3), and across all items to form one overall G-score (G). Best inclusion for situational awareness scored the minimum average points (best attitude of situational awareness and minimal errors).

Questionnaires were including six pattern questions for the 3 factors – 3 for timing and 3 for spacing – for each of the freeze moments. (6 minimal score = best answers over all; 60 maximal score = worst answers over all).

Median age was 25.73 (differentiated on experience into subgroups according to experience/practice onboard). All participants were deck students/personnel.

After completion of the simulated situations, during interviews and discussions with the participants, there were requested explanations for reactions and decisions in different situations of navigation, there were given solutions and it was created the framework for understanding how situational awareness, good information and the sense of safety can influence it.
The best general score for situational awareness was recorded in the subgroup of participants with a longer period of sailing (Figure 1) compared with those with less practice or no practice at all (9.5 vs. 27.8).

An interesting observation was made during evaluation of general awareness score according to incidents level. With the exception of experienced group, scores were higher (poor) in case of high and medium severity incidents, compared with easy situations. A similar trend was found in case of both experienced and non-experienced subgroups in case of medium severity incidents, where the scores were worst (40.2 and 13). Only the subgroup with incipient practice proved the best awareness score.
A general analyse of the results showed that situational awareness is related to knowledge and understanding of different conditions and the environment where are produced, leading to conclusion that experience is an important part of the process. (Figure 3)

An adjustment made by using the age as sub-grouping, revealed that the situational awareness is improving according to increasing periods of practice on board ships (figure 4); a similar finding was reached by simple age separation that high lightened increased responsibility reached at median age of 30 – 40 years (Figure 4).
Maybe the most important analyse was given by the correlation in between the three major indicators of situational awareness: perception, comprehension and projection. Worst scores were found in managing space comprehension and projection (3.84, respectively 4.22), but not in the perception of space. Related to second factor, most errors were found in time projection. (Figure 5)

3.4. Discussions

A review of the incident reports has identified the missing of a safety culture as the main cause of the maritime accidents. This reason lead to necessity to have in place a Safety Management System as a good practice and to implement safe working practices and attitudes through the development of a positive safety culture.

Therefore, the importance in assessing the social processes behind the safety performance of the maritime has been acknowledged. Accident investigations have moved away from a focus on proximal circumstances operating at the individual level, to investigating more latent, systemic organizational or managerial flaws. Collaborative efforts in assessing maritime safety culture have been undertaken in an effort to potentially reduce the number and severity of maritime accidents or incidents.

During the last decades, specialized literature used different definitions for safety culture. In 2000, Guldenmund [9] define safety culture as “those aspects of the organisational culture which will impact on attitudes and behaviour related to increasing or decreasing risk”. In a report on safety culture, the UK Health & Safety Executive [10] defining as “the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization’s health and safety management.” In 2008, Von Thaden and Gibbons [11] defined safety culture “the enduring value and prioritization of worker and public safety by each member of each group and in every level of an organization”.

The literature on safety culture often distinguishes between safety culture and safety climate, where the result of a safety culture survey is called “safety climate” to show that it is a snapshot of the organization taken at a certain point in time.

As defined, “Safety Culture” represents an organizational environment where are promoted self-regulations to ensure that each individual, as part of the organization, takes responsibility for those actions designed to improve safety and increase the performance [12], or, that assembly of
characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, safety issues receive the attention warranted by their significance [13].

Considering the definitions, the basic element of the concept is the people. In the maritime context, the considered person can be any crew member, the responsibility being related to his position on board. As crew member, all persons on board ship have to understand their responsibilities on the safety of life, ship and environment. These responsibilities should come from rules and regulations and as a normal behaviour also.

Most important thing is to be able to understand and define the term “safety” in a particular meaning. In the moment when a person is able to understand the right sense of the term, is capable to generate safety environment for the others. This ability is in a close relation with the level of knowledge and performance on duty of the person.

A healthy safety culture on board might be promoted and reflect by four factors [14]:
- senior officer commitment to safety,
- realistic and flexible customs and practices for handling both well-defined and ill-defined hazards,
- continuous organisational learning through practices such as feedback systems, monitoring, and analysis, and
- care and concern for hazards shared across the workforce.

Today, most of the personnel engaged in maritime activities, when are asked to define their personal vision on “Safety culture”, reply with many different answers, including [15]:
- Awareness of potential dangers and to make others aware
- Hazard awareness
- Legal, social and personal responsibility
- Developing a set of safety behaviours
- Ensuring passenger and crew safety at all time
- Avoiding harm and injury
- Developing a good communication
- Improvement of the systems and procedures
- Good training on risk assessment
- Right mindset
- Proactive (prevention) rather than reactive.

Even if, as present or future seafarer, is thinking that already have a successful safety culture, should be care that all time there is room for improvement. Striving for excellence is the key and cornerstone to any safety culture.

Essential things like safety culture are often based on good and bad examples. Regardless how many procedures and safety measures will be taken to prevent and mitigate any perceived risk, the human error means that mistakes will be made and is important to know how to handle these situations to have a success safety culture. A great leader once said, ”All men make mistakes, but only wise men learn from them [15].”

For a right understanding and usage of the “safety” and “safety culture” terms, is important to be explained and exemplified from the initial maritime training stage. Here, the training institution have a great role in creation of the sense of safety, to build from the beginning a strong safety culture among the future seafarer. A mature safety culture ensures that the working environment cultivates safe attitudes and benefitting safety performance.

The goal of a positive safety culture is the fostering of professional behaviour in routine and emergency situations, but assessing behaviour is not straightforward because:
People have a tendency to change their behaviour when they know they are being watch,
Apparent routine behaviour may not be sustained in an emergency, or stressful situations,
Behaviour assessment can be very time-consuming
Behavioural assessment requires corroboration by assessments of attitudes and values.

Attitudes, values and opinions should be drawn out as they are central to most definitions of safety culture.

4. Conclusions

Safety and security will remain the main concerning of the maritime industry. It’s important to increase the crew situational awareness into identifying and assessing the risks and to establish a culture of safety in order to prevent future dangerous situations. Proposed model is emphasizing the necessity of quantifying the level of situational awareness in the continuous education and training of maritime personnel. The best general score for situational awareness was recorded in the subgroup of participants with a longer period of sailing compared with those with less practice or no practice at all, emphasizing the importance of experience in a definite practical occupation, even if the subgroup with incipient practice prooved the best awareness score in case of risk situations (signal of decreased awareness for routined seafarers). Maybe the most important analyse was given by the correlation in between the three major indicators of situational awareness: perception, comprehension and projection. Worst scores were found in managing space comprehension and projection (especially in time projection), but not in the perception of space, showing a promising possibility of improving the ability in a close relation with the level of knowledge and performance on duty of the person, implicitly generating safety environment for the others.

References


