Technological and Educational Requirements for Inland Navigation Simulator in the Danube Region

Tehnološki i obrazovni zahtjevi simulatora za kontinentalnu navigaciju u području Dunava

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Summary

Education and practical training of the crew members in water transport have been directed towards harmonisation within the EU. One of the basic goals of the project HINT (Harmonized Inland Navigation Transport through education and information technology) is the implementation of inland navigation simulators into the educational process. They might become an alternative way for practical training of crew members in near future. In this article we analyse the requirements for the functions and complexity of an inland navigation simulator in the educational process within the Danube region. The analysis comes from the research that was carried out by the organisations that work in Inland Water Transport (IWT) in the Danube region in October 2013.

KEY WORDS

project HINT
educational requirements
navigation simulator
Danube
evaluation

Sažetak

Obrazovanje i praktična obuka članova posade u vodnom transportu usmjerena je prema harmonizaciji unutar EU. Jedan od glavnih ciljeva projekta HINT (usklađeni kontinentalni vodni transport putem edukacije i informacijske tehnologije) implementacija je kontinentalnoga navigacijskog simulatora u procesu edukacije. Oni mogu postati alternativni načini za praktičnu obuku članova posade u bliskoj budućnosti. U ovom članku analiziramo zahtjeve za funkcijama i složenostima simulatora kontinentalne navigacije za edukacijski proces unutar regije Dunava. Analiza proizlazi iz istraživanja organizacija koje rade u Inland Water Transport (IWT) u regiji Dunava u listopadu 2013. godine.

KLJUČNE RIJEČI

project HINT
obrazovni zahtjevi
navigacijski simulator
Dunav
evaluacija

INTRODUCTION / *Uvod*

Navigation simulators are commonly used in maritime crew training, but in inland navigation it is a new, dynamically developing training method. However, the maritime experience provides the basis for simulator application in inland navigation research and training, the inland navigation simulators are new born techniques due to the specific conditions of inland navigation. Because of this, the basic requirements and concepts of inland navigation simulator trainings have to be defined.[6]

While there are examples of modern inland navigation training tools (IT-based simulators and state-of-the art school ships) in Western Europe, small but significant differences can be found between navigation on Western European united waterways and the Danube. Therefore the simulator training requirements are different.

STATUS QUO AND DEMAND / *Status Quo i potražnja*

Inland navigation simulator is an alternative to the practical training of crew members on the inland vessel. The concept of the simulator has to reflect the reality of the environment. This kind of study has to be based on the analysis of the requirements that are necessary for the training of the crew members.

Under the project HINT the research was carried out between 8 countries that participated in the project. This research was focused on the requirements of the inland navigation simulator used on the Danube River. The representatives of the research were the organisations operating in the field of water transport, educational institutions and authorities. This analysis presents the summary of the survey results across all attended countries.

Over 50 organisations from different Danube countries

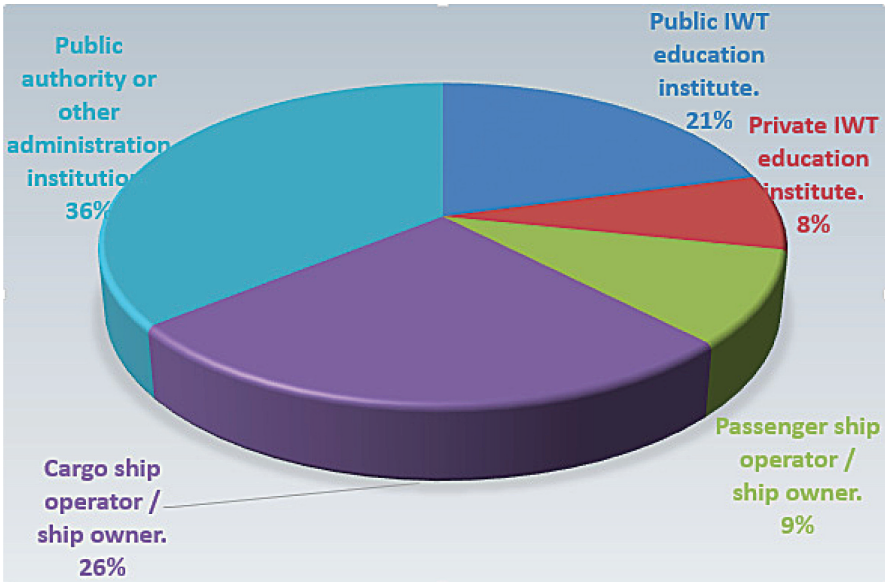

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Figure 1 Types of organizations interviewed in all countries
Slika1. Tipovi organizacija koje su intervjuirane u svim zemljama

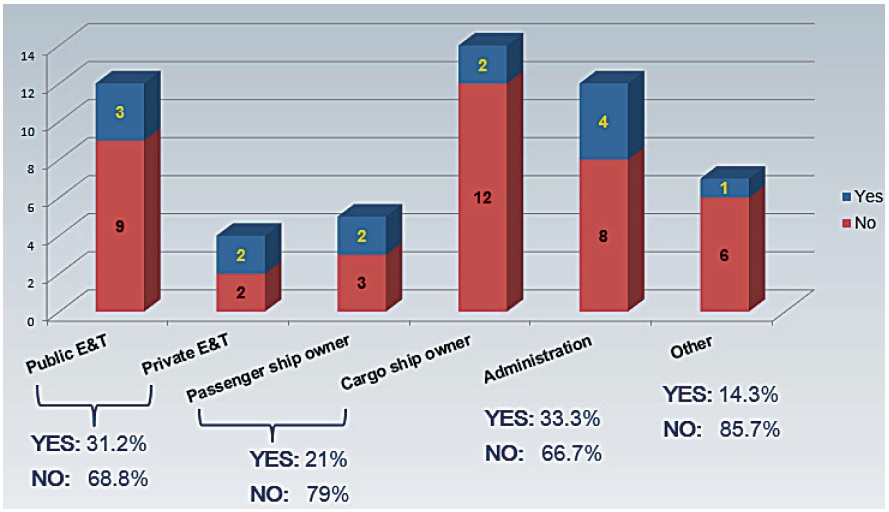

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Figure 2 Division of the organizations according to their experience with navigation simulators
Slika 2. Raspored organizacija prema iskustvu s navigacijskim simulatorom

Source: Author

Figure 3 Inland navigation simulator at the University of Zilina, Slovakia
Slika 3. Simulator za kontinentalnu navigaciju na Sveučilištu Zlina, Slovačka

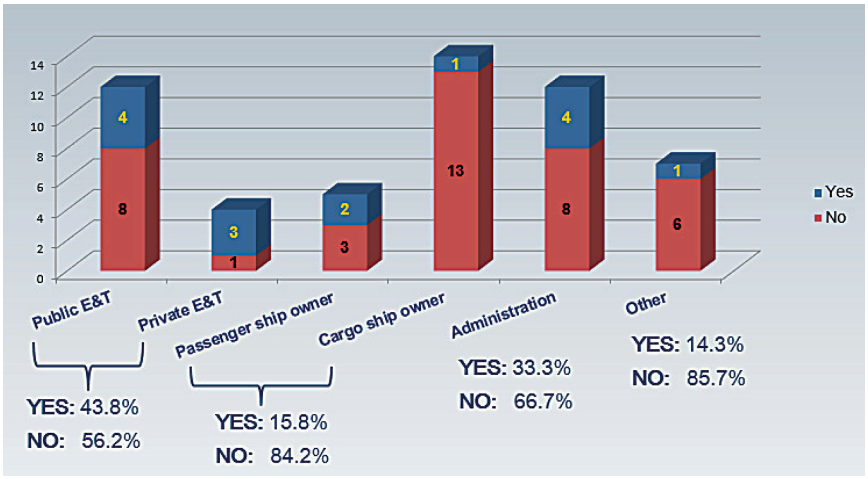

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Figure 4 The interest of the organizations in buying or renting simulator
Slika 4. Interes organizacija kod kupnje ili iznajmljivanja simulatora

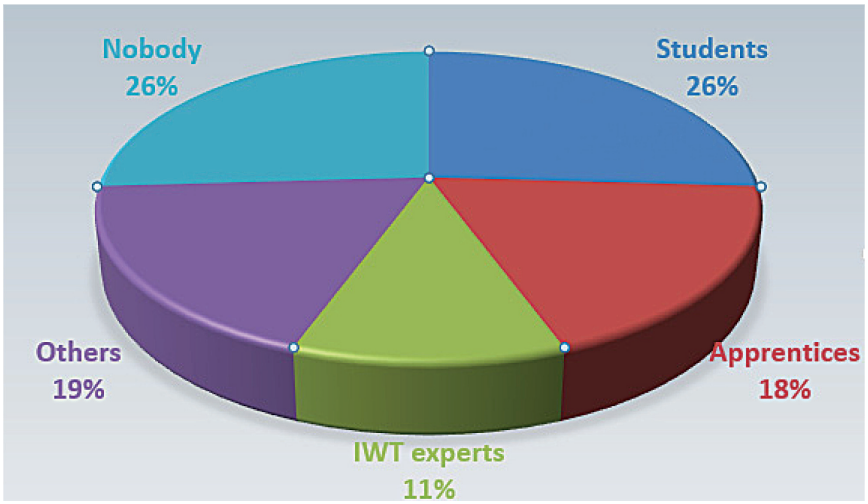

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Figure 5 Expected users of the simulator
Slika 5. Očekivani korisnici simulatora

filled this questionnaire focused on the topics related to the technological and educational functions of the Danube navigation simulator. The selected organisations were interviewed such as cargo/passenger operators, educational institutions (private/public) and authorities (see Figure 1).

About 25 % of the organisations have already had some experience with navigation simulators. Only 2 partners from Slovakia and the Ukraine have had experience with inland navigation simulators like the University of Zilina, Slovakia and Odessa National Maritime Academy, the Ukraine.

A few organizations are planning to buy or rent a simulator. It mainly depends on their financial situation. Nowadays most of them do not have enough funds to buy their own simulator. One way how to solve this problem is to establish an international association that could buy and operate it.

Simulator should be used for training of these job positions:

- ship crew on management level (Boatmaster, captains, etc.),
- ship crew on the deck at operational level (deckhands, boatswain, etc.).

According to the survey the target group of the simulator should be mainly students and apprentices (See Figure 4).

Note: "Nobody" means that the respondents do not want to use simulator. Other suggested users of practical training on simulator should be: water police, customs authorities, IWT experts of authorities or other operative staff of IWT.

The respondents suggest training mainly in the following areas like navigation and maneuvering, using of radar, I-ECDIS and AIS (see Figure 5).

About 50 % of the respondents consider that simulator can replace practical training on the vessel. On the other side 45 % of them realize that practical navigation training cannot be replaced.

The survey was also aimed at analyzing the relevant exercises which should be trained on the simulator. Training scenario should consist of the following exercises:

- passing and overtaking vessel,
- mooring,
- anchoring,
- locking,
- convoy set up,
- specific manoeuvers,

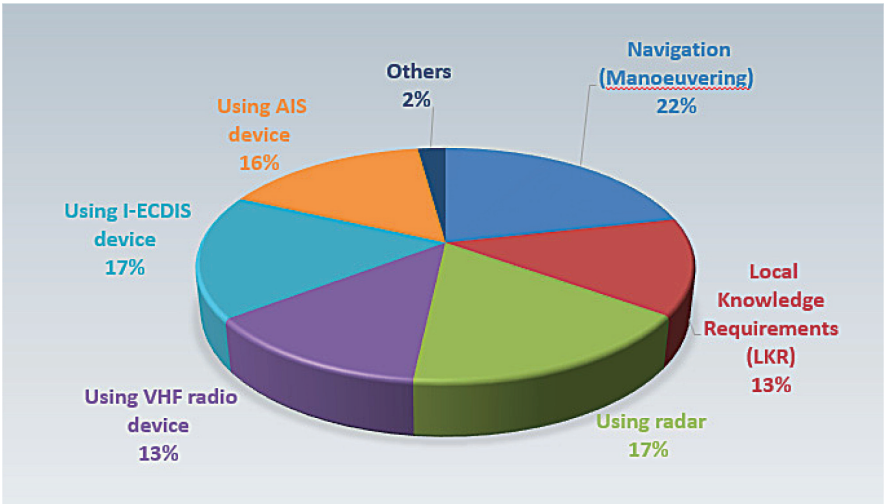

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Figure 6 The structure of the topics trained on the simulator
Slika 6. Struktura tema koje se uče na simulatoru

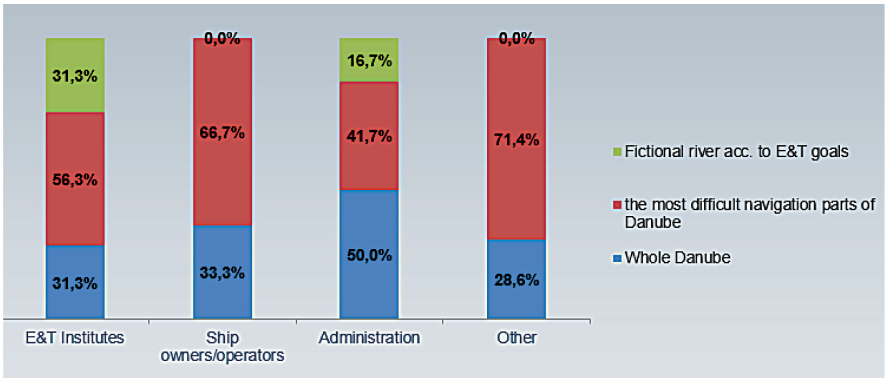

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Figure 7 Selected parts of the Danube for simulation according to the organization
Slika 7. Odabrani dijelovi Dunava za simulaciju prema organizaciji

- navigation in the different weather conditions (fog, wind, rain, snow, etc.),
- navigation in complex current stream,
- navigation in channel and in shallow water; grounding and squat,
- emergency situations,
- navigation and communication events (use of radar, radio, AIS, ECDIS, etc.).

The most preferred education topic is navigation, but all activities in the wheelhouse should be trained. Other important topics should be navigation in different weather conditions and emergency situations. All respondents think that more than one type of vessel should be simulated. They would like to simulate a single vessel and convoy as well. [3,9]

Simulation of the Danube is very difficult, because some parts of the Danube are not regulated (the middle and lower part). The river bed in these areas is unstable.

Most of the organizations are interested in using navigation simulator. Only less than 20 % of them would not like to use them for navigation purposes.

The participation in financing the simulator depends on the financial situation of the organizations. The private or public educational institutions would like to participate in the financing of simulators, but it will depend on the way of financing. Other institutions are not interested in buying or renting of simulator. [7]

TYPES AND CHARACTERISTICS OF SIMULATORS IN NAVIGATION / *Tipovi i karakteristike simulatora u navigaciji*

The navigation simulation of a vessel means the mathematical modelling of ship motions, which is controlled by control devices, and the visualization of ship motions in a specific environment. The simple simulation tasks can be fulfilled by analytical calculations, but for education or research purposes a computer based special tool is needed.

The tool of ship motion computer simulation is the navigation simulator, which can have several application aims:

- engineering (e.g. ship motion prediction, waterway infrastructure engineering, etc.),
- nautical analysis of waterways (e.g. port and waterway infrastructure design, etc.),
- accident reconstruction,
- crew training,
- demonstration.

Depending on the simulation purposes the computer

simulation requires high quality visualization and/or very accurate mathematical model, validated by ship and environment tests.

TECHNICAL PERFORMANCE OF VISUALIZATION / *Tehnička izvedba vizualizacije*

Visualization of the environment for the inland navigation simulator has to be based on the minimum requirements for a sectorial view from the wheelhouse on a real vessel. For simulation it is important to ensure "visual check" of the vessel movement during maneuvering.

Sectorial view consists of the following visible objects:

- water level (calm water, water in motion, water with ice),
- objects on the water, onshore objects, parts of the vessel seen from the wheelhouse (in the horizontal and vertical level),
- atmospheric conditions (wind, cloudy, sunshine) and its level, direction and height.

Visualization (on the screen, monitor or display) of the objects are defined with:

- visualization characteristics (size, dimension, color, level of details),
- ntensity and clarity of visualization depending on the visibility (effects of rain, snow, fog, navigation at night etc.),
- conformal visualization (corresponding to layout of the objects).

Visualization is in accordance with physical laws generated with movement of the vessel for:

- visual measurement of the distance from the vessel to the objects,
- smooth transition of scenes generated with the movement of the vessel or other displayed objects in motion,
- the visibility of signal lights and the audible (sound) signalization on the vessel and from the vessel,
- the particular displayed place (point) and an adequate indication of its position on the relevant control device.

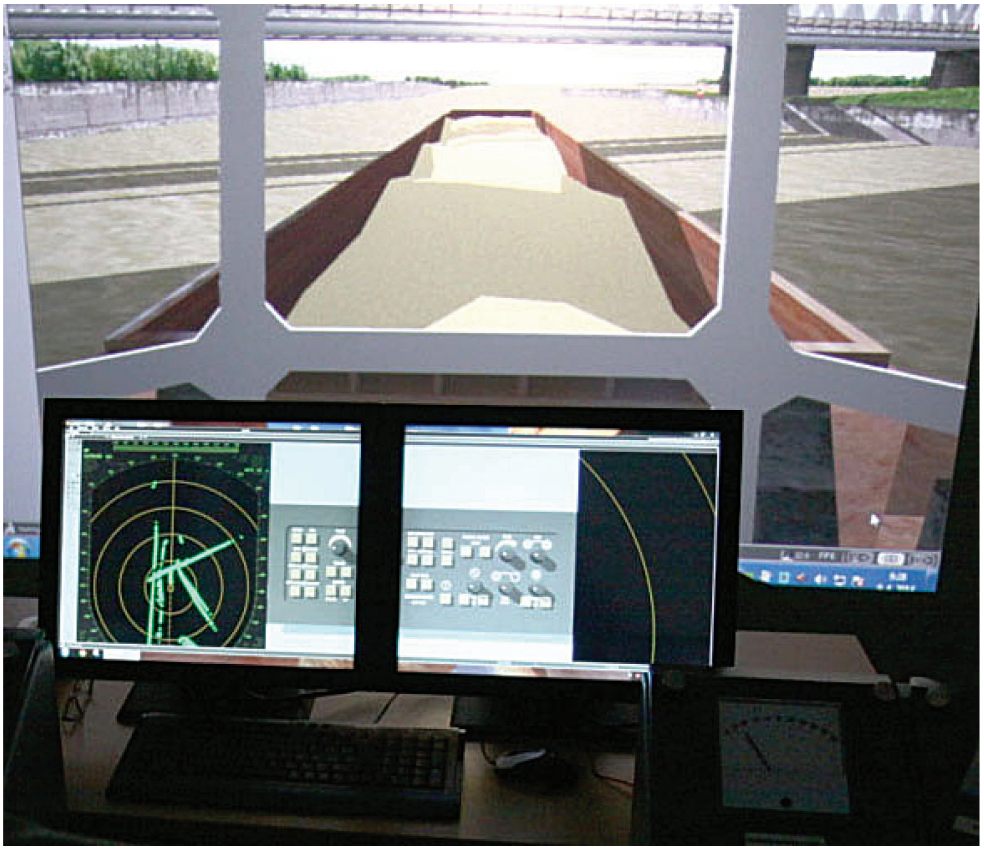
Technique of displaying must be panoramic displaying the most real environment and the individual objects around the vessel in real dimensional parameters. This provides the basic overview of the navigation conditions ahead, on both sides and behind the vessel. These factors are important for decision making process during the operation of the vessel. Other dimensional design significantly reduces the authenticity of real conditions and reduces the level of navigation training (distance estimation, the movement of the vessel, reaction time). [11]

TRAINING ROOM REQUIREMENTS / *Zahtjevi učionice*

The simulator consists of a lot of parts which provide its operating process. They are located in different parts of the navigation simulator center.

They are divided into:

- wheelhouse room,
- instructor room



Source: http://www.hintproject.net/getpage.php?page=danube-simulators

Figure 8 Full mission inland navigation simulator – example

Slika 8. Simulator kompletne kontinentalne navigacije - primjer

Source: Author

Figure 9 Top perspective of a simulator center
Slika 9. Perspektiva središta simulatora iz zraka

- multisession office
- briefing room
- technical room
- locker room,
- office room.

The wheelhouse room consists of the maquette of the wheelhouse that was created according to the real wheelhouse of the vessel. This room is designed for one trainee and his / her instructor. The room also has to have appropriate lightening and air conditioning.

The instructor room is used for the control of whole training process of a trainee on the navigation simulator by an instructor. In the room the instructor may set up, stop, pause, continue, repeat and store the training voyage on his computer. The room is designed for 1 or 2 instructors. There is also appropriate hardware equipment. The room is located between the wheelhouse and multisession room and it has windows into the both rooms.

The multisession room is designed for the control of ships in the voyage scenarios in the system multisession. The standpoints have limited visualization and equipment with nautical devices. It is designed for 3 and 4 persons.

The briefing room is used for preparation of training process and its monitoring, playing record from training voyage and its analysis. The room is equipped with an interactive whiteboard or a projecting screen, desks and chairs for the instructor and his / her trainees. It also has to have a direct communication connection with the instructor. It is designed for 5 and 6 persons.

The technical room consists of hardware components (computers) that manage the whole management operational system of the training. It also includes cable data network that links the computers to other rooms (wheelhouse room, instructor room, and multisession room). The locker room serves for changing and storing clothes of the trainees. It is designed for 12 persons.

The office room is designed for administrative work of instructors related to the operation of simulator. It is designed for 1 or 2 persons. [11]

CONCLUSION / *Zaključak*

The requirements for inland navigation simulator differ depending on the specific Danube country. It is due to its potential exploitation, which is different for each country. The harmonisation of the requirements and creation of the concept of the Danube navigation simulator is important in relation to the objectives and unification of education in the field of water transport.

The basic goal was to analyse the status quo in the field of inland navigation simulators in the Danube countries. It could provide the basis of the real future concept of the Danube navigation simulator. The idea of the development of the Danube navigation simulator mainly depends on its funding. Since it is a very expensive affair, it is necessary to find the way of financing it. One possibility is to establish an international association that will operate a Danube Navigation simulator centre. It seems as the most feasible course of action, from economical point of view. In this case the countries could

use even the national or international funds for building, maintaining and developing simulators, and for organizing national and international trainings.

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