

# Current Challenges in Professional Education and Training of Seafarers at Management Levels on Oil Tankers

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**ABSTRACT:** Maritime education and training (MET) are under constant pressure from the maritime industry, characterized by extremely rapid development. Due to the high risk in the transport and handling of crude oil, seafarers employed on oil tankers are required to have skills and competencies well above the minimum education standards set by the International Maritime Organization (IMO) and the International Convention on Standards of Training, Certification and Watchkeeping (STCW). Therefore, tanker companies should provide additional training for their employees to ensure the fundamental goals of zero-accident rates and reduce human error to a minimum. This especially applies to seafarers at the management level, who must have the competence and knowledge to operate oil tankers at the highest professional level. This paper examines the current challenges in education and the required competencies of seafarers at management levels concerning the rapid growth and development of the tanker industry. In addition, some shortcomings regarding the current form of education and training have been considered, and recommendations for the future upgrade of the education and training system for seafarers at the management level are provided.

## 1 INTRODUCTION

Transportation of goods by sea represents one of the most vital parts of global world trade. Over 50,000 merchant ships employed in international trade transport all kinds of cargo, amounting to about 90% of total world trade [1]. Moreover, with the help of the technical modernization of ships and efficient navigation equipment, maritime transport is more efficient than ever.

A significant role in the maritime industry is played by tankers, ships employed for the transportation of oil, derivatives, and gas, which make up about 30% of the total trade by sea [2]. Due to the nature of the cargo that they transport, tankers are associated with significant risk. During the transportation and handling of cargo, all operations

must be performed without errors and harmful impact on the environment and people. Despite the high sophistication of oil tankers, maritime accidents with catastrophic consequences still occur since a primary cause is often human error. According to available data, human error as the main factor played a role in as many as 30-50% of marine accidents related to oil spills and sea pollution [3].

A competent and educated crew is essential for the safe and efficient management of the ships. International Maritime Organization (IMO) recognized the importance of seafarers' education, and in 1978 The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers was issued. However, it was realized that the convention was not achieving its purpose due to constant changes in required

professional standards, and in 1995 the STCW convention underwent its first significant change. The second major amendment to the STCW Convention occurred in 2010 and was popularly called the "Manilla Amendments". Along with numerous changes in the convention's text, there is an essential change with an emphasis on developing practical skills and competencies of crew members and introducing new and modern training methods for seafarers, such as simulators, distance learning, and online learning.

The central role of Maritime Education and Training (MET) is to anticipate growing challenges and provide the necessary answers to meet the expectations of the future crew and officers on ships. The MET has a crucial role in preparing seafarers to safely and effectively respond to the operational demands of ship management. A well-designed MET program must have a properly balanced curriculum with the necessary theoretical and practical knowledge in education programs [4]. Students who complete undergraduate/graduate studies in the maritime field should be sufficiently educated and trained to perform tasks at the operational level and achieve the highest qualifications at the management level with further upgrading in their careers.

The IMO has recognized the high risk involved in transporting oil by sea and set standards through IMO model courses regarding seafarers' education and professional training on oil tankers. In order to ensure the highest level of safety on tankers, tanker companies should provide an additional training program for their crew and officers [5]. There is a high demand for the highly qualified crew, especially those at the management level, who must keep up with the technical development of the industry and continuously improve their skills.

Shipping companies are also responsible for implementing the STCW convention so that all seafarers have the appropriate certificates for the position on the ship they are employed in. The requirements of the STCW convention are aligned with the ISM code (International Safety Management Code), and all crew members must be thoroughly familiar with the company's policy and procedures and fully competent and qualified to perform their duties safely and efficiently.

Shipping has evolved to the level of a highly qualified field, and today's seafarers need specialized types of knowledge and skills to operate ships of various sizes and types successfully. This especially applies to crew members on the tanker fleet, which is particularly exposed due to potential environmental risks for the economy in coastal areas.

This paper's research subject is assessing the current level of professional training and possible upgrades in the competencies and skills of the highest-ranking officers on oil tankers. It is evident that the maritime industry must find specific corrective actions and procedures that will lead to decreased number of marine accidents connected to human error.

## 2 SAFETY ON OIL TANKERS IN CORRELATION WITH THE EDUCATION LEVEL AND PROFESSIONAL TRAINING OF SEAMEN

Accidental oil spills at sea can have a catastrophic effect on coastal areas and marine ecosystems. Also, this can lead to significant consequences in other branches, such as tourism, aquaculture, and fishing. The international transport of crude oil is constantly increasing, but the number of incidents with accidental spills into the sea has a downward trend. Currently, according to the statistics of the ITOPF (International Tanker Owners Pollution Federation), 99.99% of the total amount of loaded crude oil is safely transported by sea, as presented in Figure 1. [6].

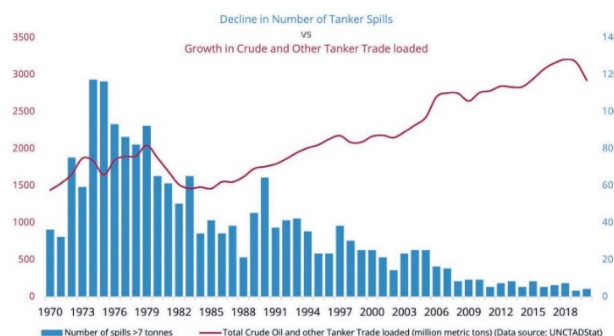


Figure 1. Decline in number of tanker spills vs. growth in crude and other tanker trade loaded, 1970-2021 (source: ITOPF statistics 2022)

The most frequent causes of tanker spills are allisions/collisions and groundings, with the emphasis on the collision category that has had a constantly growing tendency since 1970. In the available ITOPF statistics, getting factors contributing to marine casualties on tankers is impossible. In the Annual Overview of Marine Casualties and Incidents for 2022 issued by the European Maritime Safety Agency (EMSA), human action is the leading accident event type, with 59.6% of the total for the various ship types. Concerning the focus area of human actions, 45.1% is related to the training, skills, and experience of the ship's crew. [7].

### 2.1 Required education and training for seafarers at the management level on oil tankers

One of the key elements for maintaining a safe shipping industry and preserving the marine environment lies in the fact that all seafarers in the world should possess high competence and knowledge for the duties they perform on board. This particularly applies to officers at the management level on oil tankers, where the IMO and the STCW have set high standards.

According to research data from Gilbert Maturan, global seafarer training manager at Teekay Tanker Company [8], 60% of learning takes place on board through hands-on experience, 30% of learning takes place through interaction with colleagues through mentoring and coaching, and only 10% comes from formal learning and short courses at the end.

With a completed undergraduate or graduate degree in maritime university (nautical or marine engineering), the STCW Convention has set minimum standards for officers and crew sailing on oil tankers. The IMO has developed a series of mandatory courses to improve seafarers' education in the rapidly growing maritime industry. IMO model courses have very detailed lesson plans with clear training outcomes and competencies that must be achieved after completing the course.

According to the requirements of the oil tanker industry, in addition to IMO Model courses, there are numerous mandatory and recommended courses that seafarers at the management level on oil tankers must possess or are strongly recommended to possess.

In addition to all of the above, seafarers at the management level on oil tankers are required, in accordance with their duties on board, to attend the so-called CBT training (Computer Based Training) by means of computer programs and e-learning. It is common for tanker companies to set a Training matrix for each rank on board so that every individual crew member can access required courses via computers and a specially designed marine developed system. A significant advantage of CBT training is that the necessary training can be done during a stay on board and mostly during regular working hours, so it is not necessary to attend the same training during vacation periods at home.

For officers at the management level and potential junior officers, some oil tanker companies design unique "in-house" courses and training. They are primarily designed to inform the highest-ranking officers (Captain, Chief Engineer, Chief Officer, and 2nd Engineer) about the latest changes in the tanker industry. Some additional training sometimes refers to unexpected circumstances, such as piracy, where it is necessary to train the crew very quickly.

Oil tanker companies must also comply with the high safety standards set by OCIMF (Oil Companies International Marine Forum). OCIMF introduced the SIRE program (Ship Inspection Report) to address concerns about sub-standard shipping. [9]. Objective reviews based on the SIRE program have contributed to reducing incidents and improving operational standards. Transitions to the new SIRE 2.0 model are currently being carried out. This is a step change in the inspection process, changing the focus from the management processes to human factors. Along with the SIRE program, a significant role is played by the Tanker Management Self-Assessment Program - TMSA. The main advantages of TMSA are raising the standards of safety management systems on tankers, where particular emphasis is placed not only on the training and education of seafarers who sail on oil tankers but also on employees in offices.

## 2.2 *Survey of IMO Model courses curricula and seafarers' training policy on oil tanker companies*

For the purpose of this paper, four tanker companies were requested to share all relevant documentation regarding seafarers' education policy, including the following: Crew Manual, Officer's Training Policy, Minimum STCW and National Requirements for the

Officers, Additional Training as per rank and Certification Matrix for Officers. Comparing the education and training policies among the four tanker companies shows a remarkable similarity in the requirements for certain ranks serving on oil tankers. The main reason is the global influence of the tanker industry and the strict rules set primarily by the OCIMF. Due to the numerous rigorous annual inspections of each tanker and open access to the databases of all tankers worldwide, a high standard has been created that every tanker on the oil market must achieve. In order to achieve those goals, a well-educated and highly-trained crew is required.

Although the STCW convention emphasizes the obligation and responsibility of the highest-ranking officers on oil tankers, the mentoring and teaching of junior officers are not particularly highlighted and elaborated in detail in the training policies of the observed companies. It is evident that mentorship and direct training on board represent the best means of educating junior officers. Building high individual competencies of seafarers requires many years of experience, and a complex system of continuous mentoring work is essential. This issue has been partially solved with the "Train the Trainer" course for the highest-ranking officers, where they have been trained to teach younger and inexperienced officers.

In order to reduce human errors to a minimum in the process of managing the vessel, there are several additional courses that the officers must complete (Bridge and Engine Team Management, Bridge and Engine Resource Team Management, Shipboard Hazards Simulation & Situational Awareness Training). The fundamental goal of the additional courses with an emphasis on reducing human errors is to manage the ship with a zero-incident goal. However, deeper insight into the teaching syllabus of the latest editions of the IMO model courses related to reducing human errors shows that some courses have not been updated despite the rapid development of technology in the tanker industry [10]. Also, there is currently no IMO model course for the highest-ranking officers focusing on reducing human errors and teaching top-rank officers the special techniques and skills for managing the vessel safely.

The use of ship/cargo simulators is strongly emphasized in the education policies of observed tanker companies. The simulation environment provides numerous benefits and leads to the immediate application of knowledge and insight into current errors and the performance of corrective actions. Using the simulator eliminates the problem of traditional learning and achieves much better learning outcomes. In order to maintain a highly trained crew, top-rank officers on oil tankers must be trained in the following:

- fully integrated navigational bridge simulator
- fully integrated engine room simulator
- cargo handling simulator
- hydraulics simulator
- Polar Ice navigation simulator
- ECDIS simulator
- GMDSS simulator

A detailed analysis of the available education policies of observed tanker companies and the STCW curricula showed that there is no special additional

training in the use of advanced information technology and automation. Despite general digitization and increasing utilization of electronic equipment on newbuildings, seafarers have no additional training in managing highly sophisticated automated systems.

The current trend of introducing multinational crews on oil tankers increases the need for effective communication in English. Inadequate communication between the officers and the crew or between the ship and the shore can endanger the ship's safety, crew, and environment. Within regular and routine shipboard operations, the current language barrier may not immediately create a problem as there is time to repeat or explain it differently. However, if the crew cannot communicate adequately and accurately in emergency situations, this poses a significant challenge to the safety of the ship. By studying the available crew manuals of oil companies, it becomes apparent that all crew members are required to have good speaking and writing skills in English according to the IMO Model Course 3.17 "Maritime English". However, neither the oil companies nor the IMO/STCW noticed the necessity for additional and advanced education in the Maritime English language.

Industrial and organizational psychology plays an increasingly important role in the maritime industry. Although it is primarily used in the recruitment process when hiring cadets and junior officers, it is also employed in the officer promotion process, where a specific set of skills required for the appropriate role on board is determined. During the detailed examination of the available oil tanker company education policies and STCW curricula, a fully developed psychometric assessment of the capabilities of the highest rank officers on oil tankers was not observed. Only a minor part concerned with psychometric assessment was found in the additional courses related to the management of human resources on the ship, teamwork, and the initial recruitment of cadets. Through interviewing people employed in the training centers in Croatia, it was noted that currently, no detailed teaching syllabus nor the necessary human resources (psychologists or organizations specialized in this area) exist to perform a psychometric assessment of participants during real-scenario practice on ship simulators.

### 2.3 Survey results among the management level officers serving on oil tankers

According to a survey of curricula of the IMO Model courses and seafarers' training policy on oil tanker companies and the possible deficiencies identified in the process, a short survey was also conducted among seafarers at the management level encompassing Masters, Chief Officers, Chief Engineers, and First Engineers. In addition, seafarers from different tanker companies participated in the survey. The survey consisted of 5 questions, and all of them were related to the topic of research presented in this paper. Altogether 40 active highest-rank officers participated in the research.

In the first question, survey participants were asked about the implementation of learning and

mentoring of younger and less experienced officers. 31% of the survey participants reported that the mentor teaching process was fully executed, and the rest of the answers referred to the partial application of the teaching process on board or no application at all.



Figure 2. Program of mentoring junior officers on board (source: Author's own work)

In question 2, survey participants were asked to evaluate general knowledge and proper communication in the English language onboard their vessels during navigation and communication with other vessels and cargo operations at oil terminals. Communication in English was evaluated by 38% of the participants as excellent, while 50% of them reported it as very good.

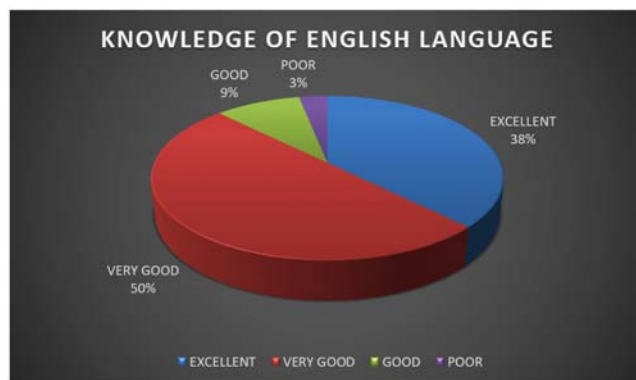


Figure 3. Assessment of communication in English in the maritime industry (source: Author's own work)

Considering the growing trend of digitization and automation in the tanker industry, survey participants were asked to rate their knowledge of managing high-tech and automated systems on board. 35% of the participants rated their knowledge as good and 29% as very good. However, only 30% stated that their knowledge of managing high-tech systems was excellent.

In the 4th question of the survey, the participants were asked about implementing psychometric assessment of seafarers during the extensive practice on a simulator or in the final process of promotion to the highest rank. Only 19% of participants have experience attending that kind of additional training.

### 3 ANALYSIS AND INTERPRETATION OF THE SURVEY

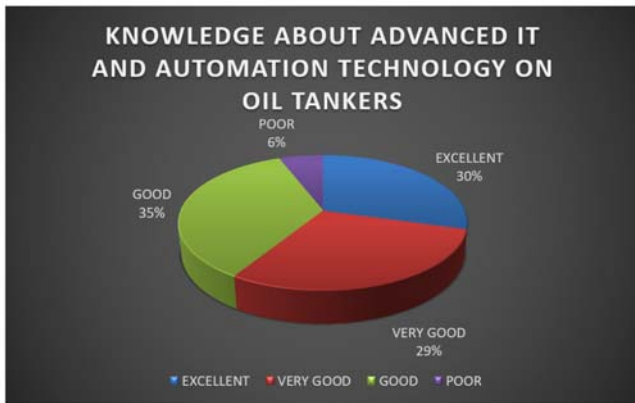


Figure 4. Assessment of knowledge in managing advanced digital and automated systems on board oil tankers (source: Author's own work)

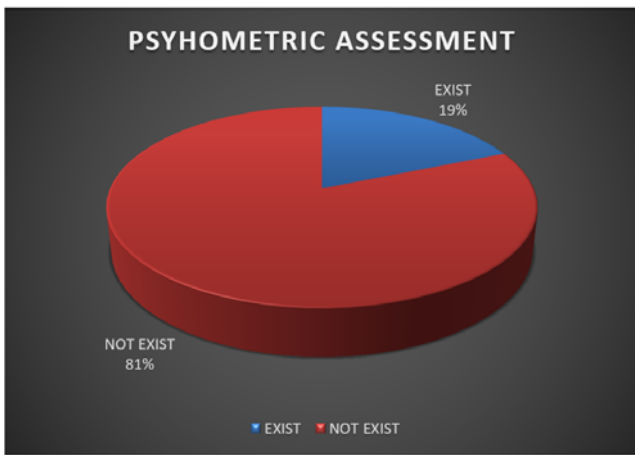


Figure 5. The presence of psychometric assessment in the training and promotion process of seafarers at the management level on oil tankers (source: Author's own work)

In the last question of the survey, participants were asked to select all relevant categories that can contribute to reducing human errors on board, complying with the company goal of zero accident rate. The participants indicated, with a total of 43% (24% referring to competence and skills and 19% to additional training), that improving the competencies and training of seafarers at the management level can significantly reduce human errors leading to accidents on oil tankers.

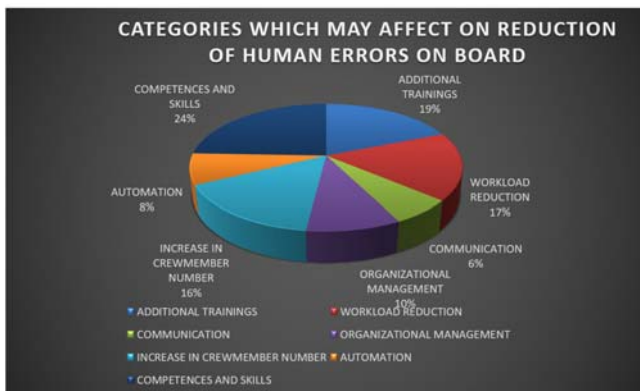


Figure 6. Impact on the reduction of human errors on board (source: Author's own work)

The process of education and professional training of seafarers at the management level on oil tankers is still a very complex issue. Comparing the current education policies of the observed tanker companies, a significant similarity and unification of the requirements based on the minimum requirements of the STCW Convention and the IMO can be identified. However, there are apparent divergences in the form of essential additional education of the highest-ranking officers on board oil tankers. Additional education and professional training of seafarers are the basis of the outlined policy of creating a zero-accident rate and reducing human errors to a minimum. However, despite the statistics of maritime accidents showing that human error is still the leading cause, there is currently no specific training for seafarers in the tanker industry that only focuses on reducing human error in various situations. In order to make it happen, in maritime training centers, it would be necessary to have experts in human factor impact who would use their teaching techniques and skills to work in a targeted way to reduce the natural limitations of the human mind.

The analysis of oil tanker companies' education policies and the survey results show that the practical learning or mentoring process of junior officers on board has room for further improvement. It is quite clear that the mentoring process cannot be fully realized due to the impact of the high workload of the ship's personnel and the increasing economic demands in the oil tanker industry. The skill of mentoring, i.e., training other officers on board, is actually the simplest way to spread the necessary knowledge and experience. Companies should have a carefully defined learning and developing plan for each officer's rank with specific practical training tasks during their stay on board and a clear procedure for training their highest-rank officers in soft teaching skills that they would later apply in mentoring junior officers. Investment in junior officers' professional education always has long-term positive implications.

Through the research, it was determined that all the observed companies invest much effort in educating their seafarers through various types of simulators. Real events can be accurately illustrated through simulations, which is a very effective way to improve the skills and competencies of participants. Through different realistic and authentic scenarios adapted to the duties performed by officers on board, the effect of teaching can be evaluated and compared with the standard of the tanker industry. Thus, future training can be adjusted according to the perceived shortcomings. In addition, a psychometric assessment by an expert, which would be performed simultaneously with the practice on the simulator, would help a lot. Only 19% of the survey participants are familiar with this process, which should be more widely applied in the education of seafarers.

According to the data from the survey, 43% of the participants stated the importance of seafarers' education and professional training in the context of reducing human errors and accidents at sea. Although it is not relevant to this paper, it is interesting to note

that 33% of the participants consider the reduced workload and the increase in the number of crew members on board an effective response to reducing human errors and accidents at sea.

Analyzing ITOPF's statistics of maritime accidents on oil tankers, it is clearly visible that incidents occur mainly during the ship's navigation, with the two predominant categories being collisions and ship strandings. Furthermore, according to available research data from the NTSB (National Transportation Safety Board) [11], one of the most common causes of ship collisions and groundings is inadequate communication and improper use of automation on board vessels. Comparing these data with the data from the survey, it can be seen that the knowledge of the English language and the use of digital/automated systems is at a satisfactory level, but it can be noted that there is room for improvement at the advanced level. Therefore, it is necessary to develop new curricula in the domain of IMO Model courses regarding the level of English language knowledge and the proper use of advanced digital technology on ships.

#### 4 CONCLUSIONS

The research on seafarers' education and training on oil tankers at management levels clearly showed its remarkable complexity and challenges. The statistics of maritime accidents involving oil tankers continue to indicate that human error is the most common cause. Even the slightest individual human error usually leads to other errors and, finally, to an incident. As a solution, the maritime industry should set clear procedures and try to reduce the poor situational assessments and decisions that most often cause ship accidents. Effective education and a carefully developed strategy of additional professional training is an effective way to achieve this goal.

Competences acquired by improving practical skills during the stay on board should be prioritized. This can be achieved by revising the learning programs regulated by the STCW Convention and the IMO and building detailed and individually adapted forms of learning during seafarers' stay on board. In addition, the standardization of the mentoring process and the active involvement of the most experienced personnel on board, including employees working in offices, would undoubtedly contribute to increasing the level of knowledge and education among officers. As an option, tanker companies with larger fleets may adopt some vessels as "Cadet ships" with dedicated training senior officers on board focused only on learning and development programs. In addition, it is necessary to continuously provide officers at management levels with better additional education in the application of advanced digital technology and automation, as well as an advanced level of knowledge of the English language.

Traditionally, MET institutions meet the requirements of STCW regulations when developing curricula, focusing on delivering IMO model courses. However, the operational and technological progress rate in maritime operations continues to accelerate.

The rapid change in technology, along with the high safety criteria for all the participants in the tanker business, require constant improvement in educating seafarers at management levels. Therefore, educational and training institutions and tanker companies should prioritize additional training of seafarers and create long-term plans and strategies to ensure a sufficiently qualified and educated workforce for the future, especially at the management level. The training and education of seafarers must be developed in parallel to the current impact of the fourth industrial revolution. The role of MET institutions is critical in implementing new technologies and fulfilling new expectations of the maritime industry.

Environmental protection and safety levels on oil tankers can only be improved through targeted education and training of seafarers. Psychometric assessment, while performing comprehensive and realistic simulation scenarios, can be used as a great tool to potentially identify someone who is "likely" or "may" contribute to a potential incident or marine casualty. Through targeted training and micro-learning involving officers at the management level, it would be possible to build unique features and capabilities to operate oil tanker vessels with a zero-incident rate.

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