

<https://doi.org/10.53656/ped2023-5s.02>

Navigation Simulators
Навигационни симулатори

A FAIR CONCERN ABOUT ECDIS

Nikolay Sozonov, Assist. Prof.
Dr. Dilyan Dimitranov, Assist. Prof.
Nikola Vaptsarov Naval Academy (Bulgaria)

Abstract. Digital technology introduced a lot of benefits in the shipping industry but the relation between the equipment and the operator remains paramount and essential. Ship's Electronic Chart Display and Information System (ECDIS), being recently a cornerstone for navigation, is not an exception. Not only scientific reviews and articles, but also marine officer's opinion exchange, in other words, ashore and on board, point out that there is a gap, which should be addressed as soon as possible. Operation of the ECDIS by the human factor is essential for safe navigation. The shortage of training and knowledge always leads to near misses and incidents. The marine society, all over the world, has to take appropriate measures in order to "fill in the gaps" and keep the safer practices. These measures should be applied by the efforts of certain participants: the educational community, the shipowners, the manufacturers and the legal aspect, International Maritime Organization and Flag Administrations. All the mentioned parties may engage in a cooperative collaboration among themselves. The aim of this article is to research the main difficulties experienced on board by the ECDIS users and the way to rectify certain shortcomings related to the ECDIS.

Keywords: ECDIS; generic training; type specific training

Introduction

From the ECDIS end-user perspective, there are various opinions and shared feedback which inspired the writing of this article. This manuscript endeavours to objectively address certain ECDIS issues, taking a balanced approach and acknowledging that it does not aim to provide an exhaustive listing.

Digital technology introduced a lot of benefits in the shipping industry but the relation between the equipment and the operator remains paramount and essential. Ship's ECDIS, becoming recently a cornerstone for navigation, is not an exception. The human factor assumes and retains accountability and responsibility for passage planning and execution, albeit with assistance by the equipment (Komitov 2019). Implementation of the ECDIS led to a revolution in the field of the navigation (Mellor 2016). It resulted in a number of benefits¹ but

in the same time it created a challenge, especially to the manufacturers and to the users. In accordance with the international requirements, two types of training for the system are required for navigation officers – ECDIS generic training course² and ECDIS Type Specific training course. From the beginning of the ECDIS era, not all sea areas were technically covered and the creation and the development of the Raster Navigational Chart (RNC) and Electronic Nautical Charts (ENC) were running simultaneously. The development of ENC has prevailed, resulting in extensive coverage across the world's oceans (Kastrisios, Pilikou 2017, p. 3). The Electronic Navigational Chart (ENC) has emerged as the preferred choice over the RNC due to its proven utility and technological advancements. As a result, only Electronic Navigational Charts (ENCs) adhere to the requirement of being carried as the sole navigational tool, whereas RNC necessitates the support of a paper chart folio³.

Nowadays, the ships are several times larger and faster, compared with those of the previous generations, maritime traffic is quite heavier, ship`s schedules are definitely tight most of the time. Consequently, the presence of competent navigators with comprehensive ECDIS knowledge is imperative to ensure continuous and proficient ship navigation.

1. Literature review

The ECDIS opened a new era in the field of navigation. The introduction of ECDIS was very welcome among the maritime officers and the society embraced the new incomer. The main reasons for that were the possibility of an uninterrupted positioning, reducing the time-load for the planning, updates and correction as well as a fast ENC delivery by electronic means. With the use of this digitalized equipment, the saved time was spent for assessment of the navigational situation, collision avoidance and route planning. ECDIS has enhanced the officer of the watch (OOW) role in maintaining the safety of a vessel by increasing the information available, which eventually assisted the mariners in planning, evaluation and decision taking.

With the availability of radar, ECDIS, and bridge windows, the bridge officer possesses three distinct sources of information to ascertain the vessel's position and the whereabouts of other ships. Through the integration of these three sources, the users have enhanced situational awareness and confidence in the execution of their duties. In addition, radar overlay, Automatic Identification System (AIS) info of the vessels nearby, the option to use different chart scales of content of selected areas is priceless, compared with the usage of conventional paper charts. All of the above significantly improves the comfort of the OOW.

As all other navigation equipment, the ECDIS opponents point out its main shortcomings, the size of the screen, the dependence on a power supply and dependence on an external source of information such a Global Positioning System

(GPS), course and speed (Kayisoglu et al. 2022; Pipchenko et al. 2021). Along with the many ECDIS benefits, the user may experience equipment over-reliance and complacency. However, the industry is unlikely to return to the paper charts and the users have to accept it and act accordingly.

Although more than 10 years after beginning of ECDIS phase-in, some authors claim that ECDIS is still in its “implementation phase” (Hilduberg et al. 2021), especially when the user takes a minimum approach to the use of ECDIS. User negligence may mostly be due to the following reasons:

- Lack of dedication of necessary time for familiarization with ECDIS.
- Work with complex menus may impair other tasks such as situation awareness and route monitoring.
- Alarm overload can lead to a development of a situation, where alarms are simply ignored. This may cause critical alert ignoring. Some important information may be missed.
- Lack of understanding in details of possibilities and availability which ECDIS has and which are at the user’s disposal.

Some users, by inertia, have been using ECDIS the same way as they had used the paper charts. The difference is only, that the position is being plotted automatically and the users are not able to make pencil marks as in the past. Some users do not take full advantage of what the system offers.

In addition, the situation is not getting better, due to a wide range of type specific software and different manufacturers’ approach with regards to the same ECDIS functions (Komitov, Belev 2020). All these difficulties become a reason for, some users to exercise minimalistic approach to the ECDIS operation and usability. In the long term, this will definitely create possible near-misses, which may escalate to navigation accidents.

2. Methodology of the study

The aim of this article is to research the main difficulties experienced on board by the ECDIS users and the way to rectify certain shortcomings related to the ECDIS. The study was carried out among navigation officers between 20th March 2023 and 29th April 2023. The questionnaire was created using Google Apps Form and distributed online. Participants of various nationalities were invited to fill up mentioned questionnaire. Some of them were the author’s colleagues. The study was independent and completely anonymous. The answers of all 49 participants were recorded. Most of them were ship Masters, Chief officers and Junior officers. They graduated at various points in time, spanning a wide range. Upon the study, 92% of the participants were with an experience of at least one year at their present position.

The study had a target to highlight the main difficulties experienced on board by the ECDIS users and the way to rectify certain shortcomings related to the ECDIS.

3. The results of the study

The results of the study follow below with questions and summary of the participants' answers. Figures are numbered and explanatory notes are added to each one.

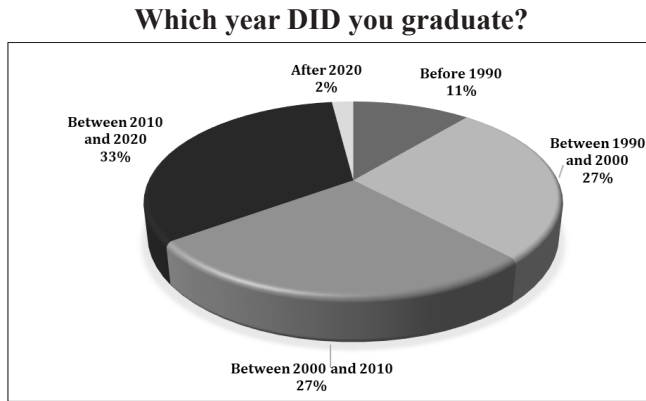


Figure 1. The answers of the participants in regards of the period of graduation

The answers show that the study has covered participants with a wide range in the period of graduation. Participants that graduated before 1990 and those between 1990 and 2000 started their career before ECDIS use on board. Those who graduated between 2000 and 2010 were witnesses of non-official electronic charts. Those who graduated between 2010 and 2020 were witnesses of the transition and implementation period of ECDIS and those graduated after 2020 started their career with compulsory ECDIS on board of vessels more than 10 000 GT.

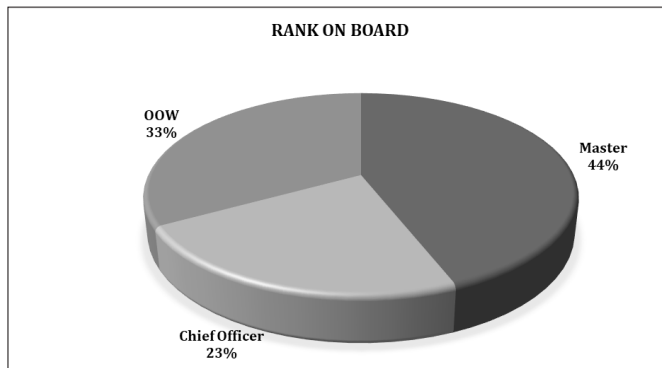


Figure 2. The answers of the participants with regards of the rank on board

The answers show that all participants are ship navigation officers with onboard experience. Consequently, all of them have daily interaction with ECDIS, provided serving on a 10,000 GT vessel. Therefore, their opinions come directly from the sea service. Senior officers constitute 2/3rd of them, which adds value to the study.

How long you have served on present position?

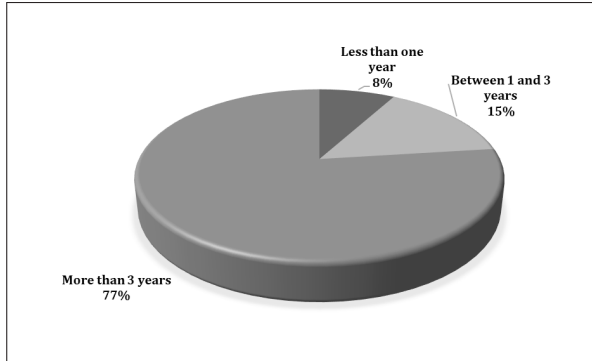


Figure 3. The answers of the participants with regards to the service on board at current position at the time of the study

The answers show that at least 92% (77% and 15%) have served as ship navigation officers for more than one year in their present position. This means that participants should already have an impression of the ECDIS ability, advantages and difficulties.

Please list which ECDIS type specific courses you have passed?

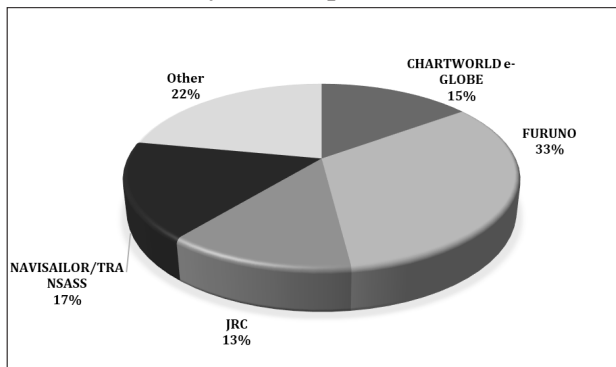


Figure 4. The answers of the participants in regards of the ECDIS type specific courses completed

The answers show that officers reported most of the world's leading manufacturers. "Others 22%" in the pie chart consists of the combination of already mentioned world's leader manufacturers and in addition Sam Electronics, Sperry, Tecdis, Totem, Wartsilla Chartpilot. This feedback contributes value by providing a more comprehensive understanding of the officers' impressions and experiences.

Do you find the ECDIS type specific course sufficient for the job on board?

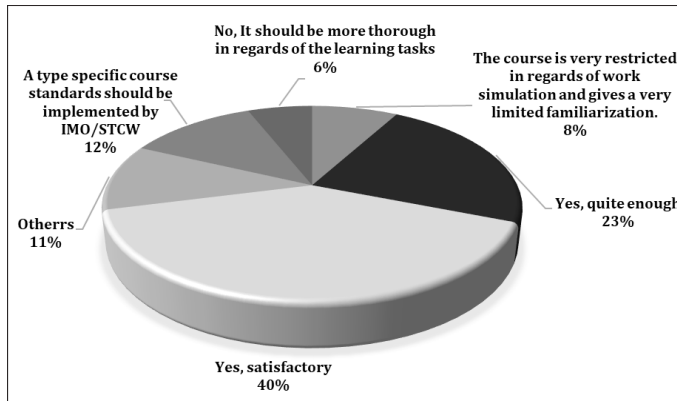


Figure 5. The answers of the participants with regards to the sufficiency of the ECDIS type specific course for the job on board

The above pie chart approaches the essence of this study. The answers show that most of the answers were "satisfactory" and "quite enough" (63%). The rest

What are the common difficulties, you or other officers have experienced, while working with ECDIS?

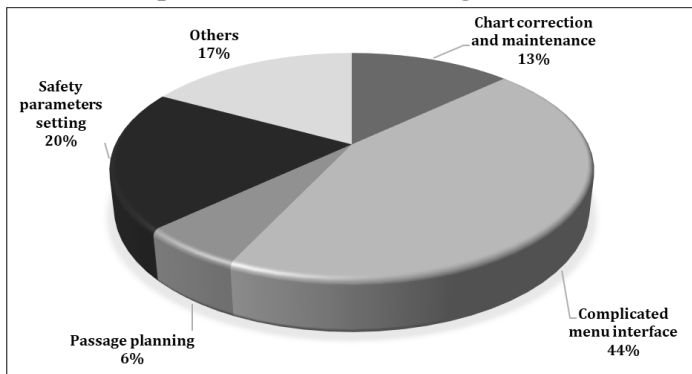


Figure 6. The answers of the participants with regards to the common difficulties officers have experienced while working with ECDIS

(37%) of the answers pointed out that the course was not enough, with a diversity of opinions and remarks, consequently at least 1/3rd of the questioned persons had certain concerns about ECDIS type specific training course. The field “Others 11%” in the pie chart consists of a combination of the above illustrated answers and in addition, the following answers: “The course does not reflect the real work with ECDIS station” and “Gives starter knowledge”. In summary, the responses exhibit a wide range of diversity, clearly indicating that the officers hold different opinions.

The answers show that the main concern is the “Complicated menu interface”, “Safety parameters setting”, “Chart correction and maintenance”. There is scope for improvement in ECDIS features both from the manufacturer's perspective and in line with the future vision of the IMO. The field “Others 6%” in the pie diagram consists of a combination of the above answers and, in addition, answers such as “Chart correction and maintenance, complicated menu interface” and “Inaccurate ENC information leading to difference for under keel clearance (UKC) calculation and Passage plan”, “Transass requires quite often restarting and Furuno has a bit complicated interface”.

If the officer’s knowledge and abilities with regard to ECDIS handling are not enough, what can be done to rectify this issue?

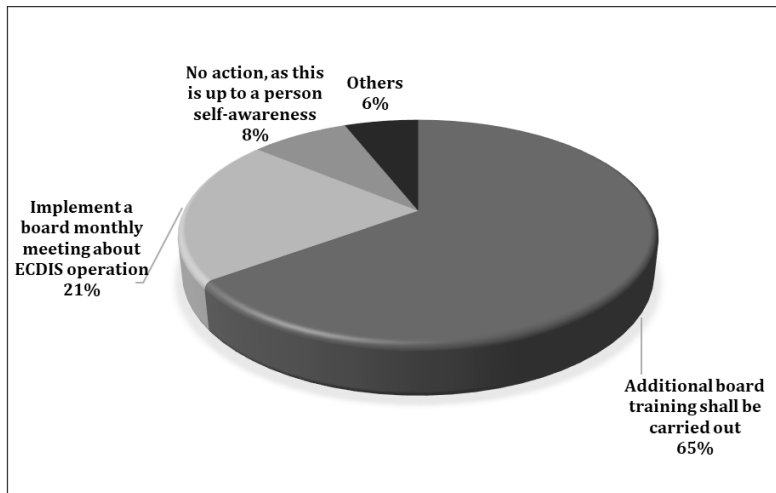


Figure 7. The answers to the question “If the officer’s knowledge and abilities with regards to ECDIS handling are not enough, what can be done to rectify this issue?”

This was the core of the study. The reasonable answer was that “additional board training shall be carried out” (65%). Although nobody on board wants any

additional monthly meeting, some of the officers (21%) recorded “Implement a board monthly meeting about ECDIS”. This is very important feedback for the conclusions which are positioned next in the article. The field “Others 6%” in the pie chart consists of “Pre-boarding examination about ECDIS knowledge and skills needs to be organized by the training department for the Watchkeepers”, “The knowledge is closely connected to the work with the software”.

Conclusions and summary

Insufficiency of ECDIS type specific training

Operators are encouraged to explore the ECDIS system to maximize its usability and potential. Although more than 63% of the questioned officers stated that the “type specific training course” was satisfactory and enough, the claims about type specific course can be described as follows:

- A type specific course standards should be implemented by IMO/STCW. The target of the course is not standardised (Weintrit et al. 2012) and it is left to the discretion of the Administration;

- The training course is very restricted in regards of work simulation and gives a very limited familiarization;

- The training course should be more thorough with regard to the learning tasks.

Common difficulties which ship officers experience while working with ECDIS

- Complicated menu interface – this seems to be a main issue, among others.

Here the comments may vary between the two extremes. First, the manufacturers should present the operators with more “user-friendly menu software”. Second, more cognitive time dedication is required by the users in order to get familiar and maintain sufficient operational level. Probably the truth is somewhere in the middle.

- Safety parameters setting – this is an extremely important feature, which implies the colouring of the water areas, which the user perceives at once and easily. At the same time, the safety parameters are related directly to electronic prewarning which enhances the safe passage of the vessel.

- Chart correction and maintenance – this important task should be tidy, easy and complete. No chance of error must exist.

- Passage planning – remains basic and essential. Although the performance of the users may differ from one another, the passage plan has to be planned and monitored in such a way that the passage can be safely and economically executed. That is why this feature remains basic and essential.

Insufficient officer’s knowledge of ECDIS handling

The question regarding the presence of deck officers with insufficient knowledge about ECDIS operation was omitted from the study due to ethical considerations. Instead, the question was formulated as “If the officer’s knowledge and abilities with regards to ECDIS handling is not enough, what can be done to rectify this issue?”. The study response of 65% of the questioned officers chose that additional board

training or board monthly meeting about ECDIS operation shall be carried out. This means that, probably, there are navigation officers whose knowledge about ECDIS handling is not up to requirements (Brčić et al. 2017). This, of course, cannot be said for the officers, who have a thorough knowledge in handling the ECDIS by exploring its extended capability, which for ensure a higher safety of navigation.

Not only scientific reviews and articles but also marine officer's opinion exchange, in other words, ashore and onboard, point out that there is a gap, which should be addressed as soon as possible. Operation of the ECDIS by the human factor is essential for safe navigation (Komitov 2019). The shortage of training and knowledge always lead to near misses or incidents and PSC remarks. Supporting this, the Australian Maritime Safety Authority (AMSA) reported a large rise in the number of vessels detained due to ECDIS deficiencies (Martek Marine 2017), (Sekine 2021).

ECDIS type specific training – gaps should be rectified either by a refined course which may include higher standards implementation or by extended training on stations that simulate real work on board (Komitov, Belev 2021).

Complicated menu interface should be avoided by the manufacturers. User-friendly software line should be maintained by the manufacturers. These features should be continuously developed to give the operators an improved user-friendliness in an ongoing design progress. This means that the manufacturers should continuously make the ECDIS systems capable of meeting various customer demands, along with the criteria set out in the Standards⁴. Safety parameters setting, passage planning, chart correction and maintenance are paramount and the ECDIS operator should not hesitate when handling them.

Implementing a bridge monthly ECDIS meeting. Insufficient officer's knowledge of ECDIS operation is pointed among the study results of question 7 (additional board training shall be carried out - 65% of the answers, Implement a board monthly meeting about ECDIS operation – 21% of the answers). Apart of the compulsory type specific training course before embarkation, upon boarding, each deck officer receives bridge ECDIS familiarization. The same is implemented in the operator company Safety Management System (SMS) but its real application and verification on board may be omitted. If, by any reason, the required knowledge of ECDIS handling is not achieved before boarding or during the familiarization period, then additional board training shall be carried out (65% of the answers of question 7).

In order to fulfil bridge duties with accuracy and confidence, each user should maintain his ECDIS operation level. This may be achieved by implementing a monthly ECDIS meeting, as can be seen from the answers of question 7 – 21%. At first, it may seem as an additional workload for the crew, but in another aspect, a monthly meeting will give seafarers a chance to learn from each other, to exchange opinions, to provide guidance to young officers or to refine the computer skills of

officers with less experience. The bridge monthly ECDIS meeting can eliminate the barriers, sometimes build between different nationalities, different user approaches and different awareness about ECDIS capabilities as they are set out in the Standards of IMO Res. MSC.232 (82). One of the potential benefits can be an increase in the level of safety, which is one of the targets in the shipping industry.

The series of measures, described in the chapter, may be used and implemented in order to fill in the gaps in the scope of ECDIS end-usage. Its application should be initiated by the IMO, manufacturers, owners and education centres. All the aforementioned parties may engage in a cooperative collaboration among themselves. The results of these measures can benefit not only the shipping industry but may also have a long-term positive impact on the maritime safety and environment.

NOTES

1. IMO – IMO amendment to SOLAS Reg V. Available from: <https://www.imo.org/en/OurWork/Safety/Pages/ElectronicCharts.aspx>. [Viewed 2023-4-04].
2. IMO – 2010 Edition, Model Course 1.27, Operational use of Electronic Chart Display and Information System (ECDIS). London, UK.
3. IMO – International Convention for the Safety of Life at Sea 1974, with amendments, Chapter V – Safety of Navigation.
4. IMO – Resolution MSC.232(82) Adoption of the revised performance standards for electronic chart display and information system (ECDIS), adopted on 5 December 2006. Available from: [https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MSCResolutions/MSC.232\(82\).pdf](https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MSCResolutions/MSC.232(82).pdf).

Acknowledgements

The authors thank all navigation officers who participated in this study for their time and their willingness to fill in the questionnaire. Their answers are extremely valuable.

REFERENCES

- BRCIC, D.; ZUSKIN, S.; BARIC, M., 2017. Observations on ECDIS Education and Training. In: 12th International Conference on Marine Navigation and Safety of Sea Transportation. Available from: <https://doi.org/10.1201/9781315099132-5>. Available from: https://www.researchgate.net/publication/318851990_Observations_on_ECDIS_Education_and_Training, [Viewed 2023-6-11].
- GARD, 2010. ECDIS – Charting the future of navigation. Gard News 200, November 2010/January 2011. Available from: <https://www.gard.no/>

- web/updates/content/8931774/ecdis-charting-the-future-of-navigation, [Viewed 2023-4-20].
- HILDUBER, O.; MOLL, A., 2021. Application and usability of ECDIS. Report. MAIB, 2.09.2021. Available from: <https://dmaib.com/reports/2021/application-and-usability-of-ecdis>. [Viewed 2023-4-24].
- KASTRISIO, C.; PILIKOU, M., 2017. Nautical cartography competences and their effect to the realisation of a worldwide Electronic Navigational Charts database, the performance of ECDIS and the fulfilment of IMO chart carriage requirement. *Marine Policy*, p. 3. Available from: <https://doi.org/10.1016/j.marpol.2016.10.007>. Available from: <https://www.sciencedirect.com/science/article/pii/S0308597X16304250>. [Viewed 2023-4-14].
- KOMITOV, D., 2019. The human factor in the use of ECDIS. *e-Journal VFU*, no. 12, p. 16. ISSN 1313-7514.
- KOMITOV, D.; BELEV, B., 2020. Critical analysis of ECDIS type specific training. *Mechanic, transport, communication*, no. 18, art. 2, pp. XV-1 – XV-8. ISSN 1312-3823 (print), 2367-6620 (online).
- KOMITOV, D.; BELEV, B., 2021. Status of ECDIS type specific training and gap in the rules. *Scientific Journal of Gdynia Maritime University*, vol. 21, no. 117, pp. 27 – 36. ISSN 2657-5841 (printed), ISSN 2657-6988 (online). Available from: <https://doi.org/10.26408/117.03>.
- KAYISOGLU, G.; BOLAT, P.; TAM, K., 2022. Evaluating SLIM-based human error probability for ECDIS cybersecurity in maritime. *Cambridge University Press: 05 October 2022*. Available from: <https://www.cambridge.org/core/journals/journal-of-navigation/article/evaluating-slimbased-human-error-probability-for-ecdis-cybersecurity-in-maritime/B7661416A7C8D5A3DF70551C33A61029> [Viewed 2023-6-13].
- MARTEK MARINE, 2017. Lack of on-board ECDIS training leads to ship being detained in Brisbane. Web site. *Martek Marine, May 2017*. Available from: <https://www.martek-marine.com/blog/lack-of-on-board-ecdis-training-leads-to-ship-being-detained-in-brisbane>. [Viewed 2023-6-12].
- MELLOR, T., 2016. ECDIS: The Quiet Revolution in Maritime Navigation. Web site. *Edition of Maritime Reporter & Engineering News*. Available from: <https://www.marinelink.com/news/revolution-navigation409963>. [Viewed 2023-6-11].
- PIPCHENKO, O., et al., 2021. Identification of weak links in the ECDIS - Operator System Based on Simulator Training. *TransNav the International Journal on Marine Navigation and Safety of Sea Transportation*, vol. 15, no. 1, pp. 83 – 88. Available from:

<https://doi.org/10.12716/1001.15.01.07>. Available from: https://www.researchgate.net/publication/353120994_Identification_of_Weak_Links_in_the_ECDIS_-_Operator_System_Based_on_Simulator_Training. [Viewed 2023-6-11].

SEKINE, H., 2021. ECDIS Detention data by AMSA PSC. *UKPANDI*. Available from: <https://www.ukpandi.com/news-and-resources/articles/2021/ecdis-detention-data-by-amsa-psc/>. [Viewed 2023-6-11].

WEINTRIT, A.; KOPACZ, P.; BAĞ, A.; URIASZ, J.; NAUS, K., 2012. Polish approach to the IMO MODEL COURSE 1.27 On Operational Use Of ECDIS. *Annual of Navigation*, vol. 19, no. 1, pp. 155 – 164. Available from: <https://doi.org/10.2478/v10367-012-0024-6>. Available from: https://www.researchgate.net/publication/260990218_Polish_Approach_to_the_IMO_Model_Course_127_on_Operational_Use_of_ECDIS. [Viewed 2023-6-10].

✉ **Mr. Nikolay Sozonov, Assist. Prof.**

ORCID iD: 0009-0005-6171-7595

Web of Science Researcher ID: IQT-7567-2023

Nikola Vaptsarov Naval Academy
Varna, Bulgaria

E-mail: n.sozonov@naval-acad.bg

✉ **Dr. Dilyan Dimitranov, Assist. Prof.**

ORCID iD: 0000-0001-7288-6005

Web of Science Researcher ID: G-4653-2019

Nikola Vaptsarov Naval Academy,
Varna, Bulgaria

E-mail: d.dimitranov@nvna.eu