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BULGARIAN VESSEL TRAFFIC MANAGEMENT AND INFORMATION SYSTEM AND EDUCATION AND TRAINING OF VTS PERSONNEL IN BULGARIA

Alexandrov, Chavdar*

Nikola Vaptsarov Naval Academy
Bulgaria

Abstract. Based on the requirements of the Directive 2002/59/EC and the Protocol of 1988 relating to the International Convention for the Safety of Life at Sea, 1974 (SOLAS), the Bulgarian Maritime Administration has an obligation to provide appropriate shore-based facilities, such as Coastal Vessel Traffic Services (VTS) and communications in GMDSS Area A1. The financial mechanism of EU Phare program has been used for this purpose. The Phare Project BG0012.01 was completed at the end of October 2004 with building up the 1st phase of a Vessel Traffic Management and Information System (VTMIS), including Operating and Management Center, two Traffic Control Centers, a number of sites equipped with Radars, VHF and AIS Base Stations, Radio Direction Finders, Weather Stations and Telecommunication Backbone. After completing current modernization, financed by the Operational Programme "Transport", Bulgarian VTMIS is expected to be fully operational by the middle of 2015.
For education and training of VTS Personnel two courses have been developed in Nikola Vaptsarov Naval Academy as follows: VTS Operator and On-the-Job Training. The Training of Instructors course has been developed and delivered by the equipment supplier. The subject has been included in the curriculums of some bachelor's and master's degree programs.
This paper presents shortly Bulgarian VTMIS and the experience of Nikola Vaptsarov Naval Academy of providing education and training of VTMIS personnel. Building up a simulator for practical exercises in the Academy's Faculty of Navigation in close cooperation with the German Maritime Simulation Center in Warnemunde and benefits of VTS simulator training are described as well.

Key words: traffic monitoring, VTMIS, education and training of VTS personnel

***Corresponding author**
e-mail: ch.alexandrov@nvna.eu

1 INTRODUCTION

As the vessel traffic in the European waters increases, so, too, the need to insure safe navigation. The Erika and Prestige accidents proved this need and resulted in a significant strengthening of safety rules and regulations at European level. Directive 2002/59/EC of the European Parliament and of the Council of 27 June 2002 establishing a Community vessel traffic monitoring and information system has been developed as a result of these efforts "with a view to enhancing the safety and efficiency of maritime traffic, improving the response of authorities to incidents, accidents or potentially dangerous situations at sea, including search and rescue operations, and contributing to a better prevention and detection of pollution by ship". According to the Directive "Setting up a Community vessel traffic monitoring and information system should help to prevent accidents and pollution at sea and to minimize their impact on the marine and coastal environment, the economy and the health of local communities" [1].

According to [5, 6] "Vessel Traffic Management or VTM is the set of efforts (measures, provisions, services and related functions) which, within a given area and under specified circumstances, intend to minimize risks for safety and the environment and to maximize the efficiency of waterborne and connecting modes of transport.

Vessel Traffic Management and Information Services, VTMIS intend to respond to public and private demand for facilitating Vessel Traffic Management. Vessel Traffic Management and Information Services include services distributing in given areas (at regional, national or transnational level) the pertinent information to be used both in real time and in retrieval modes by actors involved".

VTMIS can be used for vessel traffic management, port resource management, fleet management and cargo flow management. They deliver a traffic image to be used by for all parties concerned. Parties (authorities, ports and companies involved in shipping, vessels and cargoes) could be divided in two groups – internal and external.

The internal users of the VTMIS are the organizations directly or indirectly involved in dispatching vessels e.g.: VTMIS operators, management and supporting staff as well as vessels in the VTS area.

The external users are all entities directly or indirectly involved in marine transport outside the VTS organization. The most important are:

- Pilot-, tug-, boatman- organizations;
- Berth (terminal) operators;
- Shipping agents;
- Customs services;
- Border Guard Services;
- SAR organizations and Health Department Services;
- Dangerous Goods and Waste Disposal Departments;
- Adjacent VTS, etc.

The Competent Authority is the Authority made responsible, in whole or in part, by the Government for the safety, including environmental safety, and efficiency of vessel traffic and the protection of the environment.

According to [6] Vessel Traffic Management & Information System is a VTM System, which in addition to the VTM tasks has the capability to respond to public and private demand for information to facilitate ship and cargo handling operations, through electronic communication with other VTS, GMDSS at shore based system and Data processing systems in a region. The vessel participates in the system from the moment that its arrival has been announced until the moment it leaves the VTS area on the way to her next port of call.

The shortest possible description would be: "VTMIS are improving vessel traffic information".

2 VESSEL TRAFFIC MANAGEMENT AND INFORMATION SYSTEM (VTMIS) OF BULGARA

Bulgarian VTMIS has been built to solve the following tasks [12]:

- Constant monitoring of the sea areas of Republic of Bulgaria;
- Vessel traffic management in the ports, Bay of Varna, Bay of Burgas, anchorages, lakes and connecting fairways;
- Improvement of the efficiency in maritime search and rescue in Bulgarian SAR Area;
- Improvement of the information service for the purpose of environmental protection;
- Collecting and providing the whole necessary information for shipping to the authorities;
- Improvement of the efficiency of the maritime industry.

Development of the system passed through several steps.

The Varna Initial System (VIS) is considered as a first step in the development of the Bulgarian VTMIS. The Project PSO99/BG/3/6 Vessel traffic Management and Efficiency in Bulgaria, has been developed between December 1999 and May 2000 and was co-financed by the Bulgarian and Dutch government.

The VIS had:

- Two radars with 18 feet antennas;
- Two separate daylight displays, both showing a traffic image of the roads, the port approach and the port entrance of Varna, combining radar video and tracks of big and small vessels;
- Human interface and display functionalities;
- Traffic image storage and basis control and monitoring capabilities.

To satisfy the extendibility and flexibility requirements VIS had an open architecture and modular design. Communication between radar sites and traffic center was implemented using standard communication lines providing 64 Kbps.

Varna Initial System contributed to the development of sustainable transport by involving technical assistance, hardware and software provided by the Netherlands. The technical assistance part of the Varna Initial System project comprised assistance in defining the VTMIS development strategy, including feasibility and cost benefit assessment, preparation of the Varna Initial System functional and technical specification and implementation management and evaluation of the performance of a VTS for the Varna port approach, which later on became an integral part of Bulgarian VTMIS.

The next step of the extension from VIS to VTMIS, was to build two VTS centers configured as follows:

- VTS Varna – incorporate the date information from five Radar sensors (two old from VIS Varna plus three new located in Varna Lake;
- VTS Burgas – accept data information from one Radar sensor located at Burgas Traffic Control Tower.

The final step was to build the Vessel Traffic Management and Information System of Bulgaria. Three projects supported by European financial instruments have been developed to achieve this aim.

VTMIS-Phase 1 project was completed at the end of year 2004 [6, 8]. As a result a set of subsystems for Radar tracking, AIS monitoring, Radio Direction Finders, CCTV video observation of biggest ports were installed to provide monitoring of SOLAS vessels and reliable VHF communication between coastal systems and vessel sailing in territorial waters of Bulgaria (GMDSS Area A1 VHF system for distress, safety and public correspondence).

VTMIS-Phase 2 project has been developing for a time period of the next 3 years [7]. During this period an enhancement of the technical structure of the Bulgarian VTMIS has been carried out by installation of new radars, RDFs and other equipment for monitoring, incl. thermo-vision cameras and hydro-meteorological stations. The expansion of the Telecommunication Network has been carried out as well to connect the new equipment to the system.

VTMIS-Phase 3 project will cover a time period of years 2013-2015. This project will extend the coverage of the existing system in the sea areas of Republic of Bulgaria and will integrate all subsystems in a single maritime information system. The telecommunication infrastructure will be upgraded and a new center for electronic documentation in maritime transport in Republic of Bulgaria will be established to upgrade the scope of information services for maritime industry and to provide an interaction with other information systems of governmental and departmental structures, in accordance with the requirements of European and international legislation.

2.1 VTMIS-PHASE 1

The results of the Project Phare BG0012.01 - Vessel Traffic Management and Information System was an up-to-date high-tech automatic system aimed at enhancing the safety and efficiency of navigation, safety of human life at sea and environmental protection from the possible adverse effects of shipping in Bulgarian territorial waters. This system provided the user with various navigational information in the way of the decision making support. The system enabled the ships and other navigational objects to be identified and tracked and vessel traffic to be planned.

The objectives of the VTMIS project were:

- Promotion of marine safety in the Bulgarian territorial waters;
- Promotion of the economic development through improvement of maritime transport in Bulgarian Ports and through industrial development in Bulgaria;
- Promotion of the protection of the environment on Bulgarian territorial waters;
- The VTMIS-Phase 1 Project has built a system consisted of the following integrated sub-systems:
- A Radar Tracking System providing a traffic image of the coastal part of the territorial waters and specifically the approaches and entrances of Varna and Burgas ports, including the fairway to the Varna West Port;
- An AIS integral system for automatic identification and monitoring of the vessels movements;
- A CCTV Systems in Varna and Burgas ports, providing real time traffic image;
- A Radio Direction Finding System for vessel locating purposes in the Varna and Burgas approaches;

- Two hydro-meteorological stations;
- A Control & Monitoring System, enabling remote control and status management of the technical components;
- A VHF Communication System for communication with vessels, with full coverage of the Bulgarian territorial waters, i.e. GMDSS Area A1 VHF system for distress, safety and public correspondence;
- A Data Processing System for vessel data and vessel voyage data as well as a Data Base for track and references;
- Telecommunications Network which connects and integrates all components systems and subsystems of VTMIS. TN consists of Microwave Carrier Link (MCL) subsystem – the telecommunications backbone of the VTMIS;
- A Data Network for disseminating the traffic information to all parties concerned and capabilities for computer-computer links with external systems;
- Fully equipped Operational Centers.

The information provided by the VTMIS has been used by the Ministry of finance (Customs administration), Ministry of Interior (Border police), Ministry of defense (the Navy), Ministry of environment, Ministry of agriculture (monitoring of the fishing areas) and the entire maritime community of Bulgaria.

After the acceptance tests of the technical system there an institution (directorate) under the Ministry of Transport and communications, was set up for management, operation, and maintenance.

After completion of the 1st phase with building–up the Operating and Management Centers in Varna and Bourgas, 33 equipped sites and Telecommunication Network backbone have been available since the end of October 2004 (see Figure 1).

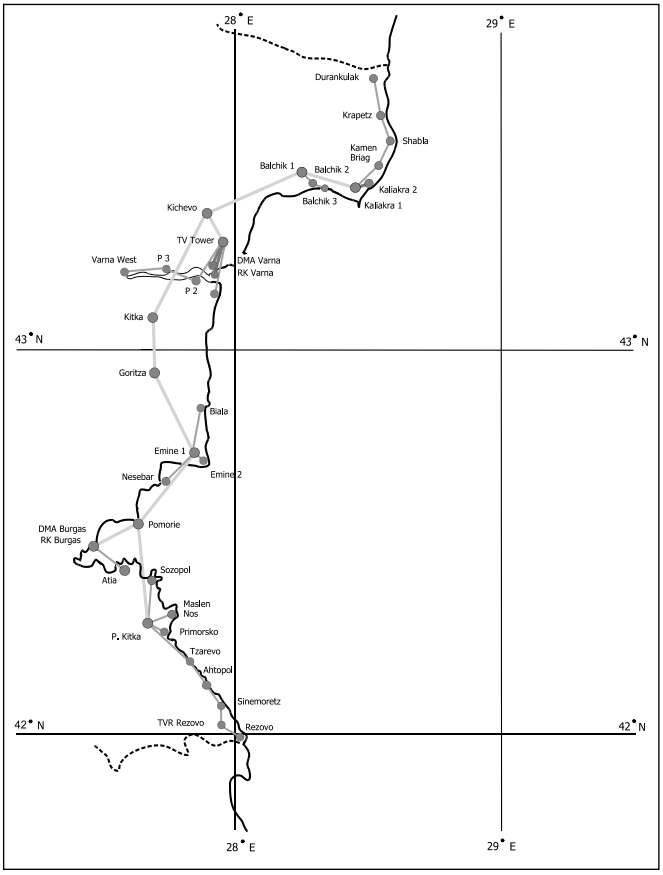


Figure 1 The site map of Bulgarian VTMIS

2.2 VTMIS-PHASE 2

In order to comply with the international standards for the operation of the system as whole completed VTMIS, the 2nd phase of the project – the Project BG 2003/004-937.04.01, under Phare programme was developed during years 2004 – 2007 [7].

Purpose of the VTMIS-Phase 2 project was to enhance the technical structure of the Bulgarian VTMIS as an integrated instrument for full achievement of the objectives stated above and also in line with the EC-Directives and the IMO Resolution A.857 (20), SOLAS 74/78 as amended, ITU-GMDSS, in conformity with the IALA VTS Guide and the IALA AIS Guide.

The VTMIS-Phase 2 project created an enhanced and upgraded system with:

- New radar observation, radar multitracking and multifusion processing subsystem implemented on the base architecture of the telecommunication system laid up in Phase 1. Seven new radars have been installed to improve the subsystem;
- The completion of the RDF coverage with additional three RDF systems to contribute for the coverage of the whole Bulgarian coast. This was a requirement for detection and homing of small (Non-SOLAS) crafts and for providing Search and Rescue operations in Bulgarian SAR Area with locating information;
- The expansion of the Microwave Carrier Link (MCL) of Radio Relay Equipment was for the connection of the radar subsystem with the Telecommunication Network and the possibility for data exchange of communication with the new radar sites;
- The additional video subsystem for coverage of the Bulgarian coast;
- The hardware and the software for the Database subsystem for the management of the traffic data, dissemination and data exchange with the external users. The database platform was very important for the VTMIS structure with the possibility for evaluation and statistical analysis of the system performance and for the support of the system information resources.

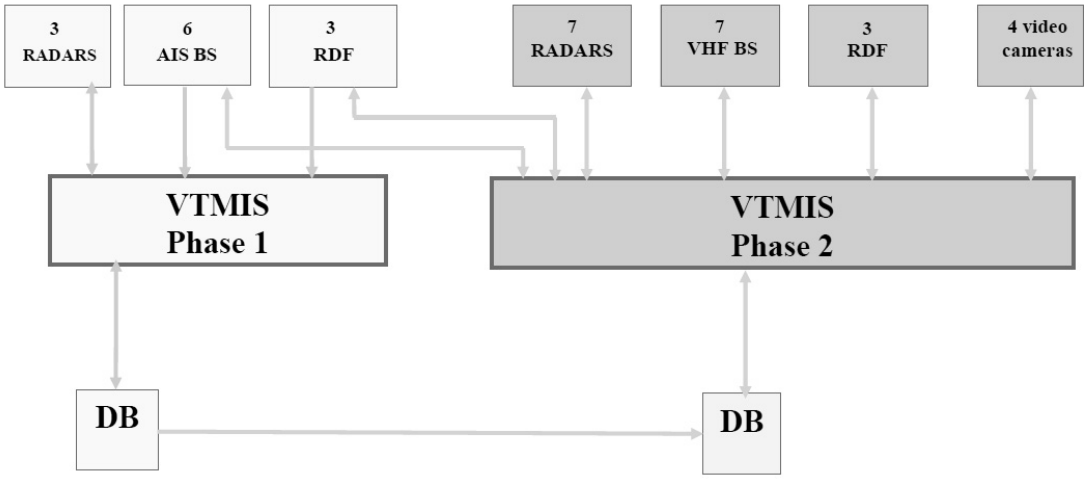


Figure 2 VTMIS-Phase 1 and Phase 2 integration

Fig. 2 illustrates upgrading the VTMIS of Bulgaria with integration of existing and new equipment.

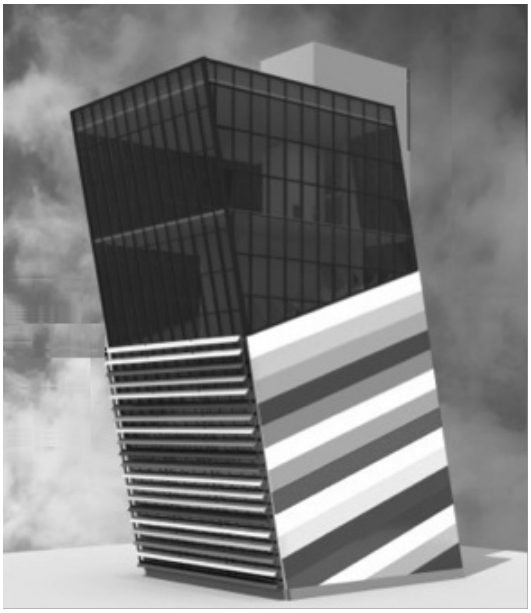
2.3 VTMIS-PHASE 3

VTMIS-Phase 3 Project is included in priority axes IV of Operational Program "Transport" – "Improvement of the maritime and inland-waterways navigation".

The main objectives of the project include installation of the new generation solid-state radars with integration of the existing radars and an upgrade of the Bulgarian coastal GMDSS system. In addition, the overall efficiency of the system will be enhanced with VTS Simulators and 3D visualization VTS software. Installation of new powerful data centres in Varna and Bourgas VTS towers will allow for full integration of all sensors into a single information system.

Purpose of the VTMIS-Phase 3 project is to satisfy the requirements of OP "Transport" as follows:

- Improvement of safety in the area and aquatory of the seaports of Bulgaria by developing and operating a system for monitoring and management of the maritime traffic and information services for the maritime transport (VTMIS) as a part of the EU safety information system SafeSeaNet;
- Establishment and development of the navigational information systems – this will be accomplished by the provided development and upgrade of the VTMIS system under VTMIS-Phase 3 of the project, improving the overall efficiency and scope of the information services for shipping and extending the coverage of the Bulgarian coastline by the system;
- Construction of buildings for the coastal centers for vessel traffic monitoring and management and information services for the maritime transport in Varna and Burgas and establishment of a center for



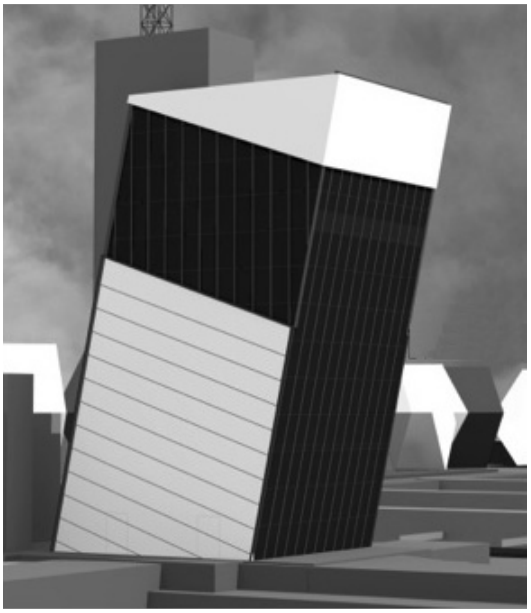


Figure 3 The new traffic control towers in Varna and Burgas

electronic documentation in maritime transport in Republic of Bulgaria (see fig. 3).

The new project will extend the coverage of the existing system in the sea areas of Republic of Bulgaria and will integrate all subsystems in a single maritime information system, connected to the pan-European structures in accordance with the requirements of European and international legislation. The telecommunication infrastructure will be upgraded, which will provide constant transfer of all data and voice. A new center for electronic documentation in maritime transport in Republic of Bulgaria ("single window") will be established to upgrade the scope of information services for maritime industry and to provide an interaction with other information systems of governmental and departmental structures, involved in maritime transport.

Expected results on completion of the project are to improve safety, to increase the efficiency of shipping and to improve environmental protection. The system will provide information and navigational services, communication with vessels, and will exchange information with competent authorities during disaster and emergency situations. It will optimize the vessel traffic management through constant exchange of information between the participants in sea transport and the Governmental competent authorities for better planning of ship calls and cargo operations. Through constant monitoring of the vessel traffic the system will give opportunities of avoidance of emergencies including spillages. In case of pollution information for all involved parties will be provided and thus the time for reaction will be reduced.

As a part of this modernization Bulgarian VTMIS has already been included in the IALA World VTS Guide [9].

2.4 THE SIMULATOR

A VTS simulator has been built as an activity under the above mentioned BG0012.01 Phare project at the end of August 2004. Based on the existing Simulator and with a view to the prospect of development of Bulgarian VTMIS, a project for enlargement and modernization of the Laboratory on Vessel Traffic Management Solutions (VTMS Lab) has been included into the Plan for Enhancement of the Nikola Vaptsarov Academy's Set of Simulators in 2012.

The renewed VTMS Lab provides better conditions for education and training of future specialists in the area of shipping – navigators, ships and port operations managers, electronics engineers and maintainers, etc.

VTMS Lab consists of two pair of VTS simulators with two Instructors workplaces. The first one has two Trainee VTS Operators workplaces and a virtual ship in addition. The second one includes three VTS Operators workplaces (See Figures 4 – 7).

This configuration allows some more flexibility in organizing different types of exercises. In addition there are some computers in the Lab, connected to high speed Internet for online vessel traffic monitoring. Appropriate software provides access to Bulgarian River information system BULRIS as well as EMSA projects SafeSeaNet and EU LRIT DC.

The instructor workplace is based on Transas NaviTrainer NTPro 5000 navigational simulator. Instructor program is intended for:

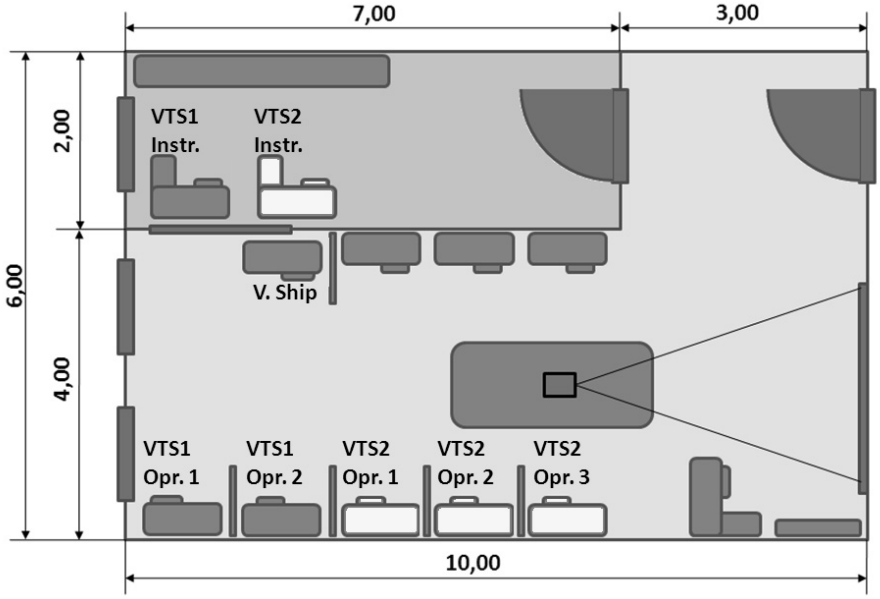


Figure 4 N. Vaptsarov Naval Academy's VTMS Simulator

– generation and editing of exercise scenarios;
– running of exercises on the operators workplaces;
– monitoring of the exercise performance;
– correction of scenarios in the process of an exercise.

Exercise scenario is a description of location and motion of objects within the scene space. Exercise objects include:

– ships, tugboats and barges;
– mooring objects;
– rescue operation objects;
– VTS surveillance equipment.

In addition, some special objects setting hydro-meteorological conditions and bathymetric characteristics for a certain part of the screen can be introduced in the exercise.

Exercise scene is a model or actual geographic area. The scene is an aggregate of:

– the terrain spatial model (submerged and surface part);
– spatial models of coastal structures (buildings. bridges, berths, etc.);
– spatial models of aids to navigation (lighthouses, buoys, etc.).

Scenes of two geographic areas – Varna and Burgas are supplied together with the Simulator. The exercise scenario generation procedure includes the following steps:

– selection of a geographic area;
– setting of the initial object positions;
– setting of the objects' speed and routes;
– setting of characteristics of the navigational equipment and ship gear for the virtual ships and target ships;
– setting of weather conditions and their changes in time;
– modification of the scene bathymetric conditions;
– setting of the exercise start date and time.

Training and certification of instructors (Training of the Trainers) was provided by the supplier of simulator's equipment.

Trainee VTS station Transas Navi Harbour, developed for training of VTS operators provides the benefit of interaction with active targets, controlled by the program or instructor. Trainee VTS station has the following main features:

– provides imitation of Navi Harbour Operator Display Unit (ODU) operations and objects (real radar signal processing is substituted with simulation software);
– interface with operator identical to that of real Navi Harbour ODU;
– easy adapting to particular operational area and environment for any real VTS.
– imitation of targets' motion based on data, received from Instructor VTS station.

Figure 5 Instructor's workplace

Figure 6 Trainee VTS Operators workplaces

Figure 7 Virtual Ship's workplace

3 EDUCATION AND TRAINING OF VTS PERSONNEL

In every implementation program for every stage of building of the Bulgarian VTMIS, described above, a training of operational and technical personnel has been included. According to the requirements of IALA described in VTS Manual [12] simulation should be used in practical training of VTS Operators because of the appropriate environment that simulators offer for acquirement and assessment of the skills and competencies required. In the training program of VTS Operators in Bulgaria the simulator of N. Vaptsarov Naval Academy has been used [10]. Programs for VTS operators and for On-the-Job Training have been developed in close cooperation with the German VTS Training Center in Maritime Simulation Centre Warnemünde (MSCW) and approved by the Bulgarian Maritime Administration. Training scenarios have been created together with senior staff of VTMIS and included not only everyday situations but also critical and emergency situations. The benefits of using simulator in VTS training are well known [11] – good realism but with no real danger and no real consequences, traffic is under control according to training objectives and scenarios, etc. Realism in the Academy's simulator is achieved by using the same software and hardware interface as in real operator's workplace and very good software models of real sensors and VTS objects.

In addition the subject of VTMIS is included now in most of the programs of Nikola Vaptsarov Naval Academy, provided by Faculty of Navigation. The course syllabuses are focused on different aspects of the subject. In Bachelor and Master degrees programs of Navigation the focus is set on interaction of ships with VTS operators, pilots, search and rescue authorities, etc., as well as on ship reporting systems, according to Manila amendments of the STCW 2010 convention; In Radio and electronics program – on all technical aspects of the system and maintenance of the equipment, while in Fleet management and Port operations programs – on the abilities of VTMIS to provide information that helps traffic and cargo flows analysis, port activities, environment protection and security, etc.

4 CONCLUSIONS

Bulgarian VTMIS is an up-to-date high-tech system for enhancing the safety and efficiency of navigation, safety of life at sea and environmental protection. It has been developing over the last decade by using support of European financial instruments.

To support education and training of VTMIS personnel, both technical and operational, Nikola Vaptsarov Naval Academy has established educational programs and specialized training facilities. Carrying out a project aimed to establish a new VTMIS Lab the Academy affords better opportunities for research in a relatively new area for applications of information technologies with great expectations towards improvement of safety at sea and coastal safety, including critical infrastructures and environment protection as well as improvement of conditions for economic growth based on activities, closely connected with shipping. And last but not least, it is expected that the new lab would give assistance to the Academy in strengthening its position as a center of marine science and technologies in Bulgaria and regional leader in the area of Vessel Traffic Management and Information Systems as well as in establishment of new contacts with National, European and International Scientific Centers and Universities for further co-operation.

Aknowlegements

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