

## **SIMULATORS USES FOR TRAINING OF MERCHANT VESSELS OFFICERS**

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### **Abstract**

*Training of merchant vessels crew covers not only theoretical knowledge from a given field but also a lot of practical exercises. Simulators play a very important role here as they make it possible to create real life situations experienced at sea and the true behaviour of a vessel in different conditions. They enable demonstrating real actions taken during ship's engine failure or during any other breakdown. Thanks to this the course participants and students can experience a variety of different situations which may happen both while operating the vessels during their routine work at sea or when something goes wrong or in distress situations. This article presents the simulators which are at Gdynia Maritime University used for training, their use and the perspective of their development. The author concentrated on presenting the significant role of simulators in the process of education and training of sea farers and officers both those from the deck and from the engine room departments.*

*The simulator base is being constantly developed and sometimes the training employs only part of its possibilities and potential; wider use in the process of training may add a lot to increase the level of safety at sea.*

**Keywords:** *simulators, practical training, safety of navigation, practical exercises*

### **1. Introduction**

High level of knowledge and skills of people employed on merchant vessels imposes on educational centres using the most modern methods of training and education.

Development of electronics, information technology and computers made it possible to construct simulators. These devices, despite their cost, facilitate the way practical skills are acquired and at what is even more important enable doing exercises which either cannot be practiced in real life conditions at all or those which are very expensive.

However it should be born in mind that learning practical skills with the help of simulators should be supported by practice in real conditions on board vessels. Simulators which allow performing practical exercises in a wide variety of problems in different fields assure preparing future officers to perform their duties at a very high level.

This article presents the base of simulators used at Gdynia Maritime University and Officer Training Centre in the process of education by students and course participants for doing practical exercises.

### **2. Simulators used in Gdynia Maritime University**

Gdynia Maritime University and Officer Training Centre created a large base of simulators in order to provide the highest level of education and to meet the international requirements and expectations of ship owners. The variety of simulators used makes it possible to train future officers to conduct vessel in a safe way and to handle very modern devices. Among the simulators used there are:

*Simulators for deck department* : visual bridge simulator, manoeuvring simulator, radar navigational simulator, ECDIS simulator, DP simulator, GMDSS simulator, Loading control simulator.

*Engine room simulators:* transshipment operations of LPG simulator, engine room simulator, diagnosis of engine simulator, automation simulator

Simulators are used to educate officers of deck and engine room departments including also electricians. Simulators make it possible to create a lot of scenarios and different situations. During educational process only part the simulator potential is used. Additional courses addressed to people who already have maritime training take advantage of this potential. A base of simulator was presented and their significant role and the process of training of maritime staff especially professional courses were discussed.

### 3. Simulators of deck department

These simulators reflect conditions observed on the navigating bridge both regarding equipment as well as operational possibilities. They make it possible to simulate trip manoeuvring exercises, handling of the equipment and realization of different procedures. Training with the use of simulators can be carried out at different levels i.e. from basic to very advanced, e.g. manoeuvring in stormy condition or at shallow water.

The deck department also employs simulators of cargo handling operations. They are basically used for vessels carrying dangerous cargo or these vessels which are affected during loading or discharging operations.

#### 3.1. Visual Bridge Simulator

The construction of bridge simulator enabled both students and course participants to experience real conditions observed at sea on the vessel. Familiarization with bridge, its equipment and procedures applied is extremely important for future officers to keep navigational watch. Visual bridge simulators at Gdynia Maritime University and in Officer Training Centre are fitted with panels which are identical with those used on merchant vessels.

Figure 1 presents visual simulator POLARIS, KONGSBERG. It offers a wide variety of operational possibilities. It is used not only for educating students but is also employed during a great number of courses: Ship's Master courses, Officers of Watch, Chief Officers courses, Bridge Team Management, Manoeuvring of large vessels characterized by specific manoeuvring characteristics. It provides unique help in running exercises because students and course participants can employ theoretical knowledge acquired during lectures in practice and see the difference in manoeuvring small and large vessel, slow and fast vessel during good or bad weather conditions. The mathematical models used are realistic as they are models of real vessels.



Fig. 1. Visual bridge simulator

The course participants can experience how the vessel reacts in canals or shallow water. The instructor can also change the following hydro-meteorological parameters: wind direction and force, the direction and rate of tidal stream or current, direction and height of wind wave, direction and force of swell, meteorological conditions (snow, rain, fog etc.), time of the day, depth of sea area, and many others.

The presented simulator is of sixth generation. When compared to previous simulators it provides more realistic conditions, it has greater screen resolution among others. It is possible to record the course participant's exercises and then discuss any possible mistakes. Because all parameters can be edited, then the instructor running the training can create scenarios which are likely to be observed in real conditions in a given sea area. All these exercises aim at improving the level of knowledge of officers and at practicing some behaviour. The navigators can be trained at basic distress and rescue manoeuvres such as: cash stop, zigzag manoeuvre, Butakoow Turn, Wiliamson Turn, Techniques for searching live raft (Expanding square search, Sector search, Parallel sweep search, Coordinated vessel – air craft search pattern).

The training is carried out in real sea areas which present true coast lines, berths, buildings, sea marks, land marks. It is possible to choose a lot of different sea areas. There is the following sea areas used for exercises: approach to Singapore, the Malacca Strait, the Dover strait, approach to Euro port and Hong-Kong. These sea areas are enough to carry out exercises and training so that the students are prepared for their future duties. It is possible to create own scenarios e.g. approaches to rivers, ports or other dangerous places. It is extremely important during upgrading courses aiming at improving navigational skills in different conditions.

### **3.2. Navigational simulator**

Navigational simulator made by Nicolson is an integrated bridge simulator used mainly for training students of Gdynia Maritime University at Navigational Faculty as it provides training in average trial and rescue manoeuvres of different types of vessels. Student's graphic reference card makes it possible to analyze given stages of performed task. Simulators are fitted with visual system and indicators are the same as those on merchant vessels e.g. GPS receiver, Doppler log, Communication system, ECDIS – electronic charts system, ARPA and radar indicators, Vessel control panel, Steering gear.

The simulator has panoramic visualization so you feel as on real navigational bridge.



*Fig. 2. Navigational simulator Nicolson*

### **3.3. Navigational radar simulator**

This simulator is also made by Kongsberg. It is made up of 4 bridges which are like navigational bridges on merchant vessels. It is fitted with a number of devices and indicators used on a real vessel

such as: log and gyrocompass repeaters, wind indicator, speed indicator, main engine revolutions indicator engine telegraph, radar fitted with ARPA, echo sounder, radiotelephone and others.

Exercises and training run with such simulator help to understand the information presented on a radar screen in order to identify objects properly. The users also learn to adjust the radar, despite different disturbances.



*Fig. 3. Navigational radar simulator*

### 3.4. ECDIS simulator

ECDIS simulator is the most modern simulator purchased by Officer Training Centre. It has eight bridges; each of them is equipped with three monitors and control panel. The main screen shows the situation and in the lower part there are control and navigational instruments, such as: gyrocompass, magnetic compass, engine telegraph, steering gear, GPS, echo sounder and others.



*Fig. 4. ECDIS simulator*

The other two screens represent radar and ECDIS. This simulator is made by Transas Marine and uses NaviTrainer 5000 system. A system of electronic charts NaviSailor 4000 is used in the simulator. This equipment makes it possible to run training regarding ECDIS handling –these trainings will be obligatory soon. This simulator in a very realistic way represents sea areas and behaviour of vessels which are almost identical with real vessels. It is possible because these models use six degrees of freedom. NaviTrainer 5000 system, with configured NaviSailor 4000 offers training for ECDIS system operators at highest level as it both enables course participants to use electronic chart, to show possible errors and restrictions but also to use ECDIS during navigational watch on bridge.

This simulator can also be used to carry out scientific research both for incorporating this equipment to improve training efficiency, to improve the safety of navigation and to carry out research into collision avoiding behaviour to plan navigational routes, port approaches etc.

### **3.5. Dynamic positioning (DP) simulator**

For the past few years a very specialized vessels i.e. vessels with DP system has been build to be employed in costal waters to carry out research. These vessels employ highly qualified people who must be trained on different simulators. Officer training centre runs such courses and uses Dynamic Positioning simulator equipped with the most modern K-Pos DP Operator Station Control and with DP RCU – 501 controls, made by Kongsberg. The equipment has been configured in this way that the simulator complies with DP class II requirements. That is why it is possible to run courses at basic and advance levels. The whole training process together with the equipment underwent audit by NAUTICAL INSTITUTE and was granted accreditation for five years. This simulator alike the others reflects conditions observed at sea and provides training on vessels which are similar to specialized vessels in reality. In this case the off shore areas are used and the vessels equipped with Dynamic Positioning system.

These systems are used on such vessel types as supply tanker multi- purpose vessel of DP class, half submerged platform. They can also be met on different types of research and survey vessels carrying out drills and also on passenger vessels. This simulator creates three independent simulation stations, so called Basic Trainers. Additional joining of consoles leads to creating DP Class II simulator, so called advance DP simulator. As the name of the simulator indicates it reflects either simple situation or tasks or very complicated both with references to the vessels and to the sea conditions. Combining Advance DP simulators with visual simulator Polaris allows creating manoeuvring DP simulator. The equipment depending on its configuration makes it possible to run the following courses: DP Basic and DP Advanced.



*Fig. 5. Dynamic positioning simulator*

As it was already mentioned the courses are compulsory for DP system operator's certificate. These courses are highly appreciated by ship owners and the Nautical Institute which approves these certificates of training. Future DP system operators can learn the obligatory procedures for running DP system and for its testing.

### **3.6. GMDSS Simulator**

This simulator provides training with reference to handling equipment and carrying out communication by means of GMDSS. The laboratory is fitted with seven training stations and the instructor station. It uses GMDSS TRANSAS TGS-4100 software enabling different training tasks. The simulator makes it possible to train future operators as far as radio communication is concerned, to provide safe navigation and to communicate in distress. Different type of communication can be carried out with the help of this simulator, i.e. ship to rescue coordinating centre, with other vessels, also with medical centres and with doctor on duty on land. The simulator also enables to introduce disturbances in order to illustrate propagation conditions at sea. This laboratory is also

fitted with real devices such as: radio console, portable and stationary radiotelephones, EPIRB, SART radar transponder, INMARSAT-B system, Navtex, GPS.

Simulation of typical communication carried out in different modes vessel-shore or vessel-vessel lets course participants learn procedures and English Standard Marine Communication Phrases in different situation at sea.



Fig. 6. GMDSS simulator

### 3.7. Loading operations control simulator

The simulator is fitted with four training stations and one instructor station. The software makes it possible to plan and carry out loading, cargo handling operations and simulation of problems which may arise during loading or discharging on the following vessels. Cargo handling operations can be trained on the following vessels: tankers, container vessels, lash type vessel, general cargo vessel, bulk cargo vessel.



Fig. 7. Loading operations control simulator

The simulator software is comparable with the software which is used on real sea-going vessels. It enables to control loading operations and necessary ballasting operations. A computer, similar to that in real conditions, constantly collects data from sensors and transmits them to the training panel. These data can comprise the following information: ships draft, ships list, amount of cargo in the holds, the level in the ballast tanks, condition of ballast, etc. All the forces, bending moments and shearing forces acting on the ship's hull can be monitored all the time. The variety of exercises done in simulated conditions provides future officers a lot of knowledge and skills which are impossible to be acquired in real life.

#### **4. Engine room department simulators**

The engine room is the heart of the vessel as it is indispensable for the proper running of the vessel. Apart from the devices which are found in the engine room also good education and training of future engineers are very important for the engine room reliability. Similar to the deck department also here simulators facilitate the process of practical training and preparing the engine room department officers to perform their duties in the most efficient way.

##### **4.1. Liquefied petroleum gas cargo handling simulator**

Liquid Cargo Operations Simulator provides very realistic real time simulation of handling of potentially hazardous bulk liquids from shore to ship and ship to shore. The whole simulation uses real LPG (liquefied petroleum gas). The cargo handling operations are carried out in two real tanks installed in the laboratory. One of them represents pressurized or semi-pressurized ship's tank and the other pressurized terminal storage tank on land. The cargo handling is controlled from a central console fitted with different controls, reading devices and alarms. Simulator exercises are conducted in real-time and future officers or chief mates are put through the critical phases of all operations carried out to learn all the problems they may face while loading or discharging LPG.



*Fig. 8. Liquefied Petroleum Gas Cargo Handling Simulator*

##### **4.2. Engine room simulator**

This simulator allows training engine room department officers to familiarize them with the equipment installed in the engine room, to train them how to handle it both during routine and malfunctioning operations. For training purposes two types of engine plants can be created: with slow speed diesel engine and with medium speed engine plant.



*Fig. 9. Engine room simulator*

This simulator includes not only the full size control console and electrical switchboard but also a complete 3D active visualization of the engine room space. This solution makes it possible to practice the following activities connected with engine operation, e.g.: opening and shutting the valves, changing of controls settings, taking measurements of fuel oil and lubricating oil, starting the mechanisms.

The course participants have the feeling of real life work of the power plant which helps to acquire the knowledge and skills in a better and faster way. The simulator is used both during training and up-grading courses. During standard courses only part of the simulator's possibilities is employed but at the ship-owner request it can be used for more complicated tasks (fire-fighting, finding and removing faults or malfunctioning).

### 4.3. Diagnostic simulator

Additional training regarding handling equipment and auxiliaries in the engine room can be performed with Engine Diagnostic Simulator. It is made up of a set of computers with software that makes it possible to familiarize and learn the principles of handling and operation of the systems installed in the engine room plant. The simulator allows learning how to start, how to handle and find malfunctioning of the equipment. It is possible to create different situations taking place in the engine room including breakdowns.

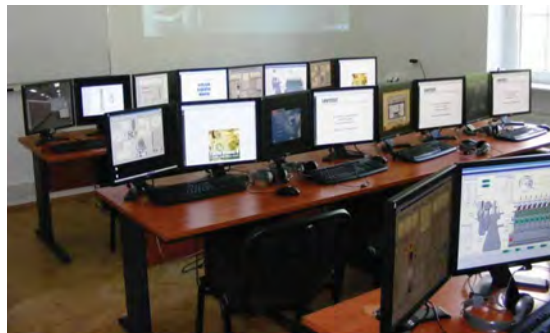


Fig. 10. Diagnostic simulator

### 4.4. Automation simulator

Modern vessels cannot be operated without automation in a proper way as it integrates and controls work of a great number of devices. Educating a good specialist in that field without a simulator seems to be impossible. Simulator which is used at Gdynia Maritime University partly uses Kongsberg equipment and also devices designed by the staff of Automation Faculty at Gdynia Maritime University.



Fig. 11. Automation simulator



## **5. The future of simulators**

As the technology develops, the simulators become more and more outdated as new generations appear. That is why there is a constant need for modernization and updating especially with reference to software or the entire simulators. Simulators have to be replaced with more modern versions because the equipment used on real vessels also is replaced with more and more sophisticated equipment. The introduction of LPG vessels gave rise to new, LPG simulators. Simulators which can be used for training different cargo handling operations e.g. container vessels or specialized vessels are now being constructed. The simulators producers are ready to build simulators to be used in the ship-owners offices. Specialized computer programmers allow learning languages, especially Maritime English in a faster way. The future of simulators lies in their integration, e.g. nowadays it is possible to integrate the navigational bridge simulator with the engine room simulator. This integration can be further expanded by adding real instruments such as for example: AIS, sensors of wind and waves. Integration with AIS will allow creating scenarios covering emergency situations such as oil pollution, collisions, fire on board which can be trained and later on used to backup real emergencies.

## **6. Conclusions**

Using simulators for training gave rise to new possibilities in practical preparation for the job. A computer game cannot be a simulator as it does not reflect real conditions and using it for training can lead to improper habits and behaviour forming. New generations of simulators mean greater possibilities – better real life conditions in ships behaviour and more accurate presentation of sea areas, port infrastructure etc. It is possible to record the exercises in order to play them back and correct possible mistakes. For the training purposes it is possible to simulate dangerous collision situations which in real life conditions are impossible because of cost and safety. The simulated conditions can be repeated till the task is performed properly. By creating problems, tasks the trainee can be forced to learn to train more intensively in order to learn how to handle and operate the device in the best way. The simulator allows creating extreme situations which the course participant is not likely to face in reality but basing on such experience he will acquire skills necessary to be used in difficult conditions. The knowledge and skills thus gained are later verified in real life conditions. Simulators can also be used for carrying a wide variety of research into different fields.

## **References**

- [1] Gale, H, *From paper charts to ECDIS, A practical voyage plan*, The Nautical Institute, 2009.
- [2] Norris, A., *ECDIS and Positioning, Integrated Bridge Systems*, The Nautical Institute, 2010.
- [3] Norris, A., *Radar and AIS, Integrated Bridge Systems*, The Nautical Institute, 2010.