New approach for safety and security training in simulators

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Abstract

Simulators have proved beneficial for ship handling training in real time on well equipped bridges during the last decades. Since last year a new type of simulator is available for training specific aspects of Maritime Safety and Security and can be used both as a standalone version as well as part of a full mission bridge simulator. Wismar University has been involved in the conceptual design and development of this new product made by Rheinmetall Defence Electronics (RDE) in Bremen, and which was successfully introduced into maritime education and training for both student lectures and further training for shipping manpower. In this paper the concept for the "Safety and Security Trainer" (SST) is described and the principle layout introduced. A Situation monitor displays scenario and information available to the trainee and an Action monitor displays operational and information elements from a trainee perspective. Each trainee guides a "Strategic Figure" to be moved throughout the ship's decks and compartments, using all the equipment for emergency handling and making simultaneous management decisions. Visualisation of fire, water, smoke, etc. is dramatised on screen plus specific information on the status of ship situation. A set of ship documents in paper format, such as fire plans and ISM procedure documents, complements the entire training environment.

Special features e.g., for training in fire fighting skills and water inrush manoeuvres are explained. Samples of training scenarios are used to give an overview of the benefits of the appropriate simulation-based safety & security training method. Assessment sessions after the training units have shown the simulation methods and the training exercises are highly appreciated.

As a result it can be concluded that some parts of the safety and security training can be done more efficiently and in more depth than before, particularly the management and strategic related part of emergency handling exercises.

Introduction

The situation in the shipping world with regard to emergency preparedness is affected by the following elements:

- Abilities and experiences in case of "disturbed" operation of systems are reduced or simply not existing
- Multilingual Crews cause specific problems in the event of an emergency situation
- Reduction of crew members causes lack of available personnel
- Complexity of emergency equipment is permanently increasing, but training in emergency handling is not following this development
- New management systems and regulations of the IMO (ISM/ISPS) are demanding new methods and technology for emergency training.

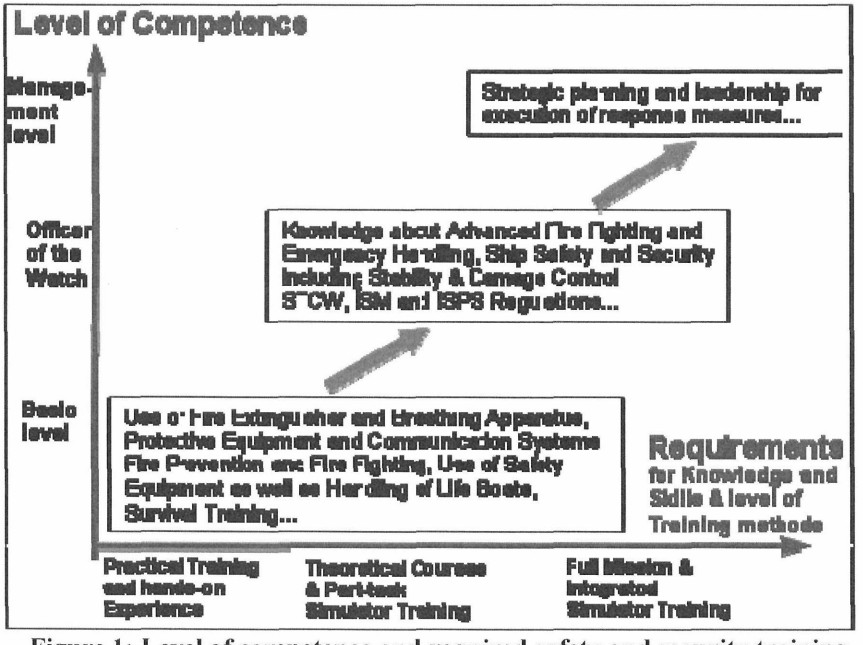

Figure 1: Level of competence and required safety and security training

According to the demand for increased level of training along with the requirements for higher competency levels, the simulator equipment at the Dept. of Maritime Studies of Hochschule Wismar was extended; adding to the existing Maritime Simulation Centre Warnemunde (http://www.sf.hs-wismar.de/mscw/) which comprises already:

- a Ship Handling Simulator SHS with for 4 Full Mission bridges and 8 Part Task Bridges,
- an Ship Engine Simulator SES with 12 Part Task station and
- a Vessel Traffic Services Simulator VTSS with 9 operator consoles

A new simulator was implemented as Safety and Security Trainer SST specifically to be used for stand alone and for integrated training with the SHS. Together with the full set up of training material, including all ships safety plans, it was introduced as the first unique comprehensive Training and Education Concept "mars^{2}" for Maritime Safety and Security including an innovative Simulation System.

In the following sections this new simulator will be described together with some elements of new developments which were designed in a student's diploma thesis at our department and implemented with the support of the manufacturer Rheinmetall Defence Electronics Bremen.

Finally some scenarios will be discussed to show samples of practical application of that simulator.

Safety and Security Trainer (SST)

2.1 Workplace Concept

Presently a new Safety and Security Trainer (SST) has been tested at the MSCW and is now available for both for student lectures and courses for shipping companies' manpower. The innovation of this most efficient simulator in the design of 2D-presentation supports specifically the management level. Additionally a 3D-version has been developed and will be implemented for training on operational level of emergency handling exercises.

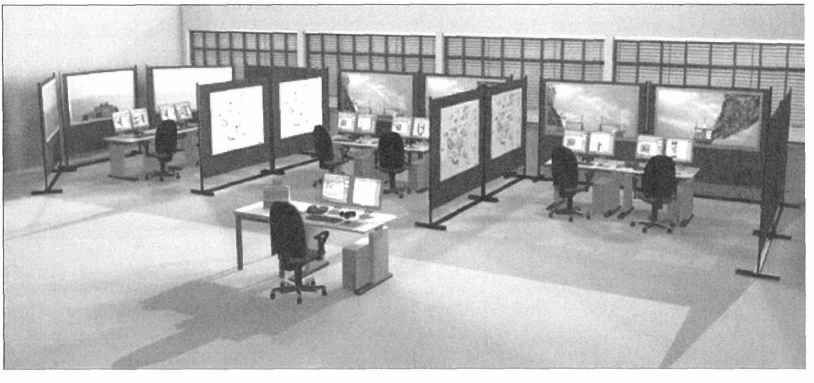

Figure 2 : 1 Instructor and 2 to 16 stations for training with the SST 7 simulator

Each station consists of two monitors. One screen is called **Situation Monitor** and the other is named **Action Monitor.** The workplace comprises the

instructor console and two to sixteen stations, providing full equipment for comprehensive safety and security training (Figure 2).

2.2 Working concept for the situation- and action monitor

A bird's eye view of one deck inside the simulated ship is mainly shown on the situation monitor. A person simulating a member of the crew can be moved through the rooms in the deck. Positioning the figure on specific IMO symbols, the related safety equipment is indicated as a generic panel on the action Monitor. All interaction done at such panels is done at the action monitor. If the "Strategic Figure" is not located on symbols representing safety equipment, the action monitor shows the ship safety plan of the appropriate deck.

In Figure 3 the main desktop displays an overview about one deck. Only rooms are shown which are viewable from the actual position of the simulated person assigned to the situation monitor. The menu bar provides access to other windows. It is possible to create new exercises and store replays. Also, malfunctions, fire, water inrush, and criteria for the incorporated assessment can be set. The actual ship status as indicated by draught, trim and list angle is shown. The name of selected person, health index and moving type (standing, kneeing, lying) is shown in the figure status display, also the kind of protective clothes worn by the figure. A single mouse click on the selected person – Captain, for example -- can be moved normally or quickly to any other position and to the IMO symbols, in which case the action monitor will show the related operable switch gear or the emergency equipment according to the Ship Safety Plan (Figure 4) provided for the trainee in a drawing beside the simulator.

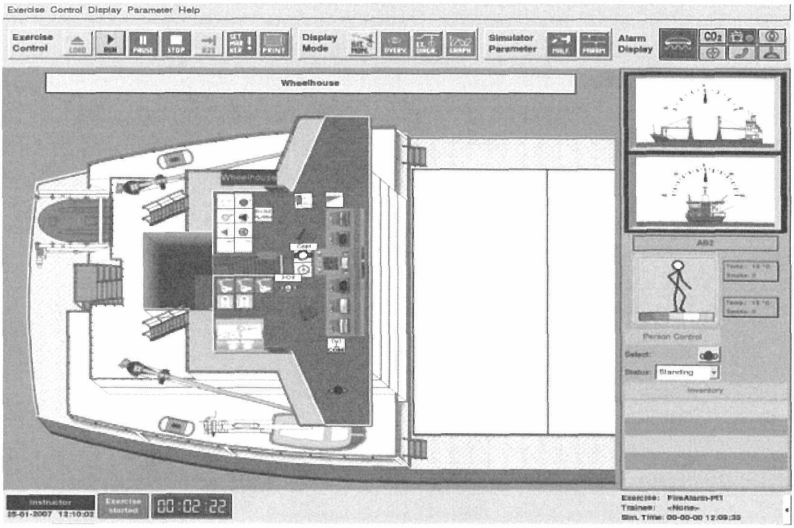

Figure 3: Situation Monitor

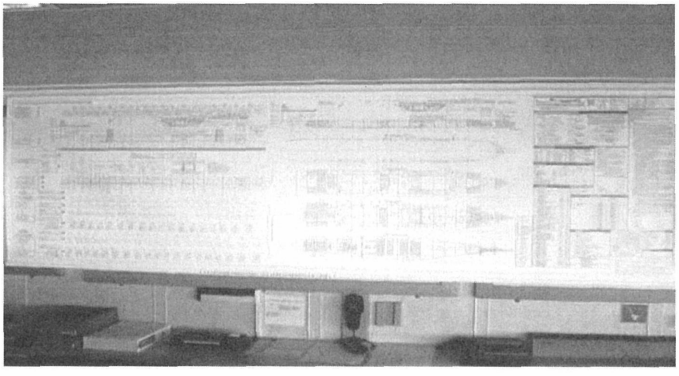

Figure 4: Ship safety plan for the complete mars system

Fire fighting system and fire fighting equipment

Most of the actions performed by the trainees with the safety equipment are performed at the action monitor. A fire model optimised visually and given noticeable effects for human beings is incorporated into the mars simulator. A modern fire alarm management system with smoke detectors and manual calling points is built into the ship. Rooms with easily flammable materials are protected by fire resistant A60 walls and doors. The fire model including smoke visualisation and the fire fighting system and equipment such as fire extinguishers, water hoses and hydrants, CO2 systems and foam, enables the

trainee to simulate a realistic fire fighting arrangement on board and interact with supporting teams and the management team on bridge and engine room. During the simulation, the strategic figure's health condition is monitored in relation to oxygen, smoke, temperature and other health influencing parameters and the measurements are monitored in diagrams. In case the figure's health is impaired his movement becomes slower. Finally the system indicates the person's exit.

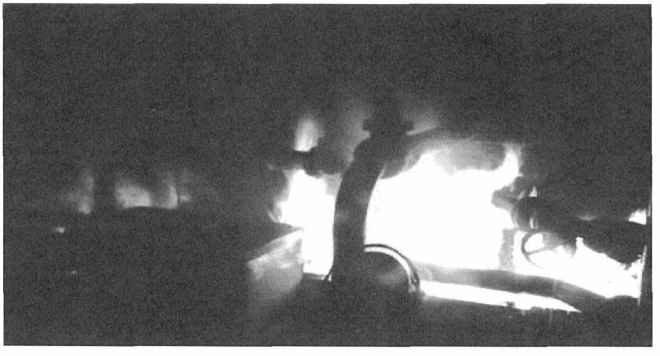

Figure 5: Fire Model on board

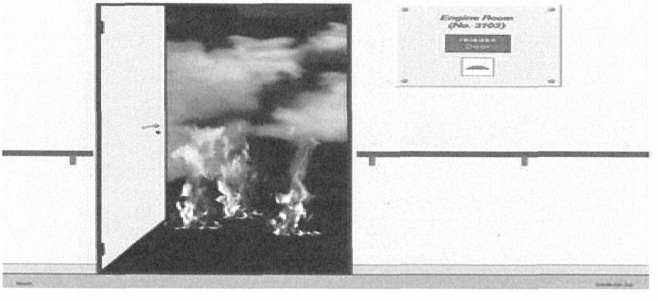

Figure 6: 2D-präsentation on the monitor

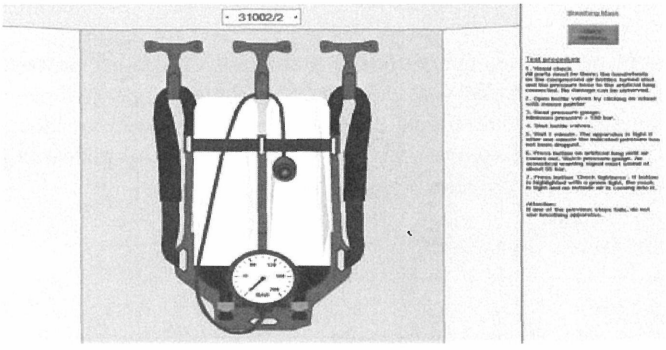

Figure 7: Breathing apparatus

Figure 5 shows a fire model on board, Figure 6 shows the presentation of fire and smoke on the monitor after opening the door of the affected area.

Also the emergency equipment is presented to the trainee on the action monitor, when the strategic figure is moved to the IMO symbol. The operation of the breathing apparatus works in the following way:
Check test instructions – visual check (no damage to be observed), open bottle valves with the mouse pointer on the wheel. The pressure should not be lower than 180 bar. Shut bottle wave, wait 1 minute. Press button of the artificial lung until air comes out. Acoustical warning signal at 55 bar. Check tightness of the mask. By activating "malfunction" the instructor can change the bottle condition, so the trainee must decide if he can use the bottle without danger. Also the instructor can refill the bottle for further use.

All emergency fire fighting equipment on board including heat protective cloth, extinguishers, fire dampers, water system and other ship safety equipment can be operated by trainees simultaneously during the simulation on the action monitor.

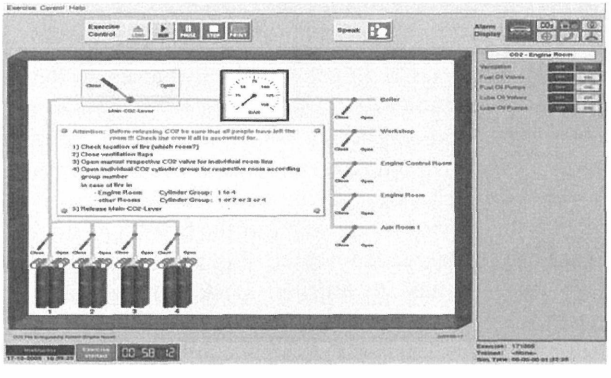

Figure 8: CO2 – operation panel for engine room

The engine room, emergency generator room and cargo holds are protected by carbon dioxide fire extinguishing system. The CO2 system is operated from a panel outside the related area. One minute after generating the alarm for leaving the area it is first time possible to open the lever of the bottles by mouse click activation. The alarm is shown graphically and acoustically.

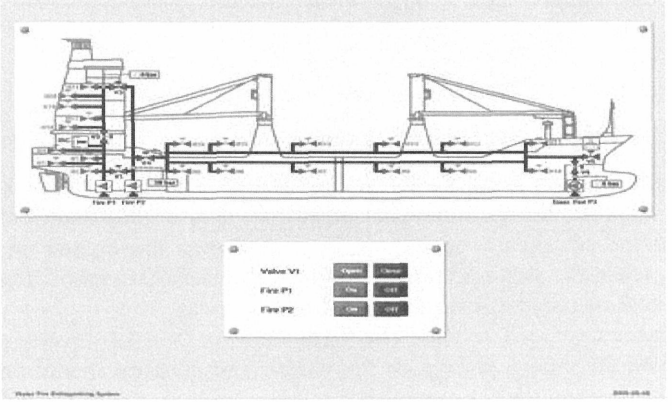

Figure 9: Overview of the water extinguishing system

A complete fire extinguishing system with water is modelled by the mars simulator. It consists of two fire pumps localised in the engine room, one emergency fire pump in the forecastle, pipes, fire hydrants, fire hoses and valves to bring the water to the area of casualty. A foam generation instrument can be added to the spray nozzle at the beginning of the hose. Water inside the ship which is not properly dealt with by the bilge pumps influences the stability of the vessel.

Water inrush system

A model calculating water inrush and its influence to the stability of the ship is part of the mars simulation. A ballast system can be used to stabilize the ship in an emergency case. The stability calculator is used to predict the consequences of a leak after collision or broken pipes. The water level in several areas can be measured. The trainee can locate the leak; determine its size and position related to the surface of the water or the bottom of the keel. Water tight doors are built into the modelled vessel. Figure 10 and Figure 11 show the ballast system and stability measuring system an enable the trainee for countermeasures.

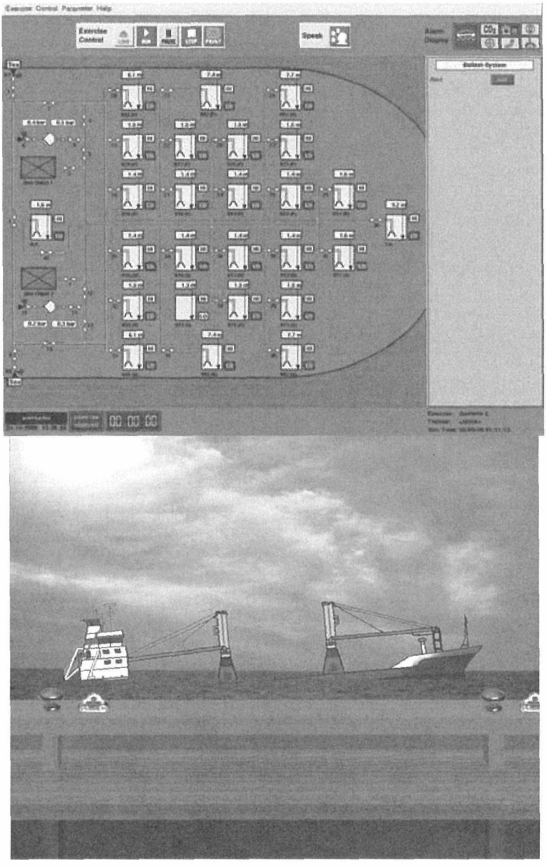

Figure 10: Ballast system for stabilization

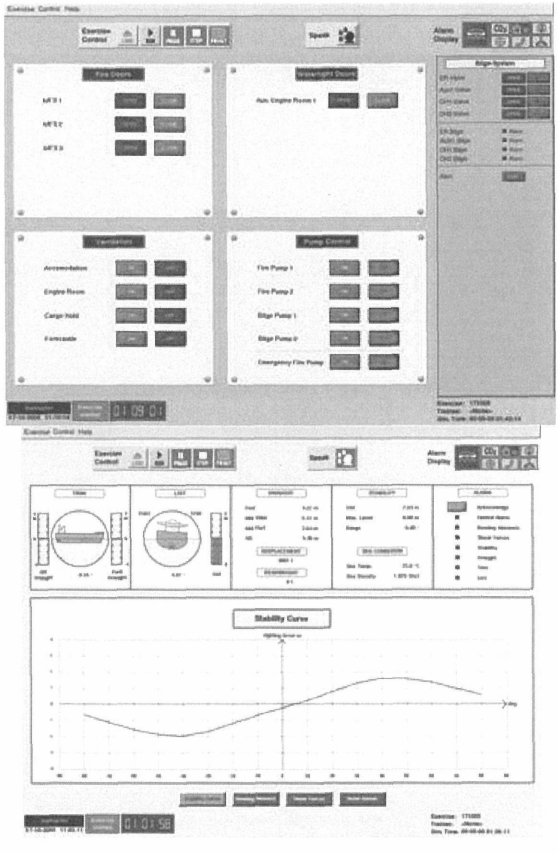

Figure 11: Fire- and bilge pump panel and stability calculator

The estimated amount of water flooding a room can be inserted into the trim and stability calculator. Taking into account the current load status of the ship and the permeability of the related room, a draught, trim and heel angle is calculated. The same is valid for the stability curve, bending moment and shear forces. The ship will have the predicted value, if the estimated mass of water floods the room for real. With information about the future development of the stability, the countermeasures can be taken into account and the bilge pumps and/or ballast system can be activated. In an emergency, the Master can give the command to abandon the ship. In this case the trainees have to follow the procedures for the life boat handling and leaving the vessel. All procedures are available for training at the mars simulator.

Innovation with the 3D-modelling at the MSCW

The most interesting innovation at the MSCW – apart from new investment in the technical upgrade of the system of the SHS, which again marks the MSCW as the chief simulation institute in Europe – was the recent innovation of a 3D- designed passenger vessel for the SST. AIDA CRUISES (one of our cooperating partners) developed the ship plans of the AIDA VITA for a spectacular 3D- visualisation of the vessel. Some decks are already available in the 3D-version, including the bridge and some passenger decks.

Figure 12: AIDA VITA

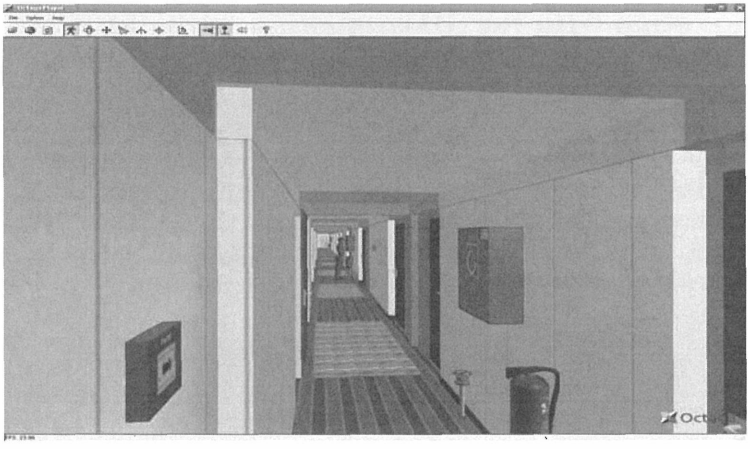

Figure 13: 3D- designed passenger deck of AIDA VITA

For a photo of the vessel and the designed passenger deck see Figure 12 and Figure 13. The inside deck illustrates the fire alarm equipment and all available equipment on the corridors and in the cabins for fire fighting. The 3D-visualisation is presently designed for to train for help with fire casualties including fire fighting (see also Figure 14) but will be supplemented to cover other danger issues, i.e. collision, water inrush, stability and ISPS alerts. Both systems, the 2D- simulation explained above in chapter 0 and the 3D-simulation, provide a complex simulation training at management level for officers and also for training at operational level inside the vessel. The crew can be trained in handling the fire fighting equipment as well as handling the collective or individual survival equipment and are thus not limited to "dry training" units as performed in weekly or monthly exercises on board the vessel. Instead they are a most sufficient way and simulating all real dangers on board and consequences involved and arising from any errors in handling.

Figure 14: 3D- visualisation of fire in a passenger cabin

Method of combined training at the MSCW with SHS – and SST – simulator

The sophistication of simulation at the MSCW has entered a new generation. Until now the training at the full mission ship handling simulator (SHS), ship engine simulator (SES) as well as the ashore based traffic simulator (VTS) embraced a network targeting ship handling and nautical and technical management on board. All systems can be combined for complex on board training and with the VTS including a ship control system from ashore. The innovation and integration of the safety and security trainer, until now considered as a useful but separate tool for training in safety and security matters, will enable the trainee to confront the entire system ship with complex scenarios and in addition to being faced with navigational and technical issues, forced to "dive inside the vessel". Now the target is to combine all simulation systems to reflect the issues which determine the reality on and around the ship. A new quality of scenarios can and has to be generated in the future for comprehensive and adequate training for ship officers. The following example will indicate the ability of training in the future.

4.1 Scenario at the SHS and SST with 2D- and 3D- designed vessel

The passenger vessel AIDA VITA, berthed at the passenger terminal Warnemünde, has embarked all passengers and is ready for sailing. Searching for stowaways completed (SST), the immigration and custom officials as well as the visitors have left the vessel, the bridge is prepared, the engines and mooring gang standby. The Master is in contact with Traffic Control (SHS) and receives

advice regarding the traffic situation. The container vessel MAERSK has entered the harbour and has to pass first. Also the frigate NIEDERSACHSEN just entering the port has to pass as second ship before AIDA can sail (see Figure 15).

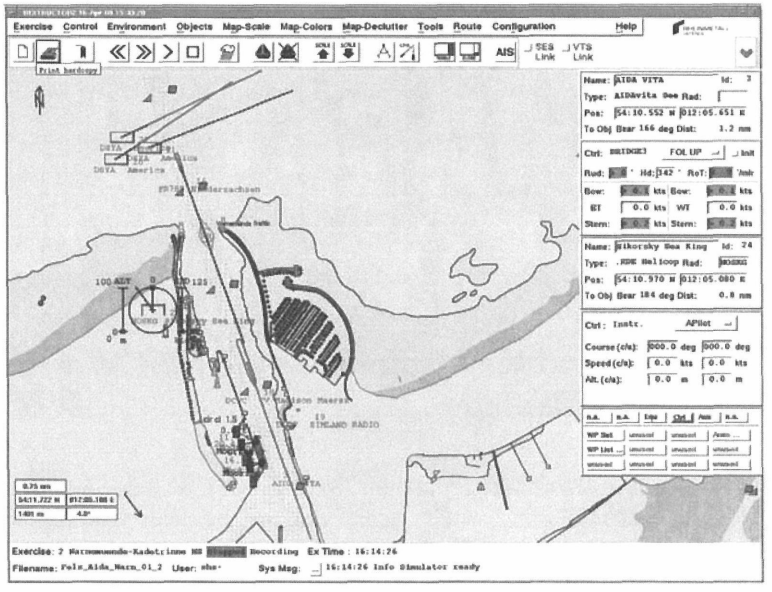

Figure 15: Traffic situation before departing Warnemünde

Four groups of trainees are working at the SHS, SES, VTS and SST simulators. The bridge management team is present on bridge (SHS), the engineers are in the engine control room (SES), the Warnemünde Traffic Control team is handling the traffic from ashore (SES), and the crew--together with the ship safety and security officer (instructor)—are handling the SST at different locations on board (instructor and for trainee stations). For example, the group at the SST has searched the vessel for stowaways.

UTC 16:35 – the two inbound vessels have safely passed the passenger terminal. VTS has granted departure to AIDA VITA. Engines are running – pitch zero. Master gives instruction for single up one and one. UTC 16:40 – vessel singled up. Master gives order to let go all lines. UTC 16:43 – all lines are on deck. Vessel departs without tugs and manoeuvring with bow thruster and two engines (pitch propeller). 16:55 AIDA VITA passed breakwater.

All groups are involved at the simulators. Four instructors and co-instructors are managing the control and observation from the instructor places.

The following scenario describes thirty minutes later, after departure (AIDA VITA is outside the port but still in the fairway channel).

UTC 17:30 – the Master has initiated the safety routine manoeuvring and called all passengers to the assembling stations. UTC 17:40 All passengers arrived at the assembling stations.

UTC 17:42 – call from engine control room. Chief Eng. reports to Master a leaking fuel pipe and gives advice to reduce speed to slow ahead. Also the SST group (2nd Eng. and Oiler) is involved in repair works in engine room – location tank top.

UTC 17:45 – fire alarm on bridge indicates fire in engine room. From now on all actions are coordinated quickly and efficiently. At the SHS alarm located, speed reduced and passengers informed by Master to wait on the assembling stations (SHS). Fire pumps activated by safety officer at the SST (2D), also the fire doors are closed simultaneously. The fire fighting team (i.e. 2nd Eng., Oiler) advised by safety officer to collect fire fighting equipment and to proceed to tank top deck with breathing apparatus and foam. Duty officer informs VTS about casualty. VTS transfer message to the traffic vessels. Only five minutes later the fire was successfully extinguished by crew (SST). The training at the SST was performed in 2D- and partly in 3D- visualisation (see Figure 14, Figure 16, Figure 17).

The effective simulation at 4 simulators completed at UTC 18:00. Debriefing with all groups and instructors includes the replay of sequences SHS, SES, VTS, SST – completed at 18:30.

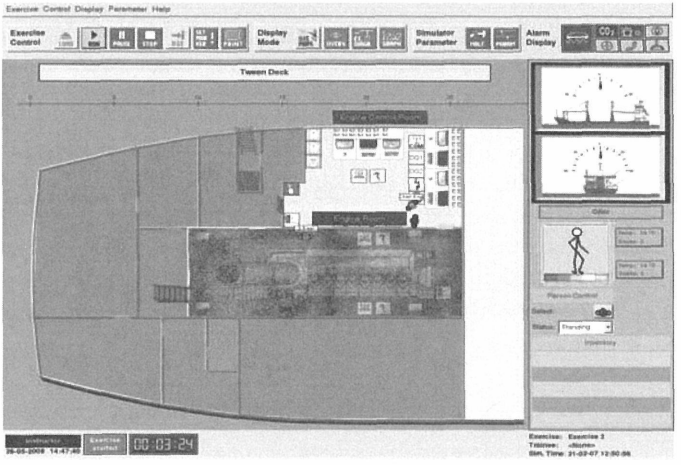

Figure 16 SST – fire in engine room

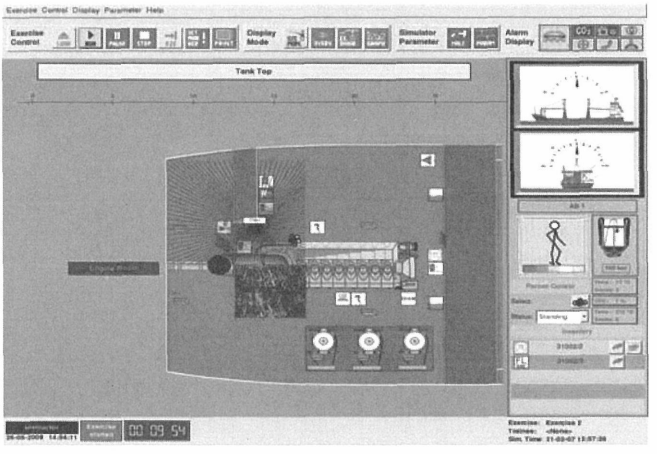

Figure 17 SST – fire fighting by crew with foam

Summary and conclusions / Acknowledgements

The Safety and Security Trainer (SST), which can be used in the same scenario optional in 2D- and 3D-version, is a new product developed by Rheinmetall Defence Electronics (RDE) Bremen in corporation with the Maritime Simulation Centre Warnemünde (MSCW) at Wismar University, Department of Maritime Studies in Rostock-Warnemünde. It can be used as a standalone version for up to sixteen training stations and would be extendable according to the product system for training of an entire ship's crew. The SST has been integrated at the MSCW for training comprehensive scenarios in combination with the SHS, SES und VTS. The complex simulation platform with four full mission simulators enables the trainees to simulate the entire system ship and challenges to officers and crew.

The investigations and developments described here are partly performed by projects funded by the German Ministry of Education and Research Berlin.

The authors would like to thank Rheinmetall Defence GmbH and AIDA Cruises Ltd for their grateful assistance and cooperation in realising the training scenarios.

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