

New level of Integrated Simulation Interfacing Ship Handling Simulator with Safety & Security Trainer (SST)

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ABSTRACT: Simulators have proved beneficial for ship handling training in real time on well equipped bridges throughout the last decades. The Maritime Simulation Centre Warnemuende (MSCW) has been complemented by a new type of simulator called the Safety and Security Trainer (SST). Wismar University has been involved in the conceptual design and development of this new technology. One of the most challenging innovations developed during the research is the 3D-designed RoPax ferry “Mecklenburg-Vorpommern” for the SST simulation system. An integrated support and decision system, called MADRAS, was interfaced into the SST and the entire system was interfaced to the Ship Handling simulator SHS in order to assist officers in coping with safety and security challenges during manoeuvres of the vessel (SHS). This new and enhanced simulation facility allows for “in deep” study of the effects of the safety and security plans and procedures on board and enable more detailed evaluation of their effectiveness under varying conditions and during different courses of events by a different series of simulation runs. This paper will introduce the basic concept of the safety and security training simulator and describe the work entailed for its integration into the complex environment of full mission ship-handling-simulators. Selected results of a case study dealing with first basic implementation of training scenarios will be demonstrated.

1 INTRODUCTION - INTERNATIONAL REGULATIONS FOR MARITIME SAFETY & SECURITY - LEVELS OF COMPETENCIES AND SIMULATOR TRAINING

The Diplomatic Conference on Maritime Security in London in December 2002 adopted new provisions in the International Convention for the Safety of Life at Sea, 1974 and the International Code for the Security of Ships and of Port Facilities - ISPS Code, which came into force 01st July 2004. The Code is in two parts, Part A which is mandatory and Part B which is recommended. The minimum requirements for ships respectively ports are ship (port facility) security assessment, ship (port facility) security plans in ports and on board the vessels and certain security equipment. Apart from existing regulations it is very important to recognize the importance of permanent process in changing and developing precautions and measures implemented to fight terrorism in port and on board the vessel. Human mental attitudes and motivation are important and necessary

for to creating a general atmosphere of security culture.

The situation in the shipping world with regard to emergency preparedness is affected in general 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 case of Emergency Situation
- Reduction of Crew Members causes lack of available Personnel
- Complexity of Emergency Equipment is permanently increasing, but Training in Emergency Handling has not developed to the same standard
- New Management Systems and regulations of the IMO (ISM/ISPS) demand new methods and technology for emergency training

According to the demand for increased level of training (see Figure 1) along with the requirements for higher competency level the simulator equipment

at Dept. of Maritime Studies of Hochschule Wismar was extended: Additionally to the existing simulators at the Maritime Simulation Centre Warnemuende a new Safety and Security Trainer was implemented and interfaced to allow for the training on the highest level for the management level for integrated training with full mission simulators in interfaced mode of operation.

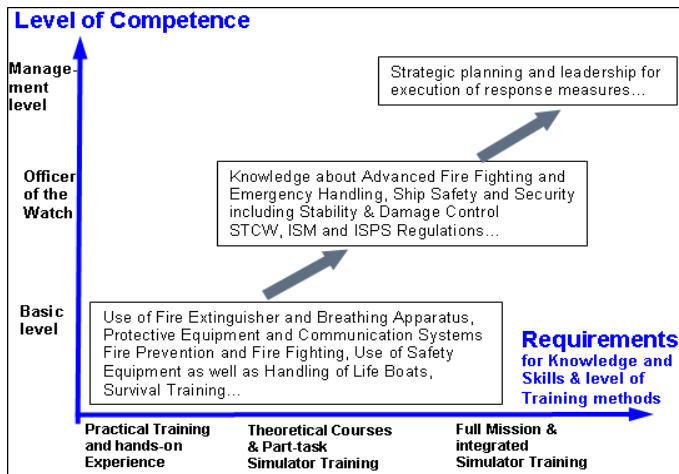


Figure 1. Level of competence and required safety and security training

2 INTEGRATED SIMULATION AT THE MARITIME SIMULATION CENTRE WARNEMUENDE (MSCW) WITH NEW ELEMENT SST

The Maritime Simulation Centre Warnemuende (MSCW) is one of the most modern simulation centres worldwide. The complex simulation platform (Figure 2; Benedict 2000) with several full mission simulators enables the department to simulate the entire “system ship” with the maritime environment including VTS and offers challenges to officers and crew on board the vessels (<http://www.sf.hs-wismar.de/mscw/>). The simulator arrangement (MSCW) comprises already

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

The new simulator, implemented as Safety and Security Trainer SST, was designed by the manufacturer Rheinmetall Defence Electronics Bremen in co-operation with Wismar University, Department of Maritime Studies (Benedict et al 2008, Oesterle 2007). The simulator was originally designed in a basic version and 2D presentation and is now being developed into a 3D version. The simulator can specifically be used for stand alone and for integrated training with the SHS (Figure 3). Beside the use for training, the simulation system will be installed and

used also for specific simulation based studies into potential upgrading of existing safety and security procedures.

3 WORKPLACE CONCEPT OF SAFETY- AND SECURITY TRAINER (SST)

10 stations are being installed in the MSCW this year, eight training stations (one of the stations on the SHS Bridge 1) and two instructor consoles as well as one communication computer system and another computer for a new support and decision system called MADRAS. Each station (with head phones or microphone for communication) consists of two monitors. One screen is used as Situation Monitor and the other is named Action Monitor. The workplace concept provides full equipment for comprehensive safety and security training (Figure 2, right).

A person simulating a member of the crew can be moved by mouse clicks through the decks on the situation monitor. The name of selected person, health index and moving type (standing, kneeling and lying) is shown in the status display window, also the kind of protective clothes worn by the figure.

Positioning the figure close to a consol the related safety equipment is indicated as generic panel on the action Monitor. All interaction is done on the action monitor. If the acting person is not located close to consoles or instruments representing safety equipment, the action monitor shows the ship safety plan of the appropriate deck.

For the instructor it is possible to create new or editing existing exercises and store replays. Also malfunctions, fire, water inrush and criteria for the incorporated assessment can be set.

Integration of Fire Fighting System and Fire Fighting Equipment: Most of the actions performed by the trainees with the safety equipment are performed on the action monitor. A fire model optimised visually and given obvious realistic effects for easy perception by trainees, is incorporated into the simulator. A modern fire alarm management system with smoke detectors and manual calling points is built into the interior of the ship and easily flammable materials are protected by fire resistant A60 walls and doors.

The fire model includes smoke visualisation and a fire fighting system and equipment such as fire extinguishers, water hoses and hydrants, breathing apparatus, CO2 systems and foam. This enables the trainee to simulate a realistic fire fighting situation on board and interact with supporting teams as well as the management team on the bridge and in the engine room.



Figure 2. Overview on MSCW (left), Bridge 1 of Ship-Handling-Simulator (SHS) with new Displays of Bridge Safety & Security Centre of SST and MADRAS Decision Support System (right top) and Training room of new Safety & Security Trainer of SST (right bottom)

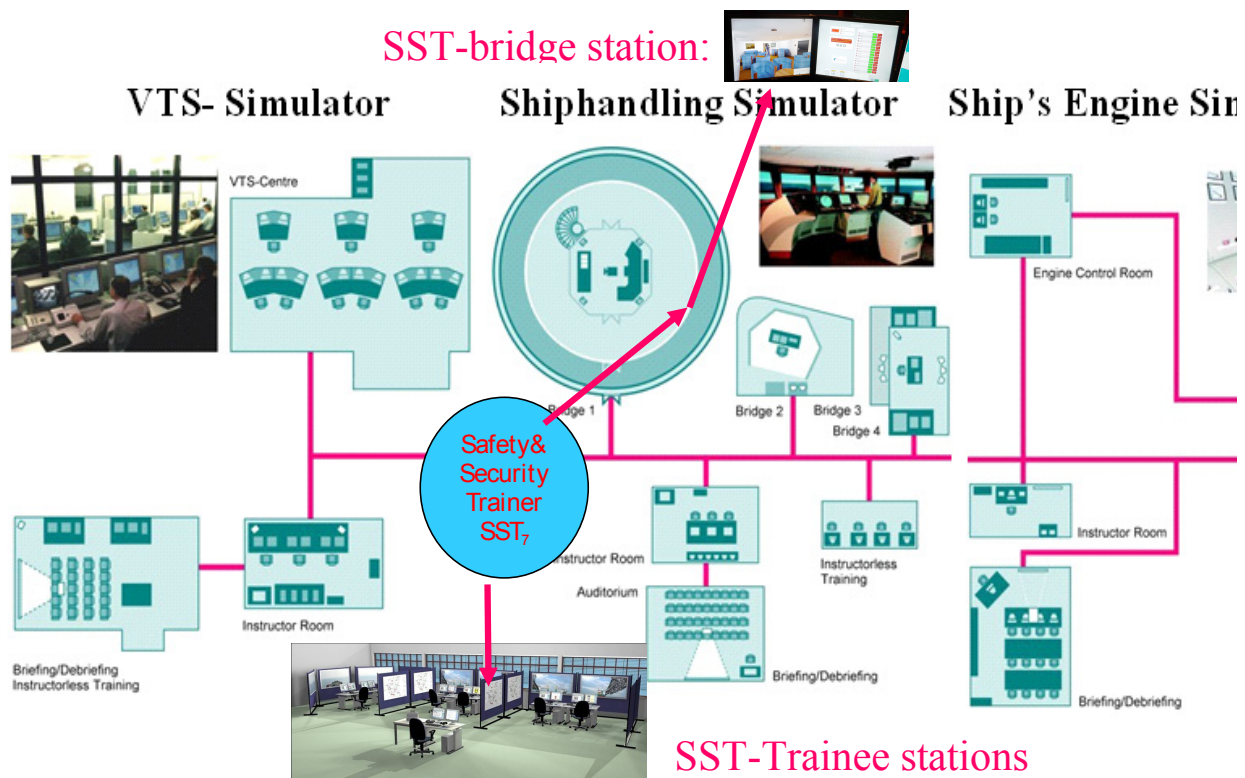


Figure 3. Simulation Centre Warnemünde (MSCW) – structure and interfacing network with new Safety & Security trainer SST

During the simulation the persons' health condition is monitored in relation to oxygen, smoke, temperature and other health influencing parameters and the measurements are monitored in diagrams

Integration of Water Inrush System: One feature of the simulation system is a model calculating water inrush and its influence to the stability of the ship. A ballast system is implemented and can be used during simulation of an emergency instance to help stabilize the ship. The trim and stability calculator is used to predict the effect of a water inrush and show the stability, bending moments and shear forces. Water tight doors are built into the modelled vessel. The ballast and stability measuring system is implemented in the simulator, which enables the trainee to take countermeasures.

4 SPECIFIC SIMULATION FEATURES FOR THE RESEARCH PROJECT "VESPER"

4.1 Elements of the Research Project "VESPER"

The research project "VeSPer" is dedicated to the "Enhancement of passengers' safety on RoRo-Pax-f ferries" and was designed thanks to various initiatives from the German government such as "Research for civil safety" and specifically "Protection of traffic infrastructures". The project is supported by the Ministry of Education and Research, under the aegis of the Technology Centre Düsseldorf (VDI). One of the most challenging innovations developed during the research is the implementation of the 3D-designed RoPax ferry "Mecklenburg-Vorpommern" for the SST simulation system.

The focus of investigations within the project "VeSPer" is laid on

- check-in procedures to increase the safety level for entrances to ferry ships and ports
- preventive measures on board (constructive and administrative)
- Sea side protection of ships in ports as well as in open sea when sailing
- investigations into potential improvement of measures in the case of a crisis
- The analysis and investigations deal with subjects such as:
- use and optimisation of monitoring and detection systems
- aspects of potential integration of decision support systems on board ships
- identification of potential for optimisation of processes and measures/procedures including the integration of new innovative technologies and
- consideration and application of rules and regulations according to national and international law

With reference to risk based scenarios in ports and on board the vessels following investigations are processed

- Process Analysis from entering the port, including booking and check in procedures, on approaching access to the vessel and access of embarkation
- Process Analysis on board the vessel from embarkation/departure until arrival/disembarkation
- Analysis of the ISPS Code and measures for the full integrated application on board
- Measurements for improved processes on board and access to the vessels and developing new security technologies and procedures
- Development of a support decision system for emergency measures on board the vessel in case of safety and/or security casualties

4.2 Integration of innovative 3D-visual model of SST

One of the most interesting innovations at the MSCW – apart from recent investments to technically upgrade the system of the SHS which marks a further noteworthy improvement and underlines the position of the MSCW as the leading simulation institute in Europe – is the 3D-designed RoPax ferry "Mecklenburg-Vorpommern" for the SST.

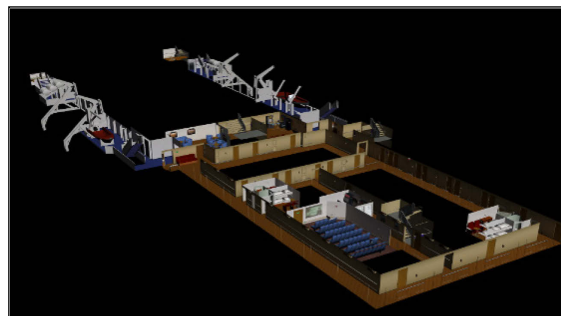


Figure 4. Deck 9 of the RoPax ferry in 3D visualisation



Figure 5. Public area of the RoPax ferry in 3D visualisation

The first step was to make an application of the ship plans which were intricately realised in a 3D Studio Max version by HSW for test trials of the spectacular 3D-visualisation of the entire vessel. All decks of the RoPax ferry are now available in the 3D-version and integrated along with the dynamic safety equipment into the games engine by RDE. Functional tests of the developed system are in pro-

gress and already running successfully. Figure 4 and Figure 5 show the 3D visualisation of decks and public areas of the ferry.

4.3 Safety and Security Components in the 3D Visualisation Model

In the 3D model moves and reacts from his own perspective and can operate the entire spectrum of safety equipment on board the vessel. In the case of fire he activates the alarm from the next manual calling point. According to the safety procedure on board, and after the release of the fire alarm from the bridge, the fire squad team (each trainee with specific role) will operate the fire fighting equipment including the breathing apparatus, fire protection suits, fire extinguishers, fire hoses and other tools located in the safety lockers or placed in the fire boxes (Figure 6 and Figure 7).

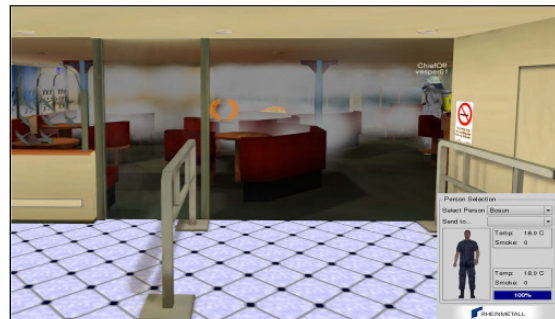


Figure 6. Fire fighting / smoke propagation in public area on deck 5 RoPax ferry



Figure 7. Crew in action with fire fighting equipment car deck 5 RoPax ferry



Figure 8. Bridge and interactive consoles



Figure 9. Engine control room with interactive consoles



Figure 10 Bomb search in the lounge and removal of suspicious object

On the bridge (Figure 8) and in the engine control room (ECR - Figure 9) all the operational consoles including; steering panel, fire panel, alarm panel, ballast- and stability panel and the water drenching system, are designed to a generic model and can be integrated on other designed vessels as well. All consoles and panels on the bridge and in the ECR correspond to the integrated sensors placed all over the vessel. The Master and officers operate an interactive board system and can be trained in a wide spectrum focussing on safety and security procedures.

In addition, the security components can be practised on the new simulator. For example the RFID based appliance, which is integrated into the SST bridge station, enables the officer to observe the movement of persons on board. In all security declared areas the doors are locked and the areas are accessible only by entering the specific code into the lock system beside the doors. On all decks cameras are installed and can be monitored from the bridge station. The camera view can be changed and adjusted by the instructor.

In the case of a bomb alert the crew can investigate the affected area with a bomb detector. On approaching any dangerous object, the detector sounds alarm. Figure 10 shows a crewmember crawling in the direction of a suspicious suitcase. When the bomb has been identified the dangerous object can be removed with a new remote controlled defence system called TELEMAT. This multipurpose vehicle can be used to detect and approach any suspicious objects from a safe distance using the remote control.

The threat of gas attack has also been integrated into the simulation system of mars³. In this kind of a threat the crew could approach the affected area wearing protection suits and breathing apparatus and can undertake all appropriate measures, i.e. for ventilation and evacuation of passengers.

4.4 Support and Decision System MADRAS

The simulation platform includes a new support and decision system called MADRAS. This system was designed by the company MARSIG mbH Rostock and especially tailored for the SST simulator and the simulated RoPax Ferry “Mecklenburg-Vorpommern”. The MADRAS computer is linked to the mars³ simulator and receives the sensor data from the SST. The control module selection contains the following elements for automatic survey; FIRE, EXPLOSIVES, SECURITY, EVACUATION, GROUNDING and FLOODING. In the event of any sensor alarm the Madras menu opens and displays the affected deck/area with the activated alarm sensor. The following menus can be selected:

MONITORING – list of all existing sensors, grouped in different types and presenting the actual data of sensors

DECISION SUPPORT – recommendation structure and decision advise in specific safety- and security issues including necessary procedures:

OVERVIEW– deck overview displaying all installed sensors and highlighting the activated ones including diagrams

DEVICE CONTROL – list of all sensors – according to type, location, showing maximum and minimum values and the adjustable alarm level

PROTOCOL CHECK– date and time of sensor activation, location loop of sensors, duration of alarm, values of alarm and time record for reset

CONTROL – menu for sensor connections, support manager, value input, extended functions and system options

MADRAS is an interactive system and is a helpful tool for Master and officers in critical situations. The system guides the officer through all necessary choices and helps in finding the correct emergency procedures. This helps to avoid dangerous mistakes and ensures not missing any steps imperative for the safety of the vessel.

MADRAS was recently installed into the SST and is still under development. Test trials are running successfully. The basic system of MADRAS was tested on board of the ferry “Mecklenburg-Vorpommern” during the last two years.

5 SUMMARY AND CONCLUSIONS

Within the frame of investigations into potential enhancements of maritime safety and security the use of simulation facilities were investigated. The Safety and Security Trainer SST is a new product developed by Rheinmetall Defence Electronics (RDE) Bremen in co-operation with the Wismar University, Department of Maritime Studies in Rostock-Warnemuende. It can be operated in a standalone version for up to eight training stations and could be extended to include the training of the entire crew. The SST is also designed for integration into complex systems and was interfaced now with the existing ship handling simulator SHS of the MSCW for training of comprehensive scenarios in combination with the SHS, SES und VTS. The complex simulation platform with the full mission simulators enables the trainees to simulate the entire ship system and presents challenges to both officers and crew. A new quality of scenarios can be generated now for the comprehensive training of ship officers. On the other hand this new and enhanced simulation facility allows for in depth studies of the effects of ship's safety procedures and to evaluate their efficiency.

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