Cross-Section of ECDIS Education and Training Worldwide and in the Republic of Croatia: Relations Between Programs and User Perceptions

M. Car[1], S. Tominac Coslovich[2], D. Brčić[2] & S. Žuškin[2]
[1] *University of Dubrovnik, Dubrovnik, Croatia*
[2] *University of Rijeka, Rijeka, Croatia*

ABSTRACT: Besides its obvious benefits, the Electronic Chart Display and Information System (ECDIS) continues to develop as a sophisticated, complex system. With ever-growing features and the integration of external data and sources, it is nowadays normally considered as one among the compact elements forming a part of an even more complex Integrated Navigation System (INS). The ECDIS handling requires a certain level of technical knowledge and operational skills to be gained, besides the usual navigational background. To utilize the system efficiently and safely, the navigator has to obtain several levels of education. The ECDIS Generic Training (EGT), as defined in the respective International Maritime Organization (IMO) Model Course, introduces the navigator to fundamental, required operational (however introductory) and theoretical knowledge. Apart from the EGT, there is an optional, ECDIS manufacturer-approved Equipment Specific Training (EST). The latter represents a special type of training where the navigator improves his theoretical knowledge, understanding, and proficiency, together with competence demonstration on a specific approved ECDIS model. This paper elaborates the dynamics of worldwide regulations on the ECDIS Education and Training (EET) plan. The reference is given to training procedures in the Republic of Croatia, placing its educational framework in the broader context. Although the EST is unofficially considered non-mandatory, there is a stable and reasonable ground to consider the opinions and arguments of the navigators who prefer the EST. This is also supported by the fact that there is a large number of approved systems on the market. Apart from fulfilling the performance standards regulated by the IMO, ECDIS models differ significantly regarding handling, interface, and interpretation of data and information, therefore biasing the required knowledge and the purposefulness of the system. The survey among navigational ranks was used to support the study and to relate the existing programs to the actual navigational situation. The aim was to consider the current relationship between the defined EET programs, their differences and the actual user needs. The selected questions referred to the possession of ECDIS certificates and basic education and knowledge, and the navigational ranks' opinions regarding the opportunity to enhance their knowledge during the EST. The latter considered a lack of standardization (including terminology), apart from the issue of different levels of education. As was expected, the answers were not uniform, revealing differences in opinion as well as in basic system interpretation. The latter could have possible causes and relations to the particular education system in the first place. The current educational framework was discussed in terms of EET enhancements and the development of the navigation curricula. The study results have been presented and discussed systematically, leading to observations on the potential safety of navigation improvement.

1 INTRODUCTION

As a computer-based and essential system, the ECDIS plays a crucial role in navigation. The Chapter V of the International Convention for the Safety of Life at Sea (SOLAS) administers nautical charts and nautical publications carriage requirements. As of 1 July 2018, the system became the primary navigational means

for most vessels regulated by the SOLAS convention [18]. To utilize the system as a means of navigation, Officer Of the Watch (OOW) has to own the flag state-approved EGT certificate as per Standards of Training Certification and Watchkeeping (STCW) [19]. Approved system certification should follow the IMO Model Course 1.27, ensuring that the training attendee learns to use the system in all aspects of maritime navigation [21]. The International Safety Management (ISM) Code demands to provide adequate training for personnel engaged in the company's safety management system rules and regulations [20]. It is the company's responsibility to ensure that all officers are properly trained and familiar with system features before its operational use at sea, i.e. that they own the ECDIS EST certification or possess a proper familiarization checklist onboard vessel.

This paper discusses system training regulations worldwide and in the Republic of Croatia. The purpose of the proposed research was to identify present regulations concerning the system training and to compare and analyze compliance with mandated policies. Legislative acts together with an insight into the world's training centers' training programs served as a motivation to broaden the research. The authors conducted two segments of research based on two separate surveys, i.e. one before and one after the ECDIS transitional period completion respectively. Both surveys were distributed worldwide among the eligible maritime navigational ranks. The respective answers were analyzed and summarized. Even though ECDIS undeniably contributes to the safety of navigation, it is necessary to consider the fact that not all of the OOWs own the ECDIS EST. The undertaken research study recognized a need for a more thorough focus on certain topics of interest pertaining to system utilization.

The paper is divided into six chapters. In the introduction, basic terminology associated with the ECDIS system and system operators' certification was elaborated. In the second chapter, background and previous research were summarized. In the methodology chapter, the research design of the study was described. Results were presented in the fourth chapter, referring to the analyses of ECDIS education requirements worldwide and the results of survey analyses. In the concluding chapters, the research results were discussed and findings presented and summarized.

2 BACKGROUND

The ECDIS system has been designed to enable safer and easier maritime navigation. Besides its primary scope, additional benefits have been recognized. The IMO prescribes useful guidance on the system use, which is divided into seven sections: the SOLAS requirements concerning chart carriage, system software maintenance, ECDIS system anomalies, usage of the Raster Chart Display System (RCDS) mode on ECDIS, officer training requirements, possible issues in transitioning from Paper Navigational Charts (PNC) to ECDIS navigation and guidance on ECDIS simulator training [22].

Digital navigation systems raise important questions regarding the OOW's adaptation to and interaction with a specific digital system [5][6]. In order to gain proper basic training prior to system handling, the candidate (OOW) has to be proficient in informatics literacy and possess navigational skills, including a certain amount of sea experience. The EGT course refers to the basic understanding and utilization of the system. Also, an OOW must be familiarized with the onboard equipment. This can be achieved as follows: by attending a course, a ship-specific ECDIS familiarization, computer-based training, and cascade training [4]. Furthermore, it is necessary to consider that ECDIS models, as perceived by the end-users, vary from user-friendly to complicated, potentially leading to ignorance and navigational issues (Figure 1).
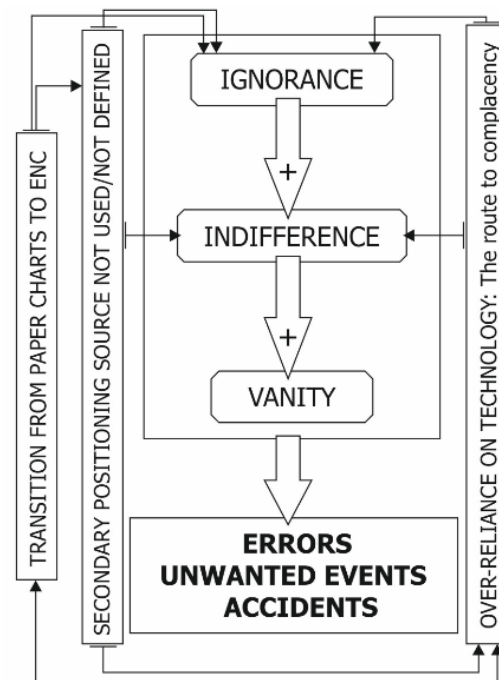

Figure 1. Model of unwanted course of events [9]

Various activities have been identified in order to eliminate potential system-related problems [3]. Despite the suggested utilization of unconventional methods and biometric tools in the maritime education process [30], it is necessary to take into consideration previously conducted surveys and research results (Figure 2) which have indicated potential problems on different levels.
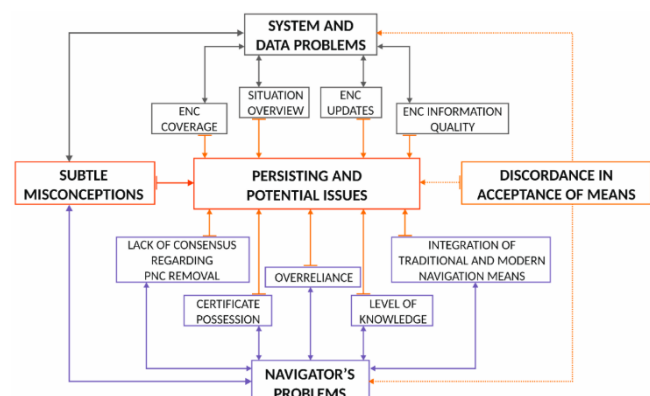

Figure 2. The model of potential system-related issues [8]

With emerging technologies, it is necessary to provide more specific guidance to instructors regarding training and teaching methodologies [35]. It is evident that each training method has its advantages and disadvantages [24].

Even though the research advancements in the maritime universities are concentrating on the implementation of new technologies [27], there is an indication that officers are not adequately trained concerning the latest emerging shipboard equipment [31].

Moreover, a mandatory EGT course covers only basic foundations, and there is a notable amount of opinions regarding the insufficiency of the 40 hours' duration of the training [4]. Necessary steps have already been proposed to revise and update the existing IMO model course on operational system use [36].

3 THE RESEARCH DESIGN

The research was conducted in several interrelated phases. The IMO, SOLAS and STCW ISM regulations and directives regarding system operators' certification worldwide and in the Republic of Croatia were analyzed. Subsequently, the authors focused on the Maritime Education and Training (MET) plan and ECDIS mandatory courses, and optional training requirements. The quality and results of the collected data were complemented with the results of two separate parts of the research: i) The ECDIS EHO (Experience, Handling and Opinion) survey and ii) HMI (Human Machine Interface) survey. The ECDIS EHO research commenced at the beginning of the system implementation period to improve educational processes and to develop an appropriate curriculum in order to increase the level of knowledge of the ECDIS central stakeholders. One of the research tools used was an international questionnaire consisting of introductory (profile-defining) and topic-related questions. The research focused on the feedback received from navigational ranks and other ECDIS stakeholders. The HMI survey was distributed to the international maritime professionals, containing 19 introductory and topic-related questions, representing the continuation of the research and referring to the period after the transitional period completion.

The proposed research was focused on eligible navigational ranks: Masters, Staff Captains, Chief Officers, Safety Officers, 1st Officers Navigation, Second Officers, and Third Officers. The surveys were distributed to officers with navigational ranks and at least one year of active seagoing experience. Introductory questions in both surveys (the rank and working experience) were used to categorize the profile of the respondents.

The following topic-related questions from the EHO and HMI questionnaires were analyzed:
– Possession of the EGT Certificate,
– Possession of the Type Specific/ECDIS manufacturer-approved equipment-specific training.

Also, the following topic-related questions from the HMI segment of the research were further evaluated:
– If you would have the opportunity to enhance your knowledge about ECDIS, from which part of the manufacturer-approved equipment-specific training would you benefit the most? (Q1)
– Do you think that besides owning the EGT, it is also necessary to complete manufacturer-approved equipment-specific training? (Q2)
– If your answer to the previous question is "Yes" please specify reasons. (Q3)

Summarized results were provided for two elaborated topic-related questions and three (Q1 - Q3) topic-related questions from the HMI segment of the research.

4 RESULTS ON EET ANALYSIS AND OUTCOME OF SURVEYS

4.1 *ECDIS system training worldwide*

The maritime industry is fast-growing, with the modernization of the systems being introduced daily. Among all stakeholders, the ECDIS users (OOWs) constantly need to adapt and extend their knowledge. One of the main components of the MET plan is the EET program, consisting of i) the mandatory course and ii) optional training.

The mandatory course (EGT) follows the IMO Model Course which can be used by any certified maritime training institution. The duration of the training is a minimum of 40 hours. The course consists of 40 topics, divided into 5 different subject areas; defining the basic elements of the system; explaining watchkeeping procedures with the system; passage planning with ECDIS; system integration with other electronic navigational devices; and clarifying legal responsibilities when utilizing the system as a navigational aid and defining successful maritime navigation venture with the system. The main goals of the training are to teach candidates how to operate the ECDIS equipment and to recognize potential errors and system limitations [21].

One of the most common training options is ECDIS EST. There are no existing requirements for the ECDIS EST, even though it is required of the OOWs to demonstrate the knowledge and operational skills when handling the specific equipment [23].

In regard to the EET program, subsequent remarks are crucial for trainees to comprehend when learning about the system: to navigate by utilizing the system as a navigational aid, to appropriately adjust relevant settings and to recognize system limitations.

4.1.1 *Generic ECDIS training worldwide*

The EGT program was reviewed as conducted in 8 countries worldwide (Table 1). From the selected training centers, the following data were gathered: name of the training center and city where it is situated, entry standards for the candidates, course highlights, duration and price of training.

Table 1. Some of the worlds' maritime navigation training centers

Country	City	Training Center	Entry Standards	Course Highlights	Duration	Price
UK	Whiteley	ECDIS Ltd.	Specified/as per STCW	Specified	5 days	905 €
USA	Seattle	Compass Courses	Specified/as per STCW	Specified	5 days	1.156 €
NZ	Auckland	Manukau Institute of Technology	Specified/as per STCW	Specified	5 days	712 €
Australia	Launceston	AMCsearch Training Center	Specified/as per STCW	Specified	5 days	2.035 €
Turkey	Istanbul	Ocean Training Center	Not Specified	Specified	40 hours	Not Specified
Netherland	Vlissingen	De Ruyter Training & Consultancy	Specified/as per STCW	Specified	5 working days	Not Specified
Brazil	Barra de Tijuca	Vision Marine	Specified/as per STCW	Specified	5 days	Not Specified
Ukraine	Odessa	Odessa Maritime Training Center	Computer working skill	Specified	5 working days	Not Specified

Source: Made by authors based on [1, 9, 10, 12, 25, 28, 29, 34]

All training centers have specified course highlights and duration of the course which amounts to 5 consecutive working days, or 40 hours respectively. Entry standards have been specified in all training centers except in the Ocean Training Center, Turkey. From the advertised course prices, it is evident that the most affordable EGT is taking place in Auckland, New Zealand, while the most expensive one is in the AMCsearch Training Center in Australia.

Apart from the mandatory EGT, the STCW convention requires that seafarers are provided with the ECDIS EST before the actual handling of the system, as elaborated further.

4.1.2 ECDIS manufacturer-approved equipment specific training

According to Flag state regulations, it is the company's responsibility to ensure that all OOWs are properly trained and familiar with all system features before they utilize the system at sea as an official maritime navigational aid. As presented in Table 2, the duration of the ECDIS EST is not uniform among ECDIS manufacturers. While SIMRAD, Kelvin Hughes and SAM Electronics perform a shorter training (8 hours), other manufacturers prefer a course of 16 hours.

Table 2. ECDIS EST duration [38]

ECDIS Manufacturer	Duration of the EST (hours)
SIMRAD	8
KELVIN HUGHES	8
SAM ELECTRONICS	8
KONGSBERG	16
TRANSAS (WÄRTSILÄ)	16
JRC	16
RAYTHEON ANSCHÜETZ	16
SPERRY MARINE	16
FURUNO	16
IMTECH MARINE	16
DANELEC MARINE	16
CHART WORLD	16

Flag state regulations concerning the ECDIS EST are provided in the following table. While some Flag States (e.g. Bahamas) are strict in terms and conditions on how to obtain the ECDIS EST, others (e.g. India) are leaving it up to shipping companies to decide on the means of familiarization and documentation.

Table 3. Flag states regulations concerning the ECDIS EST eligible methods

Flag State	ECDIS EST requirements
Bahamas	To be built on EGT and delivered by one of the following methods: i) by the ECDIS manufacturer; ii) by the ECDIS manufacturer's approved agent; iii) by the trainer who has attended a manufacturer's program; iv) utilizing a manufacturer's approved computer-based training; v) utilizing structured training program documented in the ship's safety management system.
Marshall Islands	OOW has to own the EGT certificate in order to operate the type-approved ECDIS equipment. Prior to assuming a navigational watch, the OOW has to complete the ECDIS EST in accordance with the shipboard Safety Management System procedures.
Gibraltar	OOW has to own the EGT certificate in order to operate the type-approved ECDIS equipment. The recommended training program for the OOWs to obtain ECDIS EST is manufacturer-approved computer-based onboard training.
India	No requirements for the ECDIS EST. It is left up to the shipping companies to decide how they perform the familiarization and how they document it.

Source: Made by the authors based on [15, 16, 26, 32]

At present, there are approximately 40 manufacturers and/or model approved ECDIS systems on the market, with the same number of ECDIS software system providers. Each of the models is characterized by its interface design, graphic and software solutions [13, 17], and it is not difficult to recognize the additional, demanding task for ECDIS trainees, who need to learn all aspects of system operation and become proficient in the system utilization, apart from the previously mentioned types of system-related training and potential difficulties.

4.1.3 ECDIS-related courses

Apart from the described courses, there is more system-related training available concerning other stakeholders, such as Inspector ECDIS Audit Course, ECDIS Concept and Capability, ECDIS Operator Refresher Course, etc. [12]. Keeping in mind that around 6 % of all Australian Maritime Safety Agency (AMSA) detentions fall under the findings related to

the system [7], justification of the Inspector ECDIS Audit Course (where some of the topics are crew competency assessment and best practice for the safe navigation with ECDIS) [12] is evident. Concentrated campaign requirements where officials are checking system operators' certificates and knowledge [2] are highlighting the importance of all training even more.

Mandatory and optional training courses and dissimilarities in the EGT entry standards, ECDIS EST course duration and ultimately, lack of the official existing requirements for the ECDIS EST [23], served as a motivation to consult ECDIS system training regulations in the Republic of Croatia, as presented further.

4.2 ECDIS system training in the Republic of Croatia

In the Republic of Croatia, seafarers can obtain an EGT certificate after completing the formal educational course in certain maritime schools, faculties of maritime studies (undergraduate education), or in one of the private maritime training centers. The present academic year 2020/2021 is the first year in which Maritime School in Dubrovnik will commence with a training certification. It is also important to note that regulations regarding certification are not the same among maritime faculties in the country. While some faculties will issue the EGT certificate after the student has completed the ECDIS-related course as a part of the regular educational process, that may not be the case in other maritime faculties. The maritime training center at the University of Dubrovnik offers an EGT course for the candidates. Training topics (Table 4) are divided into three major groups: chart settings, voyage planning and voyage monitoring. The duration of the training is 40 hours. Entry standards are not specified and the price of the training is 375 euros. After the training is completed, the candidate receives a certificate of attendance and there is no state exam required by the respective Ministry.

Table 4. EGT topics – University of Dubrovnik

Chart settings	Voyage planning	Voyage monitoring
Own ship	Route managing	Route loading
Safety parameters	Route editing	Chart selection
Presentation	Critical points	Waypoints input
Symbols	Object info	Vector
Chart managing	Route validation	Watch vector
		Primary position sensor

Source: Made by authors based on [33]

At the Faculty of Maritime Studies in Rijeka the EGT course is performed both as a part of the regular STCW educational program for the bachelor's degree in nautical science, as well as a navigator's course with an advertised price of 532 euros. Here, it is possible to obtain two additional certificates, namely for the Additional ECDIS Instruction Course (AEIC) and the ECDIS Stakeholders Management Course (ESMC), both held by the Faculty's Maritime Training Centre and Life-Long Learning [14].

Maritime training center in Split also offers an EGT course. The program of the training is briefly specified. The duration of the training is 40 hours, with no prescribed standard entry requirements. There is no exam after the completion of training and receiving certification [11]. Regarding the ECDIS EST, maritime training centers [11, 37] are offering training for the Transas system, with a duration of 2 days.

4.3 Survey results

A total number of 402 seafarers were engaged in both research segments, with 269 ECDIS EHO respondents and 133 HMI respondents, respectively. All participants were active maritime professionals with seagoing experience of at least one year.

ECDIS EHO survey (presented further with blue color graphs) participants' ranks and working experience is presented in Figure 3. Survey participants' ranks are classified as follows: Master, Staff Captain, Chief Officer, Safety Officer, Second Officer and Third Officer. Out of all the participants, the biggest share of the responses (37 %) falls under the rank of the Master. The working experience of the ECDIS EHO survey participants has been classified into five separate groups. The first group encompassed the survey participants with less than 5 years of working experience. The second group consisted of the survey participants with working experience of 5 to 10 years. The third group was a group with the biggest share of the survey participants (40 %), with working experience ranging from 10 to 20 years. The fourth group (37 %) comprised survey participants with working experience of more than 20 years. The fifth group consisted of the survey participants who did not specify their working experience.
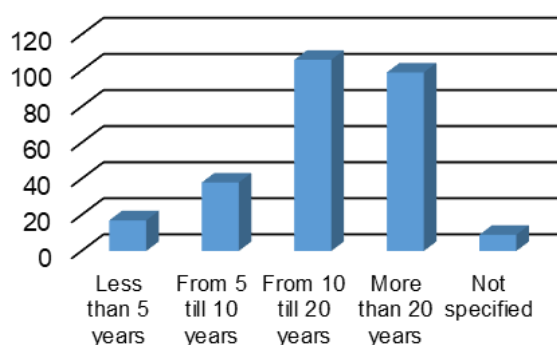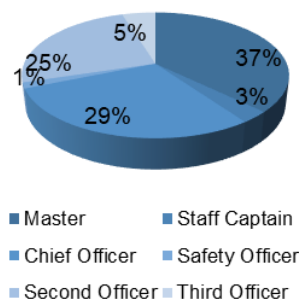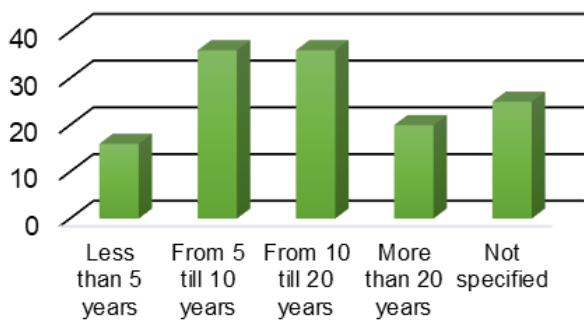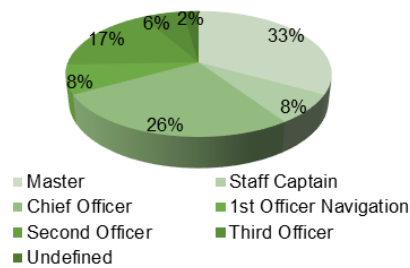

Figure 3. Navigational ranks of the survey participants (top) and survey participants' seagoing experience in years (bottom). Source: Authors

The HMI survey (presented further with green color graphs) participants' ranks and working experience are presented in Figure 4. Survey participant ranks were classified as follows: Master, Staff Captain, Chief Officer, 1st Officer Navigation, Second Officer and Third Officer. The working experience of the HMI survey participants has been classified into five separate groups. The first group consisted of the survey participants with less than 5 years of working experience. The second group included survey participants with working experience ranging from 5 to 10 years. In the third group, there were survey participants with working experience ranging from 10 to 20 years. The fourth group comprised the survey participants with working experience of more than 20 years. In the fifth group, there were survey participants who did not specify their working experience.

Figure 4. Navigational ranks of the survey participants (top) and sea experience in years (bottom). Source: Authors

As stated previously, the largest number of the HMI participants (33 %) was sailing in the rank of Master. Regarding the seagoing experience, the largest number of survey participants falls in the second and third groups (27 % each), with the working experience ranging from 5 to 20 years.

The distribution of answers regarding possession of the EGT certificate during the duration of the ECDIS EHO segment of research is presented in Figure 5. There were 61 % of the survey participants who owned the specified certificate. The general distribution of answers regarding certificate possession was also elaborated regarding the year of the questionnaire submission. Answers (Yes/No) were distributed within the bars and classified according to the questionnaire submission year. The share of responses is presented with a 100 % stacked column chart. The most significant positive relative distribution of answers regarding the possession of the EGT certificate was in 2018 and it amounted to 88 % of the total answers' distribution.
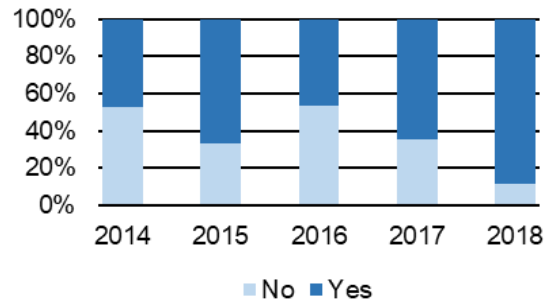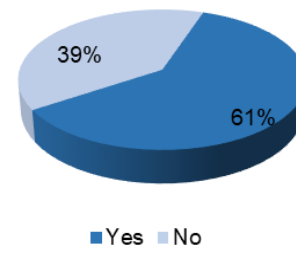

Figure 5. General possession of the EGT Certificate (top) and divided by years (bottom). Source: Authors

The distribution of answers regarding ECDIS EST possession is presented in Figure 6. In general, throughout the duration of the ECDIS EHO research, there was slightly less than half (47 %) of the survey participants owning the EST. The general distribution of answers (Yes/No) regarding certificate possession was also elaborated regarding the year of the questionnaire submission. The share of responses is presented with a 100 % stacked column chart and the most significant positive relative distribution of answers regarding the possession of the ECDIS EST certificate was also in the year 2018, amounting to 90 % of the total share.
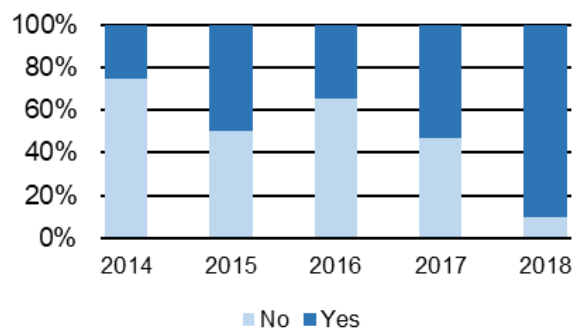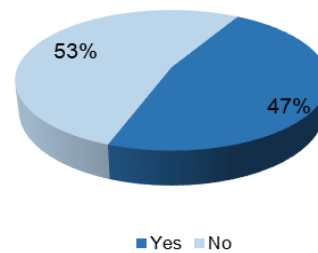

Figure 6. General possession of the ECDIS EST certificate (top) and classified by year (bottom). Source: Authors

During the transitional period, there were survey participants in possession of the EGT certificate or ECDIS EST solely, as opposed to those who owned both certificates (43 %) (Figure 7).

The distribution of answers regarding survey participants who owned the EGT certificate and ECDIS EST during the HMI segment of the research is presented in Figure 8. All of the survey respondents (100 %) owned the EGT certificate, and only 10 % did not own the ECDIS EST certificate.
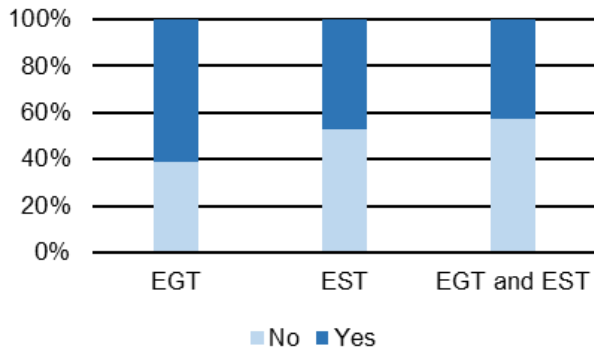

Figure 7. Possession of the EGT certificate, ECDIS EST and both certificates. Source: Authors
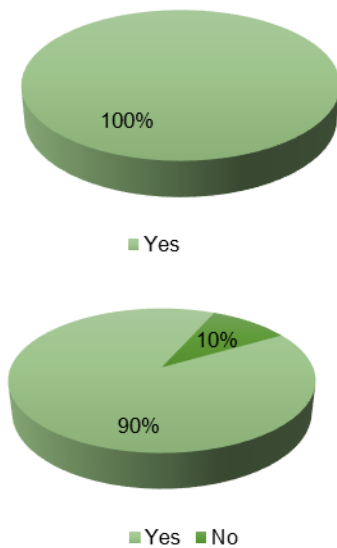

Figure 8. Possession of the EGT (top) and ECDIS EST certificate (bottom). Source: Authors
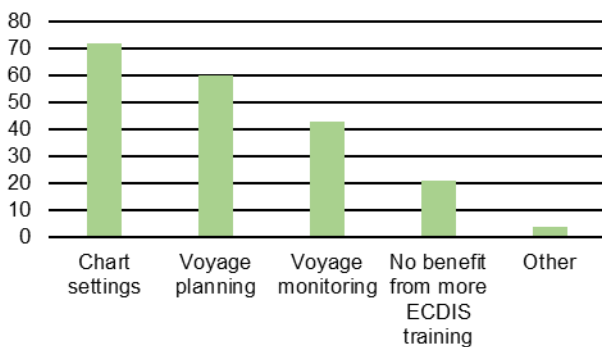

Figure 9. Clustered bar chart representing survey participants' comments on the possibility of enhancing knowledge about ECDIS from the manufacturer-approved equipment-specific training. Source: Authors

Clustered bar chart (Figure 9) represents answers (Q1) regarding the opportunity to enhance knowledge about the system during the ECDIS EST. The HMI survey participants could select one or more offered learning options. More than half (54 %) of the respondents specified Chart settings as a point of interest that would call for more thorough learning sessions. Voyage planning has been selected by 45 % of the participants, while 32 % of respondents selected the Voyage monitoring option. There were almost 16 % of participants who did not see any benefit in additional system-related training.

The survey respondents' opinions regarding the ECDIS EST necessity (Q2) and benefits of the ECDIS EST (Q3) are presented in Figure 10. The majority of survey participants (83 %) agree on the significance of the EST (Q2), while 17 % consider the above-mentioned training redundant. Participants' opinions (Q3) regarding the benefits of the EST are presented in the clustered bar chart. 57 % of the recorded answers fall in the category of the reduced familiarization time when operating with different ECDIS models. Apart from that, 56 % of survey participants mentioned insufficient standardization of the ECDIS chart settings, voyage planning and voyage monitoring functions, while 42 % of the answers referred to the ECDIS graphical user interface category, which widely differs between system manufacturers.
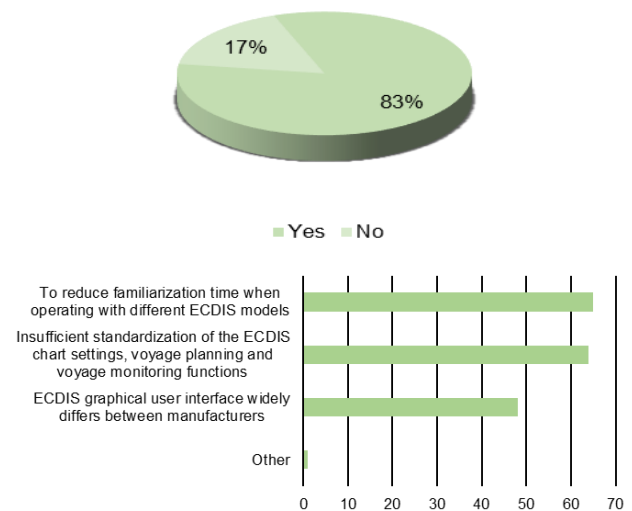

Figure 10. Distribution of answers regarding the necessity of the ECDIS EST (top) and survey participants' comments regarding the benefits of the ECDIS EST training (bottom). Source: Authors

When it comes to the participants' working experience, most of Masters, as dominant respondents, were experienced seafarers with working experience of more than 5 years. The percentage of the survey participants who own the EGT Certificate has risen from 61 % (ECDIS EHO) to 100 % (HMI survey). The percentage of the survey participants who own the ECDIS EST has risen from 47 % (ECDIS EHO) to 90 % after the mandatory system implementation (HMI).

5 DISCUSSION

Regulations regarding system training are prescribed by the IMO, SOLAS and STCW convention, ISM code and Flag State administration. The entry standards for the future system operators' candidates are not globally uniform. For instance, in order to enroll in the EGT course in the Compass Training Center, trainees must be familiar with terrestrial navigation, visual navigation, must have accomplished at least a period of supervised bridge navigational watch and have basic knowledge about radar [9], which are also defined as prerequisites in the IMO MC. At the same time, there are no prescribed entry standard requirements at all [29, 33]. On top of everything, certain training centers are advertising the EGT course by emphasizing that the final exam after the course is not required [11]. Also, the differences in course prices are evident. Considering that [21] the required course model is the same for all training centers in the world, it is necessary to determine why the EGT course price is ranging from 375 € to 2035 €. A legitimate question can be raised as to why this training is five times more expensive in Australia than in Croatia. Does the price of the training reflect on the quality of the delivered training, especially when considering that some training centers are openly advertising that candidates will obtain certificates without any formal examination upon completing the training?

Survey data analysis showed that the EGT certification had increased by an additional 39 % when comparing the EHO and HMI segments, adding up to 100 % at the end. When it comes to the ECDIS EST, certification among seafarers had increased from 47 % to 90 % during the HMI segment. Even though the majority of the survey participants (84 %) specified at least one subject-related topic they would like to learn more about during the familiarization training, some Flag states consider 8 hours of training to be sufficient. More than 80 % of participants recognize the necessity of the ECDIS EST. Thus, they specified the following arguments: reduced necessary familiarization time, insufficient standardization of the system settings and different graphical user interfaces among system manufacturers. These legitimate remarks can further enhance the EET program. A more focused approach to certain subjects of interest would surely contribute to the safety of navigation. Furthermore, it is necessary to determine why entry standards for the EGT certification and ECDIS EST duration are not the same in all maritime training centers across the world. Also, special focus should be placed on the survey participants (16 %) who do not see any benefits in more system-related types of training, while at the same time specifying one or more benefits of the ECDIS EST, which is not mandatory.

6 CONCLUSIONS

The ECDIS EHO research commenced at the beginning of the system implementation period to improve educational processes, while the HMI survey presented a continuation of the previous research, and was conducted shortly after the mandatory ECDIS implementation period. Rules and regulations regarding system operators' certification are well known to all stakeholders. The EGT certification has reached 100 % and ECDIS EST 90 % among system operators. The duration of the EGT course is the same among maritime training centers, but entry standards for the candidates are not uniform. There is a notable difference in the price of training evident from the available data and it is necessary to determine if the higher price of the training offers better training to trainees. Since Flag State regulations regarding the ECDIS EST duration are not the same among all State Flags, it is necessary to take into consideration that there is a significant number of the survey participants who would like to learn more during a specific familiarization training and that it is very likely that the duration of the training is insufficient. In this regard, there seems to be a justified need to continue with similar analyses, including all stakeholders, i.e. both legislators and seafarers, until the optimum solution is found.

REFERENCES

1. AMCsearch Training Center: https://www.amcsearch.com.au/course/electronic-chart-display-information-system, last accessed 2020/09/23.
2. Australian Maritime Safety Agency (AMSA): https://www.amsa.gov.au/safety-navigation/navigation-systems/ecdis-training-and-familiarisation, last accessed 2020/11/09.
3. Brčić, D. et al.: Navigation with ECDIS: Choosing the Proper Secondary Positioning Source. TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation. 9, 3, 317–326 (2015). https://doi.org/10.12716/1001.09.03.03.
4. Brčić, D. et al.: Observations on ECDIS Education and Training. In: Weintrit, A. (ed.) Marine Navigation and Safety of Sea Transportation: Marine Navigation. CRC Press, London (2017). https://doi.org/10.1201/9781315099132-5.
5. Brčić, D. et al.: Partial structural analysis of the ECDIS EHO research: The handling part. In: Rijavec, R. (ed.) Proceedings of the 24th International Symposium on Electronics in Transport. pp. P16–P16 Electrotechnical Association of Slovenia, ITS Slovenia, Ljubljana, Slovenia (2016).
6. Brčić, D., Žuškin, S.: Towards Paperless Vessels: A Master's Perspective. Pomorski zbornik. 55, 1, 183–189 (2018). https://doi.org/10.18048/2018.00.12.
7. Car, M. et al.: Human machine interface: Interaction of OOWs with the ECDIS system. In: NAŠE MORE 2019. pp. 74–86, Dubrovnik, Croatia (2019).
8. Car, M. et al.: The Navigator's Aspect of PNC before and after ECDIS Implementation: Facts and Potential Implications towards Navigation Safety Improvement.

Journal of Marine Science and Engineering. 8, 11, (2020). https://doi.org/10.3390/jmse8110842.

9. Compass Courses: https://compasscourses.com/e-c-d-i-s/, last accessed 2020/09/23.

10. De Ruyter Training & Consultancy: https://drtc.nl/en/shipping/ecdis, last accessed 2020/09/23.

11. Diverso Impex: https://diversoimpex.hr/en/d44-operational-use-of-electronic-chart-display-and-information-systems-ecdis/, last accessed 2020/10/07.

12. ECDIS Ltd.: https://www.ecdis.org/courses/ecdis-generic/, last accessed 2020/09/23.

13. ECDIS Regulations: https://www.ecdisregs.com/approved-ecdis-systems/, last accessed 2020/11/06.

14. Faculty of Maritime Studies Rijeka: https://www.pfri.uniri.hr/web/hr/cip-programi-izobrazbe.php, last accessed 2020/11/12.

15. Gibraltar Maritime Administration: https://www.gibraltar.gov.gi/maritime/maritime-administration, last accessed 2020/11/04.

16. Indian Register of Shipping: https://www.irclass.org/media/3424/clarification-on-ecdis-training-and-certification-requirements.pdf, last accessed 2020/11/04.

17. International Hydrographic Organization (IHO): https://iho.int/uploads/user/enc/latest_version_of_ECDIS_software_provided_by_OEMs.pdf, last accessed 2020/11/09.

18. International Maritime Organization, IMO.: International Convention for the Safety of Life at Sea, 1974 as amended, (2014).

19. International Maritime Organization, IMO.: International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW)., http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-on-Standards-of-Training,-Certification-and-Watchkeeping-for-Seafarers-(STCW).aspx, (2020).

20. International Maritime Organization, IMO.: International Safety Management Code (ISM). Resolution A.741(18): International Management Code For The Safe Operation Of Ships And For Pollution Prevention, (1993).

21. International Maritime Organization, IMO.: Model Course 1.27: Operational use of Electronic Chart Display and Information System, (2012).

22. International Maritime Organization, IMO.: MSC.1/Circ.1503 Rev.1: ECDIS – Guidance for good practice., (2017).

23. International Maritime Organization, IMO.: STCW.7/Circ.24/Rev.1: Guidance for Parties, Administrations, port State control authorities, recognized organizations and other relevant parties on the requirements of the STCW Convention, 1978, as amended, (2017).

24. Legiec, W.: ECDIS Users Genuine Qualification in Maritime Industry Great Demand. TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation. 10, 4, 575–579 (2016). https://doi.org/10.12716/1001.10.04.05.

25. Manukau Institute of Technology: https://www.manukau.ac.nz/, last accessed 2020/09/23.

26. Marshall Islands International Registers: https://www.register-iri.com/wp-content/uploads/MN-7-041-6.pdf, last accessed 2020/11/05.

27. Mindykowski, J. et al.: Maritime Education and Research to Face the XXI-st Century Challenges in Gdynia Maritime University's Experience Part II - Gdynia Maritime University of Experience the 21st Century Challenges. TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation. 7, 4, 581–586 (2013). https://doi.org/10.12716/1001.07.04.14.

28. Ocean Training Center: http://www.oceantc.net/, last accessed 2020/09/23.

29. Odessa Maritime Training Center: http://www.omtc.ua/ru/, last accessed 2020/09/23.

30. Papachristos, D. et al.: A Neuroscience Approach in User Satisfaction Evaluation in Maritime Education. TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation. 7, 3, 319–326 (2013). https://doi.org/10.12716/1001.07.03.01.

31. Sampson, H., Tang, L.: Strange things happen at sea: training and new technology in a multi-billion global industry. null. 29, 8, 980–994 (2016). https://doi.org/10.1080/13639080.2015.1102213.

32. The Bahamas Maritime Authority: https://www.bahamasmaritime.com/wp-content/uploads/2015/08/138bulltn.pdf, last accessed 2020/11/04.

33. University of Dubrovnik: https://www.unidu.hr/izobrazba-pomoraca/, last accessed 2020/10/07.

34. Vision Marine: https://visionmarinetraining.com/ecdis/, last accessed 2020/09/23.

35. Vujičić, S. et al.: Assessment for Ensuring Adequately Qualified Instructors in Maritime Education and Training Institutions. Athens Journal of Sciences. 7, 115–126 (2020). https://doi.org/10.30958/ajs.7-2-4.

36. Weintrit, A. et al.: Polish approach to the IMO model course 1.27 on operational use of ECDIS. Annual of Navigation. 19, 2, 155–170 (2012). https://doi.org/10.2478/v10367-012-0024-6.

37. Zorovic Maritime Services: https://www.zorovic.hr/en/maritime/training/ecdis/ecdis-furuno-type-specific-training/, last accessed 2020/10/15.

38. Žuškin, S. et al.: A contribution to improving the standards of ECDIS training. Pomorstvo. 27, 1, 131–148 (2013).