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NEW NAVIGATION COMPETENCIES REQUIRED FOR AN UPDATED STCW CONVENTION

IMO started to request uniform international standards for the seafarers in the early 80ties. After fifteen years a revision of the STCW78 Convention was already needed, and an improved STCW 95 Convention was adopted. In the last ten years, the ship bridge change rapidly, a lot of new technologies have been implemented with a declared objective to increase safety of navigation. We think that it is time to update some of the STCW95 requirements regarding competencies regarding navigation at operational and management level and also some of the provisions related to the implementation of the Convention at national level. Our paper intends to underline some of these aspects that in our opinion must be revised and/or supplemented, including enforcement for theoretical training in maritime education institution and extended use of simulators in the training process. We will also state our opinion related to the necessity of cancelling some IMO courses from the compulsory list and make proposals for another IMO courses that had to became essential.

Key words: *STCW, revision, navigation, simulation, training*

1. INTRODUCTION

In the STCW95 the simulator is mentioned in different parts and connections can be drawn to a great number of functions which can be performed in simulation. Within the STCW95 the following parts have to be taken into consideration regarding training and assessment based on simulation:

- In CHAPTER I, Regulation I/6 - Training and assessment, Regulation I/8 - Quality standards, Regulation I/12 - Use of Simulators
- In Part A, Section A-I/6 - Training and assessment, Section A-I/8 - Quality standards, Section A-I/12 - Standards governing the use of simulators
- In Part B, Section B-I/6 - Guidance regarding training and assessment, Qualifications of instructors and assessors, Section B-I/8 - Guidance regarding quality standards,

Section B-I/12 - Guidance regarding the use of simulators

- In CHAPTER II, Reg. II, Section A-II/1 - 4, Reg. III, Section A-III/1 – 4.

In the STCW95 Convention, details regarding the simulators requirements and training objectives were detailed only for radar simulators, these provisions could be considered as the kick-off of the world scale training based on simulation in the maritime education and training (MET).

From the beginning of the 90ties, simulator manufacturers used computer technology on a large scale in order to create virtual navigation equipment and ship handling controls. The main reason for this policy was the reduction of the price for the simulator systems and an easier way to reproduce all the parameters of the ships equipment using full dedicated software. A combination of real equipment and virtual equipment remained an option for the buyer, but the actual trend is a limitation of the real equipment to the steering console and auxiliary panels. This trend is also justified by the new generation of real ships with integrated bridge systems (IBS), where PCs, trackballs, keyboards and monitors replaced many of the traditional knob and push button panels.

Because the number of ships using IBS is still limited, there are many voices among students, deck officers and even instructors, who believe that a good bridge simulator must be a close copy of a traditional merchant ship bridge.

Today, from the manufacturer's point of view, a radar simulator is the cheapest version of a full mission bridge simulator, because, technically speaking, the major difference between these two simulators consists in the visualization system. In other words, a radar simulator with a visualization and projection system could be converted in a full bridge simulator, because the software that generates all the other main tasks is the same. Another important difference between these simulators consists in the complexity of the mathematical model used to generate the ship motion. Most manufacturers offer radar simulators with a 3 degree of freedom (DOF) mathematical model for ships. Ships with a 6 DOF is a compulsory requirement only for Class A FMBS, in order to meet the IMO requirements for the Bridge Team Management Course (DNV, 2000).

The new generation of visual software engine and hardware project the visual scene on a cylindrical screen, where the movement of the image is smoother than on a sided screen. More visual effects have been added (waves whitecaps, sun or moon reflection on the water, stars, different types of clouds, etc.). Another important achievement of the 3D software is the visual generation of the ship movement. This feature contributed to the reduction of the necessary space for simulator installation and offered a much cheaper alternative to the moving platforms.

Realism of the visual scene and realistic ship handling behavior in different environmental conditions are the key aspects for a good FMBS and these requirements are fulfilled by the main simulator manufacturers. These characteristics could be very well assessed by harbor pilots, deck officers and masters that perform voyages on similar ships in the same maritime areas being simulated. Their positive opinions would be the most valuable quality certificate for the ship handling simulator being evaluated.

2. WHAT CAN THE NEW GENERATION OF NAVIGATION SIMULATORS DO?

To answer this question we have to compare the STCW 95 training and professional skill requirements with the objectives and tasks posed to the trainee by a FMBS scenario.

There are at least 140 tasks at operational level and 160 tasks at managerial level that could be taught and assessed using a FMBS class A. These tasks start from the basic navigation and deck watch procedures, include voyage planning and ship maneuvering in confined waters, and end with the communication procedures, use of maritime English, SAR and emergency navigation. As a result it will be easier to discuss *which training task could not be achieved and which competencies could not be demonstrated using a FMBS*.

In accordance with the STCW, examination and assessment of competence for masters, chief mates and officers, regarding navigation at operational and management level (tables AII/1 and AII/2), is based on evidence obtained from one or more of the following:

- approved in-service experience
- approved training ship experience
- approved simulator training, where appropriate
- approved laboratory equipment training.

From the STCW navigation competences category, the following tasks cannot be theoretically carried out using only the capabilities of most FMBS:

1. celestial navigation
2. proper keeping of different kinds of log in port
3. starting of the gyro-compass and the minimization of settling time
4. forecast weather and oceanographic conditions
5. use of an anchor to dredge down with a current.
6. assessment of damage and post- event actions in case of navigational emergencies
7. use of the emergency steering
8. take on board survivors from rescue boats and survival craft
9. general operation techniques of marine power plants.

Of course, other competences imposed by the STCW cannot be achieved by the cadets without a sea service period. These training objectives strictly related to the on board training were included in the following STCW competence categories:

- Monitor the loading, stowage, securing and unloading of cargoes and their care during the voyage
- Ensure compliance with pollution prevention requirements
- Maintain seaworthiness of the ship
- Prevent, control and fight fires on board
- Operate life-saving appliances

One the other hand, most of the training aims from the above list are covered by the mandatory IMO courses that each cadet had to accomplish before he could enlist for the 3rd deck officer certification exam.

Another aspect that has the same importance as the FMBS technical capabilities is the quality and realism of the simulation scenario. You could have the most expensive and up to date simulator on the market, but without well-designed simulation scenarios, the training aims will not be achieved at the desired level of performance.

We must emphasize that in this paper we are discussing the training of students and cadets using the navigation simulators. There is a great difference in terms of design and preparation between a scenario arranged for students and a scenario that must be accomplished by already certified deck officers.

We practice the first contact of the students with the FMBS in the second semester of the second year of study (in accordance with our curricula), after they have finished all the theoretical courses related to seamanship, coastal navigation and piloting, basic navigation equipment, and had a minimal knowledge of the navigation watch procedures.

What can be done in FMBS with so little theoretical knowledge?

The most important thing is familiarization with the real time navigation process. Additionally:

- hand steering of the ship on an imposed track;
- visual identification of navigation landmarks and floating navigation aids;
- taking visual bearings;
- reading gyro, compass, soundings, wind, current data;
- feeling different type of ships behavior on various weather conditions ;
- familiarization with distance perception at sea and day and night conditions;
- are also very important tasks and skills that could be achieved at that beginning stage.

After that, in the third and fourth year of study, all the other objectives and tasks could be performed on the simulator: radar and electronic navigation, passage planning, ship maneuvering, radio communications, bridge procedures, watch team management, etc.

The realism of a scenario is also very important in training students with no previous sea going experience, even considering that they do not have yet a clear scale for comparing the virtual environment with the real one. We could count at least four reasons in support of this statement:

1. Skills and competences achieved during simulator exercises will be more accurate if the simulation environment is realistic.
2. Once on board a ship the student will be more confident in his actions realizing the similarity between the virtual and the real maritime environment.
3. If the student has a chance to be on board a ship that has similar characteristics as one of the simulated models, or if he will pass through a maritime area that was used as simulation area, he will perform his duties very well, based on the déjà-vu feeling.
4. After a sea service period the student/cadet will better appreciate the importance of simulator training and once back in school or training center, he will be more focused and involved in resolving the tasks imposed by the simulation scenarios.

We think that we have the consent of most FMBS instructors, when, in conclusion, we state that based on the new generation of full mission simulators capabilities, we can perform almost all tasks required by the STCW in the navigation competencies chapter for operational level (Barsan E. 2006b).

3. SIMULATION, THE BEST WAY TO CREATE NAVIGATIONAL SKILLS TO CADETS

As we all know, STCW 95 introduced a compulsory 12-month seagoing service for every candidate for certification as deck watch officer (operational level). At least six months of this period the cadet must perform bridge watchkeeping duties under the supervision of a qualified bridge watchkeeping officer (IMO, 1995). The cadet's achievements during onboard training programs must be documented in an approved training record book.

There were two areas where maritime administrations rushed to implement ad-literam the new STCW requirements: seagoing service periods and IMO compulsory courses. From the national Maritime Authorities' point of view these were the easiest task to accomplished, because they do not require manpower or logistic efforts from the Authority.

This one-year sea service period for cadets raised a lot of logistic problems for maritime universities. The first one was a substantial reorganization of curricula, in order to allocate time for on board training. The second main logistic problem lies in finding owners and ships for almost 200-300 cadets each year. This problem is amplified by the lack of national flag ships and in many cases by the non-implication of the national Authority for providing help and support for solving this problem.

More than that, the students lose the contact with the university for several months, and they have major difficulties to re-enter in the teaching programme.

From our 12-year experience, we identified only 7-9 large shipowners that had a coherent onboard training programme with a serious involvement of the cadets in training activities.

In conclusion, after the 12- month sea training period, we assessed great differences between the cadets regarding the competences and professional skills achieved.

In a study undertaken by Warsash Maritime Centre (Habberley et al., 2001) regarding the use of simulators for training in emergency situations, the authors run a questionnaire among various shipping companies, shipping organizations and maritime education institution, regarding different aspects of training using full mission ship simulators. One of the questions was related to the preferred method of training of deck officers for routine watchkeeping situations, that reveals some differences between the opinions of maritime education institutions and the shipping industry.

The shipping companies prefer the onboard training associated with the sea service experience. The maritime training institutions consider FMBS as the primary tool for routine training of deck officers. It is also interesting that:

- apparently, the shipping industry has more confidence in video training tapes than in simulator training;
- maritime education institutions consider lectures and text books less suitable as methods of training, but these methods are suitable for the shipping industry.

In our opinion, the answers given by the maritime training institutions are in accordance with the actual trends in MET and reflect the increasing confidence in simulation and simulator as tools for an efficient training. I think that the opinions expressed by the shipping companies reflect their predisposition to minimize the cost of training. Otherwise we could not explain why an owner could consider that lectures are almost equal in efficiency to FMBS training,

regarding the achievement of practical watchkeeping skills. This assumption is also based on the answers given by the shipping industry to the question regarding the preferred means for training in bridge team management. On this subject, maritime education institutions and the shipping industry share the same opinion concerning onboard and simulator training as methods for working out bridge team management procedures. Because the Bridge Team Management IMO model course became compulsory for deck officers at management level, the shipping companies had to pay for the training of their staff. The IMO standard for this course implies the use of a full mission simulator. The paradox is that at least 60% of this course deals with routine situations, so when you have no alternative for a cheaper training, everyone agrees that simulation is the best way to do it.

With the new generation of FMBS, purchasing and training cost has decreased considerably. On the other hand, the new technical capabilities have increased the flexibility of scenario design allowing the creation of a better tailored scenario for all kind of navigational tasks and teaching objectives.

What is the main role of a cadet during watch hours? He is mostly an observer of what, when and how things happen on the bridge deck.

Has the cadet full access to the radar? In at least 70% of the cases, the answer is no. In most of the situations he could use the radar for:

- measuring bearings and distances in order to determine the ship fix;
- measuring bearings and distances to a target ship;
- plotting target ships on an ARPA.

The cadet is not allowed to:

- change without permission the radar motion or radar display stabilization configuration;
- set up his own Parallel Index or NAVLINES;
- make adjustments to the Gain, Rain and Sea clutter controls;
- use the TRIAL function in order to simulate collision avoidance maneuvers;
- approach the radar when the Master and/or the Pilot are on the bridge.

Has the Cadet the opportunity to make his own collision maneuvers? He has not.

Has the Cadet the opportunity to steer the ship in open waters? In most of the cases, yes.

Has the Cadet the opportunity to steer the ship in confined waters? No.

Has the Cadet the chance to start and setup the electronic navigation equipment? We do not think so.

How many ship's fixes will be determined by the cadet during the watch? Maybe 6 to 8 fixes, if the officer in charge is very focused on the Cadet training.

Has the Cadet access to the VHF radiotelephone? No.

If we are realistic, we could find another page of arguments to demonstrate that the Cadet's role on board a merchant ship is mainly as an observer.

And now the great question. *Can the Cadet perform, by himself, all the watchkeeping tasks and actions of a Third Deck Officer, during a FMBS scenario?* Of course he can and all his actions will be monitored, assessed and rectified by the teacher/instructor. In the above mentioned paragraphs we talked only about routine navigation. Regarding the training for navigation emergency situations there is no doubt that it can be performed using only a

simulated environment (J S Habberley, et al., 2001).

Without any reliable statistical evidence we could only make the following logical assumptions concerning the on board training period:

- in 80% of the cases, a cadet did not spend more than 200 days on the bridge, performing watchkeeping duties;
- because cadets will be embarked on all types of merchant ships, we could consider that from the above mentioned 200 days, only 70% of this period (140 days) could be considered as near coastal voyages;
- a near coastal voyage implies also port arrival and port operations. As a result, a 15% ratio of time spent in ports (21 days) could be applied. Lets also assume that on these near coastal voyages, 40% of the transit time is represented by passing maritime areas with high traffic, confined waters, dangers for navigation, high risk areas;

In conclusion, in a 12-month compulsory sea time period, the cadet carries on watchkeeping duties for 200 days. The ship in this period will perform 140 days of near coastal voyages, including 21 days of port operations. From the remaining 116 days, 47 days will be considered as ship passages through areas dangerous for navigation, meaning that during the 1-year on board training, only 12.8% of that time will be spend by the cadet in a really challenging environment (Barsan E.,2006a),.

In contrast with the real opportunities offered by ship's voyages, all the FMBS scenarios are designed for near coastal navigation and most of the simulated areas are maritime areas difficult for navigation.

The necessity of simulators and simulations as complement of the on board training is also recognized by the big shipping companies. Many of them had different CBT (Computer Based Training) programs implemented on their onboard PCs.

4. PROPOSED UPDATES AND MODIFICATION TO THE EXISTING STCW95 PROVISIONS

In the first place we consider that the new STCW must deliberately encourage training of seafarers and especially of maritime officers in maritime education and training (MET) institutions, certified by the national maritime authorities and periodically assessed by international commissions.

More than that, for the training of maritime officers, the STCW Convention must specify a minimum number of training hours (courses and practical applications) for each main category of competences, at least at operational level. In the actual form, STCW95 encourage the vocational path for officers giving the impression that all the competences could be achieved only by onboard practice and the 8-10 compulsory IMO courses. IMO maintained all these years the IMO courses no.7.01-7.04 containing programs of maritime education and training (MET) for deck and engineers officers at operational and managerial level, but the last edition is the 1999 one, and requires a lot of updates taking into account the evolution of technologies in maritime transport in the last 5 years.

We have also to underline, that IMO did not mentioned that the content of these

courses (7.01-7.04) represents a minimum standard of training as imposed by the STCW95 Convention, so only MET universities adjusted their curricula in order to meet the courses and number of hours recommended by this courses. Because these IMO courses already exist, we think that after a major revision and update of their content, they could be declared as a minimum standard of training for maritime officers. Such documents will also help very much the national maritime authorities in their tasks to standardize the quality of national MET system and to establish the content of the certification exams for their seafarers. Because we are in the 21st century and maritime navigation had evolved and changed very much in the last 10 years from the point of view of acquiring and managing nautical information, an academic level of education for all maritime officers will be a benefit for the maritime world.

A method of signaling that IMO encourages academic training for maritime officers will be the change of order for the achieving methods of the required competences mentioned in column 3 of tables A-II/1, A-II/2, A-II/3 and A-III/1, A-III/2, A-III/3. In STCW95 order of these methods is:

.1 approved in-service experience
.2 approved training ship experience
.3 approved simulator training, where appropriate
.4 approved laboratory equipment training

From our point of view, the new order, at least for the operational level, must be more likely as:

.1 approved course including laboratory equipment training
.2 approved course including use of simulator training (where appropriate)
.3 approved training ship experience
.4 approved in-service experience

This order will clearly suggest that the basis of knowledge for a maritime officer must be created in a MET institution.

In the context of the 21st century and of the abundance of electronic navigation equipment, IMO, using the STCW regulations, must give a clear signal regarding reduction of theoretical knowledge in celestial navigation. Such a message will provide guidance for national maritime authorities in establishing assessment requirements for the certification exams. MET institutions could not take the first step in reducing the hours allotted to the celestial navigation course, because the national maritime authorities are afraid to eliminate from the certification examination the subjects involving deep theoretical knowledge of nautical astronomy. As a MET university, we suggest that the celestial navigation knowledge must be focused on measuring LOP to celestial bodies in order to determine the ship position and compass correction. For the calculation, scientific pocket calculators and even PC software must be accepted as practical means to get the results.

Regarding the IMO model course no.TA107 “Radar Navigation, Plotting and ARPA”, we believe that it is no longer needed as compulsory for deck officers. The history of this course, as a compulsory one, started more then 20 years ago, when the radar plotting techniques were not taught in all maritime schools and when the ARPA radar onboard ships was very rare.

If you remember, 10 years ago, these subjects were divided in two IMO model courses: "Radar plotting" and "Use of ARPA radar", each course lasting for almost two weeks, with a combined number of 88 hours. Nowadays, there is only one course, with a total of 66 hours.

Today, radar plotting, radar navigation, use of ARPA information is a standard compulsory course in every MET institution curricula. This course in the MET curricula has a great extend, much more than the requirements of an actual edition of the IMO model course and includes practical hours that are performed by using radar or full mission simulators. Maintaining the IMO model course no.TA107 "Radar Navigation, Plotting and ARPA" as a compulsory one, could be dangerous, because it can induce the idea that 66 hours are enough for a student/cadet to achieve all the competencies related to the operational use of the radar and ARPA mentioned in Table AI/II.

On the other hand, ARPA radars are a common presence on the ships' bridge, and deck officers are working day by day with this type of equipment. In these circumstances, such a refreshment course with no updates for more then 10 years is useless.

Speaking about radar navigation training and use of simulators for enhancing the theory for radar plotting and the use of ARPA information, we have to mention that in STCW95, the accent was on the qualification requirements for simulator instructors and evaluators.

It is also the time to add in the STCW convention that radar training must (not should) incorporate the use of the radar simulation equipment. It will be also the time to go further on regarding the use of maritime simulation and to include it in the STCW provisions stating that training and assessment in coastal navigation, electronic navigation, including the use of ECDIS and ship handling should incorporate the use of navigation and ship handling simulators.

Continuing the subject related to IMO courses and the use of simulators, we have to mention that the format of the IMO model course TA122 "Ship Simulators and Bridge Teamwork", edition 2002, must be revised and updated, including the title, because today, all courses related to bridge team management or bridge resources management include simulation scenarios and the use of navigation and ship handling simulators.

We think that this course will also have to provide some guidance on the creation of complex navigation and ship piloting scenarios and to provide also some guidance for evaluation methods and scales to be applied for the assessment of the trainees' performances. With such a kind of updates, this course could became a very useful tool for all the simulator instructors all over the world, because it will help the implementation of a common standard for evaluating simulated scenarios achievements.

In the above paragraphs we stated that the IMO model course TA107 "Radar Navigation, Plotting and ARPA" is no longer useful as compulsory. Taking into account the technological realities existing on the bridges of new ships and the expansion of these technologies onboard all other ships, we propose that an IMO model course 1.27 "Operational use of ECDIS" to became compulsory for the next 5-7 years. The STCW have to emphasis the need of training for deck officers in the use of ECDIS at operational and managerial level, because the ECDIS is, for the moment, the most sophisticated and complicated navigational equipment and the graphical display acts as an integrator of information from other very important navigational equipment (ARPA, AIS, etc.). More than that, errors or malfunctions to this equipment could be very hard to detect and solve without appropriate training.

5. CONCLUSIONS

We think that at the beginning of the 21st century, IMO will have to admit the importance of training done in MET academic institutions and the achievements of training in the simulated maritime environment. Consequently, an updated STCW Convention has to specify a minimum number of hours for theoretically training that must be performed in MET certified institutions.

An intensive use of radar, navigation and ship handling simulators (to use the same classification of simulators as in STCW95) must be also requested in the new STCW. Complexity of scenarios that could be performed on navigation and ship handling simulators must be recognized and for the deck cadets two out of the 12 months of compulsory seagoing service period can be an equivalent with the approved simulated training hours on a Full Mission Bridge Simulator, using a 1 to 6 ratio.

The IMO model course no.TA107 "Radar Navigation, Plotting and ARPA" must be cancelled from the compulsory IMO courses for deck officers and all the competencies regarding radar navigation, radar plotting and the use of ARPA radars shall be gained during the basic educational stages in MET institutions. The use of radar simulation during lab hours for these courses must be compulsory.

The IMO course "Operational use of ECDIS" must be declared as compulsory for deck officers.

The use of navigation and ship handling simulators for the training of students and cadets must be stipulated by the STCW for all the competencies related to navigation, watchkeeping and shiphandling.

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NOVA OVLAŠTENJA O OSPOSOBLJENOSTI ZA OBAVLJANJE DUŽNOSTI ČASNIKA PALUBE POTREBNA PORADI AŽURIRANJA STCW KONVENCIJE

SAŽETAK

IMO je početkom 1980. godine zatražio jedinstvene međunarodne standarde za osposobljenost pomoraca. Nakon 15 godina bilo je potrebno revidirati STCW konvenciju iz 1978. godine, pa je 1995. godine usvojena nova STCW konvencija. U posljednjih 15 godina zapovjednički je most na brodu doživio promjene, došlo je do primjene novih tehnologija s ciljem da se poveća sigurnost plovidbe. Mislimo da je sada došlo vrijeme da se revidiraju i neki od zahtjeva STCW konvencije iz 1995. godine, a koji se odnose na osposobljenost za obavljanje poslova na razini rukovanja uređajima i upravljanja, kao i neke odredbe koje se odnose na provedbu Konvencije na nacionalnoj razini. U našem se radu želi istaknuti neke od značajki koje se, po našem mišljenju, moraju revidirati i/ili nadopuniti, uključujući tu i provođenje teoretskog obrazovanja u pomorsko-obrazovnim institucijama te veće korištenje simulatora u procesu izobrazbe. Navodi se i naše mišljenje o nužnosti ukidanja nekih od IMO tečajeva s popisa obvezatnih, kao i prijedlozi drugih IMO tečajeva koji bi morali postati bitnima.

Ključne riječi: *STCW, revizija, plovidba, simulacija, izobrazba*

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