

INTEGRATED CONTROL SYSTEMS ON THE SHIP'S BRIDGE

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Abstract: *The increasing challenge of managing the complex systems located on the command bridge of the ship, together with the realization of the human potential of seafarers, represents a complex task for all ship traffic participants. The risks of inadequate management of ship systems and crew members can cause major accidents both for the lives of seafarers and the ship as a whole, as well as for the environment, i.e. the water area in which the ship performs its activities. Starting from the assumption that it is human to make mistakes, it is necessary to organize and establish a management system that would react adequately and be able to recognize mistakes in time. Recognizing the error in time and reacting in a timely manner would minimize possible consequences. Also, every mistake or lesson learned contributes to increasing the efficiency of such a system. Such a single and integrated management system on the bridge represents the ability to apply leadership skills, crew management, and teamwork improvement on board, as well as the ability to manage human resources on the bridge. The result of the integrated management system is reflected in the behavior of crew members during emergency situations on board. Also, the system is checked through training crew members in handling complex ship systems primarily at the management level, i.e. on the command bridge of the ship. In the maritime industry in the early 1990s, the term 'Bridge Resource Management', or more commonly used the acronym 'BRM' was adopted as a safety and error management tool that has now become an integral part of ship crew training.*

Key words: *Bridge Resource Management, Ship Systems, Bridge Team Management*

1. INTRODUCTION

The ship has a very complicated structure and organization, from time to time it happens that poor organization of teamwork in certain critical situations, despite having all the necessary equipment, is the cause of a bad outcome. Therefore, modern devices especially on the ship's bridge are not enough by themselves to achieve safety during navigation.

The implementation of expert training and training of all subjects of the integrated system of protection and rescue will contribute to the ability of both competent authorities and the

population to protect themselves and become more resistant to disasters. Special attention will be paid to the training of all subjects of the integrated protection and rescue system so that the staff can provide appropriate assistance and protection to others in situations of risk, natural, and other disasters (National Strategy, 2011).

Therefore, we see that work is also being done on the Serbian national level in terms of raising the level of knowledge and skills of the population in general, in order to act as successfully as possible in extraordinary circumstances. When people find themselves in a difficult situation, especially when their lives are at risk, they instinctively put themselves first and in a panic tend to make successive mistakes, and helping other people is often left aside. If they were trained to act in such situations, they would be more useful to themselves and others. Working in a team is what should be strived for because a group of people contributing together is much more effective than an individual acting alone.

2. BRIDGE RESOURCES MANAGEMENT (BRM)

STCW Convention (STCW, 2010), as amended in 2010, entered into force on January 1, 2012. However, a transitional period of 5 years has been established, i.e. until January 1, 2017, in order to enable the gradual implementation of the provisions. According to the new requirements of the amendment of the STCW Convention from 2010, all ships must have a trained SSO (Ship Security Officer), appointed by the company and subordinate to the ship's commander. The task of the SSO is to train other crew members in aspects of safe ship protection.

So, in order to board the ship, it is necessary to undergo shipboard safety training. After completing the training, the trainee is issued a certificate of competence and is awarded a certificate marked D45, which implies competence for managing human resources on the command bridge (Bridge Resource Management - BRM). Today, it is an obligation for every deck officer to be trained to manage human resources on the bridge.

The purpose of BRM is to know the measures that must be taken, in order to demonstrate the acquired knowledge, skills, and, training at all times, especially in dangerous circumstances, through timely actions and the proper use of resources intended for a certain dangerous circumstance. The management of human resources on the command bridge is nothing but the use of all available resources potential (equipment, information, and human potential) for the safe conduct of life and work on the bridge. Safety on a modern ship, despite all the technical and technological improvements, is not satisfactory, because, in 75% - 96% of accidents on the water, the error of the crew is involved. The most common causes of accidents are human factors, lack of teamwork and communication, inexperience, stress, fatigue, and the like.

Also, recent research has shown that most accidents are not caused by the lack of technical knowledge of the crew, but by ignorance of the nature of the human factor, communication procedures, unawareness of the situation (people do not know what is happening around them), stress management and the like. Simply, the crew as a team did not know or were not trained on how to manage all available resources.

Some of the other factors that make it difficult to manage the crew on board are new sophisticated equipment and cultural differences among the crew. It takes time to learn the instructions and instructions for using the equipment. People who speak different languages have a problem with the realization of communication, which is one of the most important resources of team management on board.

Also, human behavior especially in dangerous circumstances is often unpredictable. Raising the general level of knowledge, skills, and practice of procedures, contributes to the reduction of human errors, and it is achieved that people believe that they can successfully complete the task, which strengthens their self-confidence and determination, and which is crucial for successful action in urgent and dangerous circumstances (Rothblum, 2010).

If it is possible to implement these processes in the life and work of the crew on board, then it is possible to achieve the goal, which is nothing but a more modern approach to something that many nameless, conscientious and responsible deck officers have been applying in their long-term practice since ancient times.

2.1. Management rules in the ship system

The ship system consists of parts, which together represent one organizational unit, namely:

- people,
- means (ship) - technique, equipment, devices,
- external conditions (environment, media) and
- organization (operational framework, which determines the mutual behavior of staff and the conditions in which staff perform their joint and individual tasks) (Chauvin, et al. 2013).

In order for a shipping organization to function successfully, it is necessary to establish:

- areas of responsibility,
- special levels of responsibility and
- constant and clear orders and responsibilities.

In order to manage the ship's system, it is necessary to issue clear and comprehensible orders and instructions. The person issuing the order must be sure that the person to whom the order is addressed has fully understood it. After the execution of the order, feedback on the execution must be given. Especially for cases of sailing at night or with limited visibility, the captain of the ship, for the sake of the safety of navigation, writes the order in the ship's logbook or order book, in addition verbally (Cavaleiro, et. al 2020).

The general organization of work on board is significantly different from the same on land for several reasons:

- due to the nature of the work, the ships are physically separated from the management (company),
- during the voyage, the ship, crew, passengers, and cargo are subjected to weather conditions that significantly affect them,
- crew members are under the influence of difficult natural conditions and under the influence of devices and machines 24 hours a day and
- crew and passengers are often people from different regions with different habits, etc.

The stay on the ship and the work of the crew members is organized in such a way that the ship can always function safely 24 hours a day, whether it is moored, anchored or sailing.

The main parts of such an organization are:

- guards – sea, and port,
- loading/unloading cargo and/or passengers,
- plant and equipment maintenance,
- ship arrivals and departures to/from the port,

- safety of the ship, passengers, cargo, and crew in ports and in navigation,
- surveillance for fire, leaks, or other hazards,
- supervision (control) of fire protection means and
- supervision (control) of means of rescue and survival.

Nowadays communication between the management and the crew emphasizes the dominance of the management. The ship's crew feels criticized, controlled, unimportant, not listened to by the management and with a constant feeling of possible repression shows signs of fear. In such a state of excessive supervision, individuals unconsciously stop using the acquired knowledge and experience.

The vertical functional organization of individual shipping companies emphasizes and highlights the commander as a key person for the realization of the company's interests. In this way, the commander possesses the "formal authority of the vertical organization" and can convey his decisions, that is, the company's decisions, to the crew as an unquestionable order (Weintrit, & Neumann, 2011).

In contrast to the aforementioned, shipping companies organized according to the system of joint decision-making between the company and the ship's management provide some clear advantages:

- interested parties exchange information with each other,
- when making decisions, the needs and opinions of both parties are taken into account and
- the needs of the ship become equal to the needs of the company, and that is the essence of putting power back on board.

In modern accidents, in a large number of cases, the crew was guided only by the commander's decisions, even when the circumstances clearly warned of danger and the need to take actions or measures contrary to those taken by the commander.

The stranding of the tanker "Amoco Cadiz" in 1978 and the sinking of the tanker "Erica" in 1999 are clear examples of blindly listening to the commander's decision, because in the mentioned accidents, the officers noticed irregularities in making them, but did not do anything about it.

Thus, the habit of obeying and complying with orders, even when they were absent, created confused reactions in the crew members, which eventually led to the only remaining solution, which was the instinctive need for personal rescue. In such cases, the weakness of the vertical organizational model is confirmed for the umpteenth time, which is most conducive to the creation of dependence on the part of the authorities and leads to disastrous consequences in the case of wrong decisions, as well as the scheduling of authorities. We can easily conclude that vertical, strictly centralized ship organizations are not a suitable basis for the transition to teamwork.

It is very easy in a highly developed technical-technological world to fall under the influence of technology in general, especially in the conditions of sophisticated technological solutions, which change day and night and transform into some better solutions.

The crew gradually gets the feeling that the technical systems will take care of any problems on board. The knowledge and feeling that technical systems can be scheduled is increasingly suppressed. Therefore, technology can affect the crew, as a dominant factor, expressed through current technical ship subsystems.

The moment when uncritical subjection and indulgence in technology lead to dependence on technology, which means that active knowledge and skills no longer represent the basic factors of making and implementing decisions, then we talk about technological uncriticalness as a form of relying on technological solutions. Therefore, technological uncriticalness is a form of negative influence of current technology, whereby an uncritical attitude towards the capabilities of the ship as a technical system appears, which leads to greater trust in the system than in personal knowledge (Cavaleiro, et. al 2020).

An example of such a phenomenon in maritime affairs is the "Titanic" accident, where the commander, due to the general belief of its unsinkability, himself fell under the influence of the ship's superiority, and for that reason, among other things, suppressed the acquired knowledge, experience, and caution.

That such attitudes are still present today and even more dangerous due to the potential impact on the environment is confirmed by the example of the collision between the passenger ship "Norwegian Dream" and the container ship "Ever Decent" in 1999. The officer of the "Norwegian Dream" relied on radar information until the last moment, which was not adapted to the conditions of the sighting.

The same elements of misinterpretation of the radar image and blind trust in data from ARPE are also observed in the collision between "Pyotr Vaseva" and "Admiral Nakhimov", where the commander of "Vasev" himself fell under the influence of the so-called "radar hypnosis" and neglected all other sources of information, including his active knowledge and experience of visual observation and listening.

2.2. Leading and managing people in case of danger

Due to the specificity of navigation conditions in which danger can occur, regardless of experience and knowledge, it is impossible to predict all actions, measures and procedures for a given circumstance. In addition to the personal abilities of the ship's commander, other officers and each individual crew member, to carry out the prescribed procedures and instructions, the ability to conduct procedures is also required by coordinating, directing actions and behavior, adapting all the time to current conditions. First of all, the commander should recognize the danger that threatens, and then determine the time and manner, when he will establish a connection with the experts on land, for the purpose of technical support and/or rescue of people and property. First, after determining that there is a danger for the ship and the people on it, the commander will use the prescribed signal to announce the danger and alert the crew. The crew is obliged to act in accordance with the assigned duties immediately after the alarm signal, according to the ship's muster list. The crew members gather at assembly points, as well as the person in charge (officer or navigation watch member), who is obliged to bring a portable VHF device with him. In case of real and immediate danger to the ship or persons on board, the commander is obliged to report to the competent center or sub-center for search and rescue at sea. In the case of an extraordinary event of danger, when the commander assesses that the safety of the ship and the people on it is threatened, he is also obliged to immediately, through the ship's radio devices, get in touch with the competent center or sub-center for search and rescue at sea. In the event that the commander receives a distress call from another ship, or receives an order from the center to engage in a search and rescue operation, he is obliged to establish a connection.

The schedule of actions in the event of an emergency is as follows:

1. to act in the event of danger, the commander, first of all, uses the crew, and in the first place that part, which is specially trained to confront the type of danger that has arisen.

2. in the shortest possible time, i.e. from 5 to 8 minutes after collecting basic data about the danger that befell the ship and persons, the commander decides to alert the service on land and reports to the competent center or sub-center for search and rescue at sea.
3. when the danger is of limited scale and under the control of the crew, the commanding officer will first call the ship-in-distress support team on land and
4. coordination of the search and rescue of people at sea, upon notification of a death, is taken over by the center or sub-center for search and rescue at sea, according to the determined areas of competence.

As soon as possible, when he judges that the conditions exist, the commanding officer is obliged to request liaison with the ship's shore support team.

To the team members, the commander should communicate the current situation using data on:

- position of the ship, weather conditions,
- number of crew, number of passengers, number of injured or missing crew members or passengers,
- the number of vehicles on board, the state of fuel, lubricants, ballast, and drinking water and
- preparatory actions for leaving the ship.

The order is issued exclusively by the commander when he judges that the actions taken to bring the danger under control remain unsuccessful and that human lives would be endangered by continuing to stay on the ship. In such situations, the commander must immediately order the ship to be abandoned. These are most often explosions, collisions, or strandings, and the safety of the people on board is directly threatened, and all rescue actions are disabled and a death signal is sent.

2.3. Management of personnel during navigation

A detailed navigation plan facilitates safer navigation for deck duty officers on the bridge. The plan consists of several phases. Each phase contains key execution elements related to the safety of navigation.

The ship's itinerary includes:

- recognition of dangers in navigation areas (shallows, shipwrecks, and physical-geographic characteristics),
- sailing courses,
- plans of extraordinary circumstances, which will be used in cases of danger, and the sequence of actions in extraordinary situations and
- determination of priorities and distribution of responsibilities on certain parts of the navigable route (Weintrit, & Neumann, 2011).

A prepared and analyzed travel plan, approved by the commander, is a prerequisite for the safe navigation of the ship. The planning phase is followed by the implementation of the planned voyage, and many segments must be taken into account when it comes to manpower. First of all, after all the previous preparations and assuming that the navigational preparation is well done and that the command bridge is ready, someone should take care of the crew at all times (Cavaleiro, et. al 2020).

In certain segments of the trip, attention must be paid to the rest of the crew members, but of course in accordance with the available time. For this reason, all of this is planned before the actual sailing and no mistakes should be made in this regard. Therefore, it is necessary to

anticipate the existence of fatigue and take special account of it. The availability of the crew must be sufficient at all times, and strict care must be taken to avoid a situation where one of the crew members needs to do more things than intended. The availability of the crew must be achieved within the limits of their daily duties (working hours), without interfering with the normal (safe) performance of routine work. Sudden needs in changes of work duties, as well as in the extension of working hours of crew members, must be in accordance with the STCW Convention regarding the keeping of a ship's watch. Since the ship sails in specific conditions and passes through many critical sectors (channels, straits, etc.), some additional procedures are undertaken during navigation. They refer to calling another officer to the command bridge or to the deck of the ship, in order to reduce the existing risk in a limited navigation area or to perform preparatory actions related to anchoring, preparation of equipment for mooring the ship in the port, etc. Changes to the travel plan are often made in order to safely navigate the ship in a restricted navigation area due to:

navigation devices (unreliable or imprecise),

compensation for the lost sailing time of the ship during the influence of unfavorable meteorological factors and

change of port of destination, etc.

3. LEADERSHIP, CREW MANAGEMENT, TEAMWORK IMPROVEMENT (BTM)

Teamwork is the most widespread form of performing complex professional tasks, the realization of which requires either knowledge from different professional areas, or specialized knowledge from the same or similar professional areas. The purpose of creating teams and teamwork is to integrate the knowledge and experiences of team members when solving the same problem. Teamwork enables maximum use of individual knowledge, creative and innovative potential and increases the speed and flexibility of reactions to user and market requirements. The basic difference between a team and an individual is more than obvious. The team can handle a larger task, can perform a greater professional effort, and has greater knowledge and experience than one of its members, and based on everything presented, we can say that it can perform a complex task faster and with better quality. As the complexity of jobs increases, the hierarchical structure decreases by transferring responsibility to lower hierarchical levels so does the need for a heterogeneous, flexible, and competent workforce of various specializations. It is necessary to mention that in traditional vertically structured shipping organizations, there is no possibility of a common and correct approach to the use and analysis of work, and thus the possibility of noticing possible malfunctions and structural defects. Considering the above, it can be said:

- organizational factors of functionally organized shipping companies affect the quality of work of commanders, managers, and officers in regular and extraordinary circumstances,
- a pronounced hierarchical command structure can suppress the constant performance of duties and jobs, while free and interactive relationships prevent the affirmation of the mentioned concept and
- we should strive to introduce an efficient model of teamwork on board.

It is necessary to develop skills in planning, handling information, ability to influence others, negotiation skills, creativity, curiosity, tendency to learn and improve, teamwork, professionalism, self-confidence, socialization, responsible attitude towards work, correct relationship with other people, and strive for development and productivity. The current state of the ship, in which modern approaches to management are accepted but cannot be literally implemented due to the structure and existing culture, creates confusion between the wishes

and the possibility of accepting new management achievements. In fact, it is paradoxical that the water transport industry was among the first to dare to accept the principle of continuous training of seafarers and new methods of additional non-traditional education, knowledge renewal and training. All this goes through various specialist training in accordance with the IMO and STCW conventions, but no one had the strength to embark on the restructuring of the existing hierarchical structure on board, which is contradictory to teamwork and other elements of modern management. The current situation, in which the ship's commander and other management personnel are responsible for all mistakes, negatively affects the organization's desire to better train its employees. Teamwork on board can achieve greater creativity, greater job satisfaction, motivation, flexibility, better mutual communication, synergy, faster problem solving and implementation of ideas, better use of existing knowledge and skills of the crew, and the possibility of improvement by learning from other team members. Significant problems arise during the development of a new team or when new members arrive in the team, i.e. the departure of key members from the team, which has a special weight on a ship where crew members often change.

It should be noted that both the group and the team must meet at least three characteristics:

- have a purpose and goal of existence, and act in the direction of achieving that goal,
- have a leader, i.e. leadership and
- a specific structure, which can be very diverse, but is always in the function of achieving the purpose and goals of the group.

We can even say that there is no real teamwork on board, it would rather be said that it works in a group. On the ship, the situation in this context is further complicated, due to the frequent change of crew members, so the crew goes through frequent conflicts and changes, especially when the management staff changes, which also affects the performance (Weintrit, & Neumann, 2011). If the crew members are members of different nationalities and cultures, the situation becomes even more complicated. Apart from the fact that the ship is dislocated, so the crew works in specific conditions, far from their home, there are also cultural and language barriers that need to be overcome, because open communication is an important success factor in achieving goals. Through mutual communication, the team leader must explain what is to be achieved and make sure that the team members understand the company's intentions. For easier understanding and overcoming language barriers, it is good to use visual methods. After that, you can start determining the processes and procedures that will be used to achieve the set goals. It is important to create, with the cooperation of all team members, rules and norms that will be respected, because different cultural predispositions create different expectations and different approaches to problems. It is especially important to develop the habit of giving quick feedback in parallel with completing tasks. Since there are language problems, associates should be democratically guided and encouraged to communicate, since due to poor language skills it may happen that some team member feels inferior and is afraid to communicate with the team leader. The team leader must develop people management skills and choose the right approach to situations and to different team members, in order to facilitate mutual relations among members of a multicultural team and successfully resolve conflicts that arise due to different cultural heritage. These problems also occur on board, where feedback is extremely important. If the ship's crew is not led democratically and constantly emphasizes formal power, then feedback and trust will be absent or feedback will arrive too late to avoid causing more damage, and performance will be significantly reduced. We can add a cultural dimension to the previously mentioned team development cycle, which affects the development of a multicultural team. Disbanding the team must not and cannot happen on board, and the work must be done safely and efficiently. In addition, the ship's manager does not have a set time to develop the team, but the crew must function from the moment the new crew members arrive

on board. Today, the influence of different foreign cultures is being analyzed, which could explain the complexity of the characters of different crews and the contradictions in culture, as well as language problems. There are many crews of different nationalities, so a compromise is resorted to, i.e. combining experienced crew members with those who have less experience. The lack of conflict management, which arises on board due to misunderstanding of cultural, religious, and other differences, causes weaker team effectiveness and permanently bad interpersonal relations, in a specific workplace where living and working conditions are completely different from the usual ones (Weintrit, & Neumann, 2011).

4. CONCLUSION

Fatigue and sleepiness of the management staff, which often result in nervousness on the ship, which is then transferred to all crew members, are a common cause of both work errors and poor interpersonal relations, as well as a significant decrease in effectiveness and increased costs for the ship owner. As the human factor is still the biggest cause of accidents on the water, one of the ways to reduce that negative impact is possible if every seafarer completed training in BRM and BTM or underwent certain training on simulators. Acquiring knowledge from BRM and BTM would greatly improve the interpersonal relationship on board and thus reduce the risk of an accident on board caused by the human factor.

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