Raising the Bar

Refresher and Familiarization Training for Seafarers

by Anthony Patterson

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Ensuring maritime safety and the protection of the marine environment is inextricably linked to the competence and professionalism of those working on the seas. Over the past three decades, there have been fundamental shifts in the requirements for training, safety management and the management of occupational health and safety. The latest changes occurred on January 1, 2012, the date that the Manila Amendments to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) came into force, and signalled a new era in emergency training for seafarers.

The current method of emergency training is based upon a two-stage process of initial shore-based training followed by routine practice drills on board ships. Over the years there have been concerns raised over the adequacy of routine practice drills to develop and maintain the competencies required to respond to onboard emergencies. As a result, two key changes were implemented in the Manila Amendments, which are intended to improve the overall preparedness to respond to emergencies at sea. The first is the requirement for seafarers to provide proof that they have maintained their safety skills, especially those skills which cannot be practiced on board, once every five years ("refresher training"). The second is the requirement for new crew members to become familiar with ship specific safety equipment and emergency procedures before being assigned any duties ("familiarization training").

The two new STCW requirements are a significant departure from the existing safety training model, and the maritime industry is being challenged to find new and cost effective means to implement the new standard. There is no doubt that the most cost effective way of implementing refresher and familiarization training is through a blend of computer-based training and simulation. If the industry moved in this direction, would the "artificial experience" gained by interacting with a virtual environment through a simulator adequately prepare a seafarer to respond to an emergency? Initial research in Canada and Germany indicates that simulation-based emergency training is the preferred method to prepare workers, especially for high risk and complex emergency situations.

Current Training Method

Shore-based training generally follows Model Courses published by International Maritime Organization (IMO) and uses generic equipment, which meets the minimum standards contained in the Model Course. Upon completion of a shore-based course, seafarers are granted a training certificate. Once the training certificates are awarded, seafarers do not need to undertake any additional formal safety training unless they are upgrading their certification or if they are returning to the industry after a prolonged absence. The only real exception to this rule is first aid training, which normally requires periodic recertification.

Practice drills on ships require crews to periodically muster to their emergency stations and to role play the response to a simulated accident. The operation of some safety equipment, such as fire pumps and hoses, is also checked at the same time as drills. Some ships also launch a lifeboat during a practice drill if they are in sheltered waters, but practice launches with crew on board are becoming increasingly rare due to fatal accidents associated with premature release of hook systems when launching or recovering a boat.

Under the current training system, the role of a nautical school is to deliver initial training for new entrants and provide enhanced training for those who are upgrading their certification levels. Training facilities tend to be generic in nature and are fitted with equipment that meets the minimum requirements articulated by the Model Courses. Since there is no recurring revenue model for seafarer safety training, schools rarely invest in specialized equipment and it is not uncommon for them to use donated or second-hand equipment as a means to keep costs under control. Notable exceptions are for those schools that also provide safety

It is not practical to expect that a controlled fire could be started on a ship so that crew members could practice extinguishing it. An evaluation of simulation as a method to train seafarers to manage shipboard fires was sponsored by the German Ministry of Education and Research and conducted by Wismar University and the Maritime Simulation Centre Warnemuende. The test subjects provided high ratings on the perceived realism of the simulation. Photo shows an image of VMT's SurvivalQuest: a fully immersive simulator that enables trainees to practice control familiarization and pre-launch check, launch timing and sail away procedures, high sea state navigation and pilotage, and equipment fault and failure response.

training for offshore oil and gas workers. The oil and gas industry has already shifted some of their training from onboard practice to periodic shore-based refresher training.

Weaknesses in the Current Training Method

Over the years, three serious weaknesses have been noted with the existing training method which results in seafarers being poorly prepared to respond to emergencies at sea. The first weakness is the inability to practice certain critical safety skills on board a ship during routine drills. The most obvious skill falling into this category is firefighting. It is impractical to expect that a controlled fire could be started on a ship so that crew members could practice extinguishing it. When one considers that skills tend to fade over time, it is reasonable to expect that a seafarer's performance would drop below a minimum acceptable threshold if he/she is unable to regularly practice the skills.

The second weakness arises from the reliance of generic equipment in initial training. While generic equipment is satisfactory for learning overall concepts and demonstrating basic skills, the wide variety of safety equipment that is actually fitted on board ships demands additional training in order for the seafarer to become competent in its usage. The classic example is the operation of freefall lifeboats. They have a completely different launching mechanism than davit launched lifeboats and have a unique set of operating procedures for both the passengers and the coxswain. Most schools do not operate freefall training facilities because of the large capital investment required, high operating costs and the risks associated with launching freefall lifeboats. The normal practice is that students are briefed on freefall systems as part of a lecture on alternate launching systems. If seafarers start working in the bulk trade or on vessels fitted with freefall lifeboats, their initial training has not adequately prepared them to launch or operate a key element of the life saving appliances on board their ship.

The final weakness is the inability to practice all the skills required under STCW. Given the

Additional research in using 3D environments for training seafarers is underway by research teams at Memorial University of Newfoundland (MUN) and in a cooperative research program between Maritime Simulation Centre Warnemuende and the World Maritime University (WMU). The MUN research is focused on reducing training times to learn evacuation routes on oil platforms while the WMU's research team has implemented and tested simulation-based training modules specifically focusing on aspects of multicultural and multilingual teams. In both cases, there has been a strong show of support from student focus groups that such 3D simulation training environments be integrated within their education programs.

hazards involved, the use of real equipment requires that all training be conducted under highly controlled environments to ensure the safety of the students and their instructors. There are skills that are simply too dangerous to practice using real equipment and are relegated to classroom briefings even though the STCW Convention requires that the skills be *demonstrated* as part of the certification process. The classic example is the ability to launch and operate lifeboats in rough seas. Launching a lifeboat in a storm is simply too dangerous to practice using real equipment. As a consequence, seafarers only need to describe how they would launch into rough seas without actually demonstrating their skills. The example of the launching lifeboats into storms can be extended to most extreme survival skills. It is unsafe and simply not practical to develop extreme survival skills using real equipment under controlled conditions.

New Rules – New Methods

The new STCW rules are intended to address the shortcomings in the existing training method and to ensure that seafarers are fully prepared to respond to emergencies at sea. Implementation of the new provisions is already underway. Transport Canada has already enacted changes to their Marine Personnel Regulations, which places the onus on Masters and ship owners to ensure that seafarers serving on board Canadian ships are properly trained in ship specific emergency procedures and use of emergency equipment *before* they are assigned any duties. Administrations around the world are currently trying to determine how they can implement the demonstration of proficiency requirements over the next four years. What is clear is that the new rules cannot be satisfied using existing training methods. The costs of implementation would be too high and the effectiveness of the training would be inadequate.

New rules will require the introduction of new methods into the training regime. A proven strategy to implement training for high risk operations at an affordable price is the incorporation of simulation into the training program. In aviation, simulation is used as the primary strategy for familiarization and refresher training – why not adopt the same strategy for seafarer emergency training? Is simulation based training realistic enough to adequately prepare seafarers to respond to emergencies? Both Canada and Germany have been conducting research to determine if simulation-based training is an acceptable option for emergency training. The Canadian research focused on lifeboat evacuation skills while the German research focused on the management of shipboard firefighting.

The Simulation Option

There have been two separate studies sponsored by Transport Canada to assess the impacts of simulation in lifeboat training. The first was done by Memorial University of Newfoundland to determine the types of training tasks which could reasonably be delivered by simulation. The report concluded that roughly 40% of the skills in the curriculum could be delivered through simulation including high risk skills such as operating in rough sea states.

The second study was done by the National Research Council of Canada (NRC) to test the impacts of simulation training for evacuations in ice fields. The NRC reported dramatic increases in performance (27% increase in success rate), satisfaction with training method (38% increase when compared to current methods), and confidence levels (40% increase). The NRC report is significant since all of the test subjects had no previous experience in operating a boat. The first time the simulation-trained test subjects ever drove a boat of any kind was when they participated in the evaluation exercises using real boats in real ice.

An evaluation of simulation as a method to train seafarers to manage shipboard fires was sponsored by the German Ministry of Education and Research and conducted by Wismar University and the Maritime Simulation Centre Warnemuende (MSCW). The research team used a 3D visualization, first person perspective, virtual representation of a Roll-on-Roll-off-Passenger-Ship/Ferry (RO-PAX) ferry to train 110 seafarers from the passenger ferry industry to respond to and manage an escalating shipboard fire and water inrush incidents. The test subjects provided high ratings on the perceived realism of the simulation and on the use of simulation as a training strategy in emergency response at the management level. Pre-trials conducted on board a RO-PAX vessel to supplement onboard drills also received high subjective ratings from the Master and crew. Two further courses have been recently carried out at the MSCW to provide emergency training for seafarers with a precisely modelled container vessel.

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The importance of increases in confidence levels and satisfaction rates noted in the Canadian and German studies cannot be overstated. Simulation permits the design of training programs that are inherently interesting for students and create within those students a desire to not merely maintain skills but improve their levels of competence. As students' skills improve, the simulated scenarios can get harder. Challenging exercises will keep students interested and motivated to keep up with their safety training. Once seafarers can develop a sense of pride and accomplishment in achieving

very high levels of performance in simulated emergency drills, then one would expect to see a corresponding improvement in the safety culture on board vessels.

As a result of the Canadian research, Table A-VI/2-1 of STCW was amended by IMO to officially recognize simulation as a valid form of training for survival craft operators. IMO included simulation as a training method to enable compliance with the section of the STCW Code which requires seafarers to *demonstrate* their competence to launch and operate lifeboats in rough seas. Before the amendment, only real boats were permitted to be used to evaluate the competence of seafarers. Given the dangers associated with operations in rough seas, there was no way anyone could comply with the requirement in the STCW Code without the use of simulators.

The research teams in Canada and Germany are also redrafting the relevant IMO Model Courses to incorporate the simulation option into the international training guidelines. As simulation becomes more popular as a training method for emergency training in the maritime industry, the guidelines will accelerate the adoption of the technology and ensure that best practices are adopted worldwide.

A Cost Effective Option

When looking at the issue of implementing refresher and familiarization training, a key issue is the costs of implementation. Can the simulation option make implementing the new rules more affordable? By our estimates, overall cost savings (capital expenditures and five-year operational expenditures) of 75% or more are possible with the simulator option. The savings would be much larger if the school intended to add multiple boat types to their training fleet.

As an example, consider the situation of a training school wishing to expand its facilities in order to offer refresher and familiarization training for a particular type of lifeboat. If the school were to implement real equipment to deliver the training, the school would need to increase its waterfront wharf space, install a new davit system, and buy a new boat to put in the davits. It would also need to increase its operating budget to cover the mandatory maintenance and surveys required to adhere to the manufacturer's minimum requirements.

The simulator option, however, is much different. The school would need to designate a small classroom for simulator training and install one multi-purpose lifeboat simulator cabin. The launching arrangement for the boat would consist of swappable components that would enable instructors to reconfigure the simulator to multiple boat types. The harbour is replaced by a virtual environment of a ship or oil platform at sea with rescue vessels and rescue helicopters available to provide assistance. The virtual environment is under the control of the instructor and can emulate a wide variety of conditions. The operating budget would also need to be increased, but only to the extent required to maintain computer equipment.

Alternate Training Delivery Scenarios using Simulators

Based on the preliminary experience with lifeboat training, simulation shows great promise as a means to learn extreme survival skills, increase student satisfaction with training and reduce the overall costs of implementing the new STCW rules related to familiarization and refresher training. Simulation also enables innovative methods to be employed by training institutions to deliver refresher and familiarization training.

One delivery scenario would be to simply shift high risk training, including extreme survival skills, from onboard training to shore-based simulation training. Routine, low risk and simple tasks will still be practiced on board through periodic practice drills and onboard computer-based training. Simulation training would be reserved for training for complex and high risk tasks. By our estimates for lifeboat training, roughly 55% of training tasks would be delivered through onboard training while 45% of training tasks would be delivered through simulators. Under this model, schools could offer "drop-in" courses for emergency training since they would no longer require a

Launching a lifeboat in a storm is simply too dangerous to practice using real equipment. The author estimates that roughly 55% of training tasks could be delivered through onboard lifeboat training while 45% could be delivered through simulators.

minimum student complement for safety or economic reasons. This opens the options for students, and more importantly their employers, to take training at a convenient time.

An alternate scenario would be for schools to deploy mobile simulators enabling dockside training. Dockside training would permit the vast majority of safety refresher and familiarization training to be performed during working hours and significantly reduce the burden of conducting training at specialized facilities during leave periods. It also enables short but frequent training scenarios so that the seafarer never really gets out of practice and avoids the situation of long intervals between training interventions at specialized facilities. Under this model, schools could offer a refresher service for their clients at various major ports around the world.

Finally, some vessels – such as passenger vessels – could deploy simulators on board to augment their routine practice drills with simulated emergency scenarios. If a ship had the space to deploy onboard simulators and sufficient crew members to justify the investment, this would be a very effective option. There would be no additional costs associated with travel and crew members would never get out of practice. Indeed, the overall competence of trainees would be expected to increase dramatically because they would be frequently practicing and refining their safety skills.

Implementing the Simulation Option into Safety and Survival Training

To highlight recent examples of the incorporation of simulation into advanced safety training systems, the Marine Institute of Memorial University of Newfoundland has deployed a freefall lifeboat simulator and commissioned the construction of a helicopter ditching simulator. In both cases, the simulators will extend the Marine Institute's training capabilitiessignificantly beyond what they could achieve by using real equipment.

The freefall lifeboat simulator was built as a collaborative research project between the Faculty of Engineering and Applied Science at Memorial University of Newfoundland and Virtual Marine Technology Inc. (VMT) and is the only DNV accredited freefall simulator in the world. The simulator replicates the coxswain's position and two crew positions in a FASMER freefall lifeboat. The coxswain control system, launching systems and passenger seats were all obtained from the manufacturer and are arranged to replicate what is found in an actual freefall lifeboat. The simulator has a cabin which can hold three people and is fitted with a visual system and sound systems. The entire structure is mounted on a motion base

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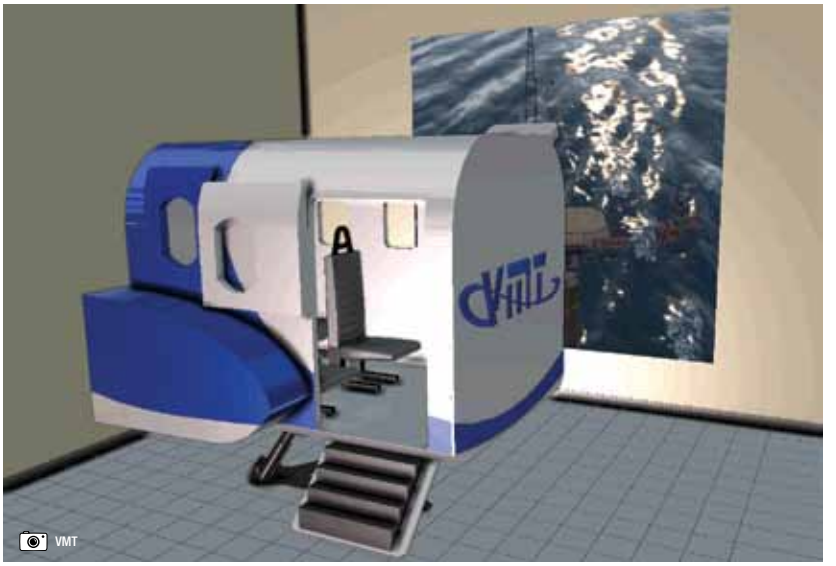
that can replicate motion with six degrees of freedom (roll, pitch, yaw, surge, sway, and heave) and can simulate the launch, impact and sail-away phases of a freefall lifeboat. An instructor station is available to monitor student performance and to adjust scenario parameters as required to meet the training objectives.

The helicopter ditching simulator was designed by VMT as a means to permit helicopter passengers to practice bracing for the impacts of a helicopter ditching at sea. It is not practical to simulate the rapid descent and motions associated with a ditching evolution using a Helicopter Underwater Escape Trainer (HUET). The importance of training helicopter passengers to rapidly and correctly prepare for a ditching at sea was highlighted in a 2009 offshore accident off the Grand Banks. VMT's ditching simulator has been purchased by the Marine Institute and is scheduled to be installed in the near future. Helicopter training has now been extended to simulate all phases of a ditch from the initial descent to underwater egress. The helicopter ditching simulator cabin is completely modular and can be reconfigured to practice other missions such as rescue hoisting and lookout operations.

Conclusion

Implementing the concepts of refresher and familiarization training to maintain enhanced states of emergency preparedness will be a significant challenge for the maritime industry, but a challenge which can be met through innovative uses of simulation technology. Regulators have responded to the research conducted to date by signalling their willingness to accept simulation as a valid training and evaluation method in



The helicopter ditching simulator being developed for the Marine Institute was designed by Virtual Marine Technology Inc. as a means to permit helicopter passengers to practice bracing for the impacts of a helicopter ditching at sea. The helicopter ditching simulator cabin is completely modular and can be reconfigured to practice other missions such as rescue hoisting and lookout operations.

emergency training. Seafarers have signalled their preference for simulation-based training to prepare them for hazardous and complex emergency response tasks. Financial analysis indicates that simulation could offer significant cost savings over alternative refresher and familiarization training methods.

The key challenge will be for the industry to define optimal models for incorporating simulation into emergency-based training programs. Training providers, in particular, are being provided with the opportunity to implement new business models to extend their training programs at increased margins.

With the implementation of simulation into emergency programs, it is possible to achieve the overall goal of improving safety of life at sea by ensuring that all seafarers maintain a constant state of readiness to respond to all emergencies, especially those in an extreme survival situation, and to do so in a cost effective manner.

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