

The Analysis of the Causes of Emergencies on the Vessels

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ABSTRACT: The article discusses the results of research conducted on the vessels, covering a wide spectrum of issues relating to the exploitation of vessels of various flags, as well as operating security and safety systems on board. The main aim of the study was to collect numbers of data directly from the crew, for examples: indicate by the crew marine areas with the greatest probability of occurrence of casualties and incidents, trying to the definition the causes of their occurrence, prevention actions used on board and analyses operating safety systems used on the various type of vessels. The analysis of research became the basis to identify strengths and weaknesses areas of the vessel operation. The author proposes a solution to be implemented on board and emphasizes meaning of safety management system.

1 INTRODUCTION

Since the tragedy of RMS Titanic, maritime safety has become an issue constantly referred to by international organisations, agencies, insurance companies, maritime administrations and all those interested and involved in the sea freight services. The source literature features numerous publications addressing the issue of maritime safety enforcement and improvement, accident reports, statistics on the number of dangerous occurrences, total loss of vessels along with the causes of the loss, and the number of human casualties and people injured in the accidents. The aim of the article is to present the opinion of vessels' crews on the safety on board and in maritime areas, as well as to evaluate existing safety management systems.

Maritime areas are a driving force for the global economy. Whatever issues limiting the freedom of movement of vessels, caused by external or internal factors i.e.: interference of third parties (unauthorised

persons), adverse weather conditions, collisions, technical failures, errors committed by people, or other failures and events which would generate a chain of unwanted events, may lead to an economic crisis affecting various industries.

Seas and oceans constitute a strategic potential for the European Union, and any disturbances in sea freight may lead to serious economic losses and even to an economic crisis. Therefore, ensuring the wide-understood safety for the EU shall be a priority. The majority of the world's commercial ports, amounting to the number of 1,200 are located in the EU. Moreover, there is a commercial fleet which constitutes 25% of the world's registered tonnage. 90% of the trade with countries outside the EU, and 40% of internal trade within the EU is performed by sea. That includes energy-producing raw materials 40% of oil and 15% of natural gas.

According to the data available from the accident reports issued by European Maritime Safety Agency in 2015 were reported: nearly 3296 marine

casualties, 1700 cargo ships were involved in marine casualties and incidents, 115 fatalities, 976 persons injured, 36 ships lost [EMSA, 2016] Hence, appear number of questions in the survey for examples: "Have you been an on-board crew member during a collision with another vessel, object (navigation beacon, berth), submarine base?"

2 ANALYSIS OF SURVEYS CONDUCTED AMONG POLISH CREWS

The participants of the survey were Polish seafarers working on vessels of various flags, sailing in international shipping. 67% of the surveyed were people with over 15 years of experience, working on ships, holding positions of a chief officer, a master, two of them worked as a deckhand. Extensive experience of respondents reflected not only in their long-standing practice, they also had a chance to acquire their competences on different types of vessels, i.e.: general cargo vessels, container ships, bulk carriers, oil tankers, chemical tankers, gas carriers, car carriers, ro-ro passenger vessels, cruisers, oil-field vessels, as well as on fishing vessels or yachts.

2.1 Marine casualties and incidents maritime

Marine casualties are always highly distressing experiences, especially for people involved and their families, but also for all those interested in the situation in the waters of the World Ocean. 83% of the surveyed have not experienced the emergency situation. Other people had been involved in such events in ports, where three people had been killed. None of the above cases featured the sinking of the vessel, the damaged vessels entered the port, and then the shipyard.

The event, considered to be one of the most hazardous situations that can occur on the vessel is a fire. If the fire is noticed on time and an immediate fire extinguishing actions are taken, the tragedy can be averted. The efficient operation of the crew is ensured throughout regular monthly (or even more frequent) fire drills consisting of exercises where the crew members practice fighting a simulated fire on the vessel. As an answer to the survey question referring to the fire on the vessel, 58% of participants responded that they have experienced a fire on their vessel including such situations as: fire in a cooling unit of a refrigerated truck, fire in the laundry room, fire in an electric pump - a short circuit of electrical wiring (Figure 1).

No lives have been lost during the aforementioned events and the fires were extinguished by firefighting measures available on the vessels. In three of those cases, the fire was quickly extinguished and there was no damage to the vessel. However, in the case of fire in the cooling unit of the refrigerated truck, the losses were significant and the vessel was unfit for further operation due to the damage to the electrical installation, which prevented the work of such equipment as i.e.: winch moorings or stern ramps. The fire was difficult to locate because there were

several dozens of other vehicles on the car deck, and dense smoke prevented rapid location of the source of fire. What made the fire even more difficult to spot, was the location of the burning unit which had been on the truck instead of next to it. Due to the high temperature it fell into the trailer and was burning inside.

Another dangerous event is a man overboard. Regardless of the time or place of event, such a situation requires an immediate search and rescue operation. 42% of the surveyed reported that they had witnessed a man overboard situation (Figure 2).

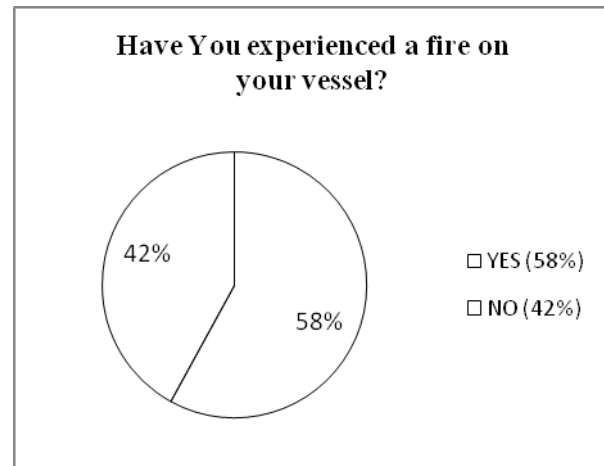


Figure 1. The answer to the survey question referring to a fire on the vessel.

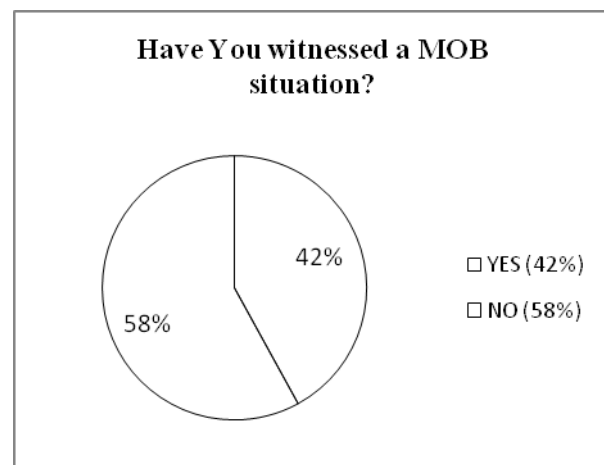


Figure 2. The answer to the survey question referring to MOB situation.

Those situations included i.e.: industrial accidents, where a crew member fell overboard due to a lift crane breakdown, notice a man overboard event, where the affected person had not been a member of the rescuing crew, a man overboard event, where the affected person suffered from hypothermia and fell overboard while trying to pass from one vessel to another. Noteworthy was the case of a person who fell into the water from 12 metres, and being in the state of shock, swam several dozens of metres to a nearby standby vessel whose crew pulled the affected person on board using a safety net. Due to the fall, the person had numerous skin injuries and bruises as well as broken ribs, but after being airborne to the hospital and receiving the first aid, did not require

further hospitalization. The root cause of this accident was most likely haste and routine. It should be noted that the maximum altitude for a safe jump into the water should not exceed 7 metres providing that the jumper maintains a specific body position (safety tips for jumpers). When the body position is inappropriate for the jump into the water, it can lead to numerous injuries including back injury.

Another man overboard situation occurred when it was noticed that one of the passengers of a ro-ro passenger vessel sailing in the Baltic Sea, was reported missing. Most likely the event occurred in the central part of the Baltic Sea. The immediate search and rescue operation was not successful and the missing person not found.

To have a bigger picture of situations occurring in maritime areas, one of the survey questions related to search and rescue operations. Two of the surveyed admitted participation in such operation, where the rescue group was looking for a missing helicopter. In both situations the missing helicopters were transporting offshore rig crews. The missing helicopter was transporting the crew of an offshore rig operating on an oilfield located on maritime areas of Angola in the first, and of Norway in the second situation. There are records of other aviation accidents involving helicopters. Due to numerous accidents involving helicopters Super Puma, the European Aviation Safety Agency issued executive order grounding civil helicopters AS332L2 Super Puma and H225LP. None of the crew or passengers of the above mentioned missing helicopters survived the accident. The inspection of the wrecks of the helicopters showed that there was no chance for the people inside to get out of the machine after it hit the water. Everyone who flies a helicopter is required to complete evacuation training - Helicopter under water escape - HUET. Evacuation is possible only when the helicopter falls on the water surface and starts sinking slowly, however, it wouldn't stand a chance when it falls into water at high speed, as it would happen in the case of a sudden breakdown of the rotor, propeller, or other helicopter's load-lifting elements.

2.2 Operation of safety management systems on vessels

Emergency response plan for vessels shall be developed according to the requirements of Resolution IMO A.852(20) as amended by Resolution A.1072(28) adopted as at December 4th, 2013. In addition, pursuant to the ISM Code (International Safety Management Code), item 1.2.2.2., the ship Owner is obliged to: identify any hazardous situation for vessels, the crew as well as any situation which may be hazardous to the environment; set in place all appropriate safety measures in the event of the occurrence of such situations. Pursuant to item 1.2.2.3 of the ISM, the ship owner is obliged to ensure to the ship-based and shore-based personnel, continuous safety management trainings, including preparation for emergency operations, carried out in compliance with the provisions of section eight of the ISM Code Every vessel should have an Emergency Contingency Plan for any possible on-board emergency situations

as well as procedures which should be undertaken in their occurrence.

Question No 9 of the survey related to the implementation of the contingency plan for shipboard emergencies by the crew members. 78% of the crew members responded that the plan is useful, however, is the competence of the crew that determines its proper use, 20% stated that the plan is complete and its content provides for efficient emergency operations, 2% considered that the plan requires amendments and updates (Figure 3).

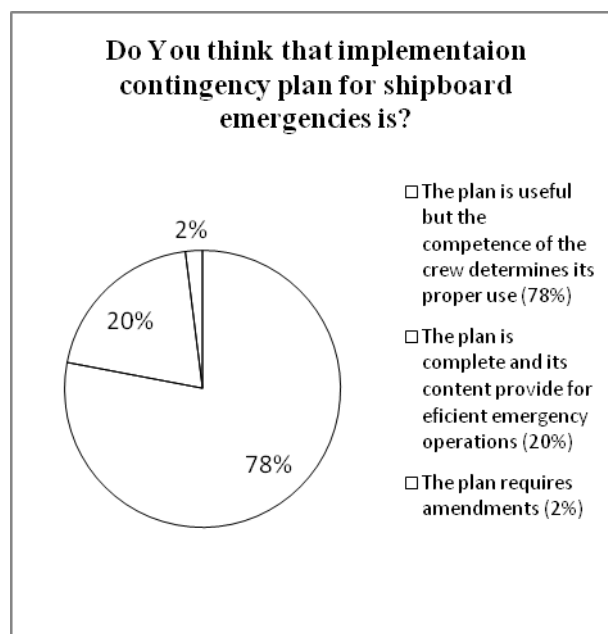


Figure 3. The answer to the survey question referring to the implementation of the contingency plan for shipboard emergencies.

Emergency procedures available on the vessel are developed for its personnel to ensure an adequate crisis response. The procedures shall be prepared and available to the crew in such a way so they can be applied at any time of emergency. Responses to this question suggest that the crew accept the procedures. Proper emergency response and implementation of those procedures, however, isn't determined by their provisions but by the know-how of the crew members. What it means is that the emergency procedures available on board cannot foresee and cover all possible hazardous situations. Let's take the procedure in the event of a fire on the vessel as an example. There could be different types of fire emergency depending on the source of fire, its location, the type of vessel and its equipment in fire-extinguishing systems. First of all, emergency procedures have to be up to date and available to the crew members. The crew members should accept the procedures and be trained in their implementation. In order to be useful, the procedures should be constantly reviewed and updated. Asked "How often do you submit comments to the office/supervisor/ Designated Person Ashore, if you notice irregularities (nonconformities) in emergency procedures and daily duties procedures?", 78% of the surveyed responded that they do it immediately, as soon as they notice the nonconformities, 10% of the surveyed submit their comments on once a year/once a month basis, while 12% never submit comments (Figure 4). The survey

shows that the 12% of surveyed who never submit feedback were employed as deckhand. Other crew members holding positions of chief officers and masters verify the timeliness of the procedures and give current feedbacks to persons responsible for the updates.

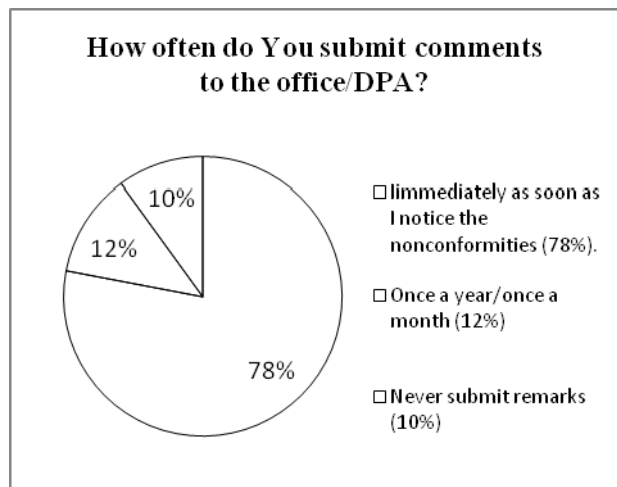


Figure 4. The answer to the survey question referring to the comments submit to the office/DPA.

The freight safety can be perceived as a complex system Figure 5, whose interacting elements are: the marine environment, the vessel, the cargo and the crew. These elements are mutually interconnected and connected with many various external links which may have a direct or indirect impact on the operation of the whole system and the level of security.

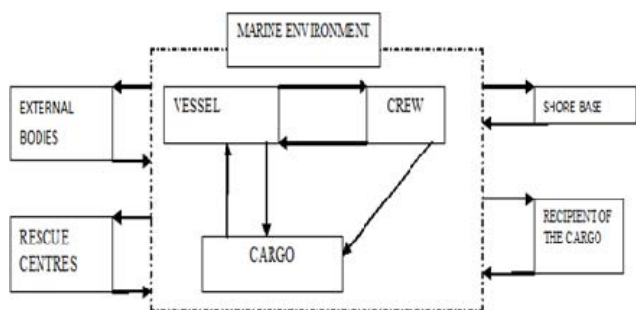


Figure 5. Mutual correlation of the system elements in maritime areas.

However the weak point is the fact that there is no one standard of the documentation for each operators in the marine areas. It maybe a cause of incomprehension and extension operation especially during search and rescue operation. The fact is that the management of vessels was on inadequate level before implementation of requirements of ISM Code. There was not enough links between vessel operation and support form Company. The tragedy at sea before 1996 were the examples.

The next question related to the operating procedures contained in the safety management system implemented on the vessel. According to the international requirements and regulations of the flag State, every vessel shall have in place an operational, updated safety management system which should be subjected to systematic internal and external audits.

The aim of the system is to provide safe working conditions, reduce level of fatalities and injured and protection to the environment and property. Hence came the idea of surveying the crews about their opinion on the subject. 50% of the surveyed responded that safety management systems improve safety at work, while 38% of the surveyed believe that they are useful, though their content does not extend to all possible circumstances. 12% of the surveyed stated that procedures of safety management systems are too long and illegible, therefore, they should be modified to a more usable form such as i.e.: patterns of conduct.

Operation of the safety management system is described in Safety Management System Manual guide book. It is a document that contains a set of procedures, instructions and guidelines specific for each vessel. The documentation of the System which are incorporated on board and on Shore (Shipowner) takes the following structure:

- Safety and environmental protection policy - established, implemented and carried out.
- Ship owner's responsibilities and authority - organizational structure, providing resources for the safe operation of the vessel.
- Designated Person Ashore - coordinator between the vessel and the shore, taking action in emergency situations as well as during daily operation, maintaining contact 24/7.
- Master's responsibility and authority - authority to make decisions to ensure the safety of the crew, protection of the environment, maintenance of the vessel.
- Resources and personnel - providing adequately skilled and trained crew on the vessel and ensuring adequate support from the shore.
- Development of the vessel manual- operating instructions on the vessel to ensure proper operation and in compliance with safety principles.
- Emergency preparedness - hazard identification and the development of operational procedures for dangerous situations.
- Reporting and analysis of nonconformities, accidents and hazardous occurrences - reporting and analysis of events.
- Maintenance of the vessel and its equipment - ensuring the conduct of surveys and inspections, early detection of faults.
- Supervision of the system documentation - keeping existing documents up to date.
- Review of the operation of the system - the conduct of systematic internal and external controls verifying the proper operation of the system Continuous improvement of the system and its adaptation to changing conditions.

While developing this document, the following important internal regulations should be taken into account: type of shipping operations, i.e. type/types of vessels, character of the management company/ship owner (size, type, location, organizational structure etc.), also external requirements identified by: international organizations, the flag State as well as local regulations and regulations of classification societies, should be put into consideration. Company which complies with the requirements shall be awarded the Document of Compliance-DoC (DoC is

valid for 5 years and should be confirmed on annual basis by the maritime administration appropriate to the specific ship management entity), and the Safety Management Certificate – SMC (SMC is valid for 5 years and should be confirmed between 2d and 3d years by the administration of the flag State of the vessel). Absence of valid DoC certificate or its annulment, due to various factors, such as: incompatibilities identified during external audits, lack of awareness, accidents shall result in the suspension of operation of all the ships regardless of their current location. Absence of valid SMC certificate shall result in the detention of the ship until the issuance of a valid SMC certificate. It is also worth noting that, shall any irregularities occur on the vessel, the inspection of the Port State Control – PSC has right to suspend the SMC certificate. An example of such irregularities could be inappropriate manning of the vessel, according to Principles of Safe Manning, or technical breakdowns, defective navigation equipment and a number of other irregularities or negligence. ISM nonconformities have the highest score (points) and can led to the detention of the vessel, until the irregularities are removed or the second inspection at the next port. In this case, a number of measures should be undertaken in order to remove the irregularities.

2.3 Causes of the collision of vessels and accidents at work

Accidents that occur in marine areas and on board of vessels constitute the basis for analysis of events. They aim to determine the causes of accidents and implement appropriate prevention measures which would preclude recurrence of such situations.

In response to the survey question about the most possible causes of collision of vessels, the crew members stated that in 43% it is due to an error of the person on watch, 26%, believe that is a sequence of adverse events, and 14% believe that it is due to a delayed response to the threat. 8% of surveyed stated that unfavourable weather conditions are the cause collision of vessels, 6% gave the failure of the devices as the cause of collisions, and 3% said that other causes mostly routine are to blame (Figure 6).

An example of such event can be a collision of the container ship CORVUS J with the car carrier Baltic Ace on December 5th 2012, which occurred in the North Sea 39 nautical miles southwest of Rotterdam, in high traffic area. As a result of the collision Baltic Ace heeled over and sank within 15 minutes; 11 crew members lost their lives in the sea, 13 were rescued. "It was found that the most likely cause of the accident was a mutual misunderstanding of intentions by the watch keeping officers. The vast amount of information available for the watch keeping officers, while insufficient number of crew members on both vessels, however, permissible by the regulations, have also contributed to the occurrence of the accident. Loss of life experienced by so many crew members was inevitable, as the ship, whose broadside was crushed, had not been designed to survive this kind of event" [State Commission on Maritime Accident Investigation, 2016].

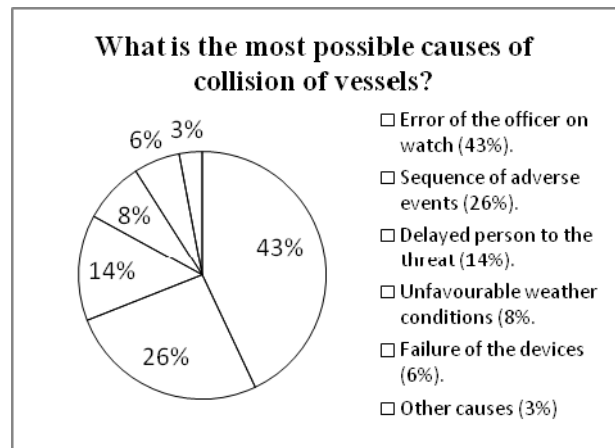


Figure 6 The answer to the surveyed question referring to the most possible causes of collision of the vessel.

During the collision on the bridge of the Baltic Ace there were a watch keeping officer and an apprentice, while on the bridge of the container ship there was a watch keeping officer. The STCW Convention of 95, Chapter VIII, section A-VIII/2, part 3, provides that: "The officer in charge of watch can be the only watch keeper during the daytime (taking into account weather condition, visibility, heavy traffic etc.)". The accident occurred at 6:15pm. Keeping watch by a single officer without assistance of a crew member holding A-type permissions, increases the risk of an accident.

A seafarer's job could be hazardous by definition, regardless of external or internal factors. A possible accident could occur while performing daily activities on the vessel, such as: maintenance works, surveys, inspections, repairs, or any routine operations. The surveyed crews were asked about the main cause of accidents at work. 44% responded that the main cause is the routine, and 33% of surveyed pointed towards the non-compliance with the safety management system procedures, while 15% think that the fault lies with the lack of abilities and predispositions for the job, namely, that inept people hold responsible positions on vessels (Figure 7).

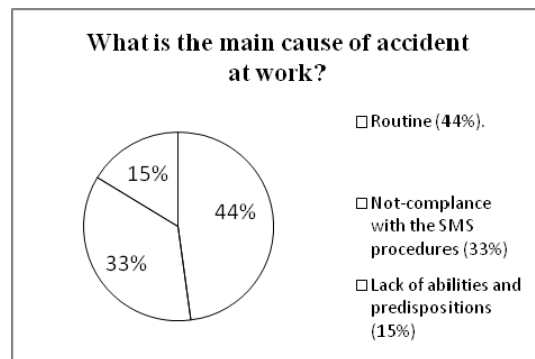


Figure 7. The answer to the surveyed question referring to the main cause of accidents at work.

Every seafarer shall comply with the natural laws of the sea, which is truly expressed through the following words ... "The sea knows no compromise, its laws are consistently harsh, its strength is huge, and its generosity is boundless. It has much to give, though it requires complete and utter devotion" [Voss, 1968].

2.4 On-board trainings

The question arises as to what to do to prevent marine accidents, how to improve working conditions, ensure the protection of the marine environment and property and, above all, how to increase awareness of the risks.

To the question relating to on-board trainings, 100% of all respondents replied that trainings on board of the vessel improve ability to act in emergency situation and constitute a practical preparation of the vessel's personnel to act in a state of emergency (Figure 8).

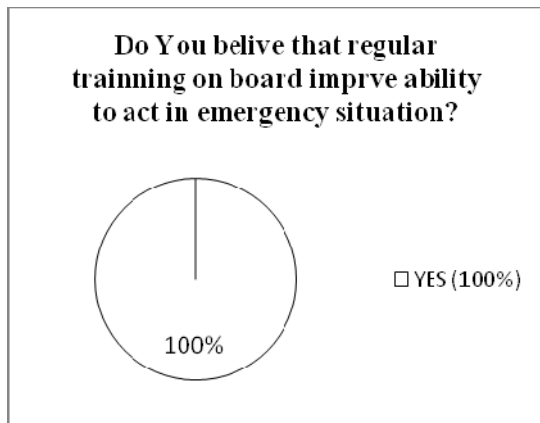


Figure 8. The answer to the surveyed question referring to the improve ability of the crew to act in emergency situation?

The ship owner or manager shall ensure that the crew are prepared to act in emergency situations and therefore shall organise training and workshops for the crew members, supervise the crew skills and draw up reports which would clearly present the strengths and the stretches of the crew. Asked whether regular trainings organised by the ship management will improve the safety of the vessel, 50% of the crew members responded "yes", and that those trainings constitute an addition to their regular emergency alarm drills, 40% of the crew also gave a positive response, admitting that the trainings will improve the safety providing that they are carried out are by a professional team focusing on the crew's ability to work in an emergency state, while 10% replied that those trainings are waste of time and that the crew members shall practice self-trainings according to the emergency alarm practice.

Other practices that can reduce the hazard of an accident at work are: the Job Safety Analysis and discussions about a given piece of work, called "Toolbox talks", which should be carried out before the piece of work gets started. 62% of the surveyed responded that this is a good way to get ready for your tasks, and 38% responded that this is a good way to get ready for your tasks providing that the tasks are new and never performed before. None of the crew members said that those tools are a waste of time or constitute additional bureaucracy, because they are discussed while issuing work permits.

Next question referred to the emerging information about the introduction of "unmanned vessels", whether the crew believed that electronic devices can replace men in the future - 90% of

surveyed gave a negative and 10% a positive response.

No sophisticated device would replace the vessel's manned crew. On the other hand an unmanned vessel would be an easy target for pirates and terrorists.

The last question referred to the areas considered as the most dangerous in terms of maritime safety. The respondents were asked to justify their choice.

The answers were the following:

- In terms of hazard due to the heavy traffic on maritime waters the surveyed selected i.e.: traffic separation schemes, narrow channel, areas with increased fishing and tourist activity,
- In terms of piracy - Somalia, HRA and Nigeria.
- In terms of weather conditions: cyclone areas, Scottish Islands (currents and winds from different directions - navigation in this area requires additional information primarily from the local people).
- In terms of heavy traffic and inept local seafarers who do not comply with COLREG Convention - the China Seas.
- In terms of breaching the safety limits - cargo overload.
- The North Sea - in terms of extremely strong currents, heavy traffic and adverse weather conditions.
- The Strait of Gibraltar - in terms of heavy traffic.

3 CONCLUSION

Conducted a survey among Polish crews of vessel operating in international waters have been received with great approval. The seafarers willingly participated in the survey and were interested in their results. Also they expanded the questions and discussed the issues of interest to them giving their direct opinions based on professional experience. Not of all seafarers attend in casualties and incidents at sea. There were the "lucky" surveyed who did not participate in the any emergency situation.

The Surveyed stated that the basis for ensuring and improving safety on board are regular training on board and improvement of awareness between the crew and shore personnel. However, despite many aspects to improve maritime safety, still it comes to incidents. The status reports and statistics show how many events have been occurring in marine areas. The crew indicate the main reason of incidents and casualties which are: adverse weather condition, human errors, machinery failure, heavy traffic and do not meet the requirements of COLREG Convention. The Safety Management System is constantly important aspect of ensuring safety on board and during carriage cargoes by sea but only its application determines well-qualified crew. The numbers of emergencies that take place at sea show that operating systems are not able to predict the development of events, it can only provide support in activities. So therefore competent crew is the basis of ensuring safety at sea. No sophisticated device would replace the vessel's manned crew.

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