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IMPLEMENTING INNOVATIVE APPROACHES AND LEARNING METHODS IN MARITIME EDUCATION

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Abstract. The maritime education is generally developed in two directions: training of seafarers and port specialists. Nowadays, the shipping business is changing rapidly and in the era of digitalization the working staff should be able to use computerized information systems and to understand the capabilities of automated programs in order to respond to existing and future requirements in this area. The main goal is to prepare highly skilled personnel trained to work in continuous change in the digital era. The current state of the job market for maritime personnel requires the introduction of new approaches and more practically directed learning methods. The acquisition of the basic science and fundamental engineering courses required for seafarers or port specialists are not sufficient. They need to achieve more practical and cognitive skills throughout their education and training courses. This paper discusses some innovative methods and approaches used for learning and training considering important changes and ongoing digitalization in the maritime industry combined with necessary soft skills management. The proposed adaptive self-correcting model of training course is developed based on the authors' experience in maritime education with students and on empirical method of research and system analyses performed with seafarers and port specialists with long practical experience.

Keywords: maritime education; training of seafarers; digitalization and soft skills management

Introduction

Maritime education should ensure the necessary knowledge in the maritime sphere and, together with training during the process of studying, to provide better realization of seafarers and port specialists. The trainings should be performed as per specific requirements for each working position and in full compliance with international standards such as those prescribed in the Standards for Training, Certification and Watchkeeping of Seafarers (STCW Convention) and to ensure

the acquisition of a wide range of additional personal skills that help for smooth adaptation to the specific jobs in the maritime branch.

The current state of the job market for maritime personnel requires the introduction of new approaches and more practically directed learning methods. Taking the basic science and fundamental engineering courses needed for seafarers or port specialists is not sufficient and they need to achieve more practical and cognitive skills during their education and training. They should be able to work in a team, to take a decision in complicated situation and to work under stress.

The application of modern technological solutions to support the assessments contributes to the objectification and the application of scenario-based methods. (Dimitrov 2020, pp. 4-10). The communication and information system can be pointed out as one of the priorities in this aspect, in particular its construction and development in the context of the current requirements. The methodology of training in a certain subject matter must include a learning objective and a practical objective, as well as means and methods of achieving them (Nikolov 2017, pp. 483 – 485). Simulators are designed to provide a realistic reproduction of real-life environmental conditions together with approximated essential elements and characteristics of the modeled vessel. It gives an integrated comprehensive approach to implementing theory at first hand during education. It is applicable during both fundamental training and post-graduate qualification (Vasilev 2019, pp. 1 – 7). Close partnerships with companies from the maritime field will help in the establishment of a current educational concept that meets the new requirements and needs of the maritime business.

1. The complex framework of the contemporary maritime education

The employment of well-trained and competent maritime crew and other sea professionals is very important for decreasing the number of maritime incidents and emergency situations. Some maritime companies such as port control authorities and classification societies prefer to employ ex-seafarers with long working experience, particularly officers, pilots, engineers, in positions such as shipyard managers, ship safety inspectors and instructors. Considering that, maritime building and training during the course of education should include additional courses, containing acquisition of skills that might be helpful not only for work at sea but also onshore. All syllabi should be reviewed periodically. The mariners must acquire also certification related to their future operational duties on board the ship and in most cases is connected with watch keeping, effective assessment of the current situation and information received simultaneously from all communication systems.

Today, one of the leading causes of ship accidents is the influence of the "human factor" in the functioning of the "People-Machine-Environment" system. The international maritime shipping system refers to the multi-functional system whose constituent elements are "man-machine-environment". It combines the functions of one or several operators

with a machine, forming a single whole that interacts with the environment under specific conditions. It is a closed loop of interconnected and interacting components. A person enters the system as an operator, who plays a key role because he performs management functions, i.e. plans, evaluates the plans and the environment and makes decisions based on this. In the majority of accidents, there is a combination of causes and circumstances that cause a particular incident. These reasons include: the technical condition of the control facility, organizational and technological activities, the environment and its impact on the controlled object, and the action of the human factor.

Despite the progress of science and technological achievements, the inequality between the components of the human-machine-environment system have remained unaddressed for centuries. Through the conventions adopted by the IMO, the new rules for shipping in the 21st century are confirmed, outlining a new model of the master, who manages the extremely complex socio-technical system of the vessel, considering the constantly changing environmental factors. The characteristics of each component of the triad and how they influence each other to form the navigational process are discussed. The interrelationships between the elements are complex, dynamic, mutually influencing, and environmental conditions should be evaluated and analyzed very carefully when changing each of the parameters. According to the adopted international convention STCW'95, not only complex legal normative and quantitative changes have been approved, but the foundations of qualitative changes in world maritime transport have been laid. According to them, ship officers are required to have not only technical competence, but also socio-psychological competence, which is of great importance to ensure the safety of navigation.

In the presence of difficulties, each person is characterized by limitations of possibilities, due to the discrepancy of their psychological and psychophysiological characteristics, to the degree of complexity of the tasks that arise under specific working conditions. The key to understanding the human element and its impact on maritime safety lies in the socio-psychological factors that influence it. The question of the structure of socio-psychological influence is quite complex due to the variety of ways of influence and the changes associated with it. Numerous studies indicate that the negative influence and complexity of work at sea not only worsens the functional state of the individual, but also changes the personal status, disrupts the efficiency of the activity, develops psychosomatic and other disorders (Stoyanov 2000, p. 5)

The training of maritime specialists exceeds national borders. The requirements of IMO, connected with their maritime character development and training for acquiring the necessary knowledge and professional skills, are valid worldwide and should be strictly followed by the people who develop the curricula. Moreover, they should be fully compliant with the specifics and activities of each maritime branch. The process of maritime education is of the competencies of maritime institutions that should make the appropriate reforms in methods and technologies for teaching and training of maritime specialists with a clearly defined focus on internationalization and globalization.

The revision of the relevant provisions in Chapters II-1, III, IV and V of SOLAS and the preparation of related and subsequent amendments to other existing instruments is the result of a decade of detail-oriented work by the IMO, in particular by the NCSR Committee Division. The safety of shipping and the safety of life at sea depend on integrated satellite and terrestrial radio communication systems to maintain ship-to-ship, ship-to-shore and shore-to-ship communication in distress, emergency and safety at sea. (IMO; Maritime Safety Committee (MSC), 104th s. 2021)

The future of the maritime professions is related to the modern innovative technologies. A Report on future skills and competence needs states that the gap between everyday practice and expected competencies in this area is growing (Oksavik et al. 2020). A number of functions is being transferred from ships to shore-based control centers. This requires advanced skills in analytics and the use of data in optimizing fleet operations.

The study states that digital skills are becoming increasingly important for maritime professionals, but the time to study them during fundamental maritime training competes with current criteria and puts pressure on existing STCW training, while studying them after graduation is more expensive and costs time as well. Nevertheless, STCW training should be broadened with digital and sustainable skills integrated within courses, along with maritime law, business and project management, remote control operations and other new technology-based skills using current developments and devices used in health condition measurement, etc. It will also be possible to use the technology to assess when to put people to work – whether the crew is fit, well-rested and ready to carry out their tasks. Many people already use portable devices in their daily lives to monitor their activity, heart rate and sleep patterns. This technology can also be used for alerts in safety-critical industries when people are fatigued, and their performance may pose a risk to themselves or others. Using data on fatigue, eye-hand coordination, etc., can prevent dangerous situations and help employers identify patterns of performance and isolate risky circumstances.

An example of ensuring the safety of seafarers is the technology developed by LR Safety Accelerator alumnus Senseye, who work in partnership with Pacific International Lines through the program. Their smart technology scans the retina of the eye using standard cameras to determine if the crew on board is "fit for duty". This essentially indicates whether they are fatigued or in any way hindered from performing their job safely, which may be due to stress, depression or alcohol or drug abuse. This type of solution, if widely deployed at sea, could dramatically reduce accidents caused by human error. Despite all the positives at this stage, there are obstacles related to data protection and privacy, as well as cyber security.[1]

Safetytech is a term used for safety technologies, products and services. This term avoids traditional safety approaches and reduces risk by using operational databases. It is a highly differentiated strategic tool in which Lloyds Register develops and tests safety and risk innovation solutions. The pace at which technology has taken

hold in maritime transport is extremely fast. 2020 was a year when acceleration increased, especially given the challenges presented by the COVID-19 pandemic. The technologies are routinely deployed for a variety of uses, from shipbuilding, oil and gas extraction to marine environmental protection technologies. Perhaps less visible in shipping is safety technology. Manufacture and adoption has only just begun for this new sector. Recent research conducted by the LR Foundation found that the combined global safety technology market is expected to be worth $863 billion over the next three years, with safety-critical industries alone expected to be at least $257 billion. When we look at it through the lens of the marine industry, the marine safety technology market is expected to grow to approximately $6.6 billion by 2023, with a compound annual growth rate of 7.7%[1]. There is no doubt that the adoption of new technologies is currently accelerating, and in fact is expected to accelerate even more rapidly.

There is no need to emphasize the importance of the concepts of "Getting the right people" and "Getting the people right", but definitely these two concepts are very important for motivation of the personnel. "Getting the right people" is selection process that provides to best possible and most capable and qualified people. "Getting the people right" means a consistent policy for continually training, qualifying, and educating of the hired work staff. It contains two categories: policy and practice of human resources. The first category refers to the education and training courses for achieving of additional qualification or professional skills and the second is related to the motivation of the work staff.

In this regard, the experience of the so-called SMART (Specific, Measurable, Attainable, Realistic, Time-scheduled) system for port training by the port authorities in Singapore shows several advantages (Meletiou 2006):

1) The learner knows exactly what is required from him;

2) The different instructors know exactly how each one of them is teaching;

3) The final test shows the actual knowledge of the participant and is easy to complete;

4) It is easy to check whether an essential part of the subject matter missing and needs additional work.

Upgrading knowledge and skills is an integral part of their personal and professional development. The implementation of new software solutions and applications for various purposes requires a high level of computer knowledge on the part of today's seafarers and stakeholders.

The danger of the sea is well known and has been much discussed and analyzed over the years. Seafarers' lives are lost every year, despite the industry's best efforts to improve safety. Marine casualties are often out of control despite the many processes and safety measures in place. Extreme weather, freak accidents, human error – these things are hard to predict and mitigate. However, innovative technology can improve processes and reduce danger in day-to-day operations. Drones and sensors will be

able to ensure that the human will be completely spared from performing dangerous tasks or inspections, such as those at height, extreme locations or confined spaces, or spaces with life-threatening substances.

Human performance is dynamic and decisions are often made based on real-time, on-the-spot conditions, sometimes without much analysis or no information at all. When physical demands or challenging conditions affect people's ability to perform their jobs efficiently and safely, technology can complement the work of the on-board engineer, making the job more efficient, less challenging and safer overall. Mechanical and software technologies, including automation, can reduce workload and stress by eliminating apparently difficult or dangerous work.

2. Description of the learning approach

Learning is a process of education that prepares people for a future job. It leads to the development of professional skills in one direction that might be also helpful in various spheres of work. Personal development is a long-term learning process of acquiring, building, and improving of individual skills that ensures maximum efficiency and adaptability. One training course might be considered effective when it helps people perform better their duties at work, according to the actual standards and rules. Effective training is achieved by applying a set of basic principles and systematic selection of methods and, last but not least, implementation of the latest modern technologies and approaches of education. The systematic methods of training are composed of various series of independent modules/subsystems that are interconnected and integrated into the one training system. Trainings connected to the improvements of personnel abilities are a complicated task and require understanding of the nature and essence (basic precondition) of the problem.

Training, education and development of personal skills are the main activities labeled as “human resource development”. Prof. Leonard Nadler from George Washington University defines the concept of “human resource development” as the provision of organized educational learning for a certain period, deeming significant improvement of results and growth of personalities. In this sense, there is no apparent distinction between the three terms covering “human resource development”. Their goal is connected with quality performance and improvement of knowledge, skills and habits (Bennett et.al. 1999; Manuel 2011; Ziarati et.al. 2010). Training is related more to the current job of the trainees and development relates to the future work.

The proposal considers initial personal and soft skills assessment of the seafarers and after that performing the relevant development and training. The innovative approach consists of two stages. The first stage is connected with determination of the emotional stability of seafarers and what kind of responsibility might be expected of them in order to take the adequate decisions under stress and in risky situations. Based on the results received, each candidate might be assigned to the relevant study and training courses. Our proposal is that the training system, used

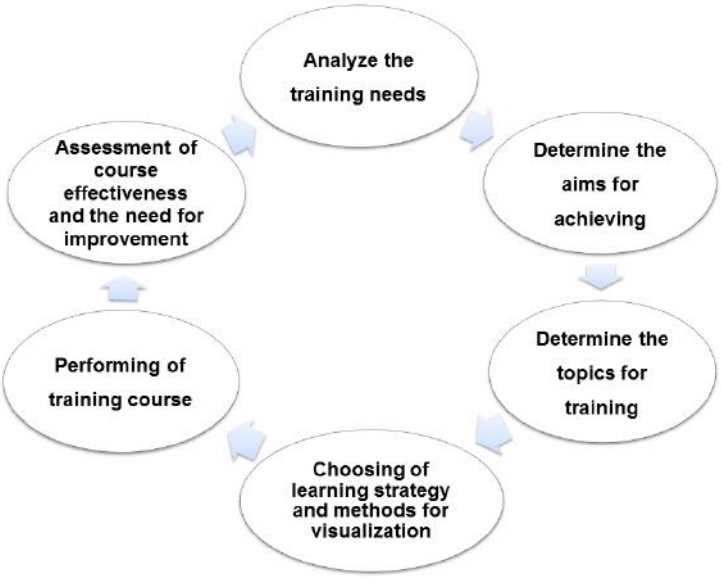

Figure 1. Self-correcting model of training course

Source: Developed by the Authors.

in the second stage, be structured and based on a self-correcting model of a training course in order to be adaptive to upcoming changes in maritime sector (fig. 1).

A careful analysis of accident reports shows that 80 to 85% of all accidents result from incorrect actions in a specific situation, human error, or an inappropriate management decision. Deficiencies in the appropriate education or training of seafarers and non-compliance with current international standards and regulations are pointed out by the researcher as the main reasons leading to incidents at sea. The computer programs and information systems used on board are changed over short periods or time and this tendency will continue.

The industry needs highly qualified and versatile personnel that is capable of easy adaptation to the future changes in ship operations. The combination of simulation and optimization methods provides all the flexibility of the simulation device in terms of determining the various performance measures of the respective solution. Simulations should be as realistic as possible in order to increase benefits of training fulfilling IMO regulations and rules of national maritime authorities. Standardized and specialized data related to the ship's safety that is gathered and stored for competent investigation authorities would be useful for improvement of trainees' practical skills and knowledge in advance.

For instance, the protection of the marine environment from pollution is related to ensuring shipping safety and reliable communication system for continuous

connection between vessels and shore. This imposes necessitates more practical exercises and implementation of additional hours in specially equipped maritime simulators. These simulators have to be designed according to the specific job position on board of the ship and also to train the future seafarers or port specialists in various emergency situations that may arise in the course of their work. They should acquire skills, necessary for working in team and be able to take the right decision in difficult situations, within short time and under stress.

Conclusions and summary

The success in the maritime sector depends on a capable, highly skilled and motivated staff. Maritime education and training should be developed to stimulate the improvement of professional skills that can provide opportunities for better realization. Legislative barriers such as the lack of mutual recognition of certificates for qualifications or additional national requirements for seafarers should be eliminated. The implementation of the EU Directives on the mutual recognition of seafarers' certificates issued by EU member states should remove these obstacles. The EU community funds should be used to support changes aimed to facilitate the requalification and additional professional support for easy adaptation in other spheres in the maritime sector.

The implementation of innovative technologies in maritime transport, including Safetytech, cannot eliminate humans from the maritime profession, because the human element is a key factor in carrying out the activity. To a large extent, the human element influences the occurrence of incidents and accidents. Conventions and regulations aim to reduce the percentage of events resulting from human error. Revealing all the patterns and the large variety of individual human behavior that contribute to marine accidents is practically impossible. Skills of adaptation, flexibility and resilience are required.

The challenges higher maritime education faces can be summarized in the requirement of staying up to date. It is very important to follow the changes and new amendments related to international standards and to implement new approaches and technologies during the entire process of education.

NOTES

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