

The Use of the Electronic Chart Display and Information System (ECDIS) in the Navigation Process on the MV. Hanwoori

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Abstract.

Modern maritime navigation has shifted from conventional methods to integrated electronic systems, where the Electronic Chart Display and Information System (ECDIS) plays a crucial role in improving navigation safety and efficiency. This study aims to analyze the deck officers' understanding level and identify factors that influence the effectiveness of ECDIS use on the MV. Hanwoori. The study employed a qualitative approach with a case study method. The study population was deck officers, with a purposive sampling technique involving the Chief Officer, Second Officer, and Third Officer as informants. Data were collected through structured interviews, direct observation, and documentation, then analyzed using an interactive model of data reduction, data presentation, and conclusion drawing. The results show that ECDIS has been used effectively in route planning and monitoring, but there are still inconsistencies in setting safety parameters, updating ENC's, and managing alarms. These findings indicate that human factors, operational discipline, and technical competence influence system performance. The study's conclusion confirms that although deck officers have a fairly good operational understanding, optimization of safety features and continuous improvement of training are essential to improve navigation safety and minimize human error.

Keywords: *Electronic Chart Display And Information System, Human Factors, Maritime Navigation, Navigation Safety, Ship Operations.*

I. INTRODUCTION

Modern maritime navigation is no longer solely based on compasses and paper charts, but rather on a combination of sophisticated electronic systems designed to ensure safety, efficiency, and compliance with international regulations. Equipment such as radar, AIS, GNSS, and especially the Electronic Chart Display and Information System (ECDIS) have become crucial components in determining position, planning routes, and monitoring vessel movements in busy and high-risk shipping lanes (Edward & Junianto, 2024; IHO, 2016, as referred to in the context of ECDIS update). Global trends indicate that ECDIS is now a mandatory standard on international merchant ships through amendments to SOLAS chapters V/19 and V/27, while strengthening this technology's position as a key pillar in navigational safety management (IMO, 2011; IHR, 2023).

In practice, the use of ECDIS has the potential to reduce human error, increase the efficiency of route planning, and support compliance with maritime safety regulations such as SOLAS, STCW, and COLREG (Ojode & Hogwei, 2020; Hafasy Journal on Effectiveness of Use of ECDIS on Navigation Safety, 2023). However, excessive reliance on ECDIS without adequate understanding can actually give rise to “hidden risks” in the form of errors in screen settings, scales, alarms, and safety contours, which have implications for collisions and grounding incidents (Lušić & Bakota, 2022; Kristić, 2021; IHR, 2023). At the national level, this challenge is relevant for Indonesia as a maritime nation with many vessels recently switching to ECDIS, while type-specific training and technological instruction readiness at maritime academies still experience significant deficits (Munim et al., 2021; JTMIT, 2026; IJECA, 2024).

In the specific context of merchant vessel operations, navigational incident investigation reports indicate that human error in ECDIS operation—particularly errors in updating the Electronic Navigational Chart (ENC), determining the safety contour, and understanding symbols and alarms—often appears as a triggering factor for accidents (Lušić & Bakota, 2022; Shipowners' Club, 2023; MAIB/DMAIB study, as cited in the context of ECDIS effectiveness). Recent studies have shown that most deck officers acknowledge the benefits of ECDIS in improving situational awareness, but also acknowledge a limited understanding of the system's advanced features and a tendency to over-reliance on screen displays, without

cross-checking with traditional navigation (Krstić, 2021; Safety4Sea Guidance, 2022; IHR, 2025). In Indonesia, empirical surveys on training vessels and commercial vessels found that officers responsible for ECDIS were often not fully familiar with the system settings, thus increasing the risk when sailing in congested waters or potentially running aground (Optimizing the Use of ECDIS, ICMAD24, 2024; JTMIT, 2026).

Various previous studies have examined the effectiveness of ECDIS in improving navigational safety, maneuvering efficiency, and supporting passage planning. For example, research on the Sultan Hasanuddin found that ECDIS accelerated hazard identification, facilitated channel monitoring, and reduced the workload of deck officers when planning voyage routes (Jurnal Hafasy, 2023). Globally, a comparative study between the S57 ECDIS and the S100 ECDIS integrated with ENDS demonstrated significant improvements in the speed and accuracy of navigation data visualization, thereby shortening planning time and improving the quality of navigation decisions (IHR, 2023; 2025). Furthermore, these studies also emphasized that the technical benefits of ECDIS are only realized when supported by high user competence, accompanied by adequate type-specific training and familiarization (Munim et al., 2021; IJECA, 2024; Efficiency of ECDIS Type-Specific Education and Training, 2025).

However, several studies have shown inconsistencies in ECDIS proficiency levels across operators and shipping lines. On some vessels, ECDIS mitigates risks through active use and integration into navigation procedures, while on others, the system serves only as a secondary display that is not regularly updated or operated at an inappropriate scale (Shipowners' Club, 2023; ICMAD24, 2024). In Indonesia, an evaluation of the readiness of maritime academies revealed that navigation laboratories in many polytechnics do not yet have integrated ECDIS simulations, resulting in graduates often mastering only theoretical concepts without adequate practical experience (IJECA, 2024; Munim et al., 2021). These limitations are reflected in human reliability and human error analysis studies related to ECDIS, which show that the highest error probabilities occur in ENC update tasks, alarm configuration, and human-machine interface errors, especially in environments with high workload and time pressure (Jiang et al., 2022; Enhancing Human Reliability in ECDIS Application, 2026; Lušić & Bakota, 2022).

This study identifies several research gaps. First, most previous studies have focused on the technical benefits of ECDIS or the system's effectiveness in general, but few have examined in depth the level of understanding and operational practices of ECDIS by deck officers on specific commercial vessels in Indonesia, particularly in the context of relatively safe waters that require regular hydrographic and navigational data updates. Second, research on factors influencing the effective use of ECDIS often emphasizes technological aspects, while human-element variables such as workload, safety culture, and the quality of type-specific training at the ship level remain underexplored in real operational settings (Safety4Sea, 2022; IJECA, 2024). Third, research in Indonesia tends to be macro-based (academic, training, or national policy), thus underexploring the micro-context of technical understanding and operational practices of ECDIS by deck officers on a specific vessel, such as the MV Hanwoori, which sails only in safe waters but still requires dynamic chart updates and traffic separation scheme management.

Based on these conditions, this study formulates the following problem statement: what is the level of understanding of deck officers regarding how to operate the ECDIS feature in the navigation process on the MV. Hanwoori, and what factors influence the effective use of ECDIS in the context of safe but dynamic cross-water navigation (e.g. from Gamman Citizen's Port to Jeju Island, Donghae, and Jinhae)? This study aims to identify the level of technical competence of deck officers in utilizing ECDIS, analyze organizational, technical, and human element factors that influence the effectiveness of the system, and relate it to the risk of navigation incidents such as collisions and grounding. This research is important to be conducted at this time because the Indonesian shipping industry is in a transition phase towards full digitalization of navigation, while the readiness of human resources and factual practices on ships still show a gap between regulatory policies (SOLAS, STCW, and ECDIS standards) and the reality in the field.

In its novelty, this study positions ECDIS not merely as a “technical device” but as a “human-technology interface system” that is explored contextually on a specific commercial vessel, with an approach that combines operational observations, in-depth interviews with deck officers, and analysis of navigation

documentation (passage plans, ECDIS usage logs). The main scientific contribution lies in enriching the literature on the relationship between mastery of ECDIS features by deck officers, the quality of data updates, and safety culture on board, especially in a relatively safe but dynamic water environment. Its practical contributions include recommendations for shipping companies regarding the improvement of type-specific training and ECDIS monitoring procedures, as well as reference materials for educational institutions such as the Surabaya Shipping Polytechnic in designing curricula and simulations that are more relevant to actual operational practices on board ships.

II. METHOD

This research uses a qualitative design with a case study approach to in-depth explore the understanding and utilization of the Electronic Chart Display and Information System (ECDIS) by ship crews during navigation. The qualitative approach was chosen because of its ability to holistically understand the phenomena of subject behavior and perception through language descriptions in a natural context (Moleong, 2010; Sugiyono, 2019). The case study method is considered the most relevant for examining specific ship operational systems, in line with the latest developments in navigation technology research (Patton, 2021; Emzir, 2022). This approach allows researchers to obtain data that is rich in meaning and can be replicated by other researchers in the maritime operational sphere (Sudaryono, 2020; Wijaya, 2018).

The population in this study consisted of ship officers (First, Second, and Third Officers) directly involved in navigation operations during sea practice. The sampling technique used was purposive sampling, where informants were selected based on their daily involvement with ECDIS use and navigation experience, resulting in more focused and relevant data (Creswell, 2013). Inclusion criteria included officers with at least two years of experience operating ECDIS and having watchkeeping responsibilities, while exclusion criteria applied to crew members outside the deck area. This strategic selection of informants aimed to obtain in-depth information that supports the quality of qualitative research (Nugroho et al., 2023; Sudaryono, 2020).

The research instruments consisted of structured interviews, open-ended observations, and documentation. Interviews were conducted using a predetermined questionnaire to ensure consistency in exploring the navigators' understanding of ECDIS system components, map updates, and failure mitigation (Sugiyono, 2019; Moleong, 2014). Observations were conducted systematically to record the practice of using ECDIS features and adjusting map scales when navigating narrow channels, while documentation included written notes and navigation reports as supporting data. To ensure data validity, this study employed source triangulation, verifying data through a combination of interview results, observation findings, and document analysis (Sugiyono, 2016; Sari & Pratama, 2024).

The research procedure began with a preparatory phase, which included obtaining permits and instrument adjustments, followed by field implementation during the sea practice period. Data collection was conducted chronologically: researchers conducted direct observations of watchkeeping activities, then conducted in-depth interviews lasting approximately 30 to 45 minutes per informant, and collected relevant documents on board. All observations and interactions with informants were recorded and transcribed immediately to maintain data accuracy within a realistic operational context (Sutrisno Hadi, 1987; Hidayat et al., 2022; Miles & Huberman, 2019).

The data analysis technique used the interactive model from Miles and Huberman, which consists of three main stages: data presentation, data reduction, and conclusion drawing. The collected data was presented in narrative or matrix form to facilitate the identification of ECDIS usage patterns. Data reduction was then carried out by sharpening and grouping important information to focus the research findings (Moleong, 2014; Sugiyono, 2017). This analysis process was assisted by qualitative data processing software to ensure the order of the findings, which ultimately resulted in substantive conclusions regarding the obstacles and crew skills in using electronic navigation facilities (Braun & Clarke, 2021; Moleong, 2007).

The ethical aspects of the research were prioritized through the principles of transparency and participant protection. The researchers ensured that all informants had provided informed consent to participate in the research and guaranteed their anonymity through the use of pseudonyms in the reports. The data obtained was stored securely to maintain confidentiality, in line with applicable maritime research

ethics standards (Creswell, 2013; Indonesian Maritime Authority guidelines, 2022). Although this research was non-intrusive, ethical standards were adhered to during onboard observations to maintain operational comfort and professional relationships with all crew members.

III. RESULTS AND DISCUSSION

Data Presentation

1. Observation Results

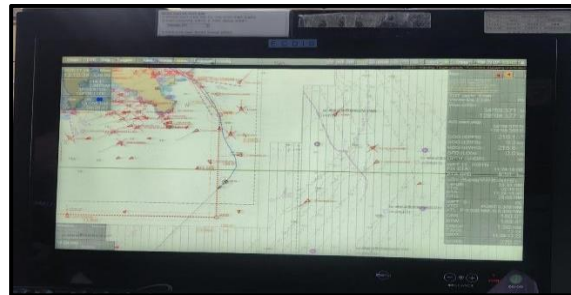


Fig. 1. ECDIS MV. Hanwoori

Source: Personal Documentation

Observer Name : Nesi Natasha Christy
 Date : July 25, 2024
 Start Time : 08.00 LT
 Finish Time : 12.00 LT
 Location : Namhae Sea

Table 1. Observation of ECDIS Use on the MV. Hanwoori

No	Aspect Observation	Key Indicators	Yes	No	Information
1	ECDIS Preparation	Checking the system and chart before navigation ✓			Initial inspection was performed, but the checklist was not Always documented systematically
2	Route Planning	Create routes, waypoints, and safety boundaries correctly ✓			Route planning is in accordance with procedures, but a thorough evaluation of navigation risks has not been carried out.
3	Route Monitoring	Monitoring the position of the ship and path deviation ✓			Monitoring is running well with radar cross-check.
4	Alarm Response	Understand the meaning of the alarm and act appropriately		✓	Some alarms are not immediately analyzed because considered uncritical
5	Update Chart	Using the latest electronic maps ✓			Updates are made, but sometimes closer to departure time.
6	Equipment Condition	Navigation systems and sensors are working properly ✓			Equipment is normal, but performance tests are not performed regularly.
7	Implementation SOP	Use according to ship procedures ✓			SOPs are implemented, although flexibility often occurs during busy conditions.

Based on observations on July 25, 2024, the use of ECDIS on board the MV Hanwoori demonstrated a fairly good level of effectiveness, particularly during the system preparation and route planning stages. Deck officers conducted initial checks of the navigation equipment prior to the voyage, reflecting an awareness of the importance of equipment readiness in supporting navigational safety. Furthermore, the route planning process was carried out in accordance with the established passage plan.

However, several challenges remain that could potentially impact the optimal use of ECDIS. Alarm responses have not been fully investigated, as some are deemed non-critical. This situation could increase the risk if the alarms are related to navigational hazards. Meanwhile, electronic chart updates have been performed, but they tend to be performed closer to departure time, leaving limited time for verification.

Observer Name : Nesi Natasha Christy
 Date : July 30, 2024
 Start Time : 08.00 LT
 Finish Time : 12.00 LT

Location : Namhae Sea

Table 2. Observation of ECDIS Use on the MV. Hanwoori

No	Aspect Observation	Key Indicators	Yes	No	Information
1	ECDIS Preparation	Check the system and charts before Navigation	✓		Preparations are carried out independently by the duty officer.
2	Route Planning	Create routes, waypoints, and safety boundaries correctly	✓		Route verified by captain before sailing
3	Route Monitoring	Monitoring the ship's position and path deviation		✓	Occasional supervision decreases as the workload increases
4	Alarm Response	Understand the meaning of the alarm and act appropriately	✓		The alarm is responded to with a position recheck procedure.
5	Update Chart	Use latest electronic maps	✓		Updates are made on ENC
6	Equipment Condition	System and navigation sensor working well	✓		System works fine
7	Implementation of SOP	Use according to ship procedures		✓	A trend was found. Reliance on personal experience rather than SOP

Observations on July 30, 2024, indicated that deck officers had a good understanding of ECDIS operation. This was evident in their independent navigation preparation and verified route creation.

However, the human factor remains a challenge in maintaining consistent navigational oversight. Under certain conditions, the intensity of monitoring shipping lanes has decreased due to increased workloads on the bridge. Furthermore, some officers have tended to rely more on personal experience than on written procedures in standard operating procedures (SOPs).

The SOP for turning on the ECDIS on the MV. Hanwoori is:

- A. Turn on Main MCB in the Console
- B. Turn on the Main Stavol in the Console
- C. Turn on the UPS CPU ECDIS in the Console
- D. Turn on the UPS Monitor in the Console
- E. Turn on the ECDIS CPU in the Console
- F. The ECDIS 900 program will autorun automatically
- G. Turn on AIS SIMRAD

And the SOP for turning off ECDIS is:

- A. Close and Save ECDIS 900 and SM Program Data
- B. Turn off the computer
- C. Turn off AIS SIMRAD
- D. Turn off the ECDIS CPU UPS in the Console
- E. Turn off the UPS Monitor in the Console
- F. Turn off the main stabilizer in the console
- G. Turn off Main MCB in the Console

Observer Name : Nesi Natasha Christy

Date : August 5, 2024

Start Time : 08.00 LT

Finish Time : 12.00 LT

Location : Namhae Sea

Table 3. Observation of ECDIS Use on the MV. Hanwoori

No	Aspect Observation	Key Indicators	Yes	No	Information
1	ECDIS Preparation	Checking the system and chart before navigation	✓		Checking is done system by officers before navigating
2	Route Planning	Create routes, waypoints, and safety boundaries correctly	✓		Route created correctly
3	Route Monitoring	Monitoring the position of the	✓		Monitoring route

		ship and path deviation		implemented well
4	Alarm Response	Understand the meaning of the alarm and act appropriately	✓	Alarm responded correctly
5	Update Chart	Use latest electronic maps	✓	Updates are made by the duty officer
6	Equipment Condition	Navigation systems and sensors are working properly	✓	No significant disturbances were found.
7	Implementation of SOP	Use according to ship procedures	✓	SOP well implemented

Observations showed that ECDIS was used optimally and in a structured manner. The vessel's position was monitored effectively. All alarms were analyzed before action was taken, reflecting a high level of vigilance on the part of the officer on duty.

Furthermore, ENC updates proceeded on schedule and were supported by preventative maintenance on navigation equipment. Compliance with SOPs was also consistently observed, indicating a culture of improved inter-team coordination and increased speed and accuracy in responding to simulated fires.

Observer Name : Nesi Natasha Christy
 Date : August 17, 2024
 Start Time : 08.00 LT
 Finish Time : 12.00 LT
 Location : Namhae Sea

Table 4. Observation of ECDIS Use on the MV. Hanwoori

No	Aspect Observation	Key Indicators	Yes	No	Information
1	ECDIS Preparation	Checking the system and chart before navigation		✓	The examination was carried out, but only visual, without functional testing
2	Route Planning	Create routes, waypoints, and safety boundaries correctly	✓		Route available, However limited navigation hazard analysis
3	Route Monitoring	Monitoring the position of the ship and path deviation	✓		Positions are monitored properly and regularly
4	Alarm Response	Understand the meaning of the alarm and act appropriately		✓	Alarms are silenced to reduce distractions
5	Update Chart	Use latest electronic maps	✓		Implemented map update
6	Equipment Condition	System and navigation sensor working well	✓		System working normally
7	Implementation of SOP	Use according to procedure boat	✓		SOP well executed

Based on observations on August 17, 2024, the use of ECDIS on ships was not fully optimized. Pre-navigation checks were sometimes conducted only in a limited manner without thorough system function testing. Although the sailing route was available, a comprehensive analysis of potential navigational hazards had not been conducted.

In surveillance practice, officers tend to use the track line as the primary reference without verifying it using other navigation methods. Alarms are also often disabled to reduce distractions on the bridge.

Interview Results

On this occasion, the sources of information the researcher observed were obtained from interviews with the Chief Officer, Second Officer, Third Officer, and Deck Cadet. The following interviews were conducted while the researcher was conducting sea practice (prala) on the MV Hanwoori. The following presents the results of the interviews.

1. Results of the interview with informant 1 (Chief Officer)

Based on information provided by JOO Juhung as Chief Officer, as an officer who has great responsibility for the readiness of navigation equipment and shipping safety, it is known that the use of Electronic Chart Display and Information System (ECDIS) is very helpful in supporting the navigation process on board the ship. The Chief Officer explained that ECDIS is a modern navigation system that integrates various important devices such as Electronic Navigational Chart (ENC), Global Positioning System (GPS), gyro compass, speed log, radar, and Automatic Identification System (AIS). With this integration, the watch officer can monitor the ship's position accurately and in real-time and more easily identify potential navigational hazards.

In practice, electronic chart updates are conducted periodically according to data received from official providers. This updating task is generally carried out by the Second Officer, but the Chief Officer still monitors as a form of control to ensure that the charts used are updated and suitable for use in navigation. The verification process is carried out by checking the update status on the ECDIS system. However, the Chief Officer revealed that sometimes there are still technical obstacles or time constraints that prevent some charts from being updated optimally. This condition certainly requires attention because map accuracy significantly affects the level of navigation safety.

Regarding shipping route planning, the Chief Officer emphasized that every route must be inspected using the route check feature in the ECDIS. This inspection aims to ensure that the shipping route is safe from shallow waters, restricted areas, and various other navigational hazards. Furthermore, setting safety parameters such as safety depth and safety contour is also an important part of the planning stage. However, in practice, these parameter adjustments are not always carried out consistently, especially when there are changes in the ship's draft. This indicates that optimization of ECDIS settings still needs to be improved so that the system can provide optimal early warning.

To support surveillance during navigation, the AIS feature is one of the most frequently used features, especially when ships navigate waters with heavy traffic. This feature helps officers monitor the movements of other vessels, thereby reducing the risk of collisions. Furthermore, radar overlays are used as a comparison tool to improve the accuracy of target information around the ship. The use of these features demonstrates that ECDIS functions not only as an electronic map but also as a decision-making tool in navigation.

In the event of a disruption or failure of the ECDIS system, the steps taken are to switch to the backup ECDIS as a form of implementing a redundancy system on board. However, if the backup device cannot be operated, the navigation process will revert to using paper charts and radar as an alternative. This procedure aims to ensure that shipping safety is maintained even if there is a disruption to the main system. Furthermore, the Chief Officer emphasized the importance of discipline in updating electronic charts, accuracy in setting safety parameters, and improving officer competency through continuous training. According to him, a good understanding of ECDIS operation will help the crew in utilizing all features optimally, thereby minimizing the potential for human error.

Overall, the interview results indicate that the use of ECDIS on ships has been quite successful and has made a positive contribution to navigational safety. However, several areas still need to be optimized, such as consistent chart updates and safety parameter settings. With increased supervision and user competence, ECDIS is expected to function more effectively in reducing the percentage of ship accidents during navigation.

2. Results of the interview with informant 2 (Second Officer)

Based on the results of an interview conducted with Second Officer, LEE Myeonghoon, as the officer who is fully responsible for voyage planning and updating navigation charts, it is known that ECDIS plays a crucial role in supporting navigation safety on board ships. The Second Officer explained that the main features of ECDIS that are most frequently used in daily operational activities are the Electronic Navigational Chart (ENC), route planning, and setting safety parameters such as safety contour and safety depth. These features are the basis for determining safe and efficient voyage routes.

Regarding electronic chart updates, the Second Officer stated that the ENC update process is based on data received periodically from official chart providers. These updates are generally carried out before a ship

sails or while the ship is in port. However, the Second Officer acknowledged that in practice, the update process sometimes experiences delays. This is also caused by several factors such as busy watch duties, time constraints, and technical difficulties with the ECDIS system. As a result, some electronic charts are still found to be nearing their expiration date and have not been optimally updated.

Regarding chart condition verification, the Second Officer stated that checks are conducted through the update status menu on the ECDIS to ensure that the ENC used is consistent with the shipping area. Although such checks are routine, the Second Officer revealed that further monitoring is still necessary to ensure all navigation data is truly up-to-date. This is crucial, as outdated information can directly impact the safety of the ship while sailing.

At the sailing route planning stage, the Second Officer explained that the route was prepared using ECDIS by considering various safety aspects, such as depth.

waters, shipping lanes, and potential navigational hazards. Once the route is determined, a route check is performed to detect potential hazards the ship may encounter. However, in practice, safety parameter settings, particularly the safety contour, are not always accurately adjusted to the actual draft conditions of the ship. This situation has the potential to reduce the effectiveness of the early warnings generated by ECDIS.

In addition to planning functions, the Second Officer also utilizes the Automatic Identification System (AIS) feature, integrated with ECDIS, to monitor the movements of other vessels in the shipping lanes. This feature is considered very helpful in increasing awareness of potential collisions, especially in waters with heavy ship traffic. Meanwhile, other supporting features, such as weather overlays, have not been fully utilized, both due to data limitations and because the primary focus is directed more towards basic navigational safety.

If a problem occurs with the ECDIS system, the Second Officer explained that the steps taken are to immediately report the situation to the captain and to use alternative navigation equipment such as radar and paper charts. This procedure demonstrates that although ECDIS is the primary aid, conventional navigation principles are still applied as a precaution against system failure.

Overall, interviews with Second Officers indicate that ECDIS has been actively used in the planning and implementation of ship navigation. However, several aspects still need improvement, particularly in terms of the discipline of ENC updates and the accuracy of safety parameter settings. With increased oversight, better time management, and a deeper understanding of ECDIS functions, the system is expected to play a more optimal role in reducing the risk of ship accidents during navigation.

3. Results of the interview with informant 3 (Third Officer)

Based on the results of an interview conducted with Third Officer, KIM Minjang, as the watch officer directly involved in navigational surveillance activities on the bridge, it was found that ECDIS made a significant contribution in assisting the implementation of sea watch duties. According to the Third Officer, the most helpful features during the watch period were the real-time display of the ship's position and the navigational alarm system that functions to provide early warning of potential dangers, such as shallow waters, deviations from the course, or proximity to certain objects. With these features, the watch officer can increase vigilance and take action more quickly if a risky condition occurs.

Third Officer He explained that his involvement in the electronic chart updating process was minimal, as that responsibility generally falls to the Second Officer. However, he still checked the chart status on the ECDIS as part of his readiness before carrying out watch duties. This demonstrated coordination between officers to ensure the navigation system was operating properly during the voyage.

Regarding the use of the alarm system, the Third Officer stated that every alarm that appears on the ECDIS must be immediately checked to determine the cause. This check is important so that the officer on watch can determine the appropriate action according to the situation at hand. However, in practice, sometimes the alarm sounds too frequently due to inappropriate safety parameter settings. This condition has the potential to cause concentration disturbances during the watch, so it is not uncommon for the alarm to be temporarily deactivated. This action certainly requires attention because it can reduce the primary function of the ECDIS as an early warning system for navigational hazards.

Furthermore, the Third Officer revealed that one of the challenges still encountered in ECDIS use is that parameter settings are not fully optimized. Settings such as safety depth, safety contour, and alarm limits must be adjusted to the vessel's conditions for the system to operate effectively. If parameters are not set correctly, alarms can become less relevant or even overly sensitive.

In terms of user competency, the Third Officer emphasized the importance of familiarizing all watch officers with ECDIS equipment. He stated that simply being able to operate the device is not enough; users also need to thoroughly understand the function of each feature to maximize ECDIS utilization. A good understanding will help reduce the potential for human error, a contributing factor to ship accidents.

Overall, the interview results indicate that the use of ECDIS has helped improve the effectiveness of navigational oversight during watchkeeping. However, improvements are still needed in terms of parameter settings, alarm management, and user understanding of the system. By optimizing these aspects, ECDIS is expected to function more optimally as a modern navigational aid that supports navigational safety and contributes to reducing the risk of ship accidents.

Data analysis

The primary goal of data analysis is to simplify data to make it easier to read, understand, and interpret. This process uses a qualitative descriptive approach to describe phenomena in depth and systematically.

To ensure the credibility of the data obtained, triangulation methods are generally used. Triangulation serves as a strategy for validating data through multiple sources or perspectives, resulting in a more accurate picture. In this study, the researcher implemented source triangulation with the following details:

Table 5. Source Triangulation

No	Focus	Informant 1	Informant 2	Informant 3	Interpretation
1	Deck officer's understanding of how to operationalize features in ECDIS	JOO Juhyung, as Chief Officer, understands ECDIS integration (ENC, GPS, gyro, AIS, radar), route check, safety contour, and backup systems. He also has good conceptual understanding and oversight, but the consistency of the safety parameters settings still needs to be improved.	LEEMyeonghoon as Second Officer has technical understanding. Which The implementation is quite good, especially in the use of route planning, route check, and ENC update. However, the implementation is not yet fully consistent, especially in adjusting the safety contour to the ship's draft.	KIM Minjang as Third Officer has a better understanding of the operational aspects of guarding, but is not yet in-depth in setting system parameters.	There is Differences in understanding levels were observed based on position. Senior officers had strategic and technical understanding, while junior officers focused more on operational use. Overall, all informants understood the basic functions of ECDIS, but optimization of safety features still needed improvement.
2	What factors influence the effective use of ECDIS?	Chief Officer emphasize the importance of discipline ENC updates, accuracy of safety parameter settings, and arrangements ongoing training for	Second Officer revealed that there was a delay in updating the map due to time constraints and technical constraints, as well as the arrangements safety contour which has not	Third Officer highlight settings alarm that sometimes less precise so that the alarm often sounds and has the potential	Effectiveness of ECDIS usage This is influenced by the discipline of map updates, the accuracy of parameter settings, user competence,

No	Focus	Informant 1	Informant 2	Informant 3	Interpretation
		officers	always been adjusted with the ship's draft	to be deactivated. Also emphasizes the importance of tool familiarization	and familiarity with the system. Furthermore, optimizing safety features and increasing oversight are necessary for ECDIS to function optimally in reducing the risk of ship accidents.

IV. DISCUSSION

Deck officers' understanding of how to operate the ECDIS feature in navigation on the MV. Hanwoori

Based on observations, interviews, and documentation, deck officers' understanding of ECDIS operations is quite good, but not yet optimal in supporting navigational safety.

Most officers understand the use of basic features such as route planning and route monitoring as part of voyage preparation. The route planning process is generally carried out by considering the shipping lane, water depth, and navigational hazard information available on electronic charts. However, there is still a tendency for the route check process to be incomplete. This feature serves to identify potential hazards along the route and therefore plays a crucial role in preventing accidents at sea.



Fig. 2. Route Monitoring

Source: Personal Documentation

Furthermore, safety parameter settings such as safety depth, safety contour, and cross track distance (XTD) have not been fully adjusted to reflect the ship's actual conditions, particularly its draft while sailing. These inaccurate settings can reduce the sensitivity of the alarm system, potentially leading to inaccurate navigational hazard warnings.

Safety depth is the safe depth limit specified in the navigation system to prevent a ship from running aground while sailing. A safety contour is a depth line on a nautical chart that marks the boundary between safe and shallow waters for a particular ship, based on a predetermined safety depth. Cross track distance is the distance a ship deviates from the track line specified in the passage plan.

Understanding of the function of navigational alarms also varies. Some officers consider frequent alarms to be disruptive to watchkeeping, leading to a tendency to adjust alarm settings to the minimum level. This practice risks compromising the ECDIS's function as an early warning system, supporting rapid and accurate decision-making.

On the other hand, the use of ECDIS as the primary navigation tool aligns with the demands of modernizing ship navigation systems. However, in practice, officers still combine its use with conventional navigation methods as a precaution in case of system failure. This demonstrates an awareness of the principle of redundancy in navigation, although optimization of all ECDIS features still requires improvement.

Thus, it can be concluded that the level of understanding of the deck officers on the MV Hanwoori is quite competent, but still requires improvement, especially in the utilization of safety features and proper navigation parameter settings.

Factors influencing the effective use of ECDIS on board the MV. Hanwoori

1. Map Update Discipline

Interviews and observations indicate that ENC updates are conducted periodically based on data received from authorized providers and are generally the responsibility of the Second Officer. However, both the Chief Officer and the Second Officer acknowledged that in practice, updates are sometimes delayed due to busy guard duties and limited operational time. Some ENCs were even found to be nearing expiration before being optimally updated.

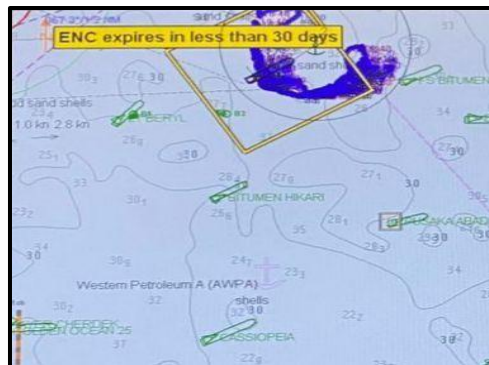


Fig. 3. ENC Warning Expiry

Source: Personal Documentation

2. Accuracy of Safety Parameter Settings

Interviews and observations revealed that the route check feature was used in voyage planning. However, the Chief Officer and Second Officer acknowledged that safety parameters, such as the safety contour, were not always adjusted when the ship's draft changed.



Fig. 4. Safety Contour

Source: Personal Documentation

This indicates inconsistencies in parameter adjustments to the ship's actual conditions. The Third Officer also reported that the alarm frequently sounded due to incorrect parameter settings. This situation even led to the alarm sometimes being deactivated due to perceived distractions during the watch.

3. User Competence

Interview results indicated that the officers had a fairly good understanding of the basic functions of ECDIS. The Chief Officer understood the integration of the ECDIS system with ENC, GPS, gyro, radar, and AIS. The Second Officer mastered aspects of route planning and ENC updates, while the Third Officer focused more on monitoring the ship's position and the alarm system during watch.

However, the Third Officer emphasized that sometimes he was only able to operate the system without thoroughly understanding the detailed functions of each feature. This indicates that operational competency is present, but comprehensive understanding of the system still needs to be improved. Therefore, increased

training and deepening technical understanding are crucial factors in increasing the effectiveness of ECDIS use.

4. Operational Supervision

Interviews revealed that the Chief Officer plays a role in overseeing ENC updates and the readiness of the navigation system before the ship sails. Although the updates are carried out by the Second Officer, the Chief Officer still double-checks them as a form of control.

This oversight role is crucial in maintaining discipline and ensuring that navigation procedures are carried out correctly. Consistent and ongoing oversight can minimize the potential for errors in parameter settings and map updates.

V. CONCLUSION

This study shows that the use of the Electronic Chart Display and Information System (ECDIS) on the MV. Hanwoori has been quite effective in supporting the navigation process, especially in aspects of route planning, monitoring the ship's position, and integration with other navigation devices such as AIS and radar. Deck officers generally have an adequate understanding of the basic functions of the ECDIS, but have not yet fully optimized their use of safety features such as setting safety contours, safety depth, and alarm management. The main findings indicate that the effectiveness of ECDIS use is influenced by the discipline of updating the Electronic Navigational Chart, the accuracy of safety parameter settings, the level of user competence, and the quality of operational supervision on board the ship. On the other hand, this study has limitations because it uses a case study approach on a single ship so that the results cannot be generalized widely, and the limited observation time has the potential to not capture all the operational dynamics of the ECDIS in various sailing conditions.

Based on these findings, this study provides practical implications that shipping companies need to improve oversight of electronic chart updates, ensure consistent implementation of standard operating procedures, and strengthen type-specific ECDIS training for deck officers to ensure understanding is not only operational but also conceptual. Furthermore, more appropriate alarm management is needed to ensure optimal early warning functions without disrupting watchkeeping concentration. For further research, it is recommended to conduct broader studies on various types of vessels and shipping routes, and combine qualitative and quantitative approaches to obtain more comprehensive and generalizable results. Further research can also examine the relationship between workload, safety culture, and human error rates in ECDIS use to enrich the development of human technology interface-based navigation systems in the maritime sector.

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