# SITUATIONAL-BASED TRAINING FOR NAVAL ENGINEERS CASE STUDY: ENGINE ROOM SIMULATOR TRAINING

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**ABSTRACT**

The educational process for naval electromechanics officers assumes that they will be prepared to handle unconventional and potential dangerous situations. This requirement can be fulfilled by simulation – a very valuable instrument, which can be used to develop useful skills, both for daily routine and for potentially hazardous situations.

The simulators give to the instructor many advantages, when we are talking about this kind of training; there is the possibility to develop scenarios starting from routine tasks that can develop in potentially dangerous situations.

In the scenario developing process, there are some strict limitations, imposed by the trainee's level of competence, mostly regarding cognitive and behavioral abilities, such as problem solving, decision making and assuming leader position (Millican, 1996). This fact is determining the necessity to adopt measurable elements during the design phase, both for the scenario itself and for the assessment module (referring to the specific activities that the trainee should perform during the exercise). The main goal of the exercise should not be the completion.

**Keywords:** *Engine Room Simulator, assessment, scenario.*

## 1. INTRODUCTION

The seafarers training standards are stated on SCTW provisions (Standards of Training, Certification and Watch-keeping for Seafarers). In this regard, the on-board personnel should accomplish those tasks and responsibilities related to navigation, goods handling and stowage, ship command and operational conduct, carrying safety the automation, communication, mechanical, electrical and electronic systems, solving the maintenance and repairing issues and facing the safety standards for persons, ship and goods as well (Mejia, 2011). The right execution of these tasks is achieved on-board of every kind of trade vessel, in respect for all responsibility levels as managerial, operational and execution one.

In accordance with STCW provisions, the levels of skills and competences that will follow to be accomplished by the seafarers for the right tasks execution on-board, in correlation with international safety standards, are related to those standards of competency or knowledge that includes also the minimum requirements of understanding and application capacities (McLaughlin, 2011).

The managerial level is related to responsibility level of the tasks accomplishment associated to the quality of service overtaking as master, chief, chief engineering, or electrical engineering on-board to maritime vessels, including the full assurance of all duties in area of professional responsibility. Therefore, to operational level concept is attached the responsibility level defined by the on-board particular tasks fulfilment in order to carry out the watch keeping service on the bridge or below to naval machine as officer, mechanical or electric rated officer, as communication specialist and so on. By execution level/auxiliary function is understood the level of responsibility associated with tasks or service obligations fulfilment stated on board to maritime vessels, under the managerial supervision of a person appointed on operational or managerial level.

Simulation training has become a mandatory activity for many professions, especially when this requires real situation expertise. Seafarers training activities benefits more and more of the simulation learning procedures, both on ship manoeuvring and engineering training or in cargo handling activities. Actually, most of the processes onboard vessels or onshore related activities are simulated during the training process, in order to develop the necessary abilities, especially in crisis situations.

The highest reality level is achieved by complex simulation systems, which are capable to work in joint mode. One of these systems is installed in the „Mircea cel Batran" Naval Academy's simulator complex.

The Integrated Ship handling Simulator consists of five subsystems that are able to work simultaneously or independently, and they are:

- Ship Maneuvering Simulator (NTPRO 5000);
- GMDSS Simulator (TGS 4100);
- Electronic Chart Display Information System (ECDIS 3000);
- Navi Harbour VTMS module;
- Engine Room Simulator (ERS 5000 and TechSim);

The main aspect that makes the simulator complex unique in Romania is the possibility to work in joint mode for three types of own ship models:

- 5000tdw Ro-Ro vessel, with a four stroke, supercharged S.E.M.T. Pielstick 16 PC2.2 V-400 main engine, 5966kW installed power;
- 65000 tdw Large Crude Oil Carrier, with a low speed, two stroke MAN B&W 6S60MC main engine, 12240 kW installed power;
- ANZAC frigate, equipped by a combined Diesel or Gas propulsion system, with two medium speed, four stroke MTU 12 V 1163 TB83 engines 3365kW each and a General Electric 7LM2500-PF-MLG1O gas turbine with an installed power of 22500 kW.

The ship manoeuvring simulator facilitates training and certification activities for watch keeping officers, masters and pilots from navy, commercial or fishing vessels. It has an own ship models database with dead eights starting from 500tdw, developed according to the IMO STCW 78/95 course models 7.01 and 7.03.

The database consists of various types of vessels (2 general cargo vessels, 5 port container vessels, 2 ore carrier vessels, 3 tankers, one LPG transport vessel, 3 passenger vessels, 2 tugs and 5 navy vessels). In this way, the most types of vessels onboard which „Mircea cel Batran" Naval Academy's graduates will execute their duties are covered.

The Engine Room Simulator was developed in order to comply with the training requirements for both Electromechanics and Naval Electromechanics cadets, for officers manning the engineering watch, second engineering officers and chief engineers, at operational and managerial level.

The facilities offered by this module can be used in order to:

- perform the initial training for the engineering crew (both for Navy and Merchant Marine);
- implement standard watch keeping procedures in normal conditions;
- achieve advanced training (Engine Room Team Management and Crisis Management);

The Engine Room Simulator complies with the IMO 2.07, 2.08, 7.02 and 7.04 course models.

After considering both the facilities and limitations of the simulator complex, one of the most important elements is represented by the instructor, who will have to act as an interface between the simulated technical processes and the trainees' actions during the exercises.

## 2. THE TRAINING PARTICULARITIES IN MARITIME TRANSPORT

The maritime transport is one of the major components of international trade. Nowadays, in professional studies is underpinned that more than 80% from international trade transactions are undertaken based on this mean of transport, that continues to remain the cheapest transport alternative, being in the same time an requisite factor for goods and services demand discharge (UNCTAD, 2011; Ching Tsung Hung, Fei Ching Chuang, 2012.).

The varied outcome of goods sorts, as rows, industrial products, food products or consumer goods have conducted toward ship technical diversification within international river and maritime fleet, together with port infrastructure and professional training needs for seafarers (Vervoort, 2012; Lindmark, 2012; Lewarn, 2009; Bin Wu, 2005). In these conditions the modern maritime transport has become a higher complexity activity in economic area that claims for specific skills, abilities, knowledge and functional-actionable competences (Nicolae, 2013).

The complexity of maritime transport is coming also from the particular features of the oceans and seas, determining efficient and rigorous measures and standards implementing that should provide the seafarers, goods and ship safety, including here the diminishing of pollution against the environment (EU, 2007). But anyway, in this picture the seafarer, no matter his hierarchical position, as master, chief mechanic on operational level or simple sailor, becomes the essential element of functional relation ,,good-ship-environment-transporter" (Nicolae, 2013).

## 3. SIMULATION TRAINING APPROACHES

The naval simulators are developed according to the international standards, as stated by STCW. The implementation level of these standards is assessed by the classification societies, which most of the times have their own standards for each simulator class. In the presented situation the simulator is recognized by DNV as a „Class A, full mission simulator", based on DNV Standards for Certification No. 2.14.

Many simulated modules from the Engine Room Simulator are generic ones but, on the other hand, most of the functional parameters are describing a real machine (e.g. the main engine). This is the main reason that allows us to customize the simulation scenarios for a certain vessel (not only for a general vessel category).

The general level of a common scenario is appropriate for the knowledge and abilities required for managerial level; in order to perform in proper conditions the training for lower levels of competence, the activities will be treated separately in the first stages of training of the complex and interdependent processes.

By using this approach, the most unexperienced trainee will be able to successfully complete its task during the simulation. The most appropriate example is that during several training meetings, unexperienced trainees will carry activities for the engineering department onboard, but each one at his level. Together they will be able to solve a complex problem with a superior level of difficulty. This approach brings their experience closer to the reality onboard and facilitates gaining new competences.

Considering the necessary stages for a proper simulation scenario, in order to be able to define a correct evaluation system and to proper assess the training goals, the passing score is minimum 70% of the maximum possible, for each module (propulsion system, electrical power plant and auxiliaries). To demonstrate the achieved goal, there will be two assessment types: intermediary (for development) and final assessment with the same goals.

The most important aspect when defining the assessment criteria is to identify precise and measurable outcomes for the training activity.

The algorithm used for the assessment activity is presented in figure 1.

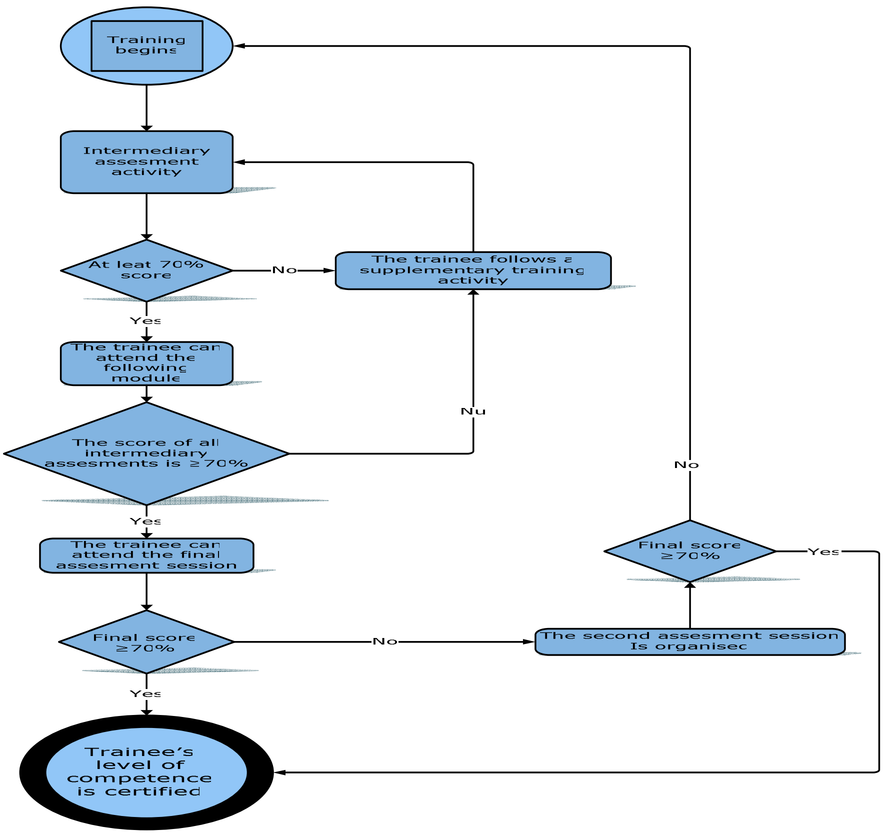


Figure 1. The assessment activity flowchart

In the Engine Room Simulator of „Mircea cel Batran" Naval Academy nine courses were carried from the vocational curricula, according to the STCW A-III/2 section and IMO 2.07 course model. The training is named as „Engine Room Team Management" and its main goal is to create coordinating abilities regarding the engine room watch keeping activities. The course was attended by 108 trainees, with an average of 12 students per session.

At the end of the course, each student completed a satisfaction assessment questionnaire, developed in order to identify the weaknesses for the course curricula. The questionnaire was structured in several sections as: Goals, Structure, The pedagogical strategy, Infrastructure and Instructor's level of competence. The results are presented in Table 1.

Table 1.Average results of the satisfaction assessment questionnaire

| Questionnaire section | Averaged result |
|---|---|
| 1. Course goal | 4,32 |
| 2. Course structure | 3,89 |
| 3. Teaching method | 3,95 |
| 4. Syllabus | 4,24 |
| 5. Infrastructure | 4,10 |
| 6. Instructor's level of competence | 4,03 |

The level values were determined on a 1 to 5 scale, and the satisfactory level was considered to be higher than 3. Although the results determined a high satisfaction level, we can class each criterion. The course objective has the highest score, while the course structure registered the lowest one.

Based on these results, it was determined that the course structure should be updated, accordingly to the course model specifications, especially regarding the scenarios, the content and scenario difficulty. The remark is that the scenario difficulty level is too high for inexperienced trainees.

The syllabus of the training session involves the development of intermediary stages, like introduction to the simulation environment, simple exercises, on every separate system onboard, being still aware on the differences between the simulated environment and the real system and the mathematical model limits.

During the training activities several corrective assessments can be taken, by observing each trainee during practical activities, in order to determine the mistakes most probably to occur especially in the first stages. In every debriefing moment, discussions on trainee's reactions will be carried in order to determine the errors in their actions and the way to repair.

When developing an educational strategy, the assessment elements have high importance and they have to be validated before.

The lifecycle model of an educational strategy points at this aspect as being crucial for applying the educational technologies (Stoner, 1996).

The assessment criteria validation process was carried with 30 trainees, during the „Engine Room Watch keeping" course from the academic curricula, which is complementary to the „Engine Room Team Management Course".

The success rate was high, approximately 90%. In the same time several mistakes were determined, which prove to be general for all students (e.g. when switching the fuel feeding system of the main engine from MDO to HFO, they don't check for the HFO temperature and the risk is to stop the main engine).

The assessment procedure development is important in identifying the most likely to occur errors during the exercise. These errors are classified on trainee generated errors and simulation environment generated errors. In this way, the assessing procedure will provide a better image on the competences gained after attending the training.

## 3. CONCLUSIONS

It is obvious that the development stages for a simulated activity can be easily converted into performance standards, which enables the quantification process regarding the trainee's actions during the exercises.

In order to create a better understanding, there is the intention to monitor and identify the most common errors and trainees reactions (positive or negative), in order to develop a comprehensive database with performance standards.

In addition, an information exchange between the institutions with similar capabilities can create a valuable instrument, which will allow the development of a „complete picture" regarding the reality level of the simulation environment and also regarding the quality of the gained competences and abilities.

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