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Reducing a Human Factor in Cruise Ships Accidents by Improving Crew Competences

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ABSTRACT: In recent decades, there has been noticed a continuous growth of passengers on cruise ships. Technical as well as technological development follow this growth side to side as far as construction, transport of passengers and strict legal regulations are concerned. However, recent maritime accidents, such as the Costa Concordia's accident, question the level of maritime safety on cruise ships.
Maritime accidents on cruise ships are almost entirely linked to human factor, directly or indirectly. Apart from the parameters affecting human factor, the literature mentions very frequently the importance of education, training and crew competences in the process of reducing the number of maritime accidents. However, very few researches have been done on competences that can affect strongly the level of maritime safety on cruise ships, i.e., that can reduce the effects of human factor on it.
The purpose of this study was to find a connection between reducing the effects of human factor on accidents and the crew competences on cruise ships. The research lasted for two years and consisted of two phases. Qualitative as well as quantitative methods of analysis were used in both phases. Competences that are the essential part of obligatory programmes the crew members on cruise ships have to master, and that are prescribed by the STCW Convention were analysed in the first part of the research. The second part of the research analysed competences that are essential part of programmes resulting from the cruise companies' demands. Cruise companies have defined and determined additional programmes and competences that seafarers, navigating on their ships, have to complete and develop. The aim of the research was to determine what type of competences the cruise companies look for through additional education programmes and to determine the amount of time needed to develop them.

1 INTRODUCTION

In recent decades, cruise industry has experienced a significant growth rate [9, 21, 22]. The afore-mentioned growth is the result of continuous shipbuilding and the increase of traffic in the area of Arctic and Antarctic. Despite technological development followed by new legal regulations, maritime accidents on cruise ships are still happening which means that challenges, as far as increasing the safety level on them is concerned, still exist. In other words, safety level can be improved [14, 20, 24]. Maritime accidents on cruise ships are fatal with more deaths than on any other type of ships [23]. Therefore, a special attention has to be given to safety, i.e. to accident prevention. Maritime accidents jeopardize maritime safety, and consequently have negative effect not only on economic performance of the shipping industry [6] but also on other sectors closely connected to shipping industry [4].

Human factor is one of the main causes of maritime accidents on all types of ships [10, 11, 13], cruise ships included [14]. Therefore, the goal of all actions intended to reduce as well as to prevent maritime accidents, should be focused on how to reduce the effects of human factor on them [2]. The effects of human factor can be noticed in the lack of organisation on board, inadequate training, lack of team working, lack of communication, lack of situation awareness, poor information exchange, poor decision making, poor crew competence, lack of proper maintenance, lack of application of safety procedures, poor judgement of the situation, poor problem solving, lack of general technical knowledge, misunderstanding of multicultural difference, etc. [2, 3, 6, 8, 14, 16]. The literature also mentions very frequently, poor crew competence, whereas MAIB, ATSB and TSB Canada report also on insufficient knowledge, skills and abilities [5], which is, basically, the lack of crew competences.

As far as crew competences on cruise ships are concerned, cruise industry must comply with the safety standards set by the International Maritime Organization (IMO) enforced through the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (hereinafter, the STCW Convention). According to the STCW Convention [17], every member of the crew on cruise ships has to develop not only competences prescribed operational and management level for all types of ships (Table II/1 and II/2 of the Convention), but also competences prescribed for cruise ships (Table A-V/2 of the STCW Convention).

Competences needed for all types of vessels are, as a rule, developed through formal education programmes. Today however, formal education provides general knowledge on the total industrial environment [12] and very frequently does not comprise all the competences needed at the job market [7]. Consequently, additional education programmes have been developing, and are oriented towards obtaining competences needed in working environment [1], e.g. short course for on board job. For cruise ships, in STCW Convention, these programmes are based on Table A-V/2.

The reason for developing such programmes results from the fact that development of new technologies and their implementation on ships effect significantly competences needed by crew members. The companies have noticed lack of competences, because crew's understanding of the system has a key role when applying a new technology. Therefore, the implementation of new technologies implies the development of new competences for the crew or/and the upgrade of the already existing ones. Shipping companies try to solve this problem with additional education programmes that comprise all the competences not included in the formal education.

In maritime industry, these programmes can be divided into the ones, already mentioned and prescribed by the STCW Convention, and, the ones prescribed by shipping companies. Competences prescribed by the STCW Convention for cruise ships refer to Training in Crowd Management, Safety Training, Training in Passenger Safety, Cargo Safety and Hull Integrity and Training in Crisis Management and Human Behaviour. However, competences that are a part of programmes prescribed by cruise companies are not elaborated in detail. In other words, we are still not familiar with the competences the companies think the crew is lacking or with the ones, they are spending their resources on.

Based on the analysed literature, it can be concluded that most of the parameters, referring to human factor, are, in a way, associated with crew competences whereas a proper education and training are one of the most important measures that can be used to reduce their effect on maritime accidents [15, 18, 19, 22]. Most of the parameters referring to human factor are associated with generic competences (e.g. lack of communication, lack of situation awareness, poor information exchange, poor decision making etc.). Therefore, a question whether it is possible to enhance the security level on cruise ships by developing additional generic competences or to reduce the effect of human factor on maritime accidents, arises. In order to answer the above-mentioned question, it is of utmost importance to analyse not only the types of competences prescribed by the STCW Convention for cruise ships, but also those, the cruise industry, i.e. cruise companies, think the crew has to develop.

2 METHODOLOGY

The research on this topic lasted for two years. It was divided in two parts:

1. analysis of the programmes prescribed by the STCW Convention for the crew on cruise ships;
2. analysis of the additional programmes of education required by the cruise industry for the crew on cruise ships.

The goal of the first phase of the research was to determine to what extent certain types of competences make part of the obligatory programmes. In order to ensure uniform implementation of STCW Convention, IMO has developed numerous Model Courses which offers a more detailed explanation of the subjects, requirements and delivery methods required for each position on board. Model Courses includes: a course framework (detailing the scope, objective, entry standards, and other information about the course), a course outline (timetable), a detailed teaching syllabus (including the learning objectives that should have been achieved when the course has been completed by students), guidance notes for the instructor, and a summary of how students should be evaluated.

Therefore, in this phase of the research, the following topics, part of the following IMO Model Courses, were analysed:

1. IMO Model Course 1.28 - Crowd Management, Passenger Safety & Training for Personnel 1.28 and
2. IMO Model Course 1.29 - Proficiency in Crisis Management and Human Behaviour Training.

IMO Model Course 1.28 comprises 158 topics divided into the following categories: Crowd Management training; Familiarization training, Safety training for personnel providing direct Service to Passengers in Passenger Spaces. IMO Model Course 1.29 comprises 286 topics divided into the following

categories: Passenger Safety, Cargo Safety and Hull Integrity Training; Crisis Management and Human Behaviour Training. To conclude, 444 topics, divided into three categories were analysed: topics needed to develop professional competences, topics needed to develop generic competences and topics needed to develop other competences. Topics needed to develop professional competences refer to acquiring knowledge and skills needed for tasks on board. Topics needed to develop generic competences refer to acquiring knowledge and skills that can be used in different environments and for various jobs. Topics needed to develop other competences refer to acquiring knowledge and skills that can be used in different sectors. The example of competence classification is shown in Table 1.

Table 1. Example of competence classification

Competence classification			
Topic	PC	GC	OC
Loading and discharging vehicles, rail cars and other transport units	x		
Communications during an emergency situations		x	
Stowage compatibility with adjacent dangerous goods			x

The goal of the second phase of the research was to analyse 41 additional programmes of education prescribed by cruise companies that manage crew on 161 cruise ships. The ships with predetermined itinerary, with capacity of more than 1500 passengers on several-days lasting voyage, that do not visit one port more than once (apart from the home port) for the scope of having fun and relaxation, were analysed in this part of the research. Ships with the capacity of less than 1500 passengers were not part of the research.

In this phase the research consisted of five parts:
1. gathering SMS documentation from cruise companies,
2. forming the base of masters on cruise ships,
3. gathering the certificates of masters on cruise ships,
4. gathering the contents of every programme of education the masters are having a certificate of and interviewing the masters on the programmes whose contents were not available,
5. analysing the contents of every programme of education.

Additional programmes of education were divided into four categories: Voyage Planning, Safety and Environmental Protection, Communication and People Management and Other. This classification was made on the basis of their contents and topics. A total of 354 topics were analysed: Voyage Planning – 154 topics, Safety and Environmental Protection – 106 topics, Communication and People Management – 67 topics and Other – 27 topics.

After determining types of competences in every category, it was necessary to calculate time needed to develop different types of competences in every category. Time was calculated as follows:

Total amount of time needed to develop competences = ratio of the type of competence x total number of hours.

Limitations of the research:
1. In the category Voyage Planning, contents of three additional education programmes were not available for the analysis. Their duration and topics were determined on the basis of interviews with masters who have attended them.
2. In the category Safety and Environmental Protection, contents of three out of nine additional education programmes were not available for the analysis (Advanced Environmental Training, T/M Master Maintenance course and Avoiding Whale Strikes). Duration and topics of these programmes could not have been determined, not even after interviewing the masters who have attended them. Therefore, they were not included in the analysis.
3. In the category Communication and People Management, contents of three out of eight programmes of additional education were not available for the analysis (Annual Bridge Resource Management Proficiency Training & Assessment, Executive Shipboard Leadership and Proficiency Training and Assessment Series A – Bridge Resource Management Skills). Duration and topics of these three programmes could not have been determined, not even after interviewing the masters who have attended them. Therefore, they were not included in the analysis.
4. In the category Other, contents of one out of four programmes of additional education were not available for the analysis (United States Public Health). Duration and topics of this programme could not have been determined, not even after interviewing the masters who have attended it. Therefore, it was not included in the analysis.

3 RESULTS OF THE RESEARCH

The results of the research were also divided in two parts. The first part refers to IMO Model Course 1.28 and IMO Model Course 1.29 (Figure 1 and Figure 2). The results of the research show that only professional and generic competences are represented in the IMO Model Course 1.28 and IMO Model Course 1.29. Topics needed to develop other competences were not registered (Figure 1 and Figure 2).

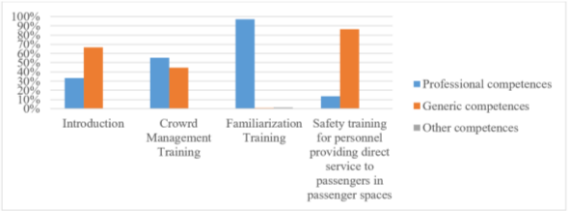

Figure 1. IMO Model Course 1.28

Figure 2. IMO Model Course 1.29

The results of the second part of the research show that 45% of the total number of additional education programmes belong to the category Voyage Planning. 25% of the total number of additional education programmes belong to the category Safety and Environmental Protection. 20% of the total number of additional education programmes belong to the category Communication and People Management and 10% of the total number of additional education programmes belong to the category Other.

In the text that follows, a representation of different types of competences and time needed to develop various competences in every category was analysed.

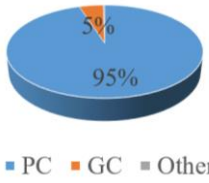

Figure 3. Types of competences in the category Voyage Planning

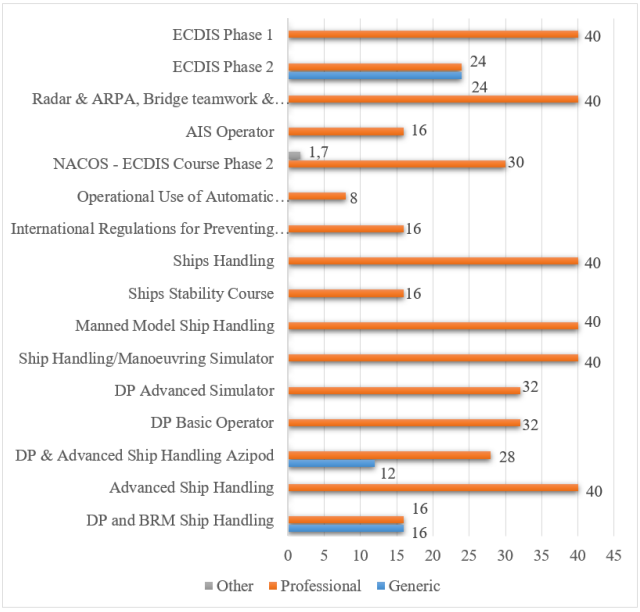

Figure 4. Total amount of time needed to develop competences in the category Voyage Planning (h)

The results show that planned number of hours needed to master the topics in the category Voyage planning on cruise ships is 536, whereas, during the second year of undergraduate studies, planned number of hours is 705. In other words, additional education programmes comprise, for this category, the number of hours that correspond to the number of hours of one and a half semester of a study programme.

In this category, additional education programmes are oriented mostly towards developing professional competences. Time needed to develop other competences is insignificant.

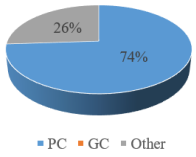

Figure 5. Types of competences in the category Safety and the Environmental Protection

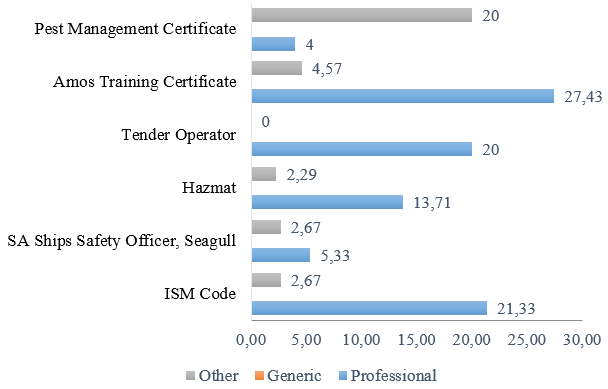

Figure 6. Total amount of time needed to develop competences in the category Safety and Environmental Protection (h)

The results reveal that, only professional and other competences are represented in the category Safety and Environmental Protection. Generic competences are not represented in this category.

The results also show that planned number of hours for topics in this category is 124. Additional education programmes are oriented mostly towards developing professional competences.

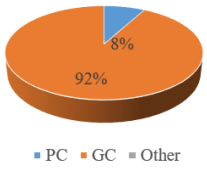

Figure 7. Types of competences in the category Communication and People Management

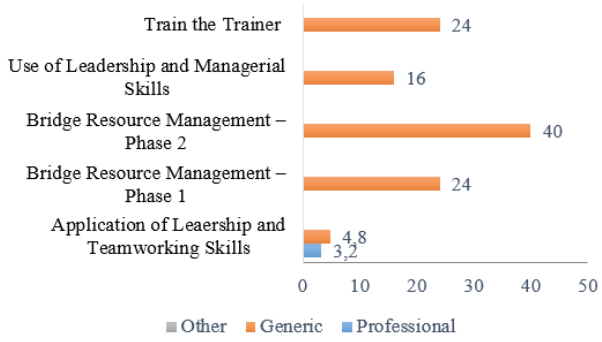

Figure 8. Total amount of time needed to develop competences in the category Communication and People Management (h)

The results of the research show that, only professional and other competences are represented in the category Communication and People

Management. Other competences are not represented in this category.

The results also show that planned number of hours for topics in this category is 112. However, this figure does not correspond to the actual situation because contents of three programmes were not analysed. That is, this number of hours is significantly higher than shown in the results. In this category, additional education programmes are oriented mostly towards developing generic competences. Time needed to develop professional competences is irrelevant. Topics needed to develop sectoral and cross-sectoral competences are not determined.

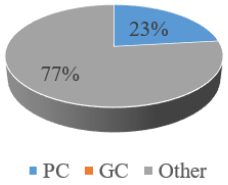

Figure 9. Types of competences in the category Other

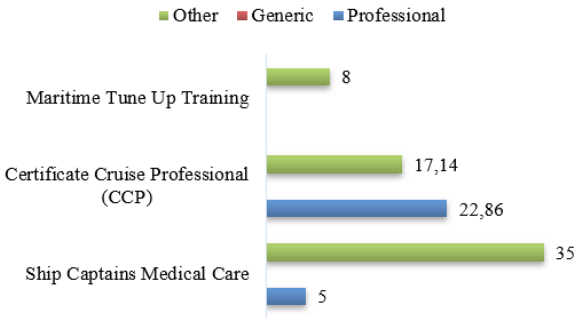

Figure 10. Total amount of time needed to develop competences in the category Other (h)

The analysis show that planned number of hours for topics in the category Other, on cruise ships, is 88. In this category, additional education programmes are oriented almost equally to acquiring generic, professional and sectoral competences. Acquiring cross-sectoral competences through these programmes is not prescribed.

The results of the research show that, only professional and other competences are represented in the category in the category Other. Generic competences are not represented in this category.

The research has shown that a significant amount of time is used to develop other competences through additional education programmes. Planned number of hours, for all categories on cruise ships, is 1632. That means that, hours planned for additional education programmes correspond to hours of five semesters of a study programme.

4 DISCUSSION

The analysis of the available documentation, of the contents of additional education programmes as well as personal contacts with people employed in cruise industry, has shown that additional programmes are focused mostly on developing professional competences and in smaller percentage on developing generic and other competences. This situation is very pronounced in the category Voyage Planning.

The research has shown that the highest percentage of additional programmes of education, for cruise ships, belongs to the category Voyage Planning. Perhaps, some of the reasons for such a situation are:

1. Navigation through the area of restricted waters,
2. DP system usage,
3. Constructional characteristics.

Ad 1) As far as navigation through areas of restricted waters is concerned, ports are of a great importance because of the very dense traffic. They are located in town centres with many tourist ships, leisure boats and yachts, fishing vessels etc. navigating the area, which can have a strong impact on the safety of a cruise ship when entering/leaving the port.

Ad 2) Cruise ships use DP system when holding a position without the anchor in the close vicinity of a port. The STCW Convention does not prescribe competences for management level needed for managing a DP system. They are a part of the recommendation for the education of the crew written in the Part B of the STCW Convention.

Ad 3) Cruise ships are very fragile when exposed to strong winds and waves. Therefore, their manoeuvring is more complex since the proportion between the above-water and underwater parts of the ship differs from other ships.

Topics referring to manoeuvring make the largest part of topics in the category Voyage Planning. Possible reason for such a situation are underequipped institutions. Due to limited resources, these institutions very frequently cannot follow technological development on cruise ships (e.g. NACOS system). Therefore, cruise companies have started their own additional education programmes that can be carried out on board or ashore. When such programmes are carried out ashore, companies choose ship personnel to take on the role of instructors. Another option is to carry out additional education programmes in institutions that possess the equipment needed and have personnel trained on it.

Generic competences have the highest representation in the category Communication and People Management. Topics that refer to teamwork, managing a team and decision-making make the largest part of topics in this category. Despite the obligatory programms based on STCW Convention, additional education programmes in the category Communication and People Management can still be improved. Generic competences that can be partially or entirely developed through formal education programmes have the highest percentage of representation (92%) in the above-mentioned category. It is important to emphasize that the International Maritime Organisation has recognised this problem and has improved the existing additional programmes on cruise ships with the:

1. IMO Model Course 1.40 – Use of Leadership and Managerial Skills,

2. IMO Model Course 1.44 (2018) – Safety Training for Personnel Providing Direct Service to Passengers in Passenger Spaces,
3. IMO Model Course 1.39 – Leadership and Teamwork.

Also, cruise companies have realised the importance of generic competences (for example competences that refer to teamwork and work in multicultural environment). However, the experience has shown that changes in STCW Convention and additional programmes of education prescribed by companies are not enough. The best example of such a situation is Costa Concordia's stranding. That is, the bridge crew has attended the above-mentioned programmes of education; however, the main cause of the accident were communication and crew management. In other words, teamwork on the bridge.

Other competences, sectoral and cross-sectoral ones, have a minimum representation in additional programmes defined by shipping companies. Since these programmes are the result of companies' requirements for competences needed on board, such results are expected.

5 CONCLUSION

The results of the research show that programmes prescribed by the STCW Convention are oriented mostly towards developing professional competences. On the other hand, programmes, results of the companies' demands, are slightly more oriented towards developing generic competences. Such a programmes are oriented towards acquiring technical knowledge, i.e. knowledge of new technologies that are being installed on sips.

Formal education programmes do not comprise all the competences needed for jobs on board because of the rapid growth of technologies and modifications of the functional organisation of a ship. That is the reason why additional education programmes have been developing. They ensure acquiring special knowledge for jobs on board. The example of cruise ships has shown that there is a significant number of additional education programmes developed as the answer to the requirements of companies or/and the industry. The number of additional education programmes needed for navigation of cruise ships shows that not all the necessary competences are being developed through programmes defined by the STCW Convention.

This research has shown that, the highest amount of time, in additional education programmes requested by companies, is spent on developing professional competences. Due to rapid development of technology, it is almost impossible to expect all the professional competences needed on board to be included in formal education. Therefore, a part of professional competences will always be developed through additional education programmes. Unlike professional competences, the implementation of additional, generic competences needed on board, should not be that frequent. That means that, generic competences, needed for jobs on cruise ships, should be mostly included in formal education programmes. Considering that it is possible to reduce the effect of human factor on maritime accidents through the development of generic competences, the following is suggested:

- All human factor parameters having effect on cruise ships' maritime accidents should be analysed.
- Generic competences that can have an effect on reducing the impact of each parameter have to be identified.
- Types and models of evaluating generic competences, which should become an essential part of the STCW Convention, should be proposed.

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